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Predicting Intention to Participate in Self-Management Behaviors in Patients with Familial Hypercholesterolemia: A Cross-National Study

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Abstract

Rationale: Familial Hypercholesterolemia (FH) is a genetic condition that predisposes patients to substantially increased risk of early-onset atherosclerotic cardiovascular disease. FH risks can be minimized through regular participation in three self-management behaviors: physical activity, healthy eating, and taking cholesterol lowering medication.

Objective: The present study tested the effectiveness of an integrated social cognition model in predicting intention to participate in the self-management behaviors in FH patients from seven countries.

Method: Consecutive patients in FH clinics from Australia, Hong Kong, Brazil, Malaysia, Taiwan, China, and UK (total $N = 726$) completed measures of social cognitive beliefs about illness from the common sense model of self-regulation, beliefs about behaviors from the theory of planned behavior, and past behavior for the three self-management behaviors.

Results: Structural equation models indicated that beliefs about behaviors from the theory of planned behavior, namely, attitudes, subjective norms, and perceived behavioral control, were consistent predictors of intention across samples and behaviors. By comparison, effects of beliefs about illness from the common sense model were smaller and trivial in size. Beliefs partially mediated past behavior effects on intention, although indirect effects of past behavior on intention were larger for physical activity relative to taking medication and healthy eating. Model constructs did not fully account for past behavior effects on intentions. Variability in the strength of the beliefs about behaviors was observed across samples and behaviors.

Conclusion: Current findings outline the importance of beliefs about behaviors as predictors of FH self-management behaviors. Variability in the relative contribution of the beliefs across samples and behaviors highlights the imperative of identifying sample- and behavior-specific correlates of FH self-management behaviors.

Keywords: Illness perceptions; hyperlipidaemia; theoretical integration; common sense model; theory of planned behavior; theories of social cognition; attitudes

Introduction

Familial Hypercholesterolemia (FH) is a genetic condition affecting 1 in every 300 to 500 individuals worldwide (Hopkins et al., 2011), indicated by excessive levels of low-density lipoprotein cholesterol and substantially increased risk of early-onset atherosclerotic cardiovascular disease (ACVD), and premature mortality (Watts et al., 2011). Risk of early-onset ACVD in FH patients can be substantially attenuated by lipid-lowering medication alongside participation in self-management behaviors including regular physical activity, and eating a diet low in saturated fat (Catapano et al., 2016; Gidding et al., 2015; Grundy et al., 2018; Watts et al., 2015). However, adherence to these behaviors among FH patients is low (Hardcastle et al., 2015). Researchers have, therefore, aimed to identify the psychological factors associated with participation in self-management behaviors in FH patients (Claassen et al., 2012; Hagger et al., 2016b) with a view to developing an evidence base of the manipulable factors to target in behavioral interventions.

Researchers have advocated the application of social cognition theories to identify the determinants of health-related behaviors (Amireault et al., 2013; Conner & Norman, 2015; Kok et al., 2016). The theories are predicated on the assumption that individuals' beliefs precede behavioral decisions and guide subsequent behavior (Conner & Norman, 2015). In the context of identifying the determinants of health-related behaviors for the management of chronic conditions, two prominent approaches have been applied: the common sense model of illness self-regulation (CSM; Leventhal et al., 1980) and the theory of planned behavior (TPB; Ajzen, 1991).

According to the CSM, decisions to participate in self-management behaviors may be a response to patients' lay beliefs about the potential threat the illness proposes to health. Illness beliefs have been shown to cluster along a number of dimensions including perceived consequences (beliefs concerning the impact of the illness on everyday life), timeline (beliefs on how long the illness is expected to last), personal control (beliefs in personal influence over the course and outcome of the illness), treatment control (beliefs that treatment will be effective in treating the illness), illness coherence (perceived clarity of the illness and its effects), and emotional representations (perceived emotional impact of the illness) (Baumann et al., 1989; Bishop & Converse, 1986; Moss-Morris et al., 2002). The personal and treatment control dimensions have been shown to be positively associated with adaptive, problem-focused coping strategies such as participating in illness management behaviors (e.g., visiting a health professional or taking medication). Illness perception dimensions related to illness threat, such as the perceived consequences, timeline, and emotional representation dimensions, have been shown to be negatively related to problem-focused coping strategies and positively related to emotion-focused coping strategies such as denial, avoidance, and emotion venting (Broadbent et al., 2019; Durazo & Cameron, 2019; Hagger et al., 2017; Hagger & Orbell, 2003).

In contrast, the TPB focuses on the beliefs related to future participation in particular behaviors (Ajzen, 1991). According to the theory, intention, a motivational construct, is the most proximal predictor of a target behavior. Intention is a function of three belief-based constructs: attitudes (beliefs that participating in the behavior will lead to salient outcomes), subjective norms (beliefs that salient others influence participation in the behavior) and perceived behavioral control (PBC; beliefs in personal capacity to participate in the behavior). The TPB has been shown to predict intention and behavior in numerous health behavior contexts (McEachan et al., 2011; Rich et al., 2015).

A recent approach to the prediction of self-management behaviors in chronic illness has been to test the simultaneous effects of sets of beliefs from both theories in an integrated model (Hagger et al., 2016b; Hagger et al., 2017; Orbell et al., 2006; Sivell et al., 2011). For example, Orbell et al. (2006) examined the utility of an integrated approach incorporating constructs from the CSM and the TPB in predicting attendance to colposcopy clinics. Results revealed that beliefs about the behavior (attitudes, subjective norms, and perceived control) were the most salient predictors with no unique effects for illness beliefs. In the context of predicting self-management behaviors in FH, Hagger et al. (2016b) found similar findings with illness beliefs explaining minimal variance in intentions to engage in FH self-management behavior, while beliefs about the behavior from the TPB, particularly attitudes, were prominent predictors. In contrast, French et al.'s (2013) study on Type II diabetics found that both beliefs about the behavior (perceptions that exercise is important) and beliefs about the illness (illness coherence, having a clear understanding of diabetes), predicted physical activity participation. These findings suggest some variability in the relative contribution of beliefs from both theoretical perspectives in determining key behavior associated with illness self-management.

The Present Study

The aim of the present study was to examine the belief-based predictors of FH patients' intention to participate in three FH self-management behaviors: physical activity, healthy eating, and taking medication. We adopted an integrated social cognition model that encompasses beliefs about FH, based on the illness perception dimensions of the CSM, and beliefs about participation in each specific behavior, based on the social cognition constructs from the TPB, as predictors of intention. The current study extends our previous research testing the integrated model in FH patients in Australia (Hagger et al., 2016b) to a further six national samples of FH patients recruited from clinics in Hong Kong, Brazil, Malaysia, Taiwan, China, and the UK. Our focus on intention is consistent with theory and meta-analytic data that has identified intention as the most proximal predictor of health-related behavior (McEachan et al., 2011; Rich et al., 2015).

