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Testicular self-examination: a test of the health belief model and the theory of planned behaviour

Carol McClenahan, Mark Shevlin, Gary Adamson,
Cara Bennett and Brenda O'Neill

Abstract

The aim of this study was to test the utility and efficiency of the theory of planned behaviour (TPB) and the health belief model (HBM) in predicting testicular self-examination (TSE) behaviour. A questionnaire was administered to an opportunistic sample of 195 undergraduates aged 18–39 years. Structural equation modelling indicated that, on the basis of all the fit indices, the TPB model was the better model, however, the quality of the models was very similar. The TPB explained 50% of the variance in intention and 22% in behaviour while the HBM (with self-efficacy) accounted for 56 and 21%, respectively. Self-efficacy was the most important predictor of TSE behavioural intention across both models. These findings contribute to the growing literature on the testing of multiple models in the health psychology domain.

Introduction

Testicular cancer is the most common form of cancer among young men aged 20–40 years. Approximately 2000 men are diagnosed with testicular cancer each year in the United Kingdom and almost half of the cases are in men <35 years of age. Generally, cancers found early are the most easily treated, and, while it is not universally agreed that testicular self-examination (TSE) should be encouraged among asymptomatic adolescents and adult males [1] it is recommended once a month as a strategy for the early detection of testicular cancer in the United Kingdom [2]. However, empirical evidence shows that relatively few men perform TSE. For example, Wardle *et al*. [3] surveyed 7304 college students throughout Europe. Of the participants, 87% reported never having performed TSE and only 3% reported that they performed TSE monthly.

In the present study, the theory of planned behaviour—TPB which is an extension of the theory of reasoned action (TRA) [4–7] and the health belief model—HBM [8, 9] are used to predict TSE behaviour.

The HBM is a health-specific model, which suggests that health behaviours are a result of a set of core beliefs and it has been used to predict many health behaviours [10, 11]. The original model focused on threat perception which depends on perception of susceptibility to the illness (e.g. my chances of getting testicular cancer are great) and severity of the illness (e.g. testicular cancer is a serious disease) and behavioural evaluation which consists of barriers to performing the behaviour (e.g. TSE can be painful) and the benefits of carrying out the behaviour (e.g. may help me find lumps). Cues to action (e.g. symptoms, family/friends prompted me to perform TSE) and (general) health motivation (e.g. I search for new information in relation to my health) were later added to the model. More recently, research has suggested that self-efficacy (e.g. I can perform testicular self-examination) should be added to the model. Garcia

University of Ulster, Magee Campus, Northland Road, Londonderry, Northern Ireland BT48 7JL, UK
Correspondence to: C. McClenahan.
E-mail: ca.mcclenahan@ulster.ac.uk.

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and Mann [12], for example, explained 19% of breast self-examination—BSE behavioural intention using the HBM. However, when self-efficacy was included in the model, 30% of the variance in intention was accounted for.

The HBM suggests that the core beliefs should be used to predict the likelihood that a behaviour will occur but recently it has been suggested that intention should be included as a mediator between beliefs and health behaviour [13]. Quine *et al.* [13] tested the HBM in relation to cycle helmet use both with and without the inclusion of intention. The HBM accounted for 22% of the variance in intention to use a helmet and 40% in behaviour when intention was included, but only 18% when it was not included.

However, the HBM has conceptual problems [11]. The model comprises a series of broadly defined constructs that might explain the variance in health behaviour but there are no clear operational definitions of the constructs or guidelines regarding relationships between them [11]. Also, the variation in both the number and type of constructs included in the different versions of the HBM found in the literature makes comparability across studies very difficult. Furthermore, Sheeran and Abraham [14] suggest that while the model frequently significantly predicts behaviour, the effects are usually small. Analyses across research studies vary as well. Quine *et al.* [13] argue that while some studies have used an additive approach in analysing HBM data, which appears to be in line with the underlying theoretical principles of the model, others have combined variables either by summing or multiplying them.

The TRA [4, 5] operates on the premise that intention is a precursor to behaviour and that the best way to predict behaviour is to measure behavioural intention, which in turn is a function of attitude and subjective norm. Attitude is an individual's positive or negative evaluation of the behaviour while subjective norm is the individual's perception of social pressure to perform the behaviour. The TPB is an extension of the TRA to include perceived behavioural control, PBC [6], a construct which was added to accommodate situations in which people lack volitional control. The TPB has been successfully applied to a variety of behaviours and increasingly to health behaviours [7, 15–18].

Recently, a number of researchers have argued that a distinction should be made between perceptions of an individual's ability to perform the behaviour (self-efficacy) and one's perception of control over the behaviour (perceived control) within the PBC construct. Self-efficacy is frequently the most important predictor of both health behavioural intention and health behaviour [19–24]. For example, Norman and Hoyle [24] found the TPB to be highly predictive of intention to perform BSE and subsequent BSE behaviour, with self-efficacy and attitude significantly predicting BSE intention.

