Physical Activity Belief Scales for Diabetes Risk: Development and Psychometric Testing

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Abstract:
This article describes the development and psychometric evaluation of behavioral belief, normative belief, and control belief scales, derived from the theory of planned behavior to predict physical activity intentions of persons at risk for diabetes. In Study 1, belief statements from interviews were categorized, ranked, and evaluated for item construction. Content validity was established by 96. 1 % agreement among a five-member expert panel. In Study 2, items developed from the belief statements were administered to 106 adults at risk for diabetes. Psychometric analyses provided evidence of construct validity and reliability of the three scales. Internal consistency was sufficient (α = .76-.95), and test-retest evaluations indicated scale stability (r = .79-.91). Factor analyses and confirmatory factor analysis using structural equation modeling provided evidence that the items were appropriately grouped under each construct. Researchers and practitioners can use these measures to assess behavioral, normative, and control beliefs about physical activity among persons at risk for diabetes.
Keywords: theory of planned behavior; type 2 diabetes; physical activity beliefs

Article:

The incidence of diabetes mellitus is increasing worldwide (Wild, Roglic, Green, Sicree, & King, 2004), and it is one of the leading causes of morbidity and mortality in the United States (Diabetes Research Working Group, 2002). More than 11.0 million American adults 20 years and older have been diagnosed with type 2 diabetes, 1.0 million will be newly diagnosed with diabetes each year, and an additional 5.9 million may have undiagnosed diabetes (National Institute of Diabetes and Digestive and Kidney Diseases, 2003). Recent data suggested that 47.0 million Americans have prediabetes, an insulin resistance syndrome associated with increased risk for type 2 diabetes (Ford, Giles, & Dietz, 2002). Moderate increases in physical activity and improved diet have been shown to prevent or delay type 2 diabetes (Diabetes Prevention Program Research Group, 2002). Yet more than half of the adult population in the United States does not participate in regular, moderate-intensity physical activity (Centers for Disease Control and Prevention, 2003), and 25% of the population report absolutely no leisure-time physical activity (Centers for Disease Control and Prevention, 2004).

The benefits of physical activity in delaying or preventing diabetes occur only if individuals maintain physical activity over time. However, designing effective interventions to help individuals establish and maintain health behaviors such as physical activity has been difficult (Blue & Black, 2005), especially among individuals who are sedentary (Morgan, 2005). Perhaps, when cognitive beliefs related to physical activity are known, interventions can be developed to strengthen these beliefs as a mechanism for changing behavior.

CONCEPTUAL FRAMEWORK

The theory of planned behavior (TpB; Ajzen, 1988), a general framework of social behavior, can be used to identify cognitive beliefs relevant to health behaviors. The TpB is an expectancy-value model with emphasis on

attitudes, subjective norms, perceived behavioral control, and intentions directed to a specific behavior (see Figure 1).

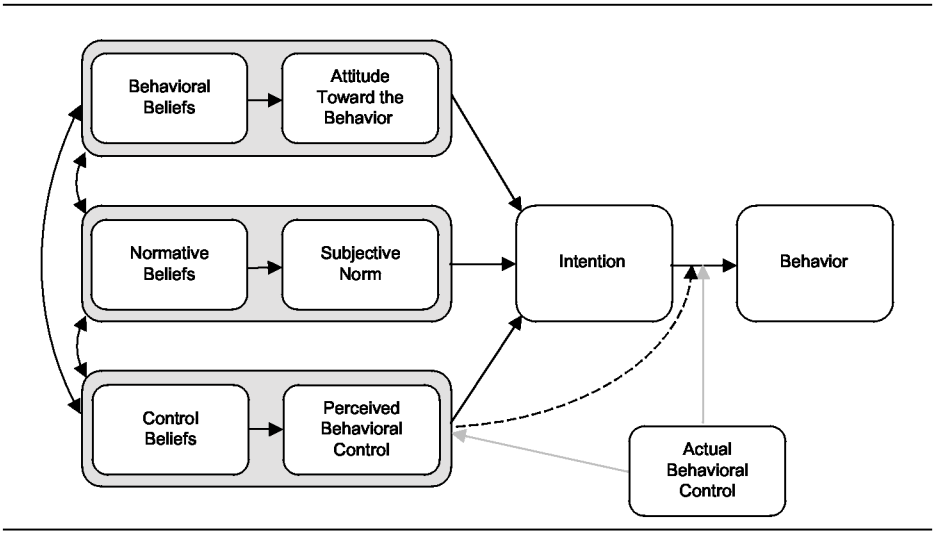

Figure 1. Theory of planned behavior.
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According to the theory, the best single predictor of a person's behavior is the intention to perform that behavior (see Figure 1). Intention suggests a person's readiness to devote time and energy to perform a behavior. If a behavior is under the person's volitional control, the person will perform the behavior if he or she intends to do so and will not perform the behavior if he or she does not intend to do so (Ajzen, 2002; Ajzen & Fishbein, 1980). Behavioral intentions are guided by the person's attitude toward per-forming the behavior, subjective norm, and perceived behavioral control.

