Predicting Self-Management Behaviors in Familial Hypercholesterolemia Using an Integrated Theoretical Model: The Impact of Beliefs About Illnesses and Beliefs About Behaviors

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Full citation: Hagger, M. S., Hardcastle, S. J., Hingley, C., Strickland, E., Pang, J., & Watts, G. F. (2016). Predicting self-management behaviors in familial hypercholesterolemia using an integrated theoretical model: The impact of beliefs about illnesses and beliefs about behaviors. *International Journal of Behavioral Medicine*. Advance online publication. doi:10.1007/s12529-015-9531-x

Abstract

Purpose Patients with familial hypercholesterolemia (FH) are at markedly increased risk of coronary artery disease. Regular participation in three self-management behaviors, physical activity, healthy eating, and adherence to medication, can significantly reduce this risk in FH patients. We aimed to predict intentions to engage in these self-management behaviors in FH patients using a multi-theory, integrated model that makes the distinction between beliefs about illness and beliefs about self-management behaviors. *Methods* Using a cross-sectional, correlational design, patients (N = 110) diagnosed with FH from a clinic in Perth, Western Australia self-completed a questionnaire that measured constructs from three health-behavior theories: the common sense model of illness representations (serious consequences, timeline, personal control, treatment control, illness coherence, emotional representations), theory of planned behavior (attitudes, subjective norms, perceived behavioral control), and social cognitive theory (self-efficacy).

Results Structural equation models for each self-management behavior revealed consistent and statistically significant effects of attitudes on intentions across the three behaviors. Subjective norms predicted intentions for health eating only and self-efficacy predicted intentions for physical activity only. There were no effects for the perceived behavioral control and common sense model constructs in any model.

Conclusions Attitudes feature prominently in determining intentions to engage in self-management behaviors in FH patients. The prominence of these attitudinal beliefs about self-management behaviors, as opposed to illness beliefs, suggest that addressing these beliefs may be a priority in the management of FH.

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

Predicting Self-Management Behaviors in Familial Hypercholesterolemia: The Impact of Beliefs About Illnesses and Beliefs About Behaviors

Familial Hypercholesterolemia (FH) is a genetic condition indicated by excessive levels of low-density lipoprotein (LDL) cholesterol and substantially increased risk of early-onset coronary artery disease, and premature mortality [1]. FH affects 1 in every 300 to 500 individuals worldwide [2]. The application of genetic testing means that early detection and treatment of FH is possible and a number of screening programs, including testing of blood relatives, have been initiated [3]. The recommended treatment regimen for FH is use of lipid-lowering drugs such as statins and cholesterol absorption inhibitors in combination with avoiding smoking and engaging in self-management behaviors including regular physical activity and eating a diet low in saturated fat [4]. Engaging in the three self-management behaviors (physical activity, healthy eating, and taking medication) is associated with reduced risk of coronary artery disease in FH sufferers [4].

While the pharmacological and behavioral treatment of FH is effective in reducing cholesterol and preventing the onset of coronary artery disease, many FH suffers fail to engage in the self-care behaviors leaving them at increased risk [5, 6]. This has led researchers to examine the psychological factors associated with engaging in self-management behaviors in FH patients [7, 8]. Identifying the psychological factors that are strongly associated with health behaviors is important as it provides an evidence base on which to develop interventions. This is based on the assumption that psychological factors can be manipulated through motivational behavior-change techniques [9] and the assumption that changing the factors will lead to a concomitant change in behavioral antecedents, such as intentions and motivation, and actual behavior [10].

A number of prominent psychological approaches have been applied to understand the factors associated with patients’ participation in clinically-relevant behaviors in health contexts

[11]. On the one hand, self-management behaviors in FH can be viewed as a response to perceived threats to health brought about by knowledge of the illness which compels an individual to adopt a coping strategy [12]. In contrast, self-management behaviors can be viewed according to the belief-based antecedents proposed to be associated with engaging in the behavior itself [13, 14]. In the current research we aim to examine both sets of factors in an integrated psychological model that aims to identify the salient psychological factors related to self-management behaviors in FH sufferers. Next, we outline the theoretical bases of the integrated model and outline the key hypotheses in the model in terms of predicting self-management behaviors in FH sufferers.

According to Leventhal, Meyer, and Nerenz's [12] common-sense model, individuals form lay cognitive and emotional representation of the illness. The representations are schematically organized sets of beliefs about the illness based on personal, expert, and cultural sources of information [15, 16]. Research has demonstrated that illness representations comprise multiple dimensions including *identity* (the label given to the illness and number of symptoms experienced), *cause* (perceived causes of the illness), *consequences* (the perceived impact of the illness on the sufferers' life), *timeline* (how long the illness is expected to last), *personal control* (the extent to which the sufferer feels he/she has control over the course and outcome of the illness), *treatment control* (beliefs that treatment will be effective in treating the illness), *illness coherence* (the extent to which a suffer has a clear picture of the illness), and *emotional representations* (perceived emotional impact of the illness). Research has shown that personal control and treatment control were positively associated with adaptive, problem-focused coping strategies and illness outcomes, while the serious consequences, timeline, cause, identity, and emotional representation dimensions tended to be negatively related to the same coping strategies and outcomes [17-20]. This has compelled researchers to suggest that promoting better control over behaviors and treatment would lead patients to engage in important problem-focused coping strategies, including participation in key health-related behaviors such as medication adherence and attendance to clinics, and lead to better illness-related outcomes including reduced illness state and progression [21, 22].

