Social Cognitive Models of Fruit and Vegetable Consumption, Moderate Physical Activity, and Sleep Behavior in Overweight and Obese Men

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Abstract

Approximately 35% of men in the United States are obese, though little theoretical work examining correlates of obesity exists for this population. The purpose of this study was to test the capacity of Bandura's social cognitive model of health behavior to account for variance in fruit and vegetable consumption, moderate physical activity, and sleep behavior in overweight and obese men. Data were collected from overweight and obese men using previously validated questionnaires. Structural equation models were built to examine the direct and indirect effects of the social cognitive theory constructs of self-efficacy, outcome expectation, socio-structural factors, and goals on the behaviors under investigation. A total of 305 men participated in this study (M_{age} = 44.52; *SD* = 6.95). Overall fit for the social cognitive models of health behavior were adequate, accounting for 35.0%, 31.2%, and 21.1% of the variance in the fruit and vegetable consumption, moderate physical activity, and sleep behavior correlates, respectively. Self-efficacy had the greatest total effect on fruit and vegetable consumption ($\beta_{total} = .500$) and sleep behavior ($\beta_{total} = .406$), while goals has the greatest total effect on moderate physical activity ($\beta_{total} = .495$). The indirect effects of self-efficacy on the three behaviors demonstrate the relative importance of self-efficacy as a mediator for health behavior change. Men are underrepresented in behavioral obesity prevention and treatment research. This study provides support for the social cognitive model of health behavior as a theoretical framework for understanding behaviors hypothesized to protect against and treat obesity in men. Additionally, this study represents the first attempt to model correlates of social cognitive constructs on sleep behavior.

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Obesity in adults is a prominent public health concern due to its epidemic prevalence and association with several physical and mental co-morbidities including coronary heart disease, stroke, sleep apnea, osteoarthritis, and depression (Guh, Zhang, Bansback, Amarsi, Birmingham, & Anis, 2009; Imes & Burke, 2014). In the United States, 37.9% of adults are classified as obese, having a body mass index (BMI) of 30 kg/m^2 or greater (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). Stratified by sex, 35.2% of men and 40.5% of women meet the BMI cut-point for obesity (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). Although obesity impacts both men and women, less is known about the efficacy of behavioral weight loss treatments for men. This is in part because, within this domain of inquiry, men are underrepresented in the research literature (Neve, Morgan, Jones, & Collins, 2010). A systematic review conducted by Pagoto and colleagues (Pagoto, Schneider, Oleski, Luciani, Bodenlos, & Whited, 2012) found men comprised only 27% of enrollees across 244 behavioral weight loss randomized controlled trials. Obesity is a particularly concerning risk factor for men as they are more likely to develop diabetes and have a propensity to have greater abdominal adiposity than women, an independent risk factor for numerous health issues, such as high blood pressure (Wirth & Steinmetz, 1998).

Adequate fruit and vegetable consumption (Wang et al., 2014), physical activity (Ekelund et al., 2015), and sleep behavior (Girardin et al., 2014) are hypothesized protective factors against obesity. Fruit and vegetable consumption is purported to reduce risk of obesity (~9-17%), either by directly decreasing bodyweight or as a component of a general dietary change, whereby fruit and vegetable intake leads to consumption of fewer calories (Schwingshack et al., 2015). To obtain obesity protective benefits, adults are recommended to consume 1.5 to 2.5 cups of fruits and 2.5 to 3.0 cups of vegetables per day (Dietary Guidelines Advisory Committee, 2015). With regard to physical activity, exercise that is of moderate intensity has been demonstrated to both reduce weight gain and induce modest weight loss (~2 kg) among those at risk for obesity (Donnelly et al., 2009). For general health maintenance, adults are recommended to engage in 150 minutes of minutes of moderately-intense physical activity per week. To promote clinically significant weight loss, adult men are recommended to engage in 225 to 420 minutes of moderate physical activity per week and can prevent weight re-gain with 200 to 300 minutes of moderate physical activity per week (Donnelly et al., 2009). Less is known about the relationship between sleep and obesity; however, epidemiological evidence indicates an increased risk of obesity among short sleepers (< 5 h per night) (Cappuccio et al., 2008). Sleep duration of less than 7 hours of sleep per night has been associated with higher BMI (Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005).

Bandura's (1986) social cognitive theory (SCT) has been a staple in developing behavioral-based obesity treatments in men (Duncan et al., 2014; Griffith, Allen, Johnson-Lawrence, & Langford, 2013; Maruyama, Kimura, Okumura, Hayashi, & Arao, 2010; Morgan et al., 2013; Morgan et al., 2011; Morgan, Lubans, Collins, Warren, & Callister, 2009; Patrick et al., 2011). However, few SCT-based interventions designed for treating obesity in men have explicitly operationalized constructs from the theory. Bandura (2004) has conceptualized a social cognitive model which includes structural pathways by which four SCT constructs exert direct and indirect influence on any given health behavior: (1) *self-efficacy*, which represents a person's confidence to accomplish a specific behavior; (2) *outcome expectations*, which includes the physical, social, and self-evaluative consequences of engaging in a specific behavior; (3) *socio-structural factors*, which encompass physical, social, and environmental impediments to achieving a behavior; and (4) *goals*, which represent either proximal or distal actions required to accomplish a behavior. Within this context, *self-efficacy* is hypothesized to influence behavior directly, as well as indirectly, through its influence on *outcome expectations*, *socio-structural factors*, and *goals*. The construct of *outcome expectations* is posited to directly influence behavior, but can also indirectly influence behavior through the *goals* construct. *Socio-structural factors* are not hypothesized to directly influence behavior, but the construct can influence behavior through its direct effect on *goals*. The construct of *goals*, in turn, is purported to have a direct influence on behavior. Given this backdrop, the purpose of the present study was to test correlates of Bandura's SCT health behavior model in order to assess the model's capacity to account for variance in fruit and vegetable consumption, moderate physical activity, and sleep behavior in a sample of overweight and obese men. Figure 1A provides an illustration of Bandura's SCT health behavior model. Based on this model, the following hypotheses were tested for each of the behaviors under investigation. Hypothesis 1 tested whether the fully operationalized SCT health behavior models would provide adequate fit to the data and would explain a significant proportion of variance in fruit and vegetable consumption, moderate