Attitude is the extent to which performing the behavior is valued by a person (Ajzen, 2002). Attitude is thought to be determined by beliefs about the positive and negative outcomes of the behavior (i.e., outcome expectancies) and the person's evaluation of those outcomes.

Subjective norm is the person's perception of social influence or pressure to perform the behavior (Ajzen, 2002). Subjective norm is thought to be determined by beliefs about the expectations of important others or *referents* and the person's motivation to comply with those expectations.

Perceived behavioral control is the person's perception of the ease or difficulty of carrying out a behavior (Ajzen, 2002). Perceived behavioral control is thought to be deter-mined by beliefs about factors that impede or facilitate performing the behavior and the power of each factor on the person's control over the behavior (Ajzen, 2002). If the person has enough actual control over the behavior, he or she is likely to carry out the behavior.

Instruments based on the TpB have been developed to measure the physical activity of older adults (Conn, Tripp-Reimer, & Maas, 2003; Courneya, 1995), corporate employees (Kimiecik, 1992), blue-collar employees (Blue, Wilbur, & Marston-Scott, 2001), and joggers (Riddle, 1980). The TpB also is useful in understanding the beliefs that lead to behaviors such as physical activity (Downs & Hausenblas, 2005; Godin & Kok, 1996). However, there are no published instruments to measure the behavioral, normative, and control beliefs about physical activity of persons at risk for diabetes. Therefore, the two studies reported developed scales to measure the behavioral, normative, and control beliefs about physical activity of persons at risk for type 2 diabetes and assessed content validity, concept validity, internal consistency reliability, and stability of the scales.

STUDY 1

The first step in developing the belief scales involved qualitative research to collect salient beliefs about physical activity from a representative sample of persons at risk for type 2 diabetes. The responses to a series of open-ended questions were recorded and a content analysis was conducted. The guidelines of Ajzen and Fishbein (1980; Ajzen, 2002) were then used to construct behavioral belief, normative belief, and control belief scales. These guidelines include counting the frequency of elicited beliefs, grouping together similar beliefs, and determining the number and kinds of beliefs to be included in modal belief sets (i.e., patterns of beliefs of a given population). Although people hold beliefs at the individual level, the modal set of salient beliefs in a given population are used to develop a TpB questionnaire. Beliefs that were elicited first and most frequently were included in modal belief sets and were used to construct the belief measures (Ajzen & Fishbein, 1980). Modal belief sets included outcome expectancies for the behavioral belief measure, normative referents for the normative belief measure, and control factors for the control belief measure.

Method

Sample and Setting

Participants were recruited from the Diabetes Research and Training Center at Indiana University. They were all enrolled in the intensive lifestyle arm of the Diabetes Prevention Program (DPP; Diabetes Prevention Program Research Group, 2002). All of the participants were aware that they were at risk for developing type 2 diabetes and all had been trying to improve their physical activity and diet for approximately 5 years. Inclusion criteria for this study were age 21 years or older, English speaking, and access to a telephone. Clients who had converted to diabetes were excluded from the study. Participants were mailed a $15 gift card after the interview to thank them for their time.

Procedures

The university's Human Subjects Institutional Review Board approved the study. Participants were approached about the study as they checked in for their appointments. If they agreed to learn about the study, the principal investigator explained the study and obtained written consent. Participants completed a demographic data form to include age, gender, race, income, education level, height, and weight and gave a telephone number where they could be reached and a preferred time for an interview. Participants were then contacted within 2 weeks for an interview to elicit their beliefs about being physically active. Following the recommendations of Ajzen and Fishbein (1980; Ajzen, 1988), recruitment was continued to saturation, when no new beliefs were elicited from the sample.

