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Development and Validation of the Cognitive Behavioral Physical Activity Questionnaire

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Abstract

Purpose—Develop and demonstrate preliminary validation of a brief questionnaire aimed at assessing social cognitive determinants of physical activity (PA) in a college population.

Design—Quantitative and observational.

Setting—A midsized northeastern university.

Subjects—Convenience sample of 827 male and female college students age 18 to 24 years.

Measures—International Physical Activity Questionnaire and a PA stage-of change algorithm.

Analysis—A sequential process of survey development, including item generation and data reduction analyses by factor analysis, was followed with the goal of creating a parsimonious questionnaire. Structural equation modeling was used for confirmatory factor analysis and construct validation was confirmed against self-reported PA and stage of change. Validation analyses were replicated in a second, independent sample of 1032 college students.

Results—Fifteen items reflecting PA self-regulation, outcome expectations, and personal barriers explained 65% of the questionnaire data and explained 28.6% and 39.5% of the variance in total PA and moderate-to-vigorous–intensity PA, respectively. Scale scores were distinguishable across the stages of change. Findings were similar when the Cognitive Behavioral Physical Activity Questionnaire (CBPAQ) was tested in a similar and independent sample of college students (40%; R^2 moderate-to-vigorous–intensity PA= .40; $p < .001$).

Conclusion—The CBPAQ successfully explains and predicts PA behavior in a college population, warranting its incorporation into future studies aiming at understanding and improving on PA behavior in college students.

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Keywords

Physical Activity; Questionnaire; Social Cognitive Theories; Structural Equation Modeling; College Students; Prevention Research; Manuscript format: research; Research purpose: instrument development; Study design: nonexperimental; Outcome measure: behavioral; Setting: school; Health focus: fitness/physical activity; Strategy: skill building/behavior change; Target population age: young adults; Target population circumstances: education/income level

Purpose

According to the National Health and Nutrition examination Survey data the prevalence of overweight in children and adolescents ages 12 to 19 (body mass index [BMI] percentile ≥85) increases from 33.2%[1] to 68.8% in adulthood,[1,2] with the greatest rate of weight increase occurring between the ages of 20 and 29 years.[3] This obesity epidemic is the result of a long-term positive energy imbalance resulting from modifiable physical activity (PA) and eating behaviors.[4] Although regular participation in PA plays a critical role in the prevention and treatment of obesity and chronic diseases,[5] approximately 80% of Americans achieve insufficient aerobic and muscle strengthening exercise to meet guidelines.[6] Specifically among college students, 49% currently meet PA guidelines, and an estimated 34% are overweight or obese.[7] These data indicate the importance of understanding the attitudes and behaviors associated with regular exercise participation in college students to develop effective interventions that aim to improve PA in this population.

Behavior change research demonstrates the most effective PA interventions are based on theoretical models that adequately explain and predict PA.[8] Among broad classes of theories, social cognitive theories have shown the most promise for behavior change and, in particular, PA behavior. Numerous social cognitive models and theories exist, including the health promotion model, theory of planned behavior, theory of reasoned action, protection motivation theory, social cognitive theory, health belief model, self-determination theory, and trans-theoretical model.[9] Although the constituent constructs differ from theory to theory, all social cognitive theories broadly propose that behavior is a function of both psychological and social processes, and to an extent person-environment interactions. A recent meta-analysis of social cognitive models and theories in terms of their utility to predict PA in adolescents found they could explain between 24% and 37% of the variance in reported PA.[9] The relatively low variance of PA explained may indicate that rather than focusing on discrete, self-contained theories, a more promising approach may be to integrate multiple social cognitive theories, drawing on the strengths of each one.

To understand and eventually intervene upon PA behavior, whether using a discrete theory or an integrated approach, it is necessary to measure these social cognitive constructs. Most existing instruments measure single constructs,[10–12] which are then compiled to meet the needs of specific research studies. This approach can result in unnecessary subject burden in studies that are collecting multiple questionnaire data bringing the total to more than 75 items to assess.[10,11,13–15] Alternatively, when assessment instruments are not available for a specific construct or population, researchers are required to develop questionnaire items that meet their individual needs. Although this approach may suit the specific needs of the

research, it places a certain burden on the researchers to validate newly developed items, and furthermore does not provide a standardized basis of comparison across a range of research.

The objectives of this study were to (1) develop a brief questionnaire that assesses social cognitive constructs predictive of PA behavior for use in college-aged populations, (2) demonstrate criterion-related validation of the questionnaire against self-reported PA participation, and (3) cross-validate the questionnaire in an independent sample of college students. We accomplished these objectives in two independent studies. Consistent with current recommendations, we will utilize constructs drawn from multiple social cognitive theories to develop an integrated model of PA behavior. To our knowledge, this is the first study to attempt to create the Cognitive Behavioral Physical Activity Questionnaire (CBPAQ), which simultaneously assesses multiple social cognitive constructs of PA in a college-age population.

Methods

Design

Two independent studies were conducted to achieve the aforementioned objectives. Study One included questionnaire development, exploratory and confirmatory analyses, and preliminary criterion-related validation tests. Study Two was conducted in an independent sample and included only cross-validation tests. The methods and results are described separately and are followed by a general discussion.