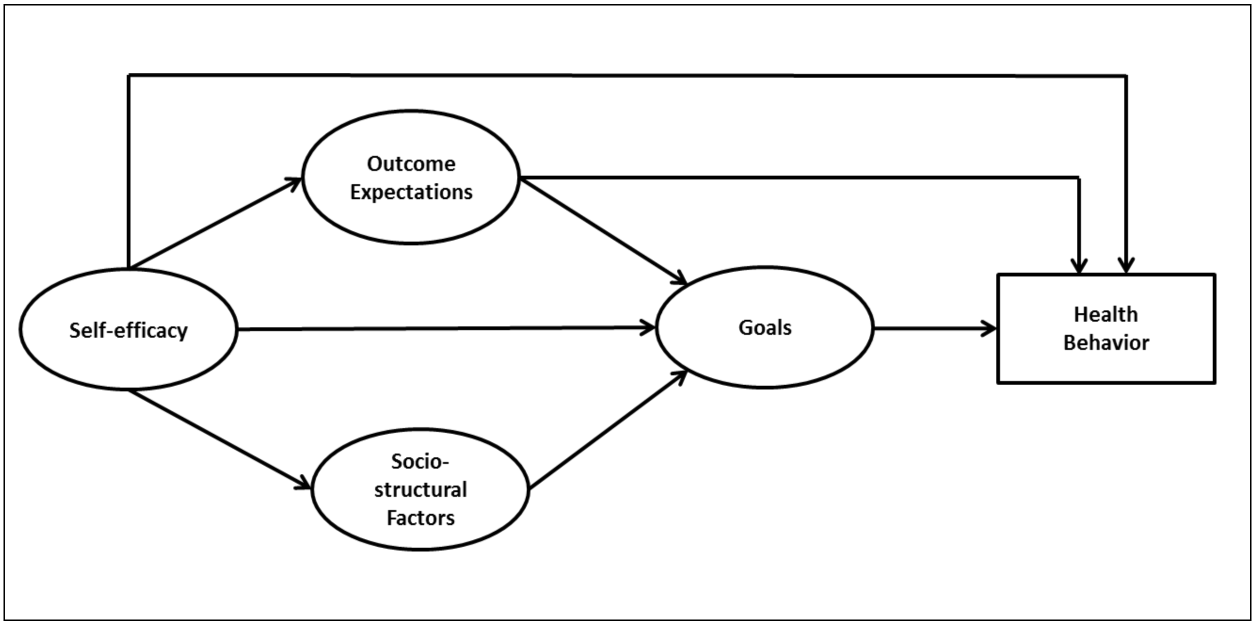

Figure 1A. Bandura's social cognitive theory model of health behavior

physical activity, and sleep behavior in a sample of overweight and obese men. Hypothesis 2a tested whether the SCT construct of self-efficacy would have a direct effect on outcome expectations, socio-structural factors, goals, fruit and vegetable consumption, moderate physical activity, and sleep behavior in the sample. Hypothesis 2b tested whether the SCT construct of self-efficacy would have an indirect effect on fruit and vegetable consumption, moderate physical activity, and sleep behavior through the SCT constructs of outcome expectations, socio-structural factors, and goals in the sample.

Hypothesis 3a tested whether the SCT construct of outcome expectations would have a direct effect on goals, fruit and vegetable consumption, moderate physical activity, and sleep behavior in the sample. Hypothesis 3b tested whether the SCT construct of outcome expectations would have an indirect effect on fruit and vegetable consumption, moderately-intense physical activity, and sleep behavior through the SCT construct of goals in the sample. Hypothesis 4a tested whether the SCT construct of socio-structural factors would have a direct effect on the SCT construct of goals in the sample. Hypothesis 4b tested whether the SCT construct of socio-structural factors would have an indirect effect on fruit and vegetable consumption, moderate physical activity, and sleep behavior in men through the SCT construct of goals in the sample. Finally, hypothesis 5 tested whether the SCT construct of goals would have a direct effect on fruit and vegetable consumption, moderate physical activity, and sleep behavior in the sample.

Methods

Participants and Recruitment

Data were collected from a cross-sectional sample of men recruited from a cohort of individuals who had completed a previously implemented maternal-facilitated childhood obesity intervention conducted by the principal investigator (Knowlden, Sharma, Cottrell, Wilson, & Johnson, 2015). Participation was limited to men without: heart disease in the past 5 years; diabetes; orthopedic or joint problems preventing moderate physical activity; weight loss of 10 lbs. in the past 90 days; current enrollment in a weight loss program; BMI < 25; current tobacco use; a medically prescribed diet and/or medications that might affect body weight; a medically diagnosed sleep disorder. Applying a participant-to-parameter ratio of 5:1 with an estimated 45 parameters, a sample size of 225 was required for modeling purposes (Westland, 2010). Permission to recruit participants was received from the University of Alabama Institutional Review Board (IRB) prior to initiating data collection.

Instrumentation

Data were collected using a 66-item survey consisting of three separate, previously validated questionnaires and a demographic section. Each of the questionnaires measured one of the behaviors under investigation as well as four SCT-based correlates associated with the behavior. Two methods were applied to tailor the questionnaires to the population under investigation. First, items from previously validated scales were modified for the priority population under investigation. Second, 10 participants matching the inclusion criteria for the current study were asked to complete a pilot test of the instrument. Pilot test participants suggested the directions were clear, the items were easy to read and to understand, and the format of the instrument was user-friendly. As none of the participants offered suggestions to improve the instrument, the pilot instrument was considered at an appropriate level of readability and comprehensibility for the population (Flesch Reading Ease Test = 73.2; Flesch–Kincaid Grade Level Test = 5.3). As the survey was delivered electronically, two attention filter items were included in the instrument as quality check indicators. Respondents not answering the filter items correctly were not included in the final sample. To increase response quality, participants completing the instrument in under 5 minutes were not included in the final sample.