An interview guide was developed to elicit beliefs about physical activity. To make sure participants understood the behaviors in question, physical activity was defined as "moderate or vigorous activities that you would do for at least 30 minutes each time on most, if not all, days of the week" (U.S. Department of Health and Human Services, 1996). Participants also were given examples of moderate (fast walking, bicycling, cleaning house) and vigorous (playing basketball, shoveling snow, jogging) activities. To elicit salient behavioral beliefs, participants were asked, "What would be the advantages or good things that would happen to you in the next 2 months if you were to get 30 minutes or more of moderate or vigorous physical activity on most days of the week?" They were then asked about the disadvantages or bad things that would happen. Salient normative beliefs were elicited with the question, "Who are those people who think you should be physically active for 30 minutes or more on most days of the week?" They were then asked about people who thought they should not be physically active for the same time period. Salient control beliefs were elicited with the question, "What things would make it easy for you to be moderately or vigorously physically active for 30 minutes or more on most days of the week?" followed by the question, "What things would make it difficult for you to be moderately or vigorously physically active for 30 minutes or more on most days of the week?"

Item Development. Modal belief sets or patterns of beliefs were generated from participant responses using the content analysis technique of Ajzen and Fishbein (1980; Ajzen, 2002). For each of the behavioral, normative, and control belief domains, com-parable responses and the most frequent form of elicited responses were grouped together into modal belief sets. For example, stated positive outcomes of physical activity such as "I

would lose weight," "would result in weight loss," "would burn calories," and "drop a pound or two" were grouped together in a modal belief set named *Helps me control my weight*. The salient beliefs were then used to develop items for the behavioral belief, normative belief, and control belief scales.

Content Validity. The categorization of responses into modal belief sets was reviewed by five experts in physical activity, the TpB, and scale development. The experts were asked to (a) examine the responses and determine whether they supported the statements in the modal belief sets for physical activity, (b) note whether each of the items reflected the appropriate construct on a 4-point scale from 1 (*not relevant*) to 4 (*very relevant*), and (c) evaluate the clarity and concision of the items (Grant & Davis, 1997).

Results

Sample

Thirty-two individuals participated in the elicitation study. Most were female (68.8%) and married (71.9%). The sample was almost entirely Caucasian (71.9%) and African American (21.9%), with minimal representation of Native Americans (3. 1 %) and Hispanics (3.1%). Overall, participants were fairly well educated; 59.4% were college graduates, 31.3% had some college or technical education beyond high school, and the remaining participants (9.4%) had at least a high school education. Ages were from 31 to 40 years old to 71 years and older, with the largest proportion (40.6%) of participants falling in the category of 41 to 50 years old. Body mass index (BMI = weight [kg]/height [mm]2 ; National Heart, Lung, and Blood Institute, 1998) was from 21.7 to 67.4; *M* BMI was 34.0 (*SD* = 9.3).

Content Validity

The experts agreed that 96.1% of participants' 190 belief statements supported the modal belief sets or most salient beliefs about physical activity, and they judged 97.2% of items to be relevant or very relevant to behavioral, normative, or control beliefs. The modal belief sets were then used to develop scale items to measure the behavioral belief, normative belief, and control belief constructs. Based on recommendations from the judges, the referent "my family" was separated into modal sets reflecting "spouse/ partner," "children," and "other family members," leaving 6 modal sets of normative referents for the scale. The modal control belief "having time" was separated into two modal belief sets, "having time" and "being able to fit it into my daily schedule and obligations," resulting in 12 sets of control beliefs. Another 6 modal belief statements were reworded to improve the clarity of the statements.

Questionnaire Items

Two corresponding scale items were developed for each belief. One measured the strength of the belief, and the other measured evaluation of the belief (Ajzen, 2002). The behavioral belief scale had 15 outcome expectancy (oe) items and 15 corresponding outcome evaluation (e) items. All of the items were measured on a Likert-type scale. Using a scale from 1 (*very unlikely*) to 5 (*very likely*), the outcome expectancy items measured the strength of belief about whether good and bad things would happen if the person got regular moderate or vigorous physical activity for at least 30 minutes each time on most, if not all, days of the week. The outcome evaluation items measured the degree to which the person judged the outcome to be good or bad, from 1 (*neither good nor bad*) to 5 (*very good* or *very bad*), depending on the outcome. Negative items were reverse scored so that higher scores indicated more positive behavioral beliefs.