Our proposed integrated model is illustrated in Figure 1. Intention to engage in physical activity, healthy eating, and taking medication behaviors was proposed to be a function of illness perception dimensions from the CSM and the belief-based constructs from the TPB. In accordance with previous research adopting the CSM (Hagger et al., 2017), threat-related dimensions (e.g., consequences, timeline, emotional representations) were expected to negatively predict intention to participate in FH self-management behaviors, while beliefs representing personal capacity to manage the threat (e.g., personal and treatment control) were expected to positively predict intention. However, consistent with previous research integrating these perspectives (Orbell et al., 2006), including our previous work applying this model in the Australia sample (Hagger et al., 2016b), we expected beliefs about the specific behaviors (attitudes, subjective norms, and PBC) from the TPB (Ajzen, 1991) to be the most prominent predictors of intention to participate in FH self-management behaviors. Nevertheless, we also expected that there would be variations in the relative contributions of the effects of these constructs across behaviors and populations. This is consistent with previous research that has identified considerable variability in the relative effects of CSM and TPB constructs across behaviors (Hagger et al., 2017; McEachan et al., 2011).

Finally, we expected the effects of the beliefs from the integrated model to hold after controlling for demographic variables (age, gender, ACVD status, income, education, health literacy, and past behavior (Ajzen, 2002b). Past behavior was included as a predictor in the models because FH patients are likely to vary in their previous experience with each self-management behavior. In addition, past behavior has been suggested to model habitual effects in social cognition models (Albarracín et al., 2001; Conner et al., 1999; Hagger et al., 2016a; Hagger et al., 2018; Ouellette & Wood, 1998) and previous decision making (Ajzen, 2002b; Albarracín & Wyer, 2000). Inclusion of past behavior may illustrate the extent to which FH patients draw from their previous experience when making decisions to participate in self-management behaviors. Alternatively, it may illustrate the extent to which beliefs and intentions in the model are a function of habits, that is, beliefs that are formed through the 'automatization' and 'routinization' of participation in the behaviors (cf., Gardner, 2015; Wood, 2017). Finally, inclusion of past behavior also permits a test of the sufficiency of the beliefs in the model in accounting for past behavior effects on intentions, consistent with theory (Ajzen, 1991).

Method

Participants, Design and Procedure

The present study used a correlational survey design and was part of the larger "Ten Countries Study" (Watts et al., 2016). Participants were patients with FH verified by a genetic test, or given a probable or definite FH diagnosis using clinical diagnostic criteria, including analysis of blood cholesterol levels, attending FH clinics in seven countries: Royal Perth Hospital, Australia; Heart Institute (InCor), University of São Paulo Medical School Hospital, Brazil; Beijing Anzhen Hospital, China; Prince of Wales Hospital, Hong Kong; Universiti Teknologi MARA Faculty of Medicine Clinical Training Centre, Malaysia; National Taiwan University Hospital, Taiwan; and UK NHS Trusts in Manchester, Bristol, Coventry and Warwickshire, and Bath. A statistical power analysis using the inverse square root and gamma-exponential methods (Kock & Hadaya, 2018) revealed that a sample sizes of 99 and 86, respectively, were required to detect a small absolute effect size for model parameters ($\beta = 0.250$, based on the averaged path coefficients for effects of social cognition constructs on intention in our previous research; Hagger et al., 2016b) with alpha set at .050 and power set at .800.

Participants completed a questionnaire comprising self-report measures of demographic, psychological, and behavioral variables. All eligible patients were referred to participate in the study by clinic staff in the order in which they attended the clinic between January 2015 and July

2017. Referred patients were provided with information about the study and completed a written informed consent form. The study was granted ethical approval from the Perth East Metropolitan Health Service Human Research Ethics Committee (#RGS0000002005), and the IRB or ethics committees at each site prior to data collection. Participants completed the questionnaire in a private waiting room while awaiting their appointment or at home and mailed it back to the research team using a pre-paid envelope.

Measures

The questionnaire comprised items measuring the illness perception dimensions from the CSM, social cognitive constructs from the TPB, and participation in each self-management behavior. All items were adopted from previous research or developed according to standardized guidelines (Ajzen, 2002a; Moss-Morris et al., 2002). Participants were presented with a brief introductory passage to each section of the questionnaire providing instructions on completing each set of items. Participants also completed a brief demographic information section and a measure of health literacy (Chew et al., 2004). Introductory passages and the full set of questionnaire items are presented in Appendix A (supplementary materials). Questionnaire items were developed in English and subsequently translated into language-appropriate versions for each national sample using a standardized iterative back-translation procedure (Squires et al., 2013).

TPB constructs. Intention, attitudes, subjective norms, and PBC with respect to all three behaviors were measured using standardized items from published guidelines (Ajzen, 2002a).

Illness perceptions. The personal control, perceived consequences, timeline, personal control, illness coherence, and emotional representations dimensions from the CSM were measured using the Revised Illness perceptions Questionnaire (IPQ-R; Moss-Morris et al., 2002).

Items were modified to refer to FH as the target illness, consistent with published guidelines (Weinman et al., 2018).

Past behavior. Past participation in physical activity and healthy eating was measured using a two-item scale used in previous research (Brown et al., 2017; Hagger et al., 2016b). Taking medication was assessed using a single item with responses provided on a binary scale, with lower scores representing better adherence. The only exception was the Australian sample in which taking medication was measured using a single item with responses provided on a six-point scale. To maintain equivalence across measures, the scale was reverse scored and standardized.

Demographic variables. Participants self-reported their age, gender, cardiovascular disease status (patients with an ACVD diagnosis vs. those without a diagnosis), annual household income stratified by seven income levels relative to national averages, and highest level of formal education in categories relevant to the national group. Binary income and highest education level variables were computed for subsequent analyses.

Health literacy. Health literacy was measured using the health literacy screening questions scale (Chew et al., 2004). Scores for each item were summed to give a total health literacy score.