Participants

For Study One, a convenience sample of 885 male and female college students 18 to 24 years old was recruited from eight large health-related general education classes at a midsized northeastern university. Approval to conduct the study was granted by the university's institutional review board prior to recruitment. Informed consent and data collection procedures were performed via online surveys. Prior to responding to any questionnaire items, participants first viewed the online informed consent. Acceptance of the terms of the consent was implied by the participant's willingness to complete the questionnaire. All students were invited to participate in the study for extra credit points in the class from which they were recruited. Those who answered at least one question were considered consented and enrolled in the study, and received extra credit points. Individuals who were younger than 18 years old or older than 24 years old (n = 25) or reported a prior eating disorder diagnosis (n=31), pregnancy (n=4), BMI,18.5 kg/m^2 from self-reported weights and heights (n = 35), or having medically related dietary restrictions (n = 12) were considered ineligible for the study and excluded from data analysis. Additionally, those who were missing eligibility data (n = 23) or who skipped a substantial percentage (.50%) of the questions (n=34) were omitted from analysis. Eligible participants (N = 721) were randomized into two subsamples for factor analyses. Based on recommended methodologies to avoid issues of overextraction (of number of factors retained) in exploratory factor analysis (EFA),[16–18] data from one-third of the sample (n = 239) were used to conduct EFA and data from two-thirds of the sample (n= 482) were used to conduct confirmatory factor analysis (CFA) and follow-up validation analyses. Gender proportion of the total sample was

maintained in each subsample. There were also no between-group differences for other participant characteristics, including age, race/ethnicity, BMI, location of residence (on/off campus), or PA behavior ($p > .05$).

The sample for Study Two included participants of Project WebHealth, an online nutrition and PA program for college students from eight geographically diverse universities. Full details of the recruitment criteria and Project WebHealth curriculum have been published elsewhere.[19,20] The CBPAQ was administered to participants in an online format 12 months after the conclusion of the 3-month intervention as part of a follow-up assessment. The CBPAQ was included as one of the questionnaires included in the follow-up assessment for all eight universities. No additional compensation was provided. A total of 1224 Project WebHealth participants were invited to completed the follow-up assessment; 1104 opted to complete the survey (90.2%). Because of missing International Physical Activity Questionnaire–Short Form (IPAQ-S) data, N = 1032 have been included in the validation study.

Measures

Questionnaire Development—As part of Study One, a five-stage process of questionnaire development was performed: (1) initial item generation, (2) item refinement and modification, (3) expert panel review, (4) factor structure analysis and item selection, and (5) factor structure validation. A review of literature pertaining to social cognitive determinants of PA and existing theory-based instruments was performed. Reviewed instruments included the Perceived Benefits and Barriers Scale,[14] the Physical Activity Enjoyment Scale,[11] and the Exercise Goal-Setting and Exercise Planning and Scheduling scales.[15] From this review, 99 test questions were either selected from existing instruments or newly written. After expert review, a total of 73 test items were selected to represent specific PA behavior domains drawn from five social cognitive theories and models. Table 1 summarizes the represented PA constructs and the health behavior theories from which the items were drawn. A five-point Likert response format was chosen with scoring from 1 (“does not describe me at all”) to 5 (“describes me completely”). All questions were modified to ensure a Flesch-Kincaid eighth-grade reading level. The 73 test items were transferred into an online format using www.surveymonkey.com for data collection.

The social cognitive construct of self-efficacy (SE) was intentionally omitted from inclusion in the questionnaire test items. Although SE is recognized as the foundation of social cognitive theory, its exclusion from this questionnaire is the result of concerns of measurement. The measure of SE must be specific to the study population given its likely behavioral skills and barriers. Available SE instruments touch upon many aspects of SE, as they can be initiation or maintenance specific, type or intensity specific, or refer to SE to perform supportive actions (i.e., planning) or overcome barriers indirectly related to PA participa-tion.[21,22] McAuley and Blissmer[22] discussed two basic categorizations of SE measures: task SE measures, which assess behavioral capabilities, and self-regulatory SE measures, which assess confidence to overcome common obstacles/barriers. The pool of potential items for this measure did not focus on task SE, as it is typically not an issue in a college population; it did include behavioral elements of self-regulation and barriers, but not

confidence assessments as required for an SE measure. The exclusion of SE from this measure maintains its integrity as a measure that can be used in a variety of research studies.

Criterion-Related Validation—In addition to the initial CBPAQ test items, the IPAQ-S[23,24] and the one-item stage of change for engaging in regular exercise (SOC-EX)[25] were included in the Study One questionnaire to assess criterion-related validity.