The normative belief scale had six normative belief (nb) items and six corresponding motivation to comply (mc) items. The normative belief referent items measured the strength of belief that another person would influence the participant to get regular moderate or vigorous physical activity on a scale from 1 (*definitely should not*) to 5 (*definitely should*), and the motivation to comply items measured the degree to which the participant would comply with the wishes of the referent on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

The control belief scale had 12 control belief factor (cb) items and 12 control power (p) items. Using a scale from 1 (*strongly disagree*) to 5 (*strongly agree*), the control belief factor items measured the strength of belief that a factor that would facilitate or inhibit getting regular physical activity was present. The power items

measured the degree of ease or difficulty of being physically active if the condition was present, from 1 (*strongly disagree*) to 5 (*strongly agree*).

Each belief item was multiplied by its corresponding item and the products were summed for the behavioral belief ($\sum oe \cdot e$), normative belief ($\sum nb \cdot mc$), and control belief ($\sum cb \cdot p$) scales. Items for the scales were evaluated with the Flesch-Kincaid Grade Level to have a seventh-grade reading level score (Center for Health Care Strategies, 2005).

STUDY 2

Method

Setting and Sample

To test the psychometrics of the scales, a convenience sample (n = 106) was recruited from a Midwestern community via posters and newspaper advertisements. Participants were self-identified as at risk for developing diabetes using the American Diabetes Association risk test (i.e., family history of diabetes, overweight, gestational diabetes; National Diabetes Information Clearing House, 2004) or they had been told by their health care provider that they were at risk for diabetes. All were 21 years or older and English speaking.

Procedures

After approval from the University Institutional Review Board, respondents were screened for diabetes risk by phone to determine eligibility. The principal investigator explained the study to each participant and any questions about the study were answered. Prospective participants (n = 134) were then sent a letter describing the study, volunteer participation, and confidentiality and were given phone numbers of the principal investigator and the Human Research Subjects Internal Review Board. Data were collected from mailed self-administered questionnaires. Participants were instructed to return the questionnaire in the enclosed addressed, stamped envelope. They were given a $10 gift card for the completed questionnaire to compensate them for their time. Of the 134 participants who were mailed a questionnaire, 106 (79. 1 %) returned them. A second questionnaire was mailed 2 months later to those 106 respondents who returned the first questionnaire. Of those, 65 mailed back a second questionnaire, resulting in a response rate of 49.3%. No differences were found on any of the belief measures in the Time 1 questionnaire between those who returned or did not return a questionnaire at Time 2, $F_{(70,35)} = .76$, $p > .70$.

Measures

In addition to the behavioral belief, normative belief, and control belief scales generated from the qualitative study described in Study 1, the questionnaire tested in Study 2 included an additional six demographic items, two items that requested height in feet and inches and weight in pounds. Height and weight were included to calculate BMI for descriptive purposes, because overweight and obesity are risk factors for diabetes. Ten items directly measured attitude, subjective norm, and perceived behavioral control relevant to physical activity to assess the construct validity of the belief measures. The questionnaire took approximately 20 minutes to complete.

Attitude toward physical activity was measured using the semantic differential scale developed by Blue and colleagues (Blue et al., 2001), which includes six bipolar adjectives. The adjectives (unpleasant/pleasant, boring/interesting, bad/good, useless/useful, worthless/valuable, and harmful/helpful) are scored on a 5-point scale. Averaging the scores resulted in possible scores from 1 to 5, with higher scores indicating a more positive attitude toward physical activity. Cronbach's alphas for the scale in this study were .85 at Time 1 and .89 at Time 2.

Subjective norm was measured by three items suggested by Ajzen (2002) using Likert-type scales asking (a) how much people who are important to the respondent approved of the respondent getting moderate or vigorous physical activity for at least 30 minutes on most days of the week in the next 2 months (1 = *strongly do not approve* to 5 = *strongly approve*), (b) whether most people important to the respondent got moderate or vigorous physical activity for at least 30 minutes on most days of the week (1 = *completely not true* to 5 =

completely true), and (c) whether people the respondent valued got moderate or vigorous physical activity for at least 30 minutes on most days of the week (1 = *completely not true* to 5 = *completely true*). Cronbach's coefficient alphas for the scale in this study were .84 at Time 1 and .83 at Time 2.

One perceived behavioral control item, adapted from that suggested by Ajzen (2002), asked, "For me to get moderate or vigorous physical activity for at least 30 minutes on most days of the week over the next 2 months would be. . . ." The responses measured on a Likert-type scale were from 1 (*very difficult*) to 5 (*very easy*).