Data analysis

Data were analyzed using variance-based structural equation modeling (VB-SEM), also known as partial least squares analysis (PLS; Haenlein & Kaplan, 2004), using the Warp PLS v.6.0 statistical software (Kock, 2018). Two models were estimated in the full sample and in each national sample for each of the three behaviors: a model in which all psychological and demographic variables were regressed on intention (Model 1), and an extended model that included past behavior with the social cognitive constructs set as multiple mediators of effects of past behavior on intention (Model 2). All constructs included in models were latent variables indicated by single or multiple items. Model parameters and standard errors were computed using the 'Stable3' estimation method, which has been shown to provide the most precise estimates and outperform bootstrapping methods in simulation studies (Kock, 2018). Prior to conducting model testing, we tested the hypothesis that missing data were missing completely at random using Little's (1988) MCAR test. Pending support for this hypothesis, missing data were imputed using linear multiple regression. Linear multiple regression was selected as the imputation method data because simulation studies have indicated that this method provides the least biased mean path coefficients when compared with data imputed using other methods and data with no missing data (Kock, 2018).

At the measurement level, construct validity of the latent factors was established using the average variance extracted (AVE) and composite reliability coefficients (ρ) which should exceed .500 and .700, respectively. Discriminant validity of the constructs was supported when the square-root of the AVE for each latent variable exceeds its correlation with other latent variables. Adequacy of the hypothesized pattern of relations among the model constructs was established using an overall goodness-of-fit (GoF) index given by the square root of the product of the AVE and average R^2 for the model, with values of .100, .250, and .360 corresponding to small, medium, and large effect sizes (Tenenhaus et al., 2005). Further information on the quality of the model was provided by the average path coefficient (APC) and average R^2 (AR^2) coefficient across the model, both of which should be statistically significant. In addition, an overall goodness-of-fit index is provided by the average variance inflation factor for model parameters (AVIF), which should be less than 3.300 for a well-fitting model (Kock, 2018). The R^2 contribution ratio (R^2CR) and the statistical suppression ratio (SSR) provided indication of the extent to which the models were free from instances of negative R^2 contributions and statistical suppression, such as an effect larger than the correlation between the corresponding variables. The R^2CR and SSR should exceed 0.900 and 0.700, respectively.

Model effects were estimated using standardized path coefficients with confidence intervals and test statistics. Effect sizes were estimated using an equivalent of Cohen's *f*-square coefficient using an adjusted algorithm that avoids the distortion associated with the use of normal-theory PLS SEM algorithms (Kock, 2014). Differences in the size of the path coefficients in the models across the seven national samples was explored using multiple group analysis using the Satterthwaite method with two-tailed significance tests (Kock, 2014). Data files and data analysis output files can be accessed online: https://osf.io/edhx9/

Results

Participants

Response rates of patients invited to participate in the survey were 52.6%, 100.0%, 94.3%, 85.0%, 83.3%, 74.3%, and 34.7% for the Australia (*N* = 110), Hong Kong (*N* = 102), Brazil (*N* = 100), Malaysia (*N* = 100), Taiwan (*N* = 150), China (*N* = 100), and UK (*N* = 100) samples, with an overall response of 66.55% and a total sample size of 762. Participants were approximately equal in gender distribution (48.8% female) with an average age of 50.62 years (*SD* = 14.28) with 28.8% diagnosed with a form of ACVD. Health literacy was generally adequate, with the highest and lowest levels in the samples reported in the UK and China samples, respectively. Income and education levels varied substantially across the samples. Such variations justify the inclusion of demographics as control variables in the model. Full participant characteristics for the full sample and each national sample for each behavior are reported in Appendix B (supplementary materials).

Preliminary analyses

Statistically non-significant values for Little's (1988) MCAR test for data in each sample supported the hypothesis that data were missing completely at random, and we consequently imputed missing data using linear multiple regression; imputed data accounted for less than 5% of the data points. Descriptive statistics, reliability coefficients, correlation coefficients, and square roots of AVE, for study variables in each sample and for each behavior are presented in Appendices C and D, respectively (supplementary materials). Composite reliability coefficients and AVE variables exceeded the .700 criterion in all but one case (the consequences construct in the China sample). AVE values approached or exceeded the recommended .500 criterion for the TPB variables, but AVE values for the IPQ-R subscales fell below this level in many of the samples. The square root of the AVE for each latent variable was in excess of the correlation between the variable and other variables indicating support for discriminant validity.

Structural equation models

Model fit. Model goodness of fit indices for the proposed models estimated in the full sample for each behavior are presented in Table 1. The models fit the data well for each behavior as indicated by statistically significant APC and AR^2 coefficients, GoF indices with at least a medium effect sizes, and AVIF, R^2CR, and SSR values that met recommended cut-off criteria. Fit indices for the models in each national sample are presented in Appendix E (supplemental materials). Model fit was adequate in most cases, as indicated by GoF indices with least medium effect sizes. In addition, APC and AR^2 indices indicated good model quality, but in some cases values were low and not statistically significant. The main reason for the low values is likely a large number of small effects that were not statistically significant. R^2CR and SSR indices surpassed recommended cut-off criteria in all cases except Model 1 for physical activity in the Australia sample and Model 1 for healthy eating in the Brazil sample. The models accounted for a statistically significant amount of variance in intention in the full sample and all national samples.

Full sample models. Standardized parameter estimates for effects among constructs in the proposed models estimated in the full sample for each behavior are presented in Table 1, and comparisons of model parameter estimates across each behavior are presented in Table 2 with formal tests for difference (Schenker & Gentleman, 2001). Parameter estimates for Model 1 revealed statistically significant small-to-medium sized effects of attitude, subjective norm, and PBC from the TPB on intentions for each of the three behaviors. By comparison, effects of the illness representation dimensions on intentions were small and not statistically significant. The only exceptions were small, statistically significant effects of personal control, consequences, and emotional representation on intentions for the physical activity, healthy eating, and taking medication behaviors, respectively. The addition of past behavior in Model 2 led to modest attenuation of effects of TPB constructs on intentions, but small, statistically significant effects remained. Effects of past behavior on intention was mediated by the social cognition constructs for all behaviors; indirect effects were smallest for healthy eating and largest for physical activity. Substantive residual effects remained, as evidenced by the statistically significant total effects of past behavior on intention for all behaviors. There were also very few effects of demographic constructs in both models. The models accounted for substantive proportions of the variance in intentions in the physical activity and taking medication behaviors, but, by comparison, a relatively modest amount of the variance in intentions for healthy eating. Comparisons of effects across behaviors in the models corroborated observed differences in effects of the illness perception dimensions. Effects of attitudes on intentions were much larger for taking medication compared to the effects for physical activity and healthy eating, effects of subjective norms on intentions were smaller for the healthy eating and medication adherence behaviors compared to the effects for physical activity, and effects of PBC on intentions were larger for the physical activity and medication adherence behaviors than for the health eating behavior.

We also tested whether linear regression imputation of missing data affected results by comparing the proposed models estimated using imputed data with models estimated using data with listwise deletion of cases with missing data. Models were estimated using the full sample for each behavior. Results indicated that the pattern of effects for the models for each behavior did not differ substantially regardless of the method used to treat missing data. Full results of the model comparisons using imputed missing data and listwise deletion of cases with missing data are provided in Appendix F.

