Readiness for physical activity in people at risk of diabetes

Carolyn Blue, David Black

This article presents a study that examined the relationships between physical activity beliefs and stage of readiness for change in people at risk of diabetes. Data on stage of readiness for change were collected from 106 adults in the US who were at risk of diabetes. Normative beliefs and control beliefs were the best discriminators of stage of readiness for physical activity. Analyses of variances revealed significant differences in normative beliefs and control beliefs between the contemplation and action stages. Identifying the beliefs of people at each stage of readiness for change may help to inform physical activity interventions, but further research needs to be done to confirm this. Although this study was performed in US residents, the authors feel its findings are applicable globally.

Article points

1. Modest improvements in physical activity and diet can delay or prevent diabetes.
2. Concepts from the theories of reasoned action and planned behaviour could be useful in designing interventions to increase physical activity.
3. This study examined the relationships between physical activity beliefs and stage of readiness for change in people at risk of diabetes.
4. The research confirms the benefits of integrating theories to explain behavioural associations and suggests practical ways of intervening to help people increase their physical activity.

Key words

- Theory of planned behaviour
- Physical activity

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An estimated 20.8 million people (7% of the population) in the US have diabetes, and the prevalence of pre-diabetes is increasing worldwide (Wild et al, 2004). Studies have shown that modest improvements in physical activity and diet can delay or prevent diabetes (Pan et al, 1997; Tuomilehto et al, 2001; Diabetes Prevention Program Research Group, 2002; Lindström et al, 2003), yet considerable effort is needed to increase physical activity (Blue and Black, 2005).

Concepts from the theory of reasoned action (TRA; Ajzen and Fishbein, 1980) and the theory of planned behaviour (TPB; Ajzen, 1988) have been shown to explain a moderate amount of physical activity intention and behaviour (Downs and Hausenblas, 2005). These concepts could be useful in designing interventions to increase physical activity.

The TPB is an expectancy-value model with emphasis on attitudes, subjective norms, perceived behavioural control and intentions related to a specific behaviour. According to this theory, the best single predictor of a person's behaviour is intention to perform that behaviour. Intentions, which are the immediate antecedents to a behaviour, are a function of attitudes toward performing the behaviour, subjective norms (a person's perception of whether relevant others think he or she should or should not perform the behaviour) and perceived behavioural control (a person's perception of ease or difficulty in carrying out a behaviour).

Attitude, subjective norm and perceived behavioural control are functions of three belief structures (Ajzen, 2002):

- behavioural beliefs (beliefs about the likely outcomes of the behaviour weighted by the evaluation of those outcomes)
- normative beliefs (beliefs about the expectations of particular important others weighted by the motivation to comply with each of these expectations)
- control beliefs (beliefs about factors that make

Page points

1. The transtheoretical model (TM), with its emphasis on readiness for behaviour change, has led to interventions tailored to people's stage-related differences.
2. The TM of behaviour change posits individual progression through five stages: precontemplation; contemplation; preparation; action; maintenance.
3. This research set out to determine whether persons at risk of diabetes can be classified by stage of readiness for physical activity based on their behavioural, normative and control beliefs about physical activity.

the behaviour easy or difficult weighted by the perceived power of these factors).

However, while the TRA and TPB have shown success in helping behavioural researchers understand physical activity behaviour, there have been limited physical activity interventions based on these models.

In contrast, the transtheoretical model (TM; Prochaska and DiClemente, 1983), with its emphasis on stages of (or readiness for) behaviour change, has led to interventions that are tailored to people's stage-related differences (Marshall and Biddle, 2001). The TM of behaviour change integrates clinical psychology concepts and posits individual progression through the following stages:

- changing a behaviour from precontemplation (not thinking about change)
- contemplation (considering change with no action)
- preparation (planning and making efforts to change)
- action (overt behavioural changes are attempted)
- maintenance (new behaviour is sustained over time).

However, a recent review of research has revealed limited evidence of the effectiveness of TM-based interventions in behaviour change or stage progression (Bridle et al, 2005).