Behaviors

For fruit and vegetable consumption, participants were asked to enter a numeric value indicating the typical amount (in cups) of fruits and vegetables they consumed each day. Illustrations of one-half cup and one-cup servings of fruits and vegetables were provided alongside the items to increase accuracy (Knowlden & Sharma, 2015). For moderate physical activity, participants were asked to enter numeric values indicating the total number of minutes they participated in moderate physical activity for each day of the week. Content validation was used to ensure only numeric responses (limited to three digits) were provided. Illustrations of moderate physical activities were provided alongside the item to help increase self-report accuracy (Knowlden, Sharma, Cottrell, Wilson, & Johnson, 2015). For assessing sleep, participants used drop down boxes to indicate how many hours and minutes of sleep they typically received each night (Knowlden, Sharma, & Bernard, 2012). The drop-down boxes were set up to restrict the possible range of hours from 2 to 16 and the possible range of minutes from 0 to 60.

Self-efficacy

The self-efficacy construct stem statement, “How sure are you that you can…”, was followed by three, 5-point Likert-type scale items for each of the three behaviors under investigation. Sample scale items included, “…eat five cups of fruits and vegetables every day if you encounter barriers?”, “…keep a self-diary to monitor total time of your physical activity every week?”, and “…get at least 7 hours of sleep each day.” Scale endpoints were “not at all sure” and “completely sure.” A range of scores from 0 to 12 was possible for the self-efficacy construct. The mean of the item scores was calculated to provide an overall self-efficacy construct score for each behavior. Higher scores reflected a greater confidence to engage in adequate fruit and vegetable consumption, moderate physical activity, and healthy sleep behavior.

Outcome Expectations

The outcome expectations construct stem statement, “If you: eat five cups of fruits and vegetables every day; participate in more than 300 minutes of moderately-intense physical activity every week; get at least 7 hours of sleep every day…you will…”, was followed by three, 5-point Likert-type scale items for each of the three behaviors under investigation. Sample scale items included, “…manage your weight,” “…have more energy,” “…enjoy life more,” and “…be healthy.” Scale endpoints were “strongly disagree” and “strongly agree.” A range of scores from 0 to 20 was possible for the outcome expectations construct. The mean of the item scores was calculated to provide an overall outcome expectations construct score for each behavior. Higher scores reflected greater positive expectations regarding adequate fruit and vegetable consumption, moderate physical activity, and healthy sleep behavior.

Socio-structural Factors

The socio-structural factors construct stem statement, “How sure are you that you can…”, was followed by three, 5-point Likert-type scale items for each of the three behaviors under investigation. Sample scale items included, “…have a place to be physically active for 300 minutes per week?”, “get the help of a family member to support you with eating five cups of fruits and vegetables every day?”, “get the help of a health professional(s) to help you in your efforts to sleep at least 7 hours every day?” Scale endpoints were “not at all sure” and “completely sure.” A range of scores from 0 to 12 was possible for the socio-structural factors construct. The mean of the item scores was calculated to provide an overall socio-structural factors construct score for each behavior. Higher scores reflected greater socio-structural factors influencing adequate fruit and vegetable consumption, moderate physical activity, and healthy sleep behavior.

Goals

The goals construct stem statement, “I will…”, was followed by three, 5-point Likert-type scale items for each of the three behaviors under investigation. Sample scale items included, “…eat five cups of fruits and vegetables every day”, “participate in 300 minutes of moderately-intense physical activity each week”, and “…sleep at least 7 hours every day.” Scale endpoints were “strongly disagree” and “strongly agree.” A range of scores from 0 to 20 was possible for the goals construct. The mean of the item scores was calculated to provide an overall goals construct score for each behavior. Higher scores reflected a greater goal-orientation to engage in adequate fruit and vegetable consumption, moderate physical activity, and healthy sleep behavior.

Results

Data Analysis

The data set was inspected for missing data, normality, homoscedasticity, linearity, and multicollinearity prior to conducting model building procedures. No violations of modeling assumptions were detected. Exploratory factor analysis was applied to assess the underlying structure of the variables, confirmatory factor analysis was conducted to evaluate validity and reliability of the measurement models, and structural equation modeling was used to explore the relationship among social cognitive theoretical constructs and health behavior. Data were analyzed using IBM AMOS version 24.0 and Microsoft Excel 2013. Table 1 summarizes the demographics and health behaviors of the participants. Tables 2A through 2C detail results of the exploratory factor analysis. Table 3 summarizes reliability statistics of the measurement models in addition to descriptive statistics of the theoretical constructs.

Table 1

Demographics for the Sample of Overweight and Obese Men (N = 305)

Variable	*f*	%
1. Race		
African American	17	5.6
Asian	8	2.6
Caucasian	254	83.3
American Indian/Alaska Native	3	1.0
Native Hawaiian/Pacific	1	0.3
More than one race	3	1.0
Other	4	1.3
2. Hispanic, Latino/a, or Spanish origin		
Yes	15	4.9
No	295	96.7
3. Marital status		
Separated	7	2.3
Divorced	30	9.8
Widow	2	0.7
Married	186	61.0
Never married	80	26.2

Table 1 (Continued)

Demographics for the Sample of Overweight and Obese Men (N = 305)

Variable	*f*	%
4. Employment status		
Part-time	76	24.9
Full-time	183	60.0
Not employed, looking for work	22	7.2
Not employed, not looking for work	7	2.3
Retired	11	3.6
Unable to work	6	2.0
5. Community		
City or urban	84	27.5
Suburban	163	53.4
Rural	58	19.0
6. Annual household income		
Less than $20,000	29	9.5
$20,000 to $34,999	42	13.8
$35,000 to $49,999	49	16.1
$50,000 to $74,999	78	25.6
$75,000 to $99,999	36	11.8
$100,000 to $149,999	50	16.4
$150,000 to $199,999	12	3.9
$200,000 or more	9	3.0
7. Education		
Less than high school degree	2	0.7
High school degree or equivalent	42	13.8
Some college but no degree	68	22.3
Associate degree	47	15.4
Bachelor degree	92	30.2
Graduate degree	54	17.7
8. Body Mass Index (BMI)		
Overweight (25.0–29.9)	174	57.0
Obese (30.0+)	131	43.0
9. Health recommendations		
< 5 cups fruits and vegetables /day	246	80.7
< 7 hrs of sleep /day	35	11.5
< 150 min of moderate physical activity /week	183	60.0
< 300 min of moderate physical activity / week	266	87.2