Participation in health-related behaviors has also been viewed as a function of beliefs and motives with respect to the behavior rather than the illness itself. Prominent among the theoretical approaches are social-cognitive theories such as the theory of planned behavior [23] and social cognitive theory [14, 24, 25]. The theory of planned behavior proposes that intentions, a motivational construct, is the most proximal predictor of behavior. Intentions are a function of sets of personal-, social-, and control-related beliefs. Personal beliefs, or attitudes, reflect individuals' beliefs that the target behavior will lead to salient outcomes. Social beliefs, or subjective norms, are individuals' beliefs that salient others would want them to do the behavior. Control beliefs, or perceived behavioral control, reflect beliefs that an individual has the personal resources to engage in the behavior. The theory has also been augmented to include self-efficacy from Bandura's [24] social cognitive theory, which reflects a person's beliefs that they can perform the behavior in the presence of salient barriers. The theory of planned behavior with self-efficacy has been shown to predict, and explain substantial variance in, intentions and behavior in numerous health behavior contexts [26-28].

There has, however, been comparatively little research examining the effects of constructs from the common sense model alongside the theory of planned behavior and social cognitive theory [29]. Many authors have advocated an integrated theoretical approach [30-38] and it has utility in the current context because it allows us to account for beliefs associated with illnesses, which may compel individuals to engage in salient health related behaviors to cope with the threat, and beliefs about actual participation in health-related behaviors. Specifically, illness beliefs are expected serve as distal predictors of behaviors relevant to coping with illness threat, a theoretically-consistent effect that has not only been corroborated by research showing relations between illness representations and coping behaviors across multiple conditions, but also in laboratory research demonstrating that activating cognitive representations of illness through priming [16, 39] leads to the activation of related behavioral responses for the illness [40]. Beliefs about behaviors derived from social cognitive models should be more proximal predictors of behavior given the correspondence and specificity of the beliefs to the behavior themselves and the measures used to tap them [41-43]. Orbell et al. [29] examined the utility of an integrated approach incorporating the common-sense model and the theory of planned behavior 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 cognitions.

The Present Study

The aim of the current research was to predict FH patients' intentions to participate in self-management behaviors adopting belief-based constructs from an integrated model based on the common sense model of illness perceptions, the theory of planned behavior, and social cognitive theory. Our focus on intentions to engage in three key FH self-management behaviors (physical activity, healthy eating, and taking medication) is consistent with theory and research that has identified intentions as the most proximal and effective predictor of behavior in health contexts, with meta-analytic effect sizes for the intention-behavior relation in health behavior ranging from .21 to .42 [28, 44]. Predicting intentions is therefore extremely relevant to understanding behavior because they reflect a strong commitment by the individual to engage in the target behavior in future. Our hypothesized integrated model is illustrated in Figure 1. In the integrated model, we predicted that intentions to engage in physical activity, healthy eating, and taking medication would be a function of illness representation dimensions as well as belief-based constructs from the theory of planned behavior and social cognitive theory. Consistent with previous research adopting the common sense model [17, 19, 20, 45], we expected beliefs from the common sense model that signal increased illness threat, including consequences, timeline, and emotional representations, to be negatively related to self-management behavioral intentions. This pattern of effects likely arises because individuals with heightened levels of these beliefs tend to focus on managing the immediate threat posed by the illness (e.g., heightened anxiety or emotional arousal), and usually do so by adopting maladaptive coping strategies like denial or avoidance, rather than by behavioral strategies focused on managing the illness. In contrast, beliefs representing personal capacity to manage the threat, including personal and treatment control, were expected to be positively related to intentions to participate in self-management behaviors. This pattern of effects is likely due to the tendency for individuals to adopt active, problem-focused, behavioral coping strategies that are adaptive (i.e., forming intentions to do something about the illness) if they believe that such actions will be efficacious in altering the course of the illness. We also expected attitudes, subjective norms, and perceived behavioral control from the theory of planned behavior [23], and self-efficacy from Bandura's [24] social cognitive theory, to significantly predict intentions to engage in the behaviors. Consistent with the findings of Orbell et al.'s [29] pioneering study in this area, we expected the effects of beliefs relating to the specific behavior to be the strongest predictors of self-management behavioral intentions, and attenuate the effects of the illness-related beliefs. Finally, we expected the effects of the beliefs from the integrated model to hold after controlling for demographic variables (age, gender), diagnosis for comorbid conditions (coronary artery disease, diabetes, and hypertension), and past behavior [46]. Past behavior was included as a control variable in the models because participants were likely to vary in their experience with the behavior. As past behavior has been show to model habit [47] and previous decision making [48], accounting for its effects in the current models is necessary in order to obtain a test of the unique effects of study variables on behavioral intentions.

Method

Design and Participants

The present study adopted a correlational design with participants asked to complete a questionnaire including demographic, psychological, and behavioral measures. Participants were recruited from a lipid disorders clinic at Royal Perth Hospital (RPH) as part of the Familial Hypercholesterolemia Western Australia (FHWA) program, which provides publically-funded genetic screening and treatment for FH. Patients with lipid disorders including FH are referred to the clinic from the community by general practitioners (GPs) and other specialists for assessment. Cases referred to the clinic via this process are known as ‘index’ cases (i.e., cases identified through a referral from a GP or specialist and subsequently verified through genetic testing). The clinic also follows a cascade screening process in which potentially affected relatives of index cases are contacted and invited to attend the clinic. The cascade screening process identifies family members with FH in the community that are more representative of FH in general as they are not likely to have been referred as a result of a diagnosis for coronary artery disease.

Participants were recruited from a pool of 415 patients matching a priori inclusion criteria: aged over 18 years, living in metropolitan Perth, and had received a prior diagnosis for FH from a genetic test. Eligible patients were recruited to the study in two ways: (a) patients were asked to participate by the consultant or clinic staff while attending the clinic as part of their routine treatment and were given the opportunity to complete the questionnaires in the clinic itself or take it home and return the questionnaire via mail in a pre-paid envelope; and (b) patients were invited to participate via a letter from their consultant and the research team accompanied by a copy of the questionnaire mailed directly to the patient's address with questionnaire return via pre-paid envelope. Participants were required to tick a box on the questionnaire indicating that they had read the study information and consented to participate in the study. The study was approved by the Curtin University and RPH Human Research Ethics Committees prior to participant recruitment and data collection.