The IPAQ-S[23,24] is a seven-item questionnaire that assesses the frequency and duration of walking and moderate- and vigorous-intensity activities during an average week. The IPAQ-S has been demonstrated to be a valid and reliable measure of PA across diverse populations, including young adults, with measurement properties as adequate as other self-report measures of PA.[24,26] Continuous and categorical scoring methods have been estab-lished.[27] In accordance with current recommendations to perform PA at least at a moderate intensity, moderate and vigorous activities were summed. Categorically, the IPAQ-S was scored to assess levels of activity (high, moderate, low) associated with health-enhancing benefits.[27] Prior to conducting validation analyses, descriptive statistics were performed. The IPAQ-S continuous measures were found to be nonnormally distributed and were normalized by square root transformation prior to conducting further analyses.[27]

The SOC-EX[25] was used to classify participants into one of five categories of PA participation: *precontemplation* (no intention of changing in the foreseeable future), *contemplation* (intending to change, but not soon), *preparation* (intending to change in the next month), *action* (recent change), or *maintenance* (maintaining change for at least 6 months). This stage of change algorithm has been validated against self-reported and objectively assessed PA in various populations.[28,29] Similarly to previously reported validation statistics, among those in the current exploratory and confirmatory samples, the correlation coefficients between SOC-EX and IPAQ-S moderate-to-vigorous–intensity PA were $\rho = .598$ to .664 and with total PA were $\rho = .436$ to .579.

Cross-Validation—As part of Study Two, cross-validation was conducted using the same criterion-related validation methods and measures described above in an independent sample. Additionally, we explored the cross-sectional associations between the CBPAQ scales with BMI, measured by standardized methods.[19]

Analysis

Exploratory Factor Analysis—EFA data reduction procedures were performed using principal components analysis and factor analysis by maximum likelihood (ML) methodology with varimax and promax rotation to ensure a robust factor structure. The number of underlying factors was decided upon using minimum average partial[30] and parallel analysis[31] methods available on SPSS, version 16.0 (Chicago, Illinois). Missing data (<1.0%) were replaced with gender-specific sample means to maintain sample size. Five of the best possible items for each of the scales were selected based on the following criteria: strong factor loadings ($\beta > .6$), lack of collinearity ($r > .8$) with other scale items, and enhancement of the scale's internal consistency (Cronbach α). All items determined to be skewed (>1.2) and/or kurtotic (>2.0) by descriptive statistics were omitted before conducting

data reduction analyses. Items not meeting all of these criteria were not considered for inclusion in the finalized questionnaire.

Confirmatory Factor Analysis—CFA procedures were performed using structural equation modeling (SEM) with normal theory ML estimation available in EQS for Windows version 6.0. Missing data were managed using ML estimators by the Fisher score method for calculating standard errors. Nested models comparisons were performed to determine the best-fitting model to the data and tested by means of χ^2 difference ($\Delta\chi^2$) testing. Model fit statistics including χ^2 to degrees of freedom ratio (≈2:1), comparative fit index > .90, and root mean square error of approximation < .05 were used as a basis of excellent model fit. The best-fitting model was selected based on these model fit indices, $\Delta\chi^2$ testing, parsimony, and consistency with empirical and theoretical research.

Criterion-Related Validation and Cross-Validation Analyses—For Study One, multiple regression, Pearson correlations, analysis of variance, and independent *t*-tests were performed to explore the relationship between the CBPAQ scales and the IPAQ-S and SOC-EX. Missing data for validation analyses were managed with listwise deletion. Validation analyses were performed using data from the CFA sample only. For Study Two, we explored the cross-sectional associations between the CBPAQ scales with the IPAQ-S and BMI using linear multiple regression analysis.

Results

Participant Characteristics

For Study One, the sample (N = 721) consisted of 69.5% females (n = 501) and 30.5% males (n = 220) with a mean age of 18.9 years (SD 1.1), range 18 to 24. Eighty-seven percent of the sample identified themselves as white and 82% were freshman or sophomores. Mean BMI, calculated from self-report weight and height, was 23.1 kg/m^2 (SD 3.5) with 24% of the sample categorized as overweight/obese (BMI ≥ 25.0 kg/m^2).

The cross-validation sample for Study Two (N=1032) consisted of 63% females (n = 650) and 37% males (n = 382) with a mean age of 20.2 years (SD 1.1), range 19 to 25. Approximately 44% were sophomores in college, 38% were juniors, and the remaining 28% were seniors or graduate students. Seventy-nine percent identified as non-Hispanic white. Based on measured height and weight, 27% were overweight or obese (BMI ≥ 25.0 kg/m^2).

EFA and CFA

EFA analysis uncovered 3 underlying PA factors represented by 15 noncomplex, high-loading ($\beta > .6$) items that accounted for 65% of the variance in the questionnaire data. The three CBPAQ (five-item) scales were labeled Outcome Expectations (CBPAQOE), Self-Regulation (CBPAQ-SR), and Personal Barriers (CBPAQ-PB). CFA analyses confirmed the three-factor, 15-question structure identified by EFA. Based on model fit statistics and $\Delta\chi^2$ testing summarized in Table 2, the hierarchical model demonstrated best fit to the data. Support for this model suggests each of the three PA factors is a correlated first-order factor related to a second-order general exercise behavior factor. Retention of this model implies

the three scales can be examined individually or summed together as a single general scale. Descriptive statistics and internal consistencies for the CBPAQ scales for both the EFA (n = 220) and CFA (n = 452) subsamples are summarized in Table 3. Independent *t*-tests were used to assure there were no significant differences in scale scores between the subsamples. The Figure depicts hierarchical model with factor loadings and path coefficients (left) for the questionnaire items scored by the provided protocol (right).