Data Analyses

Descriptive statistics (*M*s, *SD*s, and *f*s) were obtained for all variables. The amount of missing data was very small (1.4%) and most of the data missing were from the normative belief measure where the words *spouse*, *children*, or *people at work* sometimes did not apply. For missing data, the median score for each person on each scale was imputed so that the scale would have a value and not be biased at a lower score.

Construct validity was established by determining the intercorrelation and mutual exclusiveness of the items using principal components extraction with a varimax rotation (Nunnally & Bernstein, 1994). Scree plots were examined for distinct breaks and trailing off of factors, indicating items that did not correlate with the larger factor. The magnitude of the item correlations also was examined. Items with eigenvalues greater than 1 and factor loadings equal to or greater than .40 were retained. Internal consistency reliability coefficients (Cronbach's alpha) and correlations among items were examined to estimate true-score variance (Nunnally & Bernstein, 1994).

Construct validity was further tested by confirmatory factor analyses and examination of the measures as indicators for TpB constructs, using the LISREL 8.5 program. The measurement (confirmatory factor) model specified the relationships between the unobserved latent variables and the observed variables as indicators of the unobserved latent variables from which they were derived (Long, 1983). According to the TpB, behavioral beliefs, normative beliefs, and control beliefs are highly correlated with and are indirect measures for attitude, subjective norm, and perceived behavioral control, respectively (Ajzen, 2002). Because the measures of behavioral, normative, and control beliefs and the direct measures of attitude, subjective norm, and perceived behavioral control were indicators of the same underlying latent constructs (Ajzen, 2002), a positive moderate correlation between each belief measure and its respective direct measure was considered evidence for construct validity. A baseline model assumed that errors in measurement were uncorrelated. This model was refined by relaxing parameters between the error terms suggested in the LISREL diagnostic output.

Four measures of overall goodness of fit were used to determine how well the model fit the data: chi-square (χ^2), adjusted goodness-of-fit index (AGFI), standardized root mean square residual (SRMSR), and parsimony goodness-of-fit index (PGFI). The χ^2 test assesses whether there is a statistically significant difference between the covariance matrix implied by the hypothesized model and the covariance matrix of the observed variables in the population (Bollen & Long, 1993). Therefore, a nonsignificant χ^2 indicates a good fit. Although there are no consistent standards for a good-fitting model, an AGFI of 1.0 represents a perfect fit and .90 and above are considered acceptable values. Smaller values of SRMSR are best, and values less than .08 are considered adequate. Small values of PGFI indicate a good-fitting, parsimonious model (Tabachnick & Fidell, 2000). The 65 participants who returned the second questionnaire were used to calculate test-retest reliabilities. A power analysis for a two-group *t* test of equivalence in means yielded 99% power for the sample of 65 participants. The total scale scores from Time 1 and Time 2, 2 months apart, were used in the analyses rather than individual scale items.

Results

Sample

The participants were mostly female (78.3%), Caucasian (76.4%), and married (61.9%). Their ages, measured as categories, were from 21 to 61 years and older; 20.8% were 21 to 30 years old, 20.8% 31 to 40 years old, 27.4% 41 to 50 years old, 17.9% 51 to 60 years old, and 13.2% 61 years and older. They were fairly well

educated; 51.0% were graduates of a trade or technical school or college graduates. Family incomes varied, with 38.7% reporting an annual income of "less than $40,000/year" and 31.1% reporting an annual income of "more than $60,000." Their *M* BMI was 32.1 (*SD* = 8.6) kg/m^2 (National Heart, Lung, and Blood Institute, 1998).

Construct Validity

An exploratory factor analysis with varimax rotation was computed to determine the dimensions of the constructs underlying the items (see Table 1). Six factors were produced. Factor 1 pertained to the positive behavioral belief items and Factor 5 pertained to the negative behavioral belief items, with factor loadings from .64 to .92. All of the normative belief items fell into Factor 3 with loadings from .50 to .85. The control belief items fell into three factors (Factors 2, 4, and 6) with one factor (Factor 1) pertaining to facilitators of physical activity such as fitting an activity into a daily schedule, being convenient, having a plan, having equipment, and finding a likeable activity. A second factor (Factor 4) represented social support; a third factor (Factor 6) involved having comfortable weather. Loadings on these three factors were from .45 to .78. The item "Having support or encouragement from others" loaded on both Factor 2 and Factor 4. All factors represented eigenvalues that were greater than 1, and together they accounted for 71.75% of the cumulative variance in the control belief variable. Although the analysis resulted in six factors, there were no overlaps in the behavioral belief, normative belief, and control belief scales. All of the items for the three scales were retained for further analyses.