Measures

Questionnaires contained an initial section asking participants to report their demographic information including age, gender, marital status, and self-reported experiences of stress and depression as coronary artery disease risk factors. Further demographic data including when participants had received their genetic diagnosis, what treatment they had received, diagnosis for coronary artery disease, diabetes, and hypertension, smoking status and history, type of lipid-lowering therapy (if any), and occupation were obtained from patients' medical records. Subsequent sections contained measures of the psychological variables including illness perceptions and measures from the theory of planned behavior and social cognitive theory for the three FH self-management behaviors: physical activity, healthy eating, and mediation adherence. The target behaviors were defined for the participants in a narrative section preceding the measures. Physical activity was defined as: "active pastimes that raise your heart/pulse rate and make you breathe deeply for a prolonged period"; healthy eating was defined as "choosing healthy (low fat, low cholesterol) options for the majority of your regular meals to manage your FH"; and medication adherence was defined as: "taking your medication as prescribed by your general practitioner/doctor/physician to manage your FH".

Revised Illness perception questionnaire (IPQ-R). Illness perceptions were measured using the IPQ-R modified to refer to familial hypercholesterolemia as the target illness. The questionnaire included measures of six cognitive illness perception dimensions consistent with

Leventhal et al.'s [12] common sense model and an emotional representation scale. Measures of the serious consequences (11 items; e.g., "FH has major consequence on my life"), timeline - chronic (7 items; e.g., "My FH will last a long time"), personal control (11 items; e.g., "What I do will determine whether my FH gets better or words"), treatment control (6 items; e.g., "Treatment will be effective in curing my FH"), illness coherence (5 items; e.g., "The symptoms of my FH are puzzling to me"), and emotional representations (8 items; e.g., "The symptoms of my FH are distressing to me") were measured on six-point scales anchored by 1 (disagree very strongly) to 6 (agree very strongly).

Theory of planned behavior. Measures of constructs from the theory of planned behavior were developed based on published guidelines [49] and previous measures [50] for each of the three FH self-management health-related behaviors: physical activity, healthy eating, and taking medication. Attitude measures were preceded by a common stem (e.g., "My doing physical activity at least three or more times per week over the next three months is…") followed by three six-point semantic differential scales with end-points *good-bad*, *exciting-boring*, and *fun-unpleasant*. Items measuring participants' intention (1 item; e.g., "I intend to participate in physical activity at least three or more times per week over the next three months"), subjective norm (2 items; "Most people important to me think I should do physical activity at least three or more times per week over the next three months"), and perceived behavioral control (2 items; "Whether or not I participate in physical activity at least three or more times per week in the next three months is entirely up to me") were measured on six-point scales anchored by 1 (disagree very strongly) to 6 (agree very strongly).

Social cognitive theory. We also included a measure of self-efficacy in the face of salient barriers consistent with social cognitive theory and frequently included alongside theory of planned behavior constructs to capture the personal capacity aspects of perceived behavioral control [51]. Participants were first ask to write down the most salient barrier to the target behavior (e.g., “What is the greatest barrier or impediment to you doing physical activity at least three or more times per week in the next three months?” and then asked how confident they were in performing the target behavior when the barrier is present (e.g., “ Now, considering the barrier you have written above, how confident are you in doing physical activity at least three or more times per week in the next three months when that barrier is present?), with responses given on a ten-point scale ranging from 1 (10%) to 10 (100%).

Past behavior. Participants self-reported their past participation in the three target self-management behaviors (2 items: e.g., “In the course of the past three months, how often have you participated in vigorous physical activities?”) with scale endpoints 1 (never) and 6 (everyday). The self-reported measure of physical activity is based on the leisure-time physical activity and has exhibited satisfactory validity and reliability statistics when administered concurrently with more ‘objective’ behavioral measures [52]. The concurrent and criterion validity of these self-report measures has been confirmed against more comprehensive measures such as heart rate monitoring [53] and food diaries [54]. Further, factor analytic studies have shown these items to indicate latent behavioral measures with high factor loadings and average variance extracted statistics supporting their construct validity [54].

Data analysis

Data were analyzed using variance-based structural equation modeling (VB-SEM), also known as Partial Least Squares analysis, using the Warp PLS v.5.0 statistical software [55]. All constructs included in models were latent variables indicated by single or multiple items from the study questionnaire. The hypothesized models were identical to a linear multiple regression model in which constructs from the common sense model (serious consequences, timeline, personal control, treatment control, illness coherence, and emotional representations), theory of planned behavior (attitudes, subjective norms, and perceived behavioral control), and social cognitive theory (self-efficacy) were set as predictors of intentions. The model was estimated separately for each of the three self-management behaviors. Past behavior, gender, age, and illness status for coronary artery disease, diabetes, and hypertension (dummy-coded as 1 = condition present; 0 = condition absent) were included in the model as control variables and were therefore set to predict all other variables in the model.

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 [56]. Discriminant validity is supported when the square-root of the AVE for each latent variable exceeds its correlation coefficient 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 (.100, .250, and .360 correspond to small, medium, and large effect sizes) [57]. Further information on the adequacy of the model is provided by the average path coefficient (APC) and average R^2 (ARS) coefficient across the model, both of which should be significantly different from zero. 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 5.000 for a well-fitting model [55]. In order to verify the robustness of the model parameters (i.e., the path estimates representing relations among the variables), a bootstrapping resampling technique with 100 replications was utilized to estimate stable and reliable averaged path estimates and associated significance levels. Differences in path coefficients in the models for the three self-management behaviors were tested using 95% confidence intervals. To the extent that these confidence intervals overlap, we have confirmation of no statistically significant difference in the coefficient across the behaviors.