Identifying determinants of readiness to change may be important in designing intervention strategies and health messages for individuals at risk of type 2 diabetes. Staging people who are at risk of diabetes by their physical activity beliefs seems to be an appropriate approach to tailoring an intervention to stage of readiness for physical activity. As a first step towards designing interventions based on beliefs that influence change in stage of readiness for physical activity, this study was designed to determine whether we can classify those at risk of diabetes by stage of readiness for physical activity, based on their behavioural, normative and control beliefs about physical activity. [Methods and results follow the 'implications for practice' section on page 220.]

Discussion

This study was designed to determine whether people at risk of diabetes could be classified by stage of physical activity based on their behavioural, normative and control beliefs about physical activity.

The findings provide only modest support for classifying people by stage of physical activity based on theory of planned behaviour (TPB) constructs. Control beliefs were the best discriminator of the groups, followed by normative beliefs. Participants in the action stage of physical activity had substantially stronger beliefs about their control over factors that facilitated or impeded physical activity than did contemplators or planners. Additionally, participants in the action stage of readiness for physical activity had stronger beliefs about the influence of people close to them than contemplators or planners. The behavioural beliefs variable was not an important discriminator.

The finding that control beliefs were the best discriminator of stage of readiness for physical activity is consistent with previous research using the TPB and stage of readiness (Blue et al, 2003; Courneya et al, 2000). However, the lack of significance of behavioural beliefs and the significant influence of normative beliefs as a discriminator of stage of physical activity were not found in previous research. This may be an anomaly of the sample, but it may also be that this sample of people at risk of diabetes relied more on important others as they advanced in stage of readiness for physical activity. Most of the sample were overweight or obese and they may have had more people who hassled them about their weight and being physically inactive than other people. Although behavioural beliefs did not discriminate between the three stages, there was an increase in behavioural beliefs from contemplation to action.

Limitations of the study

In evaluating the findings of this study, several limitations need to be considered.

Firstly, the participants were volunteers from only one community, so the findings cannot be generalised to all people at risk of diabetes. Only three participants identified themselves as precontemplators. However, this was not surprising as precontemplators theoretically would not have enough interest in physical

Page points

1. Longitudinal studies of change in stage of readiness for physical activity over time should be a priority for research.
2. The focus should be on strengthening relationships with people who can encourage physical activity, including partners or spouse, friends, work colleagues and others whom the person deems important.
3. Factors that make physical activity easier include time to fit physical activity into one's daily schedule, comfortable weather, a physical activity plan or routine, support or encouragement from others to be physically active, and activities that one likes.
4. This research confirms the benefits of integrating theories to explain behavioural associations and suggests practical ways of intervening. The information is particularly important given the devastating consequences of diabetes.

activity to volunteer for the study. One inclusion criterion was that participants should not be regularly physically active, and this eliminated people in the maintenance stage of physical activity. Therefore, only three of the five stages of readiness for physical activity were available for analysis. If all five stages had been included in the study, the TPB variables might have been better discriminators of stage.

Secondly, the data were collected by a cross-sectional survey, and questions asking about change in behaviour cannot be assessed as accurately with this kind of data as with prospective data, nor should conclusions about causal relations be drawn.

Thirdly, physical activity is a socially desirable behaviour and even though data were collected anonymously, social desirability bias may have led to inaccurate reporting of beliefs or stage.

Recommendations for future research

Longitudinal studies of change in stage of readiness for physical activity over time should be a priority for research since these would help to explain causal relationships among the variables. In addition, a sample representing all five stages of readiness for physical activity should be included in future studies. The study sample comprised primarily Caucasian respondents, and future studies should be extended to other races and ethnic groups to determine whether the same belief sets discriminate stage of readiness for physical activity in culturally diverse populations.

Implications for practice

The most important constructs in this study were normative beliefs and control beliefs, not behavioural beliefs, in differentiating people at risk of diabetes by stage of readiness for physical activity. Thus, the main theory of planned behaviour construct to use in moving contemplators in this population to the action stage is normative beliefs about physical activity. The focus should be on strengthening relationships with people who can encourage physical activity, including partners or spouses, friends, work colleagues and others whom the person deems important. Because normative beliefs may vary from person to person, practitioners should assess each individual's beliefs and then work to strengthen those beliefs.