The two behavioral beliefs that physical activity "improves my heart and vascular health" and "improves my physical health" had the largest means, indicating that health outcomes of physical activity were their strongest beliefs. All of the positive behavioral beliefs were stronger than the negative beliefs. Among normative beliefs, "my doctor" and "my spouse or partner" were most influential in participants being more physically active, whereas friends and coworkers were least influential. On average, participants believed that finding a physical activity they liked to engage in, having support or encouragement from others, and having time would make being physically active the easiest. Item-total correlations for the behavioral belief, normative belief, and control belief scales were from .59 to .88,.53 to .79, and .26 to .72, respectively. Two control belief items on living in an area where the weather is comfortable and having a super-visor or trainer to help were eliminated from the scale because of low item-total correlations. The item-total correlations for the remaining control belief items were from .55 to .72. Cronbach's alpha coefficients for all of the belief scales exceeded .70 for Time 1 and Time 2.

Construct validity was further tested with confirmatory factor analyses and examinations of the scales as indicators of the TpB constructs, using the LISREL 8.5 program. Table 2 shows the intercorrelations, means, and standard deviations of the variables used in the LISREL structural equation modeling. The scales were significantly correlated except in the case of the behavioral beliefs measure and subjective norm, which shared only a small correlation. The LISREL estimates of the parameters of the measurement model relevant to physical activity can be seen in Table 3. The standardized lambda coefficients for the observed variables (scales), which can be interpreted like factor loadings, were from .54 (normative belief scale) to .93 (control belief scale). The behavioral belief and control belief scales were better indicators than the direct attitude and perceived control measures. The subjective norm measure was better than the normative belief scale, but all of the scales were good indicators of their respective theoretical constructs. In addition, the reliability (R^2) of the scales was acceptable, and the significant *t* value for all the indicators suggested adequate relation-ships between the latent constructs and their measures. The fit of the scales to the physical activity measurement model was sufficient (χ^2 = 3.79, *df* = 3, *p* = .28; SRMSR =.03; AGFI = .92; PGFI = .14).

Correlations of variables at Time 1 and Time 2, following exclusion of missing cases in Time 2, were analyzed, and test-retest reliabilities (Times 1 and 2) for the behavioral belief (*r* = .91), normative belief (*r* = .79), and control belief (*r* = .85) scales were all significant. The paired samples correlations and test tables for *t* test analyses indicated no significant differences in means on the behavioral belief scales between Time 1 (*M* = 16.99, *SD* = 3.88) and Time 2 (*M* = 17.23, *SD* = 3.90, *t*[65] = –1.19, *p* =.24 [two-tailed], *d* = 64). There were no

significant differences in means on the normative belief scales between Time 1 (M = 14.92, SD = 4.45) and Time 2 (M = 14.72, SD = 5.40, t[65] = 0.43, d = 64, p = .67) and no significant differences in means on the control belief scales between Time 1 (M = 12.74, SD = 4.07) and Time 2 (M = 13.18, SD = 4.43, t[65] = –1.5 1, d = 64, p =.14). This demonstrated sufficient stability of the scales.

Table 1. Item Means, Standard Deviations, Item-Total Correlations, Factor Loadings, and Coefficient Alphas for the Scales

Construct	Modal Belief Item	Item *M*	*SD*	Item-Total Correlation	Factor Loading	Alpha Time 1	Alpha Time 2
Behavioral beliefs	Total scale					.93	.92
	Factor 1: Positive beliefs					.95	.91
	Improves my heart and vascular health	19.87	5.56	0.77	.84		
	Improves my physical health	19.58	5.81	0.76	.83		
	Makes me feel good mentally	18.37	5.44	0.83	.90		
	Helps me control my weight	18.31	5.82	0.66	.75		
	Can help to relieve stress	18.25	6.16	0.71	.73		
	Makes me feel better	18.07	6.07	0.88	.92		
	Improves my muscles and joints	17.77	6.02	0.76	.83		
	Helps me sleep better	17.73	5.39	0.64	.64		
	Helps me to look better	17.58	6.10	0.70	.74		
	Gives me more energy	17.54	5.99	0.85	.89		
	Delays or prevents diabetes	17.32	6.15	0.59	.65		
	Can help me to think better	17.09	5.82	0.77	.77		
	Improves my breathing	16.89	6.05	0.69	.68		
	Factor 2: Negative beliefs					.76	.78
	May result in injury	9.36	5.61	0.61	.88		
	May result in sore muscles or joints	8.79	5.27	0.61	.86		
Normative beliefs	My doctor is important to me	17.84	5.23	0.55	.56	.87	.91
	My spouse or partner is important	16.67	6.41	0.53	.50		
	My children are important to me	15.08	5.87	0.66	.65		
	Other family members are important	14.08	5.54	0.71	.83		
	My friends are important to me	13.84	5.18	0.79	.85		
	People I work with are important to me	12.58	5.51	0.65	.85		