Results

Participants

Questionnaires were distributed to participants selected from the pool (N = 262) based on their clinic attendance and 110 completed questionnaires were returned representing a response rate of 52.67%. Of the 262 patients sent the survey, 41% were family members of patients diagnosed with FH while 40% of the 110 responders were family members. Of the index cases that responded, more than half were referred from general practice, which also represents a community-based general FH group. Overall, over 70% of the cohort was referred to the clinic from the community.

No data was excluded due to incomplete questionnaires. Missing data analysis on psychological variables revealed that data was missing completely at random and the missing data were imputed using multiple imputation analysis with a strict cut-off criterion of only imputing cases with < 5% of missing data. No data was eliminated due to missing data greater than 5%. The final sample comprised 110 patients (males = 48, females = 62; *M* age = 50.65 years, *SD* = 13.81, range = 23 to 80) with 83.10% reporting being married or in a long-term relationship. According to patient records, average time since genetic diagnosis was 4.58 years (*SD* = 2.31, range 0.69 to 8.53). The majority of participants (n = 80; 72.72%) were currently receiving lipid-lowering therapy including statins only (n = 43, 39.09%), non-statins only (n = 4; 3.63%), and combined treatment (n = 33, 30.00%). In terms of coronary artery disease, 20 participants (18.20%) had been diagnosed with a form of coronary artery disease including angina (n = 17; 15.50%), myocardial infarction (n = 8; 7.30%), stroke (n = 1; 0.91%), and transient ischemic attack (n = 1; 0.90%). Patients (n = 24; 21.81%) had received surgical treatment for their coronary artery disease including coronary artery bypass graft (CABG; n = 12; 10.90%), angioplasty (n = 11; 10.00%), and other vascular surgical procedures (n = 1; 0.91%).

With respect to coronary artery disease risk factors, patient records indicated 41 participants as either current (n = 14; 12.72%) or former (n = 27; 24.54%) smokers with the current smokers smoking an average of 9.75 cigarettes per day. A minority of patients had been diagnosed with diabetes (n = 7; 6.36%) and hypertension (n = 19; 17.27%). A number of participants reported experiencing elevated stress (n = 27; 24.54%) and depression (n = 21; 19.09%).

Preliminary analyses

Response bias analyses based on demographic data from patient records revealed no differences in gender distribution (χ^2 = .883, p = .347), age (t (259) = 1.051, p = .294, d = 0.13), years since diagnosis (t (259) = 1.595, p = .112, d = 0.19), whether or not the patient had received lipid-lowering therapy (χ^2 = .395, p = .419), type of therapy received (statins only, non-statins only, combined; χ^2 = .316, p = .854), coronary artery disease diagnosis (χ^2 = .196, p = .658), and smoking status (current, former, never; χ^2 = .2.46, p = .292) for those who completed the questionnaires and those who did not. Means and standard deviations of study constructs are provided in Table 1.

We examined the VB-SEM measurement-level statistics to confirm that the study variables met criteria for construct and discriminant validity for each model. Composite reliability coefficients, AVE, and intercorrelations for the variables in the models are presented in Table 1. Reliability coefficients exceeded the .700 criterion for all factors and AVE values approached or exceeded the recommended .500 criterion. Factor correlations among the latent variables also indicated no problems with discriminant validity. In all cases, the square root of the AVE for each latent variable approached or exceeded the correlation between the variable and all other variables.

Structural equation models

Model goodness-of-fit and quality indices are provided in Table 2. In all cases, the indices indicated adequate model fit and large effect sizes for each behavior. In addition, the models accounted for a statistically significant amount of variance in the key dependent variables: intention to engage in the FH management behaviors: physical activity (R^2 = .589, $p < .001$), healthy eating (R^2 = .683, $p < .001$), and taking medication (R^2 = .507, $p < .001$). Standardized parameter estimates for each of the proposed models are given in Table 3. Results revealed statistically significant effects of attitudes on intentions to engage in each of the FH self-management behaviors with substantive effect sizes. There was, however, no effect for perceived behavioral control in any of the models. Subjective norms predicted intentions in the model for healthy eating, but not in the models for the other behaviors. The effect of subjective norms on intentions for healthy eating was substantially larger than the same effect for taking medication, but not for physical activity as indicated by confidence intervals. There was a statistically significant effect of self-efficacy on intentions in the model for physical activity, but not in the models for the other behaviors. There were no effects of the illness representation dimensions from the common sense model on intentions in any of the models. The only exception was the treatment control construct for physical activity, which was statistically significant but negative in valance and inconsistent with the zero-order correlation for these variables (see Table 1). We concluded that this was a suppressor effect. There were few statistically significant effects of the cardiovascular disease, hypertension, and diabetes status variables in the model for each behavior. The only effects of note were increased perceived consequences and emotional representations for participants with a form of coronary artery disease, effects that were consistent in the models for each behavior.

Discussion

The present study tested an integrated theoretical model based on the common sense model, the theory of planned behavior, and social cognitive theory to predict FH patients' intentions to participate in three key self-management behaviors: physical activity, healthy eating, and taking medication. We hypothesized that intentions to participate in these self-management behaviors would be a function of beliefs about FH itself based on the common sense model [12] and beliefs regarding the actual behaviors based on the theory of planned behavior [23] and social cognitive theory [24]. This was based on formative research by Orbell et al. [29] who similarly conceptualized behavioral attendance to colposcopy clinics in patients with cervical abnormalities. Results revealed consistent roles for attitudes in the theory of planned behavior as predictors of intentions in all three self-management behaviors. There was no role perceived control or subjective norms from the theory of planned behavior, or self-efficacy from social cognitive theory. The only exceptions were statistically significant effects of self-efficacy on intentions for physical activity and subjective norms on intentions for healthy eating. There were no substantive effects for the common sense model constructs.