Validation Analysis

Table 4 summarizes multiple regression analyses demonstrating the association between CBPAQ constructs and transformed IPAQ-S outcomes of total activities and moderate to vigorous activities. A large portion of the vari-ance in total activities (28.6%; R^2_{adjusted} = .286, $p < .001$) and moderate to vigorous activities (39.5%; $R^2_{\text{adjusted}} = .395$, $p < .001$) was explained by the CBPAQ scales. Higher scores on the CBPAQ-SR and CBPAQ-OE scales and lower scores on the PB scale were associated with greater amounts of IPAQ-S activities. The constructs most strongly associated with total activities and moderate to vigorous activities were CBPAQ-SR (β = .212 and .386; $p < .001$, respectively) and CBPAQ-PB (β = −.286 and −.284; $p < .001$, respectively). CBPAQ-OE was associated only with total activities (β = .164, $p < .01$) after accounting for correlations among the CBPAQ scales.

Table 5 shows the CBPAQ scores demonstrated significant differences across the categorical measures of PA behavior such that CBPAQ-SR and CBPAQ-OE scores decreased significantly whereas PB scores increased significantly as IPAQ-S levels of PA decreased. CBPAQ-SR, CBPAQ-OE, and total CBPAQ scale scores consistently decreased from maintenance to pre-contemplation stages and increased across the stages for CBPAQ-PB. Significant differences were observed between maintenance, action, and preaction stages for the CBPAQ-SR and CBPAQ-PB scales. Those in maintenance and action also had significantly higher CBPAQOE and total CBPAQ scores than those in preaction stages. There were less pronounced differences in CBPAQSR and CBPAQPB scale scores across the preaction stages. However, individuals in preparation had significantly higher CBPAQ-OE scores compared to those in precontemplation and contemplation, and those in preparation and contemplation had significantly greater total CBPAQ scores than those in precontemplation.

Cross-Validation Analysis

Results from the cross-validation data set were quite similar to those in the initial validation. The three CBPAQ scales together explained 40% of the variance in IPAQderived moderate to vigorous PA. CBPAQ-PB (β =−.223; $p < .001$) and CBPAQ-SR (β = .472; $p < .001$) were both significantly associated with MVPA. CBPAQ-OE was not significantly associated with MVPA (β = .008; $p = .8$).

By linear multiple regression analysis, observed associations between BMI and the CBPAQ-PB (β = .143; $p < .001$) and CBPAQ-OE scales (β = —.070; $p = .061$) were significant or borderline significant. CBPAQ-SR was not associated with BMI (β = .061; $p = .132$)

Discussion

The objectives of this study were to develop a short questionnaire that assesses multiple social cognitive constructs to explain PA behavior for use in college-aged populations and to demonstrate criterion-related validation of the questionnaire against PA participation. These objectives were accomplished. The three-scale, 15-item CBPAQ accounted for 65% of the variance in the questionnaire data and demonstrated strong internal consistency. The three scales explained a substantial portion of the variance in total activities and moderate to vigorous activities (29% and 40%, respectively). Similar explanatory power was observed in an independent cross-validation sample (40%). The amount of variance explained for MVPA is especially notable because it is similar to studies using one discrete theory or a combination of social cognitive (and environmental) variables to predict self-report PA (33%, on average), based on a review of more than 20 published studies.[9] Furthermore, this is accomplished using only three constructs and 15 questions. The scales further demonstrated the ability to distinguish between individuals in various stages of PA participation. Successful development and preliminary validation of the CBPAQ demonstrates the feasibility of using a short, multi-construct questionnaire to explain PA behavior in a college population in the place of multiple existing social cognitive measures totaling more than 75 items.

The three five-item social cognitive factors of PA behavior were labeled CBPAQ-PB, CBPAQ-SR, and CBPAQ-OE. CBPAQ-PB is defined as the perceived barriers preventing the initiation or maintenance of regular PA, including personal distractions, lack of time, lack of interest, and lack of motivation. CBPAQ-SR is defined as self-regulatory actions used to maintain regular PA, including relapse prevention strategies, making commitments and goals, prioritizing, and contingency planning. CBPAQ-OE is defined as the expectation that participation in PA will produce positive and wanted results including increased energy, sense of accomplishment, mood improvements and stress relief, and feeling good physically.

The social cognitive constructs of social and environmental barriers were not found to be a relevant determinant of PA in this college-aged sample. This could be considered a limitation of a questionnaire designed to reflect various social cognitive constructs; however, most items reflective of these constructs were skewed by a low mean response and were subsequently removed from factor analyses. The low endorsement of these items implies most students (including those who were reportedly less active) may feel they have adequate support from their family and peers, or have ample access to fitness facilities. Other remaining social and environmental barrier items were found to correlate with other items on the CBPAQ-PB scale but were not selected to represent the scale because of inadequate factor loadings (<.6).