(continued)

Table 1. (continued)

Construct	Modal Belief Item	Item *M*	*SD*	Item-Total Correlation	Factor Loading	Alpha Time 1	Alpha Time 2
Control beliefs	Found a physical activity I like to do	15.89	5.50	0.68	.66	.89	.90
	Support or encouragement from others	14.68	5.96	0.58	.46		
	Have the time to be physically active	14.13	5.28	0.58	.53		
	Am motivated to be physically active	14.09	5.77	0.71	.78		
	Fit physical activity into daily schedule	13.84	5.43	0.72	.77		
	Live where the weather is comfortable	13.32	4.87	0.26	.85		
	Have a place or equipment for exercise	13.18	7.00	0.65	.73		
	Have an exercise plan or routine	12.56	6.72	0.66	.77		
	Being physically active is convenient	12.02	5.61	0.71	.75		
	Feel well, physically fit, or free of pain	11.70	5.82	0.55	.74		
	Have a partner to be physically active	11.67	7.05	0.60	.64		
	Have a supervisor or trainer to help me	7.22	5.18	0.43	.71		

NOTE: Alpha computed with items "Live in an area where the weather is comfortable" and "Have a supervisor or trainer to help me to be physically active" eliminated from the scale.

Table 2. Intercorrelations, Means, and Standard Deviations of the Theory of Planned Behavior Variables

Variable	1	2	3	4	5	6	*M* (*SD*)
1. Behavioral beliefs	1.00						16.46 (3.64)
2. Normative beliefs	0.42**	1.00					14.75 (4.45)
3. Control beliefs	0.22*	0.40**	1.00				12.26 (3.73)
4. Attitude	0.39**	0.31**	0.48**	1.00			4.19 (0.63)
5. Subjective norm	–0.05	0.34**	0.47**	0.31**	1.00		2.96 (0.94)
6. Perceived control	0.25**	0.21*	0.52**	0.21*	0.38**	1.00	3.32 (1.03)

*$p < .05$. **$p < .01$.

Table 3. LISREL Estimates of the Parameters of the Measurement Model Relevant to Physical Activity

	Latent Variables									
		Attitude			Subjective Norm			Perceived Behavioral Control		
Measured Variables	R^2	Unstd	Std	t^a	Unstd	Std	t	Unstd	Std	t
Behavioral beliefs	.46	1.00[b]	.68							
Attitude	.34	.12	.59	3.11						
Normative beliefs	.29				1.00[b]	.54				
Subjective norm	.40				.25	.63	4.04			
Control beliefs	.87							1.00[b]	.93	
Perceived control	.31							.17	.55	4.29

NOTE: Final measurement model had correlated error terms for normative beliefs and behavioral beliefs, subjective norm and behavioral beliefs, and control beliefs and behavioral beliefs. Unstd = Unstandardized LISREL lambda coefficients; Std = Standardized LISREL lambda coefficients.

a. Critical value for t approximately ± 1.96.

b. Fixed parameter value.

Discussion

This article reports the development and evaluation of scales to measure behavioral, normative, and control beliefs about physical activity among persons at risk for type 2 diabetes. Using the method outlined by Ajzen and Fishbein (1980; Ajzen, 2002), an initial qualitative study identified salient beliefs about physical activity, which were then used to develop items for each of the TpB constructs—behavioral beliefs, normative beliefs, and control beliefs. This method of item development grounds measures in the cognitive beliefs expressed by a target population such as persons at risk for diabetes, and thus, the measures are more likely to have face validity.

Psychometric testing in Study 2 provides preliminary evidence that the behavioral belief, normative belief, and control belief scales are valid and reliable indirect measures of attitude, subjective norm, and perceived behavioral control. Construct validity was supported by factor analyses as well as the results of structural equation modeling. Because the model fit was better with correlated error terms between the belief measures, further work should address possible overlap among the measures. However, because a person's beliefs and cognitions may not occur uniquely, but influence each other, sorting out unique belief measures may not be possible.