The current analysis indicates that the integrated model offers little additional explanatory power in the prediction of FH patients' intentions to engage in self-management behaviors above constructs from the theory of planned behavior. This is consistent with Orbell et al.'s research which found no effects for dimensions from the common-sense model on intentions to attend a colposcopy clinic for treatment of cervical abnormalities. There are likely two reasons for these effects. First, the illness representation dimensions are generalized sets of beliefs regarding the illness. Effects of these representations on coping responses and behaviors, therefore, have tended to be modest at best [17, 19, 20]. This is consistent with effects for trait-like individual difference and personality constructs which tend to affect multiple outcomes and behaviors across a number of domains, but with relatively small effects [58]. Second, measures of the beliefs do not make reference to any coping response, behavioral or otherwise. There is therefore little correspondence between the measures of the illness representation dimensions and measures of intentions to participate in self-management behaviors. In contrast, the social cognitive constructs from the theory of planned behavior and social cognitive theory are beliefs about engaging in a specific behavior in future. They are also measured with close correspondence with measures of intention for the specific self-management behavior in terms of target, action, context, and time [49, 59]. It is therefore unsurprising that effects for these constructs would be substantially larger.

The issues of specificity and correspondence notwithstanding, we expected some significant relations between the common sense model constructs and intentions for each self-management behavior. In Orbell et al.'s [29] research, the illness representation dimensions were significant predictors of intentions, but the theory of planned behavior variables attenuated any effects of these constructs to zero. However, in the current research this was not the case. There were no statistically significant zero-order correlations of the illness perceptions dimensions with intentions to engage in the self-management behaviors. The effects of the attitude construct from the theory of planned behavior, the most pervasive predictor of intentions across the three self-management behaviors did not influence the effects of the illness representation dimensions on intentions. It seems for the current sample that representations of the illness do not have a substantive impact on self-management and that intentions to engage in these behaviors was largely a function of attitudes. This is consistent with a substantive body of research adopting the theory of planned behavior and other attitudinal models to predict health behavior [28, 44]. These results provide the basis of persuasive communications targeting salient beliefs may be effective in promoting greater intentions to engage in self-management behaviors in the current sample.

The differences in the pattern of effects found by Orbell et al. [29] and current findings may stem from differences in the condition, particularly the perceived severity and proximity of associated chronic illnesses. While the patients with precancerous cervical abnormalities in Orbell et al.'s research and the FH patients in the current research had received a definitive diagnosis of a condition likely to compromise their future health if left untreated, patients in Orbell et al.'s study would have known that the condition could lead to cervical cancer. A potential cancer diagnosis is associated with substantive increases in anxiety and distress, given that even the word 'cancer' has been shown to illicit extremely aversive affective responses [60]. In contrast, while FH is associated with increased risk of chronic illness, the prognosis generally tends to be good, and in many patients there is no indication of current illness. Of course, FH patients with comorbid conditions like a form of coronary artery disease are also likely to have elevated anxiety and distress, and that is consistent with current findings. Nevertheless, the fact that FH is asymptomatic, there are clear pharmacological treatments for the condition, and the relatively low numbers of FH patients with comorbidities may account for the low impact of illness perceptions in the prediction of self-management behaviors in the current study when compared to Orbell et al.'s findings.

A surprising finding in the current analysis was the comparative lack of effect of the other social cognitive variables from the theory of planned behavior and social cognitive theory on self-management behavioral intentions. Across the literature, perceived behavioral control and self-efficacy, in particular, have demonstrated considerable consistency in the prediction of intentions in health contexts [28, 44]. The lack of predictive validity for these constructs in the current research suggests that beliefs regarding outcomes are more salient than barriers or personal capacities. To speculate, it may be that beliefs regarding behavioral outcomes reflected in attitudes may be sufficient to initiate action, and that much of the process particularly for mundane behaviors like taking medication have become automated and less under conscious control, as indicated by recent research [61, 62]. It is also the case that self-efficacy was strongly correlated with attitudes across all three self-management behaviors, and its effects on intentions may have been largely swamped by attitudes. Furthermore, although the self-efficacy construct was conceptualized as confidence to overcome the most salient barrier to behavior in keeping Bandura’s [63] original recommendations, this version is unlikely to have captured the full gamete of self-efficacy beliefs. A number of types of self-efficacy have been identified and incorporated in models of health behavior. For example, the Health Action Process Approach identifies action and maintenance self-efficacy which focus on individual capacities to initiate and maintain health behavior [64-66]. An avenue for future research may be to incorporate multiple measures of self-efficacy within the integrated model.

Finally, it is important to note that the pattern of effects for the theory-based constructs found in the current integrated model held while controlling for past behavior and demographic factors. It is important control for past behavior because this acts as a proxy measure of the extent to which individuals have made decisions to act on beliefs and social cognitive constructs in the past [48, 50] and the extent to which the behavior is under habitual control [47, 67]. The control for co-morbid conditions is also relevant. In the current analysis, participants diagnosed with coronary artery disease were more likely to report serious consequences and elevated emotional representations if they had received a diagnosis. This is consistent with common sense model hypotheses in that information on diagnosis serves to activate a schema related to the illness. However, diagnosis with coronary artery disease was not related to attitudes or intentions to participate in self-management behaviors. To speculate, it may be that such representations may lead to maladaptive coping behaviors such as avoidance or denial, a finding that has been identified in previous research [68].