Another construct to emphasise for movement from the contemplation stage to the action stage is control beliefs, including beliefs about control over factors that facilitate or impede physical activity. Factors that make physical activity easier may include time to fit physical activity into one's daily schedule, comfortable weather, a physical activity plan or routine, support or encouragement from others to be physically active, and activities that one likes. Again, each person's beliefs about the factors that make being physically active easy or difficult should be assessed and the intervention should focus on strengthening beliefs that make activity easy and weakening those that make activity difficult.

Strong evidence indicates that modifying lifestyle to increase physical activity and improve diet, which results in weight loss, can prevent or delay diabetes in people who are at risk; and also be beneficial to those who have been diagnosed with diabetes (Diabetes Prevention Program Research Group, 2002). The authors believe that nurses should talk with people about the kinds of physical activity that would be safe, and encourage them to start slowly and increase their activity gradually. In addition, the nurse could encourage the person to increase their activity level toward a goal of being active for at least 30 minutes a day on most days of the week. People should also be encouraged to avoid 'crash diets' and, instead, eat smaller portions of foods and more frequent meals that are low in fat and carbohydrates and high in fibre (fruits and vegetables). A healthy eating plan with physical activity will result in weight loss needed to prevent or delay diabetes and even reduce – or eliminate – the need for glucose-lowering medication in those who have been diagnosed with diabetes.

This research confirms the benefits of integrating theories to explain behavioural associations and suggests practical ways of intervening. The information is particularly important given the devastating consequences of diabetes.

Page points

1. The independent variables were behavioural beliefs, normative beliefs and control beliefs. The measures of beliefs were developed specifically for individuals at risk of diabetes .
2. Behavioural beliefs were assessed by scores on 16 outcome expectancy items multiplied by scores on the 16 corresponding evaluations of the outcome items.
3. Normative beliefs were measured by scores on six normative referents multiplied by six corresponding motivation to comply scores.
4. The control belief measure included 10 items on control factors multiplied by 10 corresponding power of control items.

Methods

Participants and recruitment

Study participants were adults at risk of diabetes who met the following inclusion criteria:

- scoring above 10 on the American Diabetes Association's (ADA) risk test for diabetes (sister, brother, or parent with diabetes; overweight; diabetes during pregnancy; birth to a baby weighing more than 9 lb; or little or no exercise; National Diabetes Information Clearinghouse, 2004)
- 21 years of age or older
- English speaking
- not diagnosed with diabetes
- not currently participating in regular, moderate or vigorous physical activity.

Approval from the University Institutional Review Board was obtained before recruitment.

Participants were recruited from a Midwestern US community via posters and newspaper advertisements. When prospective participants inquired about the study by telephone, the purpose of the study was explained and respondents were assured of voluntary participation and confidentiality. Individuals meeting the inclusion criteria (n=134) were mailed a questionnaire with a covering letter describing the study, volunteer participation and confidentiality, and were told that they would receive a $10 gift card as compensation for their time in completing the questionnaire.

Measures

The questionnaire, developed by the authors (Blue et al, 2008), contained 55 items based on TPB and TM, at an 8th grade reading level (usually 13–14 years of age), and required about 25 minutes to complete. 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', and was included along with examples of moderate and vigorous activities on the front cover of the questionnaire.

Stage

The dependent variables were intention to be physically active and stage of readiness for physical activity. According to Ajzen (2006):

> ***'An intention is an indication of a person's readiness to perform a given behaviour.'***

Intention to be physically active was measured with one item: 'I intend to get moderate or vigorous physical activity for at least 30 minutes on most days of the week over the next 2 months.' Likert-style responses ranged from 1 (extremely unlikely) to 5 (extremely likely).

Stage of readiness was measured with five items ranging from 1 ('I do not exercise and I am not thinking about starting to exercise': precontemplation) to 5 ('I have been exercising for at least 6 months and am happy with the amount of exercise I do': maintenance).

The independent variables were behavioural beliefs, normative beliefs and control beliefs. The measures of beliefs were developed specifically for individuals at risk of diabetes (Blue et al, 2008) using methods suggested by Ajzen and Fishbein (Ajzen and Fishbein, 1980; Ajzen, 2002).