Model in national samples. Results of models estimated in each national sample and tests of difference in parameter estimates using multi-group analysis are presented in Appendices G and H (supplemental materials), respectively. Patterns of effects for illness representations generally mirrored those for the full sample analysis with few effects of illness perception dimensions on intention, some sample-specific effects notwithstanding. For example, personal control was a statistically significant predictor of physical activity intention in the Australia sample, and healthy eating in the China sample. However, these effects were generally counter to the overall trend of small, non-statistically significant effects, and were notable by their significantly larger effects relative to other samples in the multi-group analyses. Similarly, effects of the TPB variables on intention were larger by comparison. Statistically significant effects of attitudes on intentions were found for healthy eating in all but the Brazil sample, for physical activity in the UK, Hong Kong, Malaysia, and UK samples, and for taking medication in all but the Brazil and Malaysia samples. Statistically significant effects of subjective norms on intentions were observed for physical activity intention in all samples except the Australia and Hong Kong samples, for taking medication in the Brazil, Malaysia, Taiwan, and China samples, and for healthy eating in the Australia and Taiwan samples only. By comparison, there were fewer statistically significant effects of PBC on intention across samples and behaviors. Statistically significant effects of PBC on intention were found for physical activity in the Australia, Hong Kong, and China samples, of healthy eating in the Malaysia, Taiwan, and China samples, and for taking medication in the Hong Kong, Malaysia, and Taiwan samples. Effect sizes were generally small-to-medium.

As with the full sample, inclusion of past behavior resulted in modest attenuation of model effects, and effects of past behavior on intention were mediated by the social cognition constructs in the majority of samples for these behaviors, but with substantive residual effects of past behavior. Indirect effects of past behavior on medication taking intention through the social cognitive variables in all samples were much smaller than for physical activity and healthy eating.

Discussion

The aim of the present study was to identify the belief-based predictors of FH patients' intentions to participate in three self-management behaviors: physical activity, healthy eating, and taking medication. An integrated model derived from two prominent social cognition theories was proposed in which beliefs about illness derived from the CSM, and beliefs about the behavior derived from the TPB, were set a priori as predictors of intention to participate in the self-management behaviors. Two models were tested for each behavior controlling for effects of key demographic variables: the first specified effects of the social cognition constructs on intention, and the second augmented this model to include past behavior as a predictor of intention, directly and indirectly with the social cognition constructs as multiple mediators (see Figure 1). Data were collected from patients from FH clinics in Australia, Hong Kong, Brazil, Malaysia, Taiwan, China, and the UK, and models were tested in the full sample and separately by national group. Both models exhibited adequate fit with the data according to the goodness-of-fit indices adopted (see Table 1 and Appendix E). Results revealed three key findings. First, the social cognition constructs representing beliefs about the behavior from the TPB were consistent predictors of intention across behaviors and samples (see Table 2 and Table 3, and Appendices G and H). In contrast, illness perception dimensions representing beliefs about the illness from the CSM did not consistently predict intention. Second, although beliefs about the behavior from the TPB consistently predicted intention, there was variability in effect sizes and relative contribution of the attitude, subjective norm, and PBC constructs in the prediction of intention across behaviors and samples (see Table 2 and Table 3, and Appendices G and H). Third, we found indirect effects of past behavior on intention through the social cognition variables for the behaviors and samples, although effects were particularly marked for physical activity. However, substantive residual effects of past behavior on intention remained (see Table 2 and Table 3, and Appendices G and H).

That effects of beliefs about behavior from the TPB were substantive predictors of intention relative to the illness perception dimensions from the CSM across behaviors and samples is unsurprising. A growing literature integrating these perspectives has corroborated this pattern of effects (French et al., 2013; Orbell et al., 2006), including our previous research in FH (Hagger et al., 2016b). Although the CSM and other social cognitive theories such as protection motivation theory (Rogers, 1975) and the health action process approach (Schwarzer, 2008) suggest that perceptions of threat and risk should motivate individuals to take action to respond to the threat, studies indicate that such beliefs make a relatively modest contribution to the prediction of health behaviors (Zhang et al., 2019). By comparison, the current research demonstrated that beliefs with respect to future participation in the management behaviors, particularly attitudes and subjective norms, were the most consistent predictors for all behaviors and across all samples (see Tables 2 and 3). Again, this is in line with previous findings integrating these perspectives in multiple illnesses and conditions (French et al., 2013; Hagger et al., 2016b; Orbell et al., 2006). Taken together, it would seem that these findings lend support for the effectiveness of the TPB in identifying determinants of intentions to engage in self-management behaviors.

However, we speculate there may be two reasons for this pattern of effects. First, FH is an asymptomatic condition that predisposes individuals to elevated risk of ACVD in future. The lack of proximal symptomatic information signaling an immediate health threat means that it is unlikely that perceptions of threat will be of sufficient strength to motivate participation. Instead, beliefs about the benefits and detriments of participating in the behaviors themselves, and beliefs about significant others' influence, as outlined in the TPB, may be more proximal, immediate, and salient with respect to motivating action. Second, the measures used tap illness perceptions from the CSM focus on generalized beliefs regarding the illness, while beliefs with respect to participation in the behavior from the TPB adopt measures that closely correspond to the target behaviors in terms of target (who is doing the acting), action (the specific behavior), context (the context in which the behavior is to be performed), and time (the time frame in which the behavior will be enacted) (c.f., Ajzen, 2002a). The larger effects of the TPB measures on patients' intentions to participate in FH self-management behaviors relative to the effects of the illness perceptions dimensions may therefore be, in part, a technical issue attributable to measurement. Current results further corroborate the imperative of measurement correspondence, outlined in the TPB (Ajzen, 1991, 2002a). Similarly, the correspondence issue has been identified in previous research examining effects of generalized measures (e.g., traits, dispositions) on behavior alongside the belief-based constructs from the TPB (Conner & Abraham, 2001; Vo & Bogg, 2015).