Strengths, Limitations, and Research Directions

The current study had a number of strengths including: (1) the adoption of a unique, multi-theory integrated model focusing on illness and behavioral beliefs with respect to intentions to participate in self-management behaviors in FH patients; (2) identification of a hard-to-reach sample of FH patients clinically diagnosed with FH; (3) use of latent variable analysis to reduce the impact of measurement effort; and (4) controlling for both demographic and past behavioral variables, both important consideration in this research. The research, however, is not without limitations and we outline these here along with some implications for future research. The current research is correlational, so the direction of relations can only be inferred from the theoretical relations among the variables and not the data. Cross-lagged panel and intervention designs are needed in this research space to confirm the direction of causality [69]. Related to this, we did not include prospective measures of the self-management behaviors. We were therefore unable to ascertain whether intentions were significantly predictive of actual behavioral engagement consistent with the theory of planned behavior [44]. Although there is considerable research that has supported statistically significant intention-behavior relations, the relationship varies across behaviors, and is seldom perfect, highlighting the need in some areas to explore the importance of volitional factors like planning that may moderate the intention-behavior relationship [70]. Finally, while we controlled for age and gender as important demographic factors in the current research, data on the socioeconomic status of the participants was neither collected nor controlled for. Given research that has shown considerable differences health behavior prevalence and predictors across socioeconomic groups [71, 72], this is a limitation of the current research and researchers are advised to correct for indices socio-economic status (e.g., postcode, household income) in future studies.

Acknowledgement

This research was supported by a grant from the International Atherosclerosis Society and Pfizer (grant #10839501).

Conflict of Interest

Martin S. Hagger, Sarah J. Hardcastle, Catherine Hingley, Ella Strickland, Jing Pang, and Gerald F. Watts declare they have no conflict of interest.

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Table 1

Factor Correlations, Composite Reliabilities, and Average Variance Extracted for Common Sense Model and Theory of Planned Behavior Constructs

Factor[a]	ρ	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Personal control	.813	4.132	0.699	**.639**											
2. Timeline	.807	5.313	0.640	.249**	**.622**										
3. Consequences	.878	3.285	0.892	-.206*	.095	**.637**									
4. Treatment control	.494	3.712	0.723	.518**	.191*	-.102	**.644**								
5. Illness coherence	.862	4.596	0.948	.445**	.349**	-.262**	.172	**.746**							
6. Emotional representations	.931	2.869	1.126	-.330**	-.048	.812**	-.112	-.395**	**.795**						
7. Intention	–	4.394	1.508	.182	.173	-.061	.049	.111	-.035	**1.000**					
	–	4.845	1.077	.094	.083	.000	.038	.179	.009	**1.000**					
	–	5.312	1.488	.001	.030	.009	.070	-.086	.104	**1.000**					
8. Subjective norms	.804	3.978	0.980	.248**	.133	-.044	.160	.141	-.040	.335**	**.820**				
	.816	4.277	0.812	.207*	.038	-.152	.061	.063	-.084	.429**	**.830**				
	.819	4.467	1.073	.020	-.056	.045	.050	.025	.070	.226*	**.833**				
9. Attitudes	.915	4.327	0.976	.201*	.060	-.011	.004	.129	.060	.585**	.258**	**.884**			
	.873	4.411	0.705	-.030	-.117	.024	-.085	.095	.079	.537**	.155	**.838**			

	.906	4.841	1.088	.163	.041	-.005	.326**	-.089	.035	.535**	.389**	**.874**			
10. PBC	.864	5.164	0.921	.250**	.199*	-.140	.089	.279	-.144	.403**	.339**	.255**	**.872**		
	.864	5.201	0.841	.157	.076	-.192*	.110	.171	-.113	.224*	.342**	.305**	**.872**		
	.813	5.710	0.701	.019	.045	-.085	.000	-.038	-.031	.095	.339**	.104	**.827**		
11. Self-	–	5.826	2.714	.391**	.218*	-.083	.193*	.196*	-.129	.575**	.339**	.394**	.452**	**1.000**	
efficacy	–	7.151	1.900	.127	.003	-.115	.013	.271**	-.089	.429**	.453**	.274**	.494**	**1.000**	
	–	8.581	2.337	.024	-.144	.025	.038	-.134	.067	.517**	.290**	.481**	.270**	**1.000**	
12. Past	.957	3.405	1.419	.168	.116	-.018	.025	.064	-.030	.553**	.196*	.411**	.410**	.514**	**.958**
behavior	.963	5.036	1.006	.104	-.079	-.091	-.010	.306**	-.135	.525**	.467**	.220*	.341**	.642**	**.963**
	.996	5.603	1.591	-.082	-.135	.025	.098	-.129	.008	.635**	.379**	.520**	.124	.631**	**.996**

Note. Average variance extracted (AVE) coefficients for each factor are provided on the principal diagonal in bold typeface. [a]For the theory of planned behavior constructs, coefficients for physical activity, healthy eating, and taking medication behaviors are depicted on the first, second, and third lines, respectively. Only one set of statistics is depicted for the illness representation constructs because these factors are common to all models.

Table 2

Model Fit and Quality Indices for Structural Equation Models for Physical Activity, Healthy Eating, and Taking Medication

Index	Physical activity	Health eating	Taking medication
GoF	.416	.396	.376
AR^2	.228**	.208**	.187*
APC	.126*	.130*	.113*
AVIF	1.242	1.194	1.231

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

Table 3

Standardized Path Coefficients (β) and 95% Confidence Intervals from Structural Equation Models for Physical Activity, Healthy Eating, and Taking Medication