Behavioural beliefs

Behavioural beliefs were assessed by scores on 16 outcome expectancy items multiplied by scores on the 16 corresponding evaluations of the outcome items. Outcome expectancy items described respondents' beliefs about how likely or unlikely each result was, for example 'Moderate or vigorous physical activity will improve my physical health,' with responses ranging from 1 (very unlikely) to 5 (very likely). Corresponding outcome evaluation items assessed respondents' beliefs about how bad or good each result would be for them, for example 'Improving my physical health is …', with responses ranging from 1 (neither good nor bad) to 5 (extremely good; Blue et al, 2008).

Normative beliefs

Normative beliefs were measured by scores on six normative referents multiplied by six corresponding motivation to comply scores. Normative referents included spouse or partner, children, family members, co-workers, friends and doctor; the respondent was asked to indicate the degree to which the person would influence the respondent's physical activity.

Each item was scored from 1 (definitely should not) to 5 (definitely should). The corresponding items on motivation to comply asked how strongly the respondent wanted to do what each of the referents wanted, and were scored from 1 (not at all) to 5 (very much) (Blue et al, 2008). The multiplied scores were averaged for a normative belief score; possible scores ranged from 1 to 25.

Box 2. Age ranges of those enrolled in the study.

21–30 years (20.8%)
31–40 years (20.8%)
41–50 years (27.3%)
51–60 years (17.9%)
61–70 years (7.5%)
> 71 years (5.7%)

Control beliefs

The control belief measure included 10 items on control factors multiplied by 10 corresponding power of control items. The control factor items asked the respondent about conditions that would make physical activity difficult or easy, for example 'I have the time to be physically active,' scored from 1 (strongly disagree) to 5 (strongly agree).

The corresponding power of control items asked the respondent to describe how difficult or easy the control factor would make getting moderate or vigorous physical activity, for example 'Having time would make my being physically active easier', scored from 1 (strongly disagree) to 5 (strongly agree) (Blue et al, 2008). The average of the scale was used as the measure of control beliefs.

Analyses

Discriminant-function analysis was used to evaluate the distinctions between stages of behaviour on the basis of beliefs about physical activity, and the degree to which members could be accurately classified into their own groups. Predictor variables were behavioural beliefs, normative beliefs and control beliefs. Groups were precontemplation, contemplation, planning and action.

To ensure these results were accurate, further statistical tests were undertaken.

Results

Participant characteristics

Of the 134 questionnaires mailed to adults at risk of diabetes, 106 (79.1%) were returned and were usable.

- The majority of participants were Caucasian (76.4%), 22.6% were black or African-American – a percentage nearly three times that of African Americans in this Midwestern population (US Census Bureau, 2004).
- Most of the participants were female (78.3%), married (61.9%) and had more than a high school education (83.0%); 48.4% reported an income of $60 000 or more. Their ages ranged from 31–71+ years (see *Box 2* for details).
- Almost half (47.2%) of respondents reported having a parent with diagnosed diabetes, and 19.8% reported having a sister or brother with diabetes.
- Most of the participants (80.2%) were overweight or obese, with a mean BMI of 32.1 kg/m^2 (SD=8.6). Of these, 71.8% were obese.
- Only 2.8% reported that they did not exercise and were not thinking about starting (precontemplation); 20.8% reported that they had thought about exercise, but had done nothing about it (contemplation); 22.6% reported that they had recently thought about what exercise they might like to do (planning); and more than half (53.8%) reported that they had recently started to exercise but not regularly (action). No participant reported exercising regularly for 6 months or more (maintenance).

Table 1. Group means and standard deviations of predictor variables as a function of stage of readiness for physical activity.