Table 2A

Factor Loadings for Exploratory Factor Analysis with Promax Rotation for the Social Cognitive Theory Model of Fruit and Vegetable Consumption (N = 305)

Social Cognitive Theory Model of Fruit and Vegetable Consumption (FVC) Constructs	Factor 1	Factor 2	Factor 3	Factor 4
Self-Efficacy for FVC (SE FVC)				
SE FVC 1			.875	
SE FVC 2			.894	
SE FVC 3			.837	
Outcome Expectations for FVC (OE FVC)				
OE FVC 1		.825		
OE FVC 2		.659		
OE FVC 3		.865		
OE FVC 4		.844		
Socio-structural factors for FV (SF FVC)				
SF FVC 1				.726
SF FVC 2				.809
SF FVC 3				.821
Goals for FVC (GL FVC)				
GL FVC 1	.838			
GL FVC 2	.852			
GL FVC 3	.916			
GL FVC 4	.866			
GL FVC 5	.878			

Note. Construct abbreviations: Fruit and Vegetable Consumption = FVC; Self-Efficacy = SE; Outcome Expectations = OE; Socio-structural factors = SF; Goals = GL. Loadings below threshold of .40 were suppressed for interpretation purposes.

Table 2B

Factor Loadings for Exploratory Factor Analysis with Promax Rotation for the Social Cognitive Theory Model of Physical Activity (N = 305)

Social Cognitive Theory Model of Physical Activity (PA) Constructs	Factor 1	Factor 2	Factor 3	Factor 4
Self-Efficacy for PA (SE PA)				.872
SE PA 1				.906
SE PA 2				.878
SE PA 3				.878
Outcome Expectations for PA (OE PA)				
OE PA 1		.834		
OE PA 2		.854		
OE PA 3		.789		
OE PA 4		.841		
Socio-structural factors for PA (SF PA)				
SF PA 1			.913	
SF PA 2			.903	
SF PA 3			.922	
Goals for PA (GL PA)				
GL PA 1	.923			
GL PA 2	.923			
GL PA 3	.942			
GL PA 4	.911			
GL PA 5	.803			

Note. Construct abbreviations: Physical Activity = PA; Self-Efficacy = SE; Outcome Expectations = OE; Socio-structural factors = SF; Goals = GL. Loadings below threshold of .40 were suppressed for interpretation purposes.

Table 2C

Factor Loadings for Exploratory Factor Analysis with Promax Rotation for the Social Cognitive Theory Model of Sleep Behavior (N = 305)

Social Cognitive Theory Model of Sleep Behavior (SB) Constructs	Factor 1	Factor 2	Factor 3	Factor 4
Self-Efficacy for SB (SE SB)				
SE SB 1				.929
SE SB 2				.735
SE SB 3				.721
Outcome Expectations for SB (OE SB)				
OE SB 1		.909		
OE SB 2		.838		
OE SB 3		.742		
OE SB 4		.878		
Socio-structural factors for SB (SF SB)				
SF SB 1			.845	
SF SB 2			.912	
SF SB 3			.920	
Goals for SB (GL SB)				
GL SB 1	.917			
GL SB 2	.915			
GL SB 3	.935			
GL SB 5	.844			

Note. Construct abbreviations: Sleep Behavior = SB; Self-Efficacy = SE; Outcome Expectations = OE; Socio-structural factors = SF; Goals = GL. Loadings below threshold of .40 were suppressed for interpretation purposes. Following items were removed due to loading values: GL SB 4.

Structural Equation Models

Fit for the final fruit and vegetable consumption structural equation model was adequate ($\chi^2 = 80.683$, df = 41, $p < .001$; CMIN/DF = 1.968, GFI = .960, AGFI = .924, NFI = .963, CFI = .981, RMSEA = .056, $R^2 = .350$; Hypothesis 1). Self-efficacy had a significant direct ($\beta_{direct} = .178$, $p = .024$; Hypothesis 2a) and indirect ($\beta_{indirect} = .322$, $p = .001$; Hypothesis 2b) effect on fruit and vegetable consumption through its influence on outcome expectations ($\beta_{direct} = .209$, $p = .012$), socio-structural factors ($\beta_{direct} = .626$, $p < .001$), and goals ($\beta_{direct} = .639$, $p < .001$; Hypothesis 2a). Outcome expectations did not elicit a direct effect on fruit and vegetable consumption ($\beta_{direct} = -.010$, $p = .850$; Hypothesis 3a), or an indirect effect on fruit and vegetable consumption through its posited influence on goals ($\beta_{indirect}$ = .032, p = .149; Hypothesis 3b). Socio-structural factors failed to elicit either a direct effect on goals (β_{direct} = .091, p = .296; Hypothesis 4a) or an indirect effect on fruit and vegetable consumption through goals ($\beta_{indirect}$ = .042, p = .363; Hypothesis 4b); however, the goals construct had a direct effect on fruit and vegetable consumption (β_{direct} = .455, p < .001; Hypothesis 5).

Fit for the final moderate physical activity structural equation model was adequate (χ^2 = 123.099, df = 80, p = .001; CMIN/DF = 1.539, GFI = .950, AGFI = .925, NFI = .967, CFI = .988, RMSEA = .042, R^2 = .312; Hypothesis 1). The direct path between self-efficacy and moderate physical activity was not significant (β_{direct} = .085, p = .336; Hypothesis 2a). However, self-efficacy's indirect path to moderate physical activity through outcome expectations (β_{direct} = .420, p < .001), socio-structural factors (β_{direct} = .677, p < .001), and goals (β_{direct} = .614, p < .001; Hypothesis 2a) was significant ($\beta_{indirect}$ =.379, p < .001; Hypothesis 2b). Outcome expectations did not elicit a direct effect on moderate physical activity (β_{direct} = -.015, p = .799; Hypothesis 3a) or an indirect effect on moderate physical activity through its posited influence on goals ($\beta_{indirect}$ = .026, p = .266; Hypothesis 3b). Socio-structural factors elicited a direct effect on goals (β_{direct} = .209, p = .003; Hypothesis 4a), as well as an indirect effect on moderate physical activity through its influence on goals ($\beta_{indirect}$ = .104, p = .002; Hypothesis 4b). The goals construct had a direct effect on moderate physical activity (β_{direct} = .495, p < .001; Hypothesis 5).