Existing research provides a rationale to assess personal barriers to PA, particularly in a college sample. In a study by Brown et al.,[14] personal barriers, including low motivation, laziness, lack of will power, and not making time to exercise, explained more than 35% of the variance in strenuous PA in a college sample. Significant personal barriers to PA, healthy eating, and weight management were also noted in a qualitative study of college students, including motivation, temptation, boredom, and stress.[32] Further support for a personal

barriers scale to explain PA is provided in this study, as the newly developed CBPAQ-PB scale independently accounts for a significant portion of the variance in total and moderate to vigorous activity (R^2=.227 and .281; not shown) and differentiates between various levels of PA frequency and participation.

Similarly, the construct of self-regulation measured by the CBPAQ contributed greatly to explaining PA behavior in this population. This construct is particularly important in that motivation to be active is often not enough to maintain regular PA.[33] In a study performed by Rovniak et al.[15] in young adults, a measure of self-regulation (planning and scheduling) was developed and demonstrated that self-regulation was strongly associated with strenuous PA (β =.48, $p < .05$). Similar associations were observed in this study such that the newly developed SR scale independently predicts a large portion of the variance in total and moderate to vigorous activity ($R^2_{adjusted}$ = .212 and .386, $p < .05$). Combining previous findings with the findings in this study suggests that the use of self-regulation strategies is of great importance to understanding regular participation in PA in a college population.

Research regarding the predictive ability of positive PA outcomes is somewhat limited in this population, and its role in understanding PA participation has yielded mixed results.[34] Based on a review of the outcome expectancy construct in PA research, certain patterns between the construct and PA were observed that may explain inconsistencies in the research.[34] The most remarkable observation was that the association between outcome expectations and PA is stronger among older adults than among young to middle-aged adults.[34] In this study, CBPAQ-OE scale scores independently differentiated between various levels of PA. However, they were not significantly associated with total or moderate to vigorous activity after accounting for CBPAQ-PB and CBPAQ-SR. This finding suggests CBPAQ-OE may be useful in identifying those who are more versus less active in a college-aged population, but that there may be an indirect association between PA and CBPAQ-OE through CBPAQ-PB and CBPAQ-SR. Additional modeling of the associations between the CBPAQ scales and PA would be needed to test this hypothesis.

Lastly, this study demonstrates the CBPAQ may be a useful measurement instrument for stage-based PA interventions. Although the CBPAQ appears to tap into dimensions of PA behavior associated with both initiation and maintenance of regular PA, it may be particularly useful in interventions that focus on PA maintenance in a college population. Specifically, greater CBPAQ-SR scores increased and CBPAQ-PB scores decreased from precontemplation to maintenance, with significant differences between preaction stages, action, and maintenance. Although these findings demonstrate the strength of the CBPAQ to differentiate between those who are active engaging in regular PA versus those who are not, the CBPAQ-OE scale may aid in differentiating between those in the preaction stages. Social cognitive theory suggests that outcome expectancy may play a larger role in the initiation of behaviors and less of a role in behavioral maintenance.[35] Consistent with these implications, the CBPAQ-OE scores did not vary significantly between individuals in action or maintenance. Additionally, stronger CBPAQ-OE score differences were observed between those in pre-contemplation and contemplation and those in preparation and action. CBPAQ-OE score differences might have reached significance between each of the preaction stages had there been larger group sizes.

This study is strengthened by the recruitment of large samples of college students. These large samples allowed for both EFA and CFA data reduction analyses as well as additional, out-of-sample validation analyses. Furthermore, the use of SEM for CFA procedures greatly strengthens this study, as SEM takes into account measurement error, greatly enhancing confidence in the structure and its psychometric properties. Another important strength is the incorporation of constructs from a variety of social cognitive models, rather than limiting our instruments to the constructs from one model.

The findings of this research are limited mainly by the lack of diversity in this college-aged sample. The populations of Studies One and Two were all college students who were predominantly female (70% and 63%, respectively) and white (87% and 79% respectively). Future research should verify the nature of the CBPAQ in more diverse populations, including young adults not attending college, to allow for greater generalization of the current findings to a broader young adult population. Another limitation of this study is its cross-sectional design. Inferences regarding the relationship between the CBPAQ maintenance of PA over extended periods of time will need to be evaluated though prospective research.

In summary, this study demonstrates the successful development and preliminary validation of a short PA behavior questionnaire that incorporates multiple social-cognitive constructs to explain PA participation in a college population. The CBPAQ, therefore, is a valuable measurement instrument for the assessment of determinants of PA; warranting its incorporation into future studies aiming at understanding and improving on PA behaviors in college students.

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References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. JAMA. 2012; 307:483–490. [PubMed: 22253364]
2. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010. JAMA. 2012; 307:491–497. [PubMed: 22253363]
3. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999–2000. JAMA. 2002; 288:1723–1727. [PubMed: 12365955]
4. Lewis CE, Jacobs DR Jr, McCreath H, et al. Weight gain continues in the 1990s: 10-year trends in weight and overweight from the CARDIA study. Coronary Artery Risk Development in Young Adults. Am J Epidemiol. 2000; 151:1172–1181. [PubMed: 10905529]
5. World Health Organization. 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases. Geneva, Switzerland: WHO Press; 2009.
6. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Ga: US Dept of Health and Human Services, Centers for Disease Control and Prevention; 2011.