With regard to differences in model effects across national groups, one might be tempted to ascribe observed differences in the effects of the TPB constructs on intention to the cultural or ethnic background of the national groups from which the current samples were drawn, we advise caution when making such an interpretation. Prior research has observed distinct patterns of differences in the relative contribution of attitudes and subjective norms to the prediction of intention across samples from different cultural and ethnic backgrounds (Bagozzi et al., 2001; Blanchard et al., 2003). Results from these studies suggest that groups with an interdependent outlook may base their intentions on normative beliefs (i.e., subjective norms), while groups that endorse an independent norm tend to form intentions on the basis of behavioral beliefs (i.e., attitudes). Considering this previous research, the consistent effects of subjective norms on intention among samples from Malaysia, Taiwan, and China observed in the current study could be attributed to the tendency of these nations to endorse interdependent cultural norms, compared to nations like Australia and the UK. However, four caveats mitigate against such an interpretation. First, the current study is not a cross-cultural investigation. Cultural orientations were not measured, so we cannot unequivocally verify whether interdependent or independent orientations, for example, impacted the observed pattern of effects. Second, the current samples of FH patients were not recruited using a random, stratified sampling procedure. The samples cannot, therefore, be considered sufficiently representative to draw generalizable conclusions with respect to the observed differences based on cultural or ethnic norms. Third, there were effects of subjective norms on intentions in some of the samples from nations that tend to endorse independent cultural orientations, such as Australia, even though effects of attitudes tended to be larger. Fourth, differences in the relative contribution of attitudes and subjective norms across behaviors should also be considered. For example, effects of subjective norms on intentions for the Malaysia and China samples were small and non-significant for healthy eating, while they were significant in the Australia sample. We look to future research in which effects of the predictors from the integrated model can be compared across representative samples with verified differences in cultural and ethnic background and across the three FH self-management behaviors (Singelis, 1994).

Current results point to the importance of adopting a sample-specific approach when identifying the belief-based correlates of intention to participate in FH self-management behaviors. While findings are suggestive of some generalized trends in model effects across samples and behaviors, such as the pervasive effects of attitudes and subjective norms on intention relative to the illness perception dimensions, it is important to point out that numerous sample-specific differences were identified. For example, the effects of attitudes and subjective norms on intention were statistically significant in many cases, but the actual size of the effects varied across samples. Although we controlled for several demographic variables such as health literacy and age, it is possible that other demographic factors such as social context and time from diagnosis, may have moderated the relative contribution of each social cognitive factor. In addition, clinic-specific practices such as amount of information provided to patients during the course of their treatment may also have affected patients' knowledge and, therefore, influenced the effects of their beliefs on self-management behaviors. Consistent with research applying social cognition theories to predict health-related behaviors in other contexts (e.g., Albarracín et al., 2001; McEachan et al., 2011), current findings further highlight the need to identify the specific behavioral correlates of the behavior and population of interest in order to pinpoint the appropriate constructs to target in behavioral interventions.

The indirect effects of past behavior on intention mediated by the social cognition constructs in the present models is consistent with theory and prior research (Albarracín & Wyer, 2000; Conner et al., 1999; Hagger et al., 2016a). Ajzen (2002b) suggested that social cognition factors from the TPB should fully account for the effects of past behavior on intention, and proposed that the indirect effects of past behavior through these constructs reflects previous decision making. From this perspective, past behavior serves as a source of information for individuals' beliefs with respect to future behavior. However, substantive residual effects of past behavior on intention were observed in most samples for the physical activity and healthy eating behaviors, suggesting that the model constructs were insufficient in accounting for past behavior effects. Such residual effects have also been observed in meta-analytic tests of the TPB (e.g., Hagger et al., 2016a). Possible reasons for the failure of the social cognition constructs in accounting for the residual effects of past behavior on intention may be imprecision in measurement, and that the specified sets of beliefs are not sufficiently comprehensive and do not encompass all possible relevant beliefs that impact intention. While we adopted a relatively comprehensive set of beliefs about illnesses and behaviors in the current study, we did not explore the specific sets of beliefs that underpin the TPB measures of attitudes, subjective norms, and PBC (Ajzen, 1991), which may account more effectively for the effects of past behavior on intention. The residual effect of past behavior on intention may also reflect effects of habits. Researchers have studied habit as a construct representing routinized, automatic participation in behavior developed by repeated experiences with the behavior in consistent contexts or in the presence of consistent cues and concomitant evaluations of the behavior (Gardner, 2015; Hagger, 2019; Wood, 2017). While measures of behavioral automaticity, routine, and frequency in contexts would be expected to mediate effects of past behavior on subsequent behavior (van Bree et al., 2015), such measures may also mediate effects on intentions. Such effects may indicate habitual intention formation, and a potential future study may focus on the extent to which habit measures mediate effects of past behavior on intentions and behavior for FH self-management behaviors. Such research may indicate the extent to which past behavior serves as a proxy measure of habit (Hagger, 2019).

Strengths, Limitations and Avenues for Future Research

The present study has numerous strengths: application of an innovative, integrated model of social cognition constructs to predict intention to participate in self-management behaviors in FH patients, a group with high risk of early-onset ACVD and premature mortality; use of appropriate design and measures; and collection of data diverse samples of patients from clinics in multiple countries. However, it would be remiss not to point out a number of limitations that may restrict the generalizability of current findings. First, the current study adopted a correlational, cross-sectional design. As a consequence, the causal direction of the proposed effects were inferred from theory alone, not the data. Second, the lack of prospective measures of FH self-management behaviors and a sole focus on intention as the primary outcome is an important limitation of the current research. Theory and research has indicated that intention is a consistent predictor of behavior across multiple populations, contexts, and behaviors, with small-to-medium effect sizes (Ajzen, 1991; McEachan et al., 2011; Rich et al., 2015). However, this suggests a non-trivial shortfall in the number of people who follow through and enact their intentions (Orbell & Sheeran, 1998). This intention-behavior ‘gap’ precludes making definitive conclusions on behavioral participation based on prediction of intention. Testing the effectiveness of the current model to account for actual participation in FH management behaviors and associated outcomes such as cholesterol levels should be considered a future research priority, preferably using non-self-report behavioral measures. Such research would also enable tests of whether intentions are sufficient in mediating effects of beliefs about illness and beliefs about behaviors on coping behaviors and relevant illness-related outcomes, consistent with previous research using these models (e.g., Brewer et al., 2002; Milrad et al., 2019). Third, some of the measures of constructs in the current study did not exhibit satisfactory psychometric properties. For example, the IPQ-R items exhibited relatively low AVE values, a finding that is not inconsistent with previous findings. Precedence for these psychometric issues comes from prior research demonstrating problems with factor structure of the IPQ-R (Hagger & Orbell, 2005). These measurement issues may have introduced additional systematic error and attenuated effects of the illness perception constructs on intentions in the current model. Finally, we relied exclusively on self-report measures of past behavior. Although such measures have demonstrated concurrent validity against objective means (e.g., Ainsworth et al., 2015), they are still subject to reporting bias which can be a further source of systematic error.