Fit for the final sleep behavior structural equation model was adequate (χ^2 = 134.858, df = 67, p < .001; CMIN/DF = 2.013, GFI = .941, AGFI = .908, NFI = .958, CFI = .978, RMSEA = .058, R^2 = .211; Hypothesis 1). Self-efficacy had a significant direct (β_{direct} = .212, p = .042; Hypothesis 2a) and indirect ($\beta_{indirect}$ = .194, p = .043; Hypothesis 2b) effect on sleep behavior through its influence on outcome expectations (β_{direct} = .265, p < .001), socio-structural factors (β_{direct} = .679, p < .001), and goals (β_{direct} = .700, p < .001; Hypothesis 2a), though this path did not reach practical significance. Outcome expectations elicited a significant direct effect on sleep behavior (β_{direct} = .146, p = .010; Hypothesis 3a), but not an indirect effect through its posited influence on goals ($\beta_{indirect}$ = .004, p = .726; Hypothesis 3b). Socio-structural factors elicited a significant direct effect on goals (β_{direct} = .166, p = .005; Hypothesis 4a) as well as an indirect effect on sleep behavior ($\beta_{indirect}$ = .047, p = .012; Hypothesis 4b), though the indirect effect was not practically significant. Finally, the goals construct was associated with sleep behavior (β_{direct} = .286, p = .005; Hypothesis 5). Table 3 summarizes the direct, indirect, and total effects for the final social cognitive theory of fruit and vegetable consumption, moderate physical activity, and sleep behavior models in overweight and obese men. Figure 1A illustrates Bandura's conceptual social cognitive model of health behavior. Figures 1B through 1D illustrate the direct model pathways for the behaviors under current investigation with standardized beta coefficients.

Discussion

The goal of this study was to evaluate SCT correlates of moderate physical activity, fruit and vegetable consumption, and sleep behavior in overweight and obese men. In support of hypothesis 1, the tested SCT constructs provided a good fit for the data, explaining 35.0%, 31.2%, and 21.1% of the variance in the fruit and vegetable consumption, moderate physical activity, and sleep behavior models, respectively. A systematic review of psychosocial determinants of fruit and vegetable consumption in adults found SCT generally accounted for

Table 3

Descriptive Statistics and Confirmatory Factor Analysis Statistics for the Social Cognitive Theory Measurement Models (N=305)

	Descriptive Statistics		Convergent and Discriminant Validity Statistics[‡]		
Construct[†]	Observed Range/ Possible Range	*M* (*SD*)	CR	AVE	MSV
Fruit and Vegetable Consumption (FVC)[a]	0.00–12.00/0.00–12.00	2.85 (2.26)			
Self-Efficacy for FV (SE FVC)	0.00–12.00/0.00–12.00	4.64 (3.22)	0.863	0.759	0.510
Outcome Expectations for FVC (OE FVC)	0.00–16.00/0.00–16.00	10.53 (2.55)	0.811	0.688	0.500
Socio-structural factors for FVC (SF FVC)	0.00–12.00/0.00–12.00	6.44 (2.90)	0.792	0.559	0.416
Goals for FVC (GL FVC)	0.00–20.00/0.00–20.00	7.01 (5.34)	0.928	0.722	0.510
Moderate Physical Activity y (MPA)[b]	0.00 - 900.00/0.00 - 787.00	138.21 (147.11)			
Self-Efficacy for PA (SE MPA)	0.00–12.00/0.00–12.00	4.23 (3.47)	0.880	0.714	0.588
Outcome Expectations for PA (OE MPA)	0.00–16.00/0.00–16.00	10.90 (2.66)	0.850	0.587	0.215
Socio-structural factors for PA (SF MPA)	0.00–12.00/0.00–12.00	6.45 (2.90)	0.902	0.754	0.450
Goals for PA (GL MPA)	0.00–20.00/0.00–20.00	6.75 (5.73)	0.943	0.770	0.588
Sleep Behavior (SB)[c]	120.00–1,440/121.00–706.00	477.29 (68.32)			
Self-Efficacy for PA (SE SB)	0.00–12.00/0.00–12.00	5.40 (3.44)	0.927	0.863	0.663
Outcome Expectations for PA (OE SB)	0.00–16.00/0.00–16.00	10.75 (2.53)	0.874	0.638	0.085
Socio-structural factors for PA (SF SB)	0.00–12.00/0.00–12.00	8.30 (3.24)	0.879	0.708	0.458
Goals for PA (GL SB)	0.00–20.00/0.00–16.00	8.07 (4.76)	0.936	0.785	0.663

Note. Construct abbreviations: Fruit and Vegetable Consumption = FVC; Moderate Physical Activity = MPA; Sleep Behavior = SB; Self-Efficacy = SE; Outcome Expectations = OE; Socio-structural factors = SF; Goals = GL.Statistical abbreviations: CR = construct reliability; AVE = average variance extracted; MSV = maximum shared variance; χ^2 = model Chi-square; CMIN/DF = minimum discrepancy, divided by its degrees of freedom; GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; NFI = normed fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation.