Generally, items in other studies of TpB belief variables have been scaled from –2 to +2 (Masalu & Åstrøm, 2003), –3 to +3 (Conner, Norman, & Bell, 2002), or 1 to 5 (Blue et al., 2001). In these formats, valid responses would most likely be skewed toward positive or negative values. In this research, the evaluation items corresponding to behavioral beliefs were directionally scaled (e.g., *neither good nor bad* to *extremely good*). For example, "Making me feel better" would most likely be evaluated neutrally or positively with a neutral value of 1 and more choices from 2 to 5 for positive (or negative) values. This response format added to the variability of responses for each scale item and should be considered by others in the future when developing similar types of scales.

Study Limitations

Although the study results provide initial evidence that these are valid and reliable measures of the behavioral, normative, and control beliefs of adults at risk for diabetes, the results may have been biased by sample homogeneity. The majority of the sample in both Study 1 and Study 2 were female, Caucasian, married, and fairly well educated, limiting the generalizability of the results. Hence, external validity may be restricted to samples similar to the study population. Further examination of the belief responses revealed that African American, American Indian, and Hispanic responses were in the same belief categories as those of the Caucasian respondents. Therefore, the items for the behavioral, normative, and control belief scales represented beliefs of persons at risk for diabetes. However, the importance of these beliefs may vary by race, gender, or income, and the homogeneous sample in Study 2 did not allow us to examine these differences.

Another limitation is that the participants in Study 1, the elicitation study, had been enrolled in a diabetes prevention study for at least 5 years and had been trying to improve their physical activity. These beliefs they expressed may not be generalizable to people who are sedentary. Furthermore, the sample in Study 2 was made up of people who answered posters and newspaper advertisements, and they may differ from the general population of persons at risk for diabetes. It is clear that further examination of the scales needs to include more African American, Hispanic, and Native American participants. Diabetes is particularly high in these minority populations, and it is essential to ensure that the scales are valid and reliable for these groups.

An additional limitation is that both exploratory and confirmatory factor analyses were conducted using the same data. The use of one set of variables (same variables—same subjects) for exploratory factor analyses and confirmatory factor analyses using structural equation modeling is appropriate to compare alternative factor solutions, especially in strong theories (Nunnally & Bernstein, 1994). However, the multiple group method (same variables—different subjects), using one sample for exploratory factor analysis and a second sample for confirmatory factor analysis to test for factor invariance, is the best method of confirming the relationship among the measured variables and their theoretical constructs. Further research is warranted to replicate these study findings in another sample to further establish if the scale items are appropriately grouped under each TpB construct.

Finally, the data in these two studies were self-reported and because physical activity is a socially desirable behavior, there may have been a socially desirable response bias. Further research should include a measure of social desirability such as the Marlowe-Crowne Social Desirability Scale (Strahan & Gerbasi, 1972) to evaluate this. Another source of response bias may occur when items are closely related on a single dimension scale such as the belief measures. Grouping of belief-based items may enhance the readability and decrease the burden of the questionnaire, but this type of formatting may also create the potential for measurement error as it allows people to answer questions without actually reading each one, a problem inherent in questionnaires requiring similar item construction and varying only a few words. Although response burden may be increased, random interspersion of items in the questionnaire would promote separation of items and counteract possible response set bias.

Implications for Practice

The scales developed and tested in these studies can be used in the practice setting to assess beliefs of persons at risk for diabetes. Systematic assessment with valid and reliable scales to measure behavioral, normative, and

control beliefs can provide information about a person's perceptions of the expected outcomes of physical activity, social influence over the behavior, and the control over factors that facilitate or inhibit physical activity. This assessment can then be used to assist people at risk for diabetes to improve their physical activity by strengthening the positive beliefs and weakening the negative ones that influence their intentions. The scales can enable practitioners to develop interventions to strengthen perceptions of positive outcomes and feelings of control and use the influence of important others to motivate individuals to increase their physical activity. Because the scales were developed specific to persons at risk for diabetes, they are particularly important to practitioners who work to delay or prevent type 2 diabetes. The results suggest that the belief scales show enough promise to be used with persons who are African American or Native American; are overweight, obese, or have a large waist size; have a family history of diabetes; had diabetes with pregnancy; are physically inactive; and have other diabetes risks such as elevated blood pressure or cholesterol levels. However, further research is needed to fully validate the belief scales with other samples.

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