Future research should seek to further verify current findings in samples of FH patients using prospective panel designs that would allow for the modeling of change in actual FH self-management behaviors from the social cognition constructs in the current integrated model. Researchers should also consider moving beyond correlational designs, and examine effects of experimental manipulation of key model constructs on subsequent behaviors. Finally, current findings suggest that behavioral interventions targeting changes in social cognition constructs, particularly attitudes and subjective norms, may offer some potential in promoting participation in self-management behaviors in FH patients. However, the aforementioned limitations, particularly the study design and measurement issues, suggest that current findings should be considered preliminary, and require further corroboration before they are considered sufficiently robust as a basis for intervention design.

Conclusions

The current study examined the relative contribution of beliefs about illness from Leventhal et al.'s (1980) CSM and beliefs about self-management behaviors from Ajzen's (1991) TPB in predicting intentions to engage in three self-management behaviors (physical activity, healthy eating, and taking cholesterol lowering medication) among samples of FH patients from seven countries. Results indicate consistent relations between beliefs about behaviors, particularly attitudes and subjective norms, and intentions across behaviors and samples, providing support for previous research integrating these theoretical approaches (Hagger et al., 2016b; Orbell et al., 2006). Beliefs about illnesses were less consistently linked to intentions. Current results may provide formative research on which to base interventions aimed at promoting FH management behaviors, and suggest that targeting beliefs about behaviors, particularly attitudes and subjective norms, may be reasonable options. Such strategies may entail eliciting salient beliefs and referents of FH patients, and developing persuasive communications that target change in those beliefs. It is also important that such interventions are sample specific, given the variability in the relative contributions of the attitude and subjective norms constructs across samples in the current study.

However, such recommendations for practice should be viewed in light of the limitations of the study, particularly the correlational design, which should not be used as a basis to infer causal relations among the model constructs. In addition, it is important to note that although studies have observed consistent relations between intentions and actual behavior, the relationship is imperfect, consistent with the intention-behavior ‘gap’ (Hagger et al., 2016a; Hagger et al., 2018). Focusing on intention change, therefore, may not be translated into actual behavior. Augmenting interventions targeting intention determinants with planning strategies that enhance intention enactment may have utility in this regard, but would need empirical corroboration in an FH context. Finally, the pervasive effects of past behavior on beliefs and intentions in the current study may signal the importance of considering habits as a determinant of intentions. Individuals’ beliefs and intentions may be a function of previous experience and, therefore, ‘habitual’ decision making (Albarracín et al., 2001; Hagger et al., 2016a; Ouellette & Wood, 1998). Strategies aimed at developing self-management behaviors into habits may, therefore, be an important addition to interventions in FH patients. Such strategies may involve developing behavioral routines and regular utilization of cues to the behavior, but should be the subject of confirmatory experimental studies before implementation.

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Table 1

Model Fit and Quality Indices for Structural Equation Models Excluding (Model 1) and Including (Model 2) Past Behavior for Physical Activity, Healthy Eating, and Taking Medication for the Full Sample

Behavior	Model	APC	AR^2	AVIF	GoF	R^2CR	SSR
Physical activity	1	.088**	.421***	1.439	.572	.995	1.000
	2	.132***	.090***	1.430	.264	.994	1.000
Healthy eating	1	.076**	.246***	1.373	.434	.802	1.000
	2	.119***	.081**	1.385	.250	.918	1.000
Taking Medication	1	.089**	.717***	1.669	.745	.972	1.000
	2	.101***	.090**	1.665	.267	.980	1.000

Note. APC = Average path coefficient; AR^2 = Average R^2; AVIF = Average block variance inflation factor; GoF = Tenenhaus goodness-of-fit index; R^2CR = R^2 contribution ratio; SSR = Statistical suppression ratio.

$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

Table 2

Standardized Path Coefficients, 95% Confidence Intervals, and Effect Size Estimates from Structural Equation Models for Physical Activity, Healthy Eating, and Taking Medication Excluding (Model 1) and Including (Model 2) Past Behavior for the Full Sample

Model and Effect	Physical activity			ES	Healthy eating			ES	Taking Medication			ES
	β	CI_{95}			*β*	CI_{95}			*β*	CI_{95}		
		LL	*UL*			*LL*	*UL*			*LL*	*UL*	
Model 1												
Direct effects												
Gender→Intention	-.055	-.126	.016	.005	.056	-.015	.127	.006	.032	-.039	.103	.003
Age→Intention	-.059	-.130	.012	.007	-.011	-.082	.060	.001	-.051	-.122	.020	.005
Education→Intention	.019	-.052	.090	.003	.094**	.023	.165	.025	-.012	-.083	.059	.003
Income→Intention	.096**	.025	.167	.009	-.019	-.090	.052	.002	.038	-.033	.109	.011
CVD→Intention	.047	-.024	.118	.003	-.041	-.112	.030	.004	-.077*	-.148	-.006	.008
Health literacy→Intention	.041	-.030	.112	.005	.038	-.033	.109	.006	-.015	-.086	.056	.003
Personal control→Intention	.071*	.000	.142	.009	-.038	-.109	.033	.007	.026	-.045	.097	.007
Consequences→Intention	-.037	-.108	.034	.002	.106**	.035	.177	.021	-.041	-.112	.030	.008
Timeline→Intention	.047	-.024	.118	.006	-.020	-.091	.051	.004	-.038	-.109	.033	.013
Treatment control→Intention	-.025	-.096	.046	.002	.018	-.053	.089	.001	.029	-.042	.100	.006
Illness coherence→Intention	.024	-.047	.095	.004	-.059	-.130	.012	.010	-.006	-.077	.065	.002
Emotional rep.→Intention	-.029	-.100	.042	.003	-.031	-.102	.040	.005	-.079*	-.150	-.008	.019
Attitude→Intention	.204***	.133	.275	.092	.227***	.158	.296	.118	.445***	.376	.514	.346
Subjective norm→Intention	.234***	.165	.303	.114	-.127***	-.198	-.056	.056	.118***	.047	.189	.074
PBC→Intention	.329***	.260	.398	.162	.260***	.191	.329	.140	.333***	.264	.402	.251
R^2 Intention	.421	–	–	–	.246	–	–	–	.717	–	–	–
Model 2												
Direct effects												
Gender→Intention	.038	-.033	.109	.004	.035	-.036	.106	.004	.034	-.037	.105	.003
Age→Intention	-.066*	-.137	.005	.007	-.026	-.097	.045	.003	-.040	-.111	.031	.004
Education→Intention	.045	-.026	.116	.006	.068*	-.003	.139	.018	.008	-.063	.079	.002
Income→Intention	.094**	.023	.165	.009	-.023	-.094	.048	.002	.033	-.038	.104	.010
CVD→Intention	.032	-.039	.103	.002	-.049	-.120	.022	.004	-.076*	-.147	-.005	.008