Table 3 (Continued)

Descriptive Statistics and Confirmatory Factor Analysis Statistics for the Social Cognitive Theory Measurement Models (N=305)

[†]Goodness-of-fit indices: $\chi^2 > .05$; CMIN/DF < 3; GFI, NFI, and CFI > .90; AGFI > .80, and RMSEA < .080
[‡]Convergent and discriminant validity indices: CR ≥ .70; AVE ≥ .50; MSV < AVE.
[a]Fruit and vegetable consumption in total cups per day. Fit statistics for the social cognitive measurement model of fruit and vegetable consumption after trimming Item 1 from the self-efficacy construct, Items 2 and 4 from the outcome expectations construct, and Item 3 from the socio-structural factors construct: $\chi^2 = 60.487$, df = 42, $p = .032$; CMIN/DF = 1.440, GFI = .968, AGFI = .940, NFI = .973, CFI = .992, and RMSEA = .038. To achieve adequate fit, trimming of Item 1 from the self-efficacy construct, Items 2 and 4 from the outcome expectations construct, and Item 3 from the socio-structural factors construct was required.
[b]MPA in total minutes per week. Fit statistics for the social cognitive measurement model of moderate physical activity after trimming Item 1 from the self-efficacy construct: $\chi^2 = 106.959$, df = 81, $p = .028$; CMIN/DF = 1.320, GFI = .956, AGFI = .935, NFI = .972, CFI = .993, and RMSEA = .032. To achieve adequate fit, trimming of item 1 from the self-efficacy construct was required.
[c]Sleep behavior in total minutes per night. Fit statistics for the social cognitive measurement model of sleep behavior after trimming Item 1 from the self-efficacy construct, as well as removal of two cases due to missing data (N = 303): ($\chi^2 = 113.188$, df = 56, $p < .001$; CMIN/DF = 2.021, GFI = .947, AGFI = .914, NFI = .964, CFI = .981, and RMSEA = .058. To achieve satisfactory fit, trimming of Item 1 from the self-efficacy construct was required, as well as removal of two cases due to missing data (N = 303).

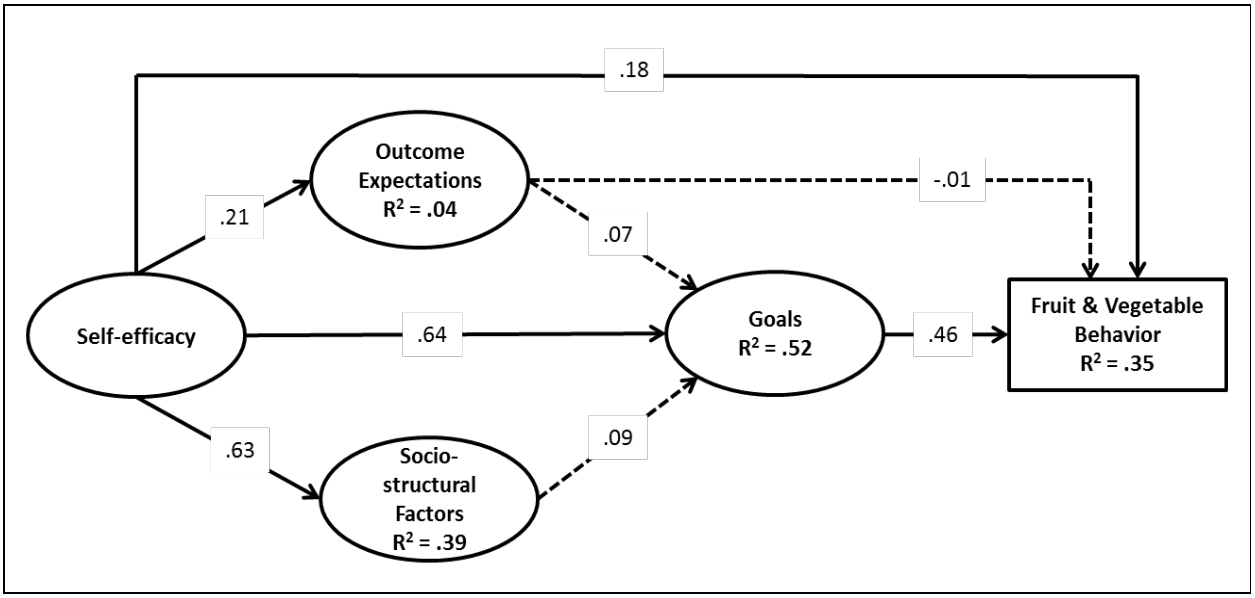

Figure 1B. Social cognitive theory model of fruit and vegetable consumption (N = 305). Filled-in lines represent significant direct pathways; dotted lines represent non-significant pathways ($p > .05$). Direct model pathways are reported as standardized beta coefficients, while squared multiple correlations are presented in bold text.