	Contemplation (n=22)	Planning (n=24)	Action (n=57)
Predictor variable	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Behavioural beliefs	15.2 (4.1)	15.8 (3.7)	17.4 (3.9)
Normative beliefs	12.6 (3.10)	15.2 (4.9)	16.2 (3.8)
Control beliefs	9.9 (3.0)	12.9 (3.2)	14.3 (3.6)

Discriminators of stage of readiness for physical activity

The multiple discriminant-function analysis was performed to discriminate behavioural beliefs, normative beliefs and control beliefs as predictors of membership in three groups: contemplation, planning and action. Precontemplators (n=3) were dropped from the analysis because of the small number in this group. Further statistical tests showed that the results would not be affected by this.

Table 1 shows the means and standard deviations of the predictor variables for each of the three stages of readiness for physical activity. Means for the behavioural beliefs, normative beliefs and control beliefs of those in the action stage were all higher than those of participants in the contemplation stage. This means that beliefs about positive outcomes of physical activity, beliefs about important others and beliefs that one has control over factors that facilitate or inhibit physical activity all are stronger as people progress from contemplation to action.

Two discriminant functions were calculated (*Table 2*). Wilk's lambda test of significant differences in the predictor (belief) variables between groups was significant, indicating differences in the three variables. The Wilk's lambda test of function 2 indicated no difference between groups in the belief variables after removing the effects associated with the first discriminant function. Eigenvalues for functions 1 and 2 were 0.34 and 0.01, respectively. Analysis output

Table 2. Discriminant function analysis of the three stages of readiness for physical activity.

	Eigenvalue	% of variance	Canonical correlation	Wilk's lambda	α	*df*	*P*-value
Function 1	0.339	96.4	0.503	0.737	30.198	6	0.000
Function 2	0.013	3.6	0.113	0.987	1.263	2	0.532

Structure matrix

Variable	Function 1	Function 2
Behavioural beliefs	0.391	0.851*
Normative beliefs	0.629*	-0.182
Control beliefs	0.891*	-0.094

Group	Discrimant functions evaluated at group centroids	
Contemplation	-1.037	0.072
Planning	-0.055	-0.202
Action	0.423	0.057

* Largest absolute correlation between each variable and any discriminant function. $P \leq 0.05$=significant

also provided the % of variance of each discriminant function. Thus, control beliefs and normative beliefs explained 96.4% of the variance in stage of readiness for physical activity The largest portion of the variance was derived from control beliefs. Behavioural beliefs explained only an additional 3.6% of the variance in stage of readiness for physical activity.

Of the 22 cases of contemplators, 54.5% were predicted correctly (*Table 3*). In the planning group, no cases were predicted correctly, and in the action group 89.5% were predicted correctly. In total, 61.2% of the cases were classified correctly.

Summary of the analysis of variance

One-way analysis of variance (ANOVA) between stages of readiness for physical activity and beliefs about physical activity showed significant differences in normative beliefs and control beliefs, but not in behavioural beliefs (*Table 4*).

The Bonferroni test was applied post hoc to compare differences in the three TPB constructs in the three different stages of readiness (not shown in *Table 4*). The test revealed no differences in behavioural beliefs between the stages of readiness for physical activity. For normative beliefs, there were differences between the contemplation and preparation stages (P=0.001) and between the contemplation and action stages (P=0.001). For control beliefs there were differences between the contemplation and preparation stages (P=0.009) and the contemplation and action stages (P<0.001). There were no significant differences in beliefs between any other stages. ■

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Table 3. Classification analysis for stage of readiness.

		Predicted group membership		
		Contemplation	Planning	Action
Actual group membership	*n*	*n* (%)	*n* (%)	*n* (%)
Contemplation	22	12 (54.5)	0 (0.0)	10 (45.5)
Planning	24	5 (20.8)	0 (0.0)	19 (79.2)
Action	57	5 (8.8)	1 (1.8)	51 (89.5)

Note: Overall percentage of correctly classified cases = 61.2

Table 4. Analysis of variance results for stage of readiness for physical activity and TPB variables.

	Stage of readiness for physical activity				
TPB variables	Contemplation	Planning	Action	*F*	*P*
Behavioural beliefs	15.22±4.09	15.80±3.74	17.38±3.86	2.59	0.057
Normative beliefs	12.55±3.06	15.21±4.91	16.22±3.85	7.21	<0.001
Control beliefs	9.87±3.02	12.92±3.18	14.29±3.60	11.66	<0.001