Health literacy→Intention	.052	-.019	.123	.007	.031	-.040	.102	.005	-.027	-.098	.044	.005
Personal control→Intention	.093**	.022	.164	.011	-.032	-.103	.039	.006	.013	-.058	.084	.004
Consequences→Intention	-.030	-.101	.041	.001	.087**	.016	.158	.017	-.048	-.119	.023	.009
Timeline→Intention	.044	-.027	.115	.006	-.034	-.105	.037	.007	-.040	-.111	.031	.014
Treatment control→Intention	-.017	-.088	.054	.001	.007	-.064	.078	.000	.038	-.033	.109	.008
Illness coherence→Intention	.034	-.037	.105	.006	-.050	-.121	.021	.009	.004	-.067	.075	.001
Emotional rep.→Intention	-.022	-.093	.049	.002	-.018	-.089	.053	.003	-.099**	-.170	-.028	.024
Attitude→Intention	.170***	.099	.241	.076	.178***	.107	.249	.093	.373***	.304	.442	.290
Subjective norm→Intention	.252***	.183	.321	.122	-.126***	-.197	-.055	.055	.106**	.035	.177	.066
PBC→Intention	.259***	.190	.328	.127	.145***	.074	.216	.078	.361***	.292	.430	.271
Past behavior→Personal control	.188***	.117	.259	.035	.091**	.020	.162	.008	.044	-.027	.115	.002
Past behavior→Consequences	-.183***	-.254	-.112	.033	.100**	.029	.171	.010	-.094**	-.165	-.023	.009
Past behavior→Timeline	.143***	.072	.214	.021	.169***	.098	.240	.028	.051	-.020	.122	.003
Past behavior→Treatment control	.166***	.095	.237	.028	-.077*	-.148	-.006	.006	.145***	.074	.216	.021
Past behavior→Illness coherence	.177***	.106	.248	.031	.205***	.134	.276	.042	.123***	.052	.194	.015
Past behavior→Emotional rep.	-.124***	-.195	-.053	.015	-.060*	-.131	.011	.004	-.098**	-.169	-.027	.010
Past behavior→Intention	.260***	.191	.329	.101	.326***	.257	.395	.176	-.153***	-.224	-.082	.045
Past behavior→Attitude	.284***	.215	.353	.080	.345***	.276	.414	.119	-.281***	-.350	-.212	.079
Past behavior→Subjective norm	.276***	.207	.345	.076	.235***	.166	.304	.055	-.181***	-.252	-.110	.033
Past behavior→PBC	.311***	.242	.380	.097	.467***	.398	.536	.218	-.064	-.135	.007	.004
Indirect effect												
Past behavior→Intention[a]	.233***	.164	.302	.091	.090**	.019	.161	.049	-.128***	-.199	-.057	.038
Total effect												
Past behavior→Intention[b]	.494***	.425	.563	.192	.416***	.347	.485	.225	-.281***	-.350	-.212	.082
R^2 Intention	.481	–	–	–	.321	–	–	–	.728	–	–	–

Note. Model 1 = Structural equation model excluding past behavior; Model 2 = Structural equation model including past behavior.
[a]Total indirect effect of past behavior on intention mediated by social cognition constructs; [b]Total effect of past behavior on intention.
β = Standardized path coefficient; CI_{95} = 95% confidence interval of path coefficient; ES = Effect size estimate; CVD = Cardiovascular disease status, coded as 1 = CVD diagnosed, 0 = No CVD diagnosis. $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

Table 3
Tests of Difference in Path Coefficients for Structural Equation Models for Physical Activity, Healthy Eating, and Taking Medication Excluding (Model 1) and Including (Model 2) Past Behavior for the Full Sample

Model and Effect	Model comparisons								
	PA–HE			PA–TM			HE–TM		
	$\beta^{diff.}$	*t*	*p*	$\beta^{diff.}$	*t*	*p*	$\beta^{diff.}$	*t*	*p*
Model 1									
Direct effects									
Gender→Intention	-.111	-2.167	.030	-.087	-1.698	.090	.024	0.468	.640
Age→Intention	-.048	-0.937	.349	-.008	-0.156	.876	.040	0.781	.435
Education→Intention	-.075	-1.464	.143	.031	0.605	.545	.106	2.069	.039
Income→Intention	.115	2.245	.025	.058	1.132	.258	-.057	-1.113	.266
CVD→Intention	.088	1.718	.086	.124	2.420	.016	.036	0.703	.482
Health literacy→Intention	.003	0.059	.953	.056	1.093	.275	.053	1.035	.301
Personal control→Intention	.109	2.128	.034	.045	0.878	.380	-.064	-1.249	.212
Consequences→Intention	-.143	-2.791	.005	.004	0.078	.938	.147	2.869	.004
Timeline→Intention	.067	1.308	.191	.085	1.659	.097	.018	0.351	.725
Treatment control→Intention	-.043	-0.839	.401	-.054	-1.054	.292	-.011	-0.215	.830
Illness coherence→Intention	.083	1.620	.105	.030	0.586	.558	-.053	-1.035	.301
Emotional rep.→Intention	.002	0.039	.969	.050	0.976	.329	.048	0.937	.349
Attitude→Intention	-.023	-0.455	.649	-.241	-4.771	.000	-.218	-4.379	<.001
Subjective norm→Intention	.361	7.147	<.001	.116	2.296	.022	-.245	-4.782	<.001
PBC→Intention	.069	1.386	.166	-.004	-0.080	.936	-.073	-1.466	.143
Model 2									
Direct effects									
Gender→Intention	.003	0.059	.953	.004	0.078	.938	.001	0.020	.984
Age→Intention	-.040	-0.781	.435	-.026	-0.508	.612	.014	0.273	.785
Education→Intention	-.023	-0.449	.654	.037	0.722	.470	.060	1.171	.242
Income→Intention	.117	2.284	.023	.061	1.191	.234	-.056	-1.093	.275
CVD→Intention	.081	1.581	.114	.108	2.108	.035	.027	0.527	.598
Health literacy→Intention	.021	0.410	.682	.079	1.542	.123	.058	1.132	.258
Personal control→Intention	.125	2.440	.015	.080	1.562	.119	-.045	-0.878	.380
Consequences→Intention	-.117	-2.284	.023	.018	0.351	.725	.135	2.635	.008
Timeline→Intention	.078	1.523	.128	.084	1.640	.101	.006	0.117	.907
Treatment control→Intention	-.024	-0.468	.640	-.055	-1.074	.283	-.031	-0.605	.545
Illness coherence→Intention	.084	1.640	.101	.030	0.586	.558	-.054	-1.054	.292
Emotional rep.→Intention	-.004	-0.078	.938	.077	1.503	.133	.081	1.581	.114
Attitude→Intention	-.008	-0.156	.876	-.203	-4.019	.000	-.195	-3.860	<.001
Subjective norm→Intention	.378	7.483	<.001	.146	2.890	.004	-.232	-4.529	<.001
PBC→Intention	.114	2.257	.024	-.102	-2.049	.041	-.216	-4.276	<.001
Past behavior→Personal control	.097	1.893	.058	.144	2.811	.005	.047	0.917	.359
Past behavior→Consequences	-.283	-5.524	<.001	-.089	-1.737	.083	.194	3.787	<.001