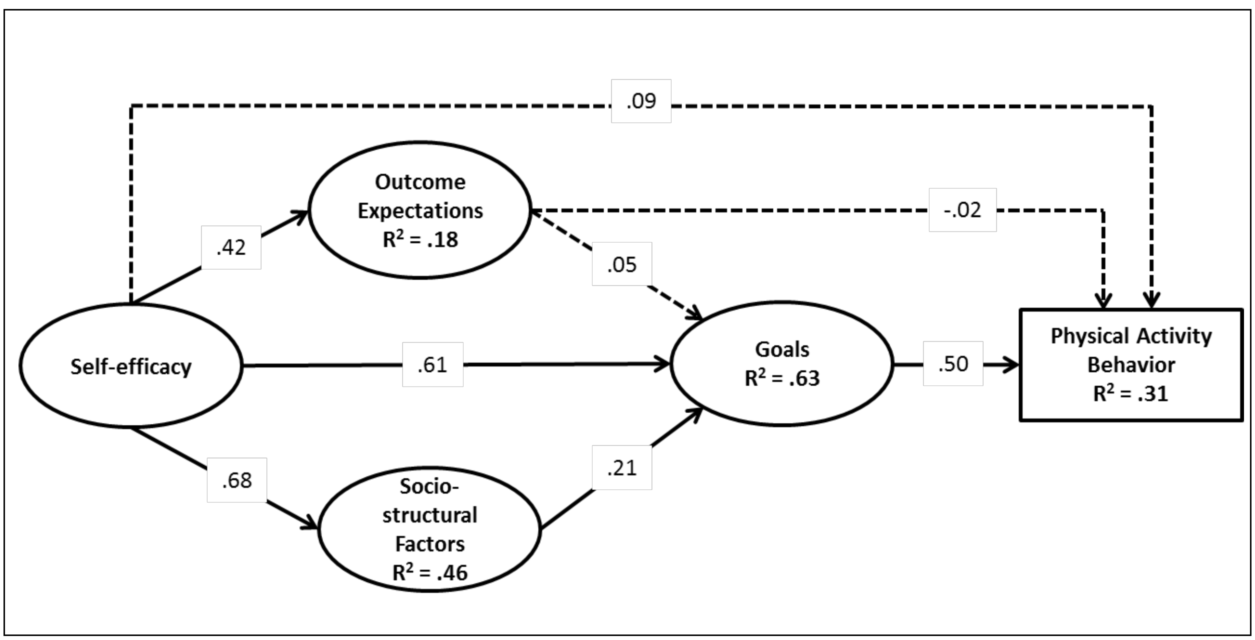

Figure 1C. Social cognitive theory model of physical activity (N = 305). Filled-in lines represent significant direct pathways; dotted lines represent non-significant pathways ($p > .05$). Direct model pathways are reported as standardized beta coefficients, while squared multiple correlations are presented in bold text.

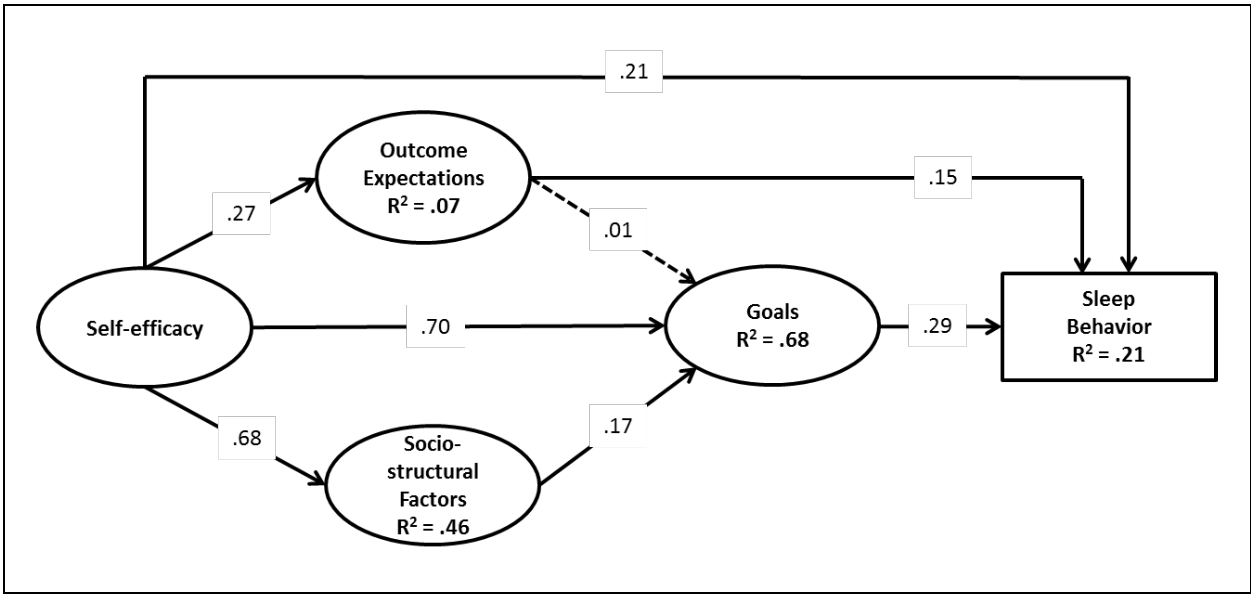

Figure 1D. Social cognitive theory model of sleep behavior (N = 303). Filled-in lines represent significant direct pathways; dotted lines represent non-significant pathways ($p > .05$). Direct model pathways are reported as standardized beta coefficients, while squared multiple correlations are presented in bold text.

41% of the variance in the behavior (Guillaumie, Godin, & Vézina-Im, 2010), which was close to the current study findings. In a meta-analytic review, Young and colleagues (2014) concluded SCT generally accounted for 31% of the variance in physical activity, which is in line with the results of this investigation. To the best of the authors' knowledge, no studies have examined the efficacy of SCT for sleep behavior in men, though other studies have used the theory of planned behavior and the health belief model (Knowlden & Sharma, 2014; Knowlden et al., 2012). Specifically, the theory of planned behavior accounted for 34.5% of the total variance in sleep behavior, while the health belief model predicted 34% of the variance.

In support of hypotheses 2a and 2b, self-efficacy directly influenced fruit and vegetable consumption and sleep behavior; however, upon applying the beta coefficient threshold of .20 (Ferguson, 2009), the direct effects were not practically significant for fruit and vegetable consumption and only minimally met the *a priori* standard for sleep behavior. However, when combined, the direct and indirect effects of self-efficacy produced a moderate total effect for fruit and vegetable consumption ($\beta_{total} = .500$) and sleep behavior ($\beta_{total} = .406$) (see Table 3). The direct effect between self-efficacy and moderate physical activity was not significant; however, when combined with its indirect effect, its total effect was moderately significant ($\beta_{total} = .466$). In terms of sleep behavior, to the best of the authors' knowledge no current SCT model exists exploring sleep behavior in men from a social cognitive perspective; however, a study operationalizing the health belief model found self-efficacy ($\beta_{total} = .388$) was a significant correlate of sleep behavior (Knowlden & Sharma, 2014). Another study by Knowlden and colleagues (2012) found perceived behavioral control was associated with sleep behavior ($\beta_{total} = .472$). Perceived behavioral control shares some attributes with self-efficacy, which may lend support to this study's hypotheses (Lippke & Ziegelmann, 2008). From an SCT perspective, the overall evidence for self-efficacy's indirect effects on other constructs in the model is mixed. Some studies have found a significant indirect effect on moderate physical activity and fruit and vegetable consumption (Ferguson, 2009; Knowlden & Sharma, 2014; Lippke & Ziegelmann, 2008), while others have not (Anderson-Bill, Winett, & Wojcik, 2011). Most studies testing SCT have used multiple regression analysis, which cannot parse out indirect effects. Therefore, the current study builds on the body of literature that self-efficacy's indirect effects must be evaluated to accurately assess SCT's utility. Based on the current investigation, self-efficacy is an important theoretical construct for changing fruit and vegetable consumption, moderate physical activity, and sleep behavior in overweight and obese men. This study provides evidence that increasing self-efficacy can indirectly influence positive expectations, bolster social support, and augment goals, to improve these behaviors.