7. American College Health Association. American College Health Association–National College Health Assessment II Reference Group Executive Summary Spring 2013. Hanover, Md: American College Health Association; 2013.
8. Baranowski T, Anderson C, Carmack C. Mediating variable framework in physical activity interventions. How are we doing? How might we do better? Am J Prev Med. 1998; 15:266–297. [PubMed: 9838973]
9. Plotnikoff RC, Costigan SA, Karunamuni N, Lubans DR. Social cognitive theories used to explain physical activity behavior in adolescents: a systematic review and meta-analysis. Prev Med. 2013; 56:245–253. [PubMed: 23370047]
10. Sallis JF, Grossman RM, Pinski RB, et al. The development of scales to measure social support for diet and exercise behaviors. Prev Med. 1987; 16:825–836. [PubMed: 3432232]
11. Kendzierski D, DeCarlo KJ. Physical Activity Enjoyment Scale: two validation studies. J Sport Exercise Psychol. 1991; 13:50–64.
12. Sallis JF, Hovell MF, Hofstetter CR, et al. A multivariate study of determinants of vigorous exercise in a community sample. Prev Med. 1989; 18:20–34. [PubMed: 2710760]
13. Sallis JF, Pinski RB, Grossman RM, et al. The development of self-efficacy scales for health related diet and exercise behaviors. Health Educ Res. 1988; 3:283–292.
14. Brown SA, Huber D, Bergman A. A perceived benefits and barriers scale for strenuous physical activity in college students. Am J Health Promot. 2006; 21:137–140. [PubMed: 17152253]
15. Rovniak LS, Anderson ES, Winett RA, Stephens RS. Social cognitive determinants of physical activity in young adults: a prospective structural equation analysis. Ann Behav Med. 2002; 24:149–156. [PubMed: 12054320]
16. Guadagnoli E, Velicer WF. Relation of sample size to the stability of component patterns. Psychol Bull. 1988; 103:265–275. [PubMed: 3363047]
17. MacCallum RC, Brown MW, Sugawara HM. Power analysis and determination of sample size for covariance structure modeling. Psychol Methods. 1996; 1:130–149.
18. Fava JL, Velicer WF. The effects of overextraction on factor and component analysis. Multivariate Behav Res. 1992; 27:387–415. [PubMed: 26789789]
19. Greene GW, White AA, Hoerr SL, et al. Impact of an online healthful eating and physical activity program for college students. Am J Health Promot. 2012; 27:e47–e58. [PubMed: 23113786]
20. Greene GW, Schembre SM, White AA, et al. Identifying clusters of college students at elevated health risk based on eating and exercise behaviors and psychosocial determinants of body weight. J Am Diet Assoc. 2011; 111:394–400. [PubMed: 21338738]
21. McAuley, E.; Mihalko, S. Measuring exercise-related self-efficacy. In: Duda, JL., editor. Advances in Sport and Exercise Psychology Measurement. Morgantown, WV: Fitness Information Technology Inc; 1998. p. 371-390.
22. McAuley E, Blissmer B. Self-efficacy determinants and consequences of physical activity. Exerc Sport Sci Rev. 2000; 28:85–88. [PubMed: 10902091]
23. IPAQ. [Accessed May 14, 2011] International Physical Activity Questionnaire–short form. Available at: http://www.ipaq.ki.se/downloads.htm
24. Craig CL, Marshall AL, Sjostrom M, et al. International Physical Activity Questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003; 35:1381–1395. [PubMed: 12900694]
25. Laforge RG, Rossi JS, Prochaska JO, et al. Stage of regular exercise and health-related quality of life. Prev Med. 1999; 28:349–360. [PubMed: 10090864]
26. Papathanasiou G, Georgoudis G, Georgakopoulos D, et al. Criterion-related validity of the short International Physical Activity Questionnaire against exercise capacity in young adults. Eur J Cardiovasc Prev Rehabil. 2010; 17:380–386. [PubMed: 19940775]
27. Sjostrom, M.; Ainsworth, B.; Bauman, A., et al. [Accessed May 14, 2011] Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)—short and long forms. Available at: http://www.ipaq.ki.se/scoring.pdf
28. Kosma M, Ellis R. Establishing construct validity of a stages-of-change algorithm for physical activity. Am J Health Promot. 2010; 25:e11–e20. [PubMed: 21039286]

29. Hellsten LA, Nigg C, Norman G, et al. Accumulation of behavioral validation evidence for physical activity stage of change. Health Psychol. 2008; 27(1 suppl):S43–S53. [PubMed: 18248105]

30. Velicer WF. Determining the number of components from the matrix of partial correlations. Psychometrika. 1976; 41:321–327.