Past behavior→Timeline	-.026	-0.508	.612	.092	1.796	.073	.118	2.303	.021
Past behavior→Treatment control	.243	4.743	.000	.021	0.410	.682	-.222	-4.333	.000
Past behavior→Illness coherence	-.028	-0.547	.585	.054	1.054	.292	.082	1.601	.110
Past behavior→Emotional rep.	-.064	-1.249	.212	-.026	-0.508	.612	.038	0.742	.458
Past behavior→Intention	-.066	-1.326	.185	.413	8.176	<.001	.479	9.483	<.001
Past behavior→Attitude	-.061	-1.225	.221	.565	11.349	<.001	.626	12.574	<.001
Past behavior→Subjective norm	.041	0.824	.410	.457	9.047	<.001	.416	8.236	<.001
Past behavior→PBC	-.156	-3.133	.002	.375	7.424	<.001	.531	10.512	<.001
Indirect effect									
Past behavior→Intention[a]	.143	2.831	.005	.361	7.147	<.001	.218	4.255	<.001
Total effect									
Past behavior→Intention[b]	.078	1.567	.117	.775	15.567	<.001	.697	14.000	<.001

Note. PA = Physical activity; HE = Healthy eating; TM = Taking medication; β^{diff} = Difference in standardized path coefficient across behaviors; *t* = Test of difference in path coefficient using Schenker and Gentleman's method; *p* = Probability value for *t*; Model 1 = Structural equation model excluding past behavior; Model 2 = Structural equation model including past behavior. [a]Total indirect effect of past behavior on intention mediated by social cognition constructs; [b]Total effect of past behavior on intention. *β* = Standardized path coefficient.

$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

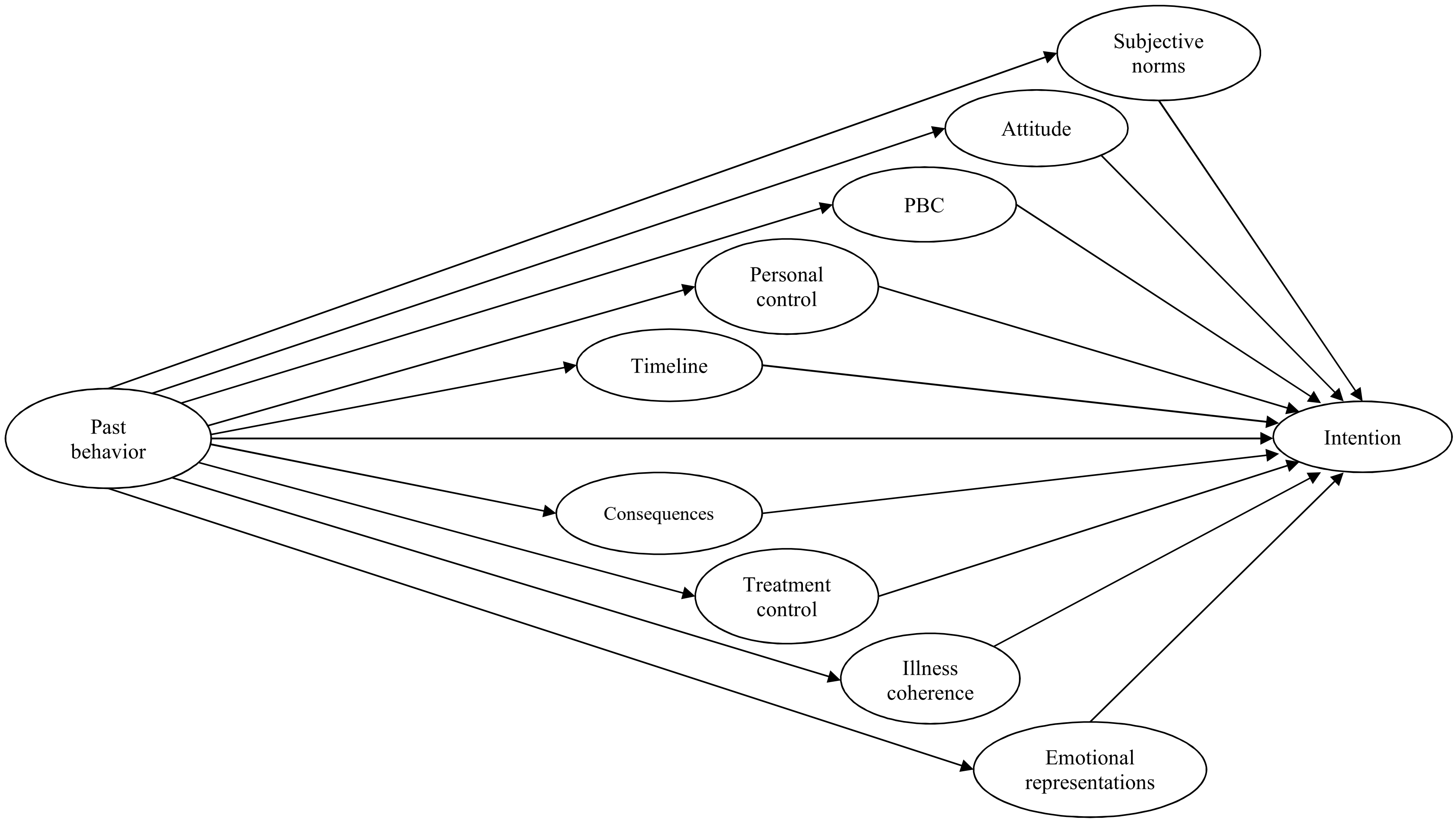

Figure 1. Proposed effects among integrated social cognition model constructs based on the theory of planned behavior and common-sense model of illness self-regulation. Two models were estimated in the current study: a model that included the social cognition constructs as the only direct predictors of intention (Model 1), and a model (presented above) that includes effects of past behavior on all model constructs and intention (Model 2) The measurement components of the latent constructs and effects of control variables (gender, age, income, education, cardiovascular disease status, health literacy) have been omitted for clarity. PBC = Perceived behavioral control.