Effect	Physical activity			Healthy eating			Taking Medication		
	β	CI_{95}		β	CI_{95}		β	CI_{95}	
		LL	UL		LL	UL		LL	UL
Personal control→Intention	.117	-.065	.299	.004	-.182	.190	-.024	-.210	.162
Timeline→Intention	.132	-.048	.312	.061	-.123	.245	.082	-.100	.264
Consequences→Intention	-.011	-.197	.175	.021	-.165	.207	-.034	-.220	.152
Treatment control→Intention	-.201**	-.379	-.023	.031	-.155	.217	.006	-.180	.192
Illness coherence→Intention	-.005	-.191	.181	.038	-.146	.222	.044	-.140	.228
Emotional representations→Intention	-.076	-.258	.106	.086	-.096	.268	.102	-.080	.284
Attitude→Intention	.391**	.222	.560	.352**	.181	.523	.243**	.067	.419
Subjective norm→Intention	.040	-.144	.224	.343**	.172	.514	-.072	-.256	.112
PBC→Intention	.056	-.128	.240	.129	-.051	.309	.141	-.039	.321
Self-efficacy→Intention	.225**	.049	.401	.018	-.168	.204	.075	-.109	.259
Past behavior→Personal control	.231**	.055	.407	.148	-.032	.328	-.168	-.346	.010
Past behavior→Timeline	.192*	.014	.370	.003	-.183	.189	-.136	-.316	.044
Past behavior→Consequences	-.198*	-.376	-.020	-.200	-.378	-.022	-.123	-.303	.057
Past behavior→Treatment control	.062	-.122	.246	-.223**	-.399	-.047	.166	-.012	.344
Past behavior→Illness coherence	.168	-.010	.346	.377**	.208	.546	-.144	-.324	.036
Past behavior→Emotional representations	.153	-.027	.333	-.235**	-.411	-.059	.174	-.004	.352
Past behavior→Attitude	.491**	.326	.656	.447**	.280	.614	.552**	.389	.715
Past behavior→Subjective norm	.307**	.135	.479	.239**	.063	.415	.354**	.183	.525
Past behavior→PBC	.527**	.364	.690	.393**	.224	.562	.201**	.023	.379
Past behavior→Self-efficacy	.583**	.422	.744	.612**	.453	.771	.620**	.461	.779
Past behavior→Intention	.232**	.056	.408	.250**	.076	.424	.444**	.277	.611
Gender→Personal control	.154	-.026	.334	.107	-.075	.289	.128	-.052	.308
Gender→Timeline	.151	-.029	.331	.154	-.026	.334	.126	-.054	.306
Gender→Consequences	-.072	-.256	.112	-.050	-.234	.134	-.071	-.255	.113

Gender→Treatment control	.184*	.006	.362	.183*	.005	.361	.214**	.038	.390
Gender→Illness coherence	.139	-.041	.319	.087	-.095	.269	.132	-.048	.312
Gender→Emotional representations	.006	-.180	.192	.020	-.166	.206	.001	-.185	.187
Gender→Attitude	.060	-.124	.244	.082	-.100	.264	.007	-.179	.193
Gender→Subjective norm	.097	-.085	.279	.038	-.146	.222	-.066	-.250	.118
Gender→PBC	.129	-.051	.309	.248**	.074	.422	.024	-.162	.210
Gender→Self-efficacy	.080	-.102	.262	.034	-.152	.220	.116	-.066	.298
Gender→Intention	.075	-.109	.259	.156	-.024	.336	.076	-.106	.258
Age→Personal control	-.130	-.310	.050	-.162	-.340	.016	.105	-.077	.287
Age→Timeline	-.252**	-.426	-.078	-.245**	-.419	-.071	-.225**	-.401	-.049
Age→Consequences	-.243**	-.419	-.067	-.263**	-.437	-.089	-.244**	-.418	-.070
Age→Treatment control	.080	-.102	.262	.142	-.038	.322	-.138	-.318	.042
Age→Illness coherence	-.158	-.338	.022	-.164*	-.342	.014	.107	-.075	.289
Age→Emotional representations	-.378**	-.547	-.209	-.362**	-.533	-.191	-.357**	-.528	-.186
Age→Attitude	-.173	-.351	.005	-.012	-.198	.174	-.151	-.331	.029
Age→Subjective norm	-.205**	-.381	-.029	-.081	-.263	.101	.076	-.106	.258
Age→PBC	-.128	-.308	.052	.040	-.144	.224	-.023	-.209	.163
Age→Self-efficacy	-.156	-.336	.024	.013	-.173	.199	.027	-.159	.213
Age→Intention	-.078	-.260	.104	.184**	.006	.362	.122	-.058	.302
CAD→Personal control	-.082	-.264	.100	-.063	-.247	.121	-.012	-.198	.174
CAD→Timeline	.045	-.139	.229	.073	-.111	.257	.098	-.084	.280
CAD→Consequences	.214**	.038	.390	.272**	.098	.446	.261**	.087	.435
CAD→Treatment control	-.064	-.248	.120	-.062	-.246	.122	-.069	-.253	.115
CAD→Illness coherence	-.108	-.290	.074	-.107	-.289	.075	-.053	-.237	.131
CAD→Emotional representations	.247**	.073	.421	.267**	.093	.441	.261**	.087	.435
CAD→Attitude	-.011	-.197	.175	.127	-.053	.307	-.058	-.242	.126
CAD→Subjective norm	-.062	-.246	.122	.027	-.159	.213	-.024	-.210	.162
CAD→PBC	-.102	-.284	.080	.002	-.184	.188	-.021	-.207	.165
CAD→Self-efficacy	.001	-.185	.187	.139	-.041	.319	.071	-.113	.255
CAD→Intention	-.117	-.297	.063	.041	-.143	.225	-.031	-.217	.155
Diabetes→Personal control	.033	-.153	.219	-.038	-.222	.146	-.022	-.208	.164
Diabetes→Timeline	-.109	-.291	.073	-.098	-.280	.084	-.078	-.260	.104
Diabetes→Consequences	.092	-.090	.274	.114	-.068	.296	.051	-.133	.235
Diabetes→Treatment control	-.098	-.280	.084	-.053	-.237	.131	-.141	-.321	.039