31. Horn JI. A rationale and test for the number of factors in factor analysis. Psychometrika. 1965; 30:179–185. [PubMed: 14306381]

32. Greaney ML, Less FD, White AA, et al. College students' barriers and enablers for healthful weight management: a qualitative study. J Nutr Educ Behav. 2009; 41:281–286. [PubMed: 19508934]

33. Bandura, A. Self-Efficacy: The Exercise of Control. New York, NY: WH Freeman; 1997.

34. Williams DM, Anderson ES, Winett RA. A review of the outcome expectancy construct in physical activity research. Ann Behav Med. 2005; 29:70–79. [PubMed: 15677303]

35. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977; 84:191–215. [PubMed: 847061]

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

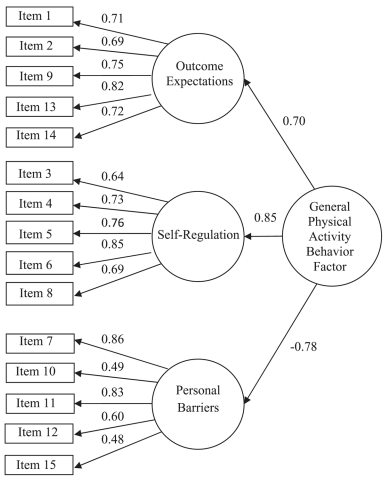
College-aged young adults are insufficiently active. Although theoretical models may guide interventions to address this, researchers lack validated instruments to measure relevant constructs in this population.

What does this article add?

The objectives of these studies were to develop and validate a brief instrument to assess theory-based determinants of physical activity that are most salient to a college-aged population. Three cognitive behavioral constructs emerged as being most relevant: outcome expectations, self-regulation, and perceived barriers. These three constructs were able to explain a relatively substantial amount of the variance in MVPA as compared to other, more intensive theory-based questionnaires. Items reflecting social and environmental barriers appeared to be less relevant to this population.

What are the implications for health promotion practice or research?

The CBPAQ can be utilized to assess underlying cognitive behavioral mechanisms that influence physical activity behavior in this population. Additionally, these findings provide preliminary evidence that interventions could focus efforts on increasing self-regulation strategies (e.g., goal setting and planning) and reducing personal barriers to physical activity to increase the intrinsic motivation to be active, while putting less emphasis on social and environmental barriers.



COGNITIVE BEHAVIORAL PHYSICAL ACTIVITY QUESTIONNAIRE

Directions: Please choose a response that best expresses how well each statement describes you.

1. I find being physically active gives me a lot of energy.
2. I feel good physically after I've exercised.
3. I schedule all events in my life around my exercise routine.
4. I schedule exercise at specific times of the week in order to maintain a routine.
5. I set goals for myself in order to keep physically active.
6. I make commitments to exercise and stick to them.
7. I'm just too lazy to exercise regularly.
8. I make back up plans to be sure I get enough exercise.
9. Being physically active gives me a strong sense of accomplishment.
10. I have too many things to do during the day and can never find time to exercise.
11. My lack of motivation stops me from being physically active.
12. When I am exercising, I often feel as though I would rather be doing something else.
13. Being physically active improves my mood.
14. I consider being physically active an effective way of relieving stress.
15. I don't exercise as regularly when I get depressed or upset about something.

Scoring Protocol
CBPAQ scale scores are calculated as the average of the summed item raw scores by the following criteria: Does not describe me at all=1; Describes me slightly=2; Describes me more or less=3; Describes me pretty well=4; Describes me completely=5

Outcome expectations= (Item 1+Item 2+Item 9+Item 13+Item 14)/5
Self-Regulation= (Item 3+Item 4+Item 5+Item 6+Item 8)/5
Personal Barriers= (Item 7+Item 10+Item 11+Item 12+Item 15)/5
Total CBPAQ Score= Outcome Expectations + Self-Regulation – Personal Barriers

Figure. Cognitive Behavioral Physical Activity Questionnaire* and Questionnaire Instructions†

*On the left is the hierarchical model of the Cognitive Behavioral Physical Activity Questionnaire (CBPAQ), depicting standardized factor loadings between questionnaire items and their constructs and path coefficients between the constructs and the general higher-order factor. Measurement error variances and disturbances were estimated in the model; however, they are not depicted. Model fit statistics: χ^2:df = 3.0 (χ^2 = 258.58; df = 86), comparative fit index = 0.947, and root mean square error of approximation = 0.064 (0.055–0.073).

†On the right are the questionnaire instructions and items along with the scoring protocol.

Table 1

Summary of Initial CBPAQ Test Items and Associated Theories*

Primary Construct	Question Set (No. of Questionnaire Items)	Associated Theories
Self-regulation	Self-management (7)	SMT, SCT
	Goal setting (7)	SMT, SCT
	Planning (6)	SCT
	Contingency management (6)	SMT, SCT, HPM
Outcome expectations	Positive (9)	SCT
	Negative (10)	SCT
Barriers	Insufficient capabilities (4)	SCT, HPM, HBM
	Lack of social support (4)	SCT, HPM, HBM
	Environmental constraints (3)	SCT, HPM, HBM
	Lack of time (6)	SCT, HPM, HBM
	Lack of motivation (4)	SDT, HPM, HBM
	Lack of self-confidence (7)	SCT, HPM, HBM

*CBPAQ indicates Cognitive Behavioral Physical Activity Questionnaire; SMT, self-management theory; SCT, social cognitive theory; HPM, health promotion model; HBM, health belief model; and SDT, self-determination theory.