Hypotheses 3a and 3b were generally not supported. Outcome expectations neither directly nor indirectly affected fruit and vegetable consumption or moderate physical activity. These findings are in line with recent studies in which outcome expectations made no independent contribution to fruit and vegetable consumption (Anderson-Bill et al., 2011) or physical activity (Young, Plotnikoff, Collins, Callister, & Morgan, 2016). The outcome expectations scales used in this study were applied to capture general measures of fruit and vegetable consumption and moderate physical activity as opposed to measuring all three types of outcome expectations—namely, physical, social, and self-evaluative (Bandura, 2004, 1989). Therefore, measurement error is a potential explanation for the failure of an identifiable direct pathway. Interestingly, outcome expectations were associated with sleep behavior in the sample, but not via the goals construct. While there is no SCT sleep model to compare the current findings against, previous studies (Knowlden et al., 2012; Knowlden & Sharma, 2014) examining sleep behavior from a health belief model and theory of planned behavior perspective found perceived severity (β_{total} = .218) and attitude toward the behavior (β_{total} = .231) were significant correlates of sleep behavior. Perceived barriers and attitude toward the behavior are in a similar cognitive domain as outcome expectations and can provide support for the significant paths identified in the current model (Bandura, 2004). It should be noted, however, that Bandura has postulated only SCT operationalizes all three dimensions of outcome expectations, while he proposed the health belief model and theory of planned behavior capture at most only two dimensions of this construct, which may partially explain the construct's inability to elicit an indirect effect (see checklist in: Bandura, 2004).

Regarding hypotheses 4a and 4b, the current study found significant direct and indirect effects of socio-structural factors for moderate physical activity and sleep behavior, but not for fruit and vegetable consumption. In contrast to the current study, Anderson-Bill et al. (2011) identified a significant indirect effect between socio-structural factors and fruit and vegetable behavior. In tandem with Young et al. (2016), the present SCT moderate physical activity model identified a direct effect between socio-structural factors and goals; however, the effect was minimal. Regarding sleep behavior, an application of the theory of planned behavior to sleep identified a connection between subjective norms and behavioral intention for adequate sleep (β_{total} = .179) (Knowlden et al., 2012), a conceptually similar psychological association to the constructs of socio-structural factors and goals. In conjunction with the current study, in the theory of planned behavior model, subjective norms' influence was small. Findings for the role of socio-structural factors in the SCT framework are mixed, with some researchers suggesting socio-structural factors may operate on behavior through self-efficacy, in which case socio-structural factors may be misplaced in the hypothesized SCT health behavior model framework

(Anderson-Bill et al., 2011). Practically, socio-structural factors, such as spousal support of obesity prevention behaviors, should influence goals for actualizing these behaviors and thus additional objective measures of socio-structural support such as built environment attributes should be incorporated into future modeling efforts. In terms of the fifth hypothesis set, the goals construct was associated with all three health behaviors. This finding is consistent with previous behavior-goal modeling research examining fruit and vegetable consumption and moderate physical activity (Young et al., 2016). In terms of the sleep behavior model, previous research identified a relationship between behavioral intention and sleep ($\beta_{total} = .190$) (Knowlden et al., 2012). Conceptually, intentions are equivalent to proximal goals, lending support for the current SCT sleep behavior model (Bandura, 2004).

Limitations

Strengths of the current study include explicit operationalization of the full SCT framework in the three health domains including nutrition, moderate physical activity, and sleep in overweight and obese men. To the best of the authors' knowledge, this is the first attempt to examine sleep behavior in men using SCT. Furthermore, this study applied structural equation modeling to gauge the direct and indirect influences of the SCT constructs on the behaviors under investigation. Nevertheless, there are limitations that should be considered when interpreting the findings of this investigation. In the current model, four correlates of SCT were operationalized; however, we did not fully operationalize all constructs of SCT as suggested by Bandura, which should be considered a major limitation of this study. Important constructs of SCT, such as knowledge, observational learning, and self-regulation, were not modeled in the current study. Future studies should measure and model all constructs from SCT to accurately evaluate the theory's validity.

Furthermore, though we only modeled moderate physical activity in the current study, weight loss and regain protective effects can also be achieved through vigorous physical activity. We limited our study to moderate physical activity based on American College of Sports Medicine strategies for weight loss and prevention of weight regain in adults (Donnelly et al., 2009); however, it is possible that by excluding explicit measurement of vigorously-intense physical activity, our modeling approach may have eliminated those participants that would have otherwise met physical activity parameters if vigorously-intense physical activity data were collected.

All behavioral measures were assessed via self-report and therefore are susceptible to social desirability and recall bias. However, as detailed in this study, reliability and validity were tested for models and found satisfactory. Future efforts should be made to collect objective measurements (e.g., accelerometry) of these behaviors. As this study applied a cross-sectional design, causal connections between the constructs and behaviors cannot be claimed. Nevertheless, cross-sectional models are a precursor to testing longitudinal interventions and are therefore an important part of the research process. Additionally, a non-probability sampling approach was used to recruit participants, limiting the ability to generalize this study's findings. However, no major violations of statistical assumptions were found, which suggests the study results are relatively robust.

Conclusion

Obesity remains a pressing public health issue. Behavior theory, such as the SCT, offers guidance on some of the cognitive factors (e.g., goals, self-efficacy) that relate to health behaviors. Our study examines associations among the cognitions outlined in the SCT and prevention behaviors (e.g., nutrition, physical activity, and sleep) among men at risk for obesity or who already have received treatment for the condition. In so doing, we identify constructs that might be explored as potential targets for future health campaigns or behavioral interventions to improve health among these populations.

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