Diabetes→Illness coherence	.071	-.113	.255	-.037	-.221	.147	.065	-.119	.249
Diabetes→Emotional representations	.144	-.036	.324	.185*	.007	.363	.113	-.069	.295
Diabetes→Attitude	.026	-.160	.212	.136	-.044	.316	-.034	-.218	.150
Diabetes→Subjective norm	-.094	-.276	.088	.052	-.132	.236	.053	-.131	.237
Diabetes→PBC	-.008	-.194	.178	.058	-.126	.242	.045	-.139	.229
Diabetes→Self-efficacy	-.047	-.231	.137	.093	-.089	.275	.015	-.171	.201
Diabetes→Intention	.087	-.095	.269	.060	-.124	.244	-.127	-.307	.053
Hypertension→Personal control	.015	-.171	.201	.030	-.156	.216	.033	-.153	.219
Hypertension→Timeline	.067	-.117	.251	.067	-.117	.251	.061	-.123	.245
Hypertension→Consequences	.030	-.156	.216	-.002	-.188	.184	.026	-.160	.212
Hypertension→Treatment control	.040	-.144	.224	.014	-.172	.200	.042	-.142	.226
Hypertension→Illness coherence	-.020	-.206	.166	.033	-.153	.219	-.014	-.200	.172
Hypertension→Emotional representations	.020	-.166	.206	-.018	-.204	.168	.018	-.168	.204
Hypertension→Attitude	-.154	-.334	.026	.066	-.118	.250	.009	-.177	.195
Hypertension→Subjective norm	.061	-.123	.245	.027	-.159	.213	.128	-.052	.308
Hypertension→PBC	.021	-.165	.207	-.053	-.237	.131	.088	-.094	.270
Hypertension→Self-efficacy	-.006	-.192	.180	-.085	-.267	.097	.010	-.176	.196
Hypertension→Intention	.007	-.179	.193	-.046	-.230	.138	-.050	-.234	.134

Note. β = Standardized path coefficient; CI_{95} = 95% confidence interval of path coefficient; CAD = Coronary artery disease status; Diabetes = Diabetes status; Hypertension = Hypertension status; CAD, diabetes, and hypertension status variables coded as 1 = condition present, 0 = condition absent.

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

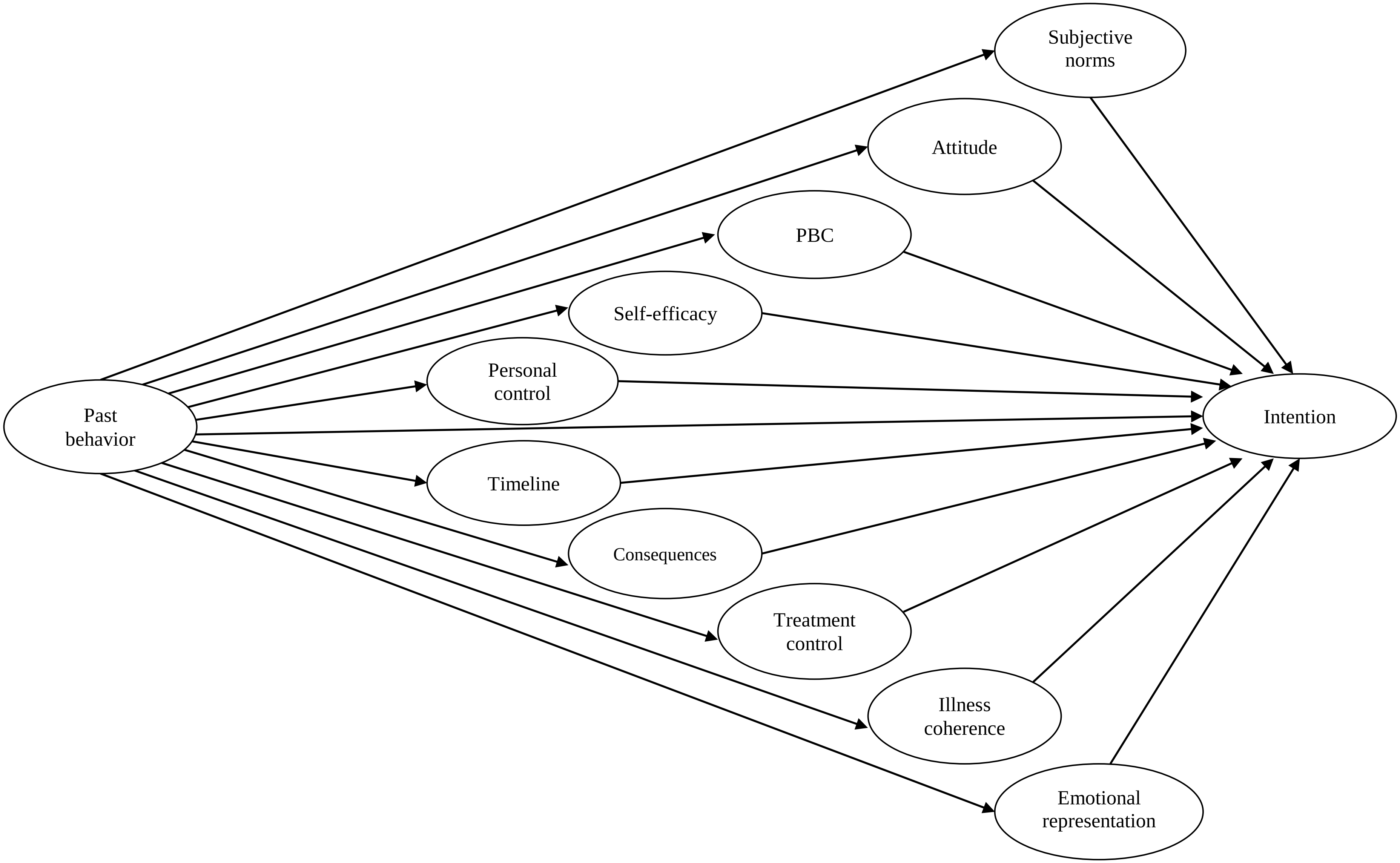
Subjective norms
Attitude
PBC
Self-efficacy
Personal control
Past behavior
Intention
Timeline
Consequences
Treatment control
Illness coherence
Emotional representation

Figure 1. Structural equation model of effects among theory of planned behavior and common-sense model constructs. The measurement components of the latent constructs and effects of control variables (gender, age, coronary artery disease status, diabetes status, hypertension status) have been omitted for clarity. PBC = Perceived behavioral control.