Table 2

CFA Model Summary Statistics for Hypothesized Models of the CBPAQ Scale (N = 482)*

	Model Fit Statistics				Model Comparison Statistics			
	χ^2	df	RMSEA	CFI	Comp.	Δdf	$\Delta\chi^2$	Δ*p*
1. Null model	3272.83	101	0.253					
2. Uncorrelated factors	625.83	89	0.111	0.832	1→2	12	2647.00	<0.001
3. Correlated factors	258.58	86	0.063	0.947	2→3	3	367.25	<0.001
4. Hierarchical model†	**258.58**	**87**	**0.063**	**0.947**	**2→4**	**2**	**367.25**	**<0.001**

*CFA indicates confirmatory factor analysis; CBPAQ, Cognitive Behavioral Physical Activity Questionnaire; RMSEA, root mean square error of approximation; CFI, comparative fit index; Comp., model comparisons; and Δ, difference. The best model fit is presented in bold text.

†Hierarchical model represents a single second-order factor associated with the CBPAQ scales.

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Table 3

Descriptive Statistics and Internal Consistencies of the CBPAQ by Sample Subgroups*

	EFA Sample (N = 220)			CFA Sample (N = 452)			
CBPAQ	**Mean**	**SD**	**α**	**Mean**	**SD**	**α**	***p*†**
Total CBPAQ Score	4.55	2.20	0.900	4.40	2.03	0.894	0.402
Self-regulation	2.59	1.02	0.891	2.48	0.88	0.856	0.156
Outcome expectations	4.02	0.82	0.876	4.00	0.80	0.853	0.894
Personal barriers	2.06	0.80	0.772	2.08	0.80	0.783	0.761

*CBPAQ indicates Cognitive Behavioral Physical Activity Questionnaire; EFA, exploratory factor analysis; CFA, confirmatory factor analysis; and α, Cronbach internal consistency α. Listwise deletion was used to manage missing data.

†Difference testing performed by independent *t*-tests.

Table 4

Multiple Regression Analyses for CBPAQ Scales and IPAQ-S Outcomes*

	CBPAQ Predictors	β	*t*	*p*	η^2
Total activity (n = 270)†					
$R^2_{adjusted}$ = 0.286	Self-regulation	0.212	3.286	0.001	0.198
	Outcome expectations	0.164	2.662	0.008	0.161
	Personal barriers	−0.286	−4.582	<0.001	−0.270
Moderate to vigorous activity (n = 327)†‡					
$R^2_{adjusted}$ = 0.395	Self-regulation	0.386	7.099	<0.001	0.367
	Outcome expectations	0.070	1.349	0.178	0.075
	Personal barriers	−0.284	−5.314	<0.001	−0.284

*CBPAQ indicates Cognitive Behavioral Physical Activity Questionnaire; and IPAQ-S, International Physical Activity Questionnaire–Short Form. Listwise deletion was used to manage missing data.

†IPAQ-S outcome distributions were normalized by square root transformation prior to performing linear multiple regression analyses.

‡Moderate to vigorous activity was calculated by summing IPAQ-S vigorous and moderate activities prior to conducting square root transformation.

Table 5

Mean Comparisons of CBPAQ Scales Against Categorical Criterion-Related Validity Measures

	IPAQ-S						SOC-EX									
	High Active (n = 138)		Moderately Active (n = 185)		Low Active (n = 22)		SOC-M (n = 188)		SOC-A (n = 71)		SOC-Pr (n = 112)		SOC-C (n = 56)		SOC-Pc (n = 24)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total CBPAQ Score	5.96	1.47[a]	4.22	1.73[b]	2.59	2.08[c]	5.79	1.51[a]	4.57	1.54[b]	3.37	1.36[c]	2.50	1.92[d]	2.31	1.82[d]
Self-regulation	3.08	0.74[a]	2.33	0.77[b]	1.83	0.84[c]	3.03	0.75[a]	2.48	0.67[b]	2.01	0.68[c]	1.84	0.70[c]	1.79	0.91[c]
Outcome expectations	4.43	0.52[a]	3.99	0.77[b]	3.53	1.01[c]	4.35	0.60[a]	4.10	0.71[ab]	3.83	0.78[b]	3.43	0.87[c]	3.28	0.92[c]
Personal barriers	1.58	0.56[a]	2.10	0.71[b]	2.76	0.78[c]	1.59	0.55[a]	2.01	0.64[b]	2.47	0.70[c]	2.76	0.83[c]	2.76	0.71[c]

*CBPAQ indicates Cognitive Behavioral Physical Activity Questionnaire; IPAQ-S, International Physical Activity Questionnaire–Short Form; SOC-EX, stage of change for engaging in regular physical activity; M, maintenance; A, action; Pr, preparation; C, contemplation; and Pc, precontemplation. Statistically significant comparisons were determined by analysis of variance and Tukey post hoc multiple comparisons. Across groups, values with different superscript letters are significantly different from each other, whereas values that share the same superscript are not statistically different from each other ($p > 0.05$). All significant comparisons reached $p < 0.01$. Listwise deletion was used to manage missing data.