Norman and Hoyle [24] suggest that a strong sense of self-efficacy [25, 26] is likely to facilitate behavioural performance and that PBC acts as a proxy measure for actual control so that behaviours subject to environmental constraints prove more difficult to perform. The results of factor analyses performed on the PBC items on behaviours such as exercise behaviour [19], dietary behaviour [21, 22], blood donation [23] and BSE [24] are strengthening the case for separating the PBC construct into self-efficacy and perceived control components.

It has also been proposed that perceived control and self-efficacy have different relationships with intention and behaviour [24]. Terry and O'Leary [19] argue that perceived control should have a direct effect on behaviour as external constraints may prevent individuals from carrying out their intentions. On the other hand, Bandura [25, 26] proposes that the influence of self-efficacy on behaviour should be fully mediated by motivation (intention).

Past studies have found factors such as having heard of testicular cancer, knowing about recommended practice rates and feeling that cancer can be controlled are associated with TSE [27]. Others have evaluated different types of interventions aimed at promoting TSE such as the role of physicians and written material [28], the effects of training in TSE [29] and the role of nurses in promoting TSE [30]. However, while many studies on BSE have based their research design or interpreted their findings in

the context of social cognition models, very few have examined the predictors of TSE behaviour or evaluated TSE interventions using such models. Exceptions include studies by Brubaker and Wickersham [31], Brubacker and Fowler [32], McCaul *et al.* [33], Moore *et al.* [34] and Trumbo [35], all based on the TRA. For example, Brubaker and Wickersham [31] reported that 38% of the variance in TSE intention was predicted by attitude and subjective norm but this increased to 52% with the addition of self-efficacy among 232 male college students. Meanwhile, McCaul *et al.* [33] showed that attitude and subjective norm predicted 43% of the variance in TSE intention and perceived control explained an additional 38% but self-efficacy did not significantly add to the variance among their 72 college student participants. On the other hand, there is a dearth of studies using the HBM to examine and promote TSE behaviour. However, a recent, multi-component, interventional study by Cox *et al.* [36], that included HBM constructs in its design, showed increased TSE and BSE behaviours among 267 adolescent cancer survivors.

Only a handful of studies have used the TPB and the HBM together to investigate health and health-related behaviours, e.g. Norman and Conner [37]—attendance at health checks, Conner and Norman [38]—uptake of health screening, Quine *et al.* [13]—cycle helmet use, Bish *et al.* [39]—cervical screening, Garcia and Mann [12]—BSE, Lajunen and Rasenan [40]—cycle helmet use. Bish *et al.* [39] found the TPB to be the superior model, explaining 51% of the variance in behaviour while the HBM accounted for only 4%. Using path analyses, Quine *et al.* [13] also found the TPB to be the superior model accounting for 34% variance in intention and 43% for behaviour against 22 and 40%, respectively, for the HBM including intention as a construct. More recently, Lajunen and Rasenan [40] demonstrated a better fit for the TPB than for the HBM using structural equation modelling.

The aim of the present, cross-sectional study was to test the utility and efficiency of the TPB and the HBM in predicting TSE behaviour. The adequacy of each model was judged on the basis of model fit and explanatory power.

Method

Participants and procedure

The opportunity sample was comprised of 195 undergraduate male participants. The participants, who ranged in age from 18 to 39 years with a mean age of 20 years (SD = 2.57), were enrolled in a range of undergraduate courses and were recruited on campus. Participation was voluntary and participants were informed that they could withdraw at any time and that their responses would be anonymous and treated confidentially.

Materials

A single questionnaire was constructed to measure the components of the TPB (direct measures only) and the HBM. Each component was measured using multiple items. The items and scale reliability (Cronbach's alpha, α) are presented below in Table I. The items measuring the HBM constructs, susceptibility, severity, benefits, barriers, cues to action and health motivation were based on those used by Umeh and Rogan-Gibson [41] in their study of BSE among asymptomatic 17- to 35-year old women. Unless otherwise stated, each item used a seven-point response format anchored with 'strongly disagree' and 'strongly agree'.

The reliabilities of the items for each of the scales were high and ranged from 0.71 to 0.87. No estimates of reliability were possible for the measures of past behaviour and PBC as they contained only one and two items, respectively.

Analysis

Three models were specified and estimated using LISREL8 [42]. We made use of a two-step approach [43] calculating 'latent variable scores' for the exogenous (predictors) measurement part of all the models [44], as these constructs comprised a large number of items. A covariance matrix and asymptotic weight matrix were derived from the latent variable scores [45] using PRELIS2.7 [46] and the parameters were estimated using robust maximum likelihood. The use of an asymptotic

Table I. *Questionnaire items used to measure components of the TPB and the HBM*

Component	Item	α
Behaviour	How many times during the past year did you examine your testicles for testicular cancer? (Never, once, twice, three times, four times, five times, six times, seven times, eight times, nine times, ten times, eleven times, twelve times or more)	
Intention	I intend to perform testicular self-examination once a month	0.87
	I will try to perform testicular self-examination in the next month	
	I have decided to perform testicular self-examination in the next month	
Attitude	My performing testicular self-examination in the next month would be (4 items: extremely harmful-beneficial, extremely negative-positive, extremely unpleasant-pleasant, extremely bad-good)	0.79
Subjective norms	Most people who are important to me think that I should perform testicular self-examination in the next month	0.74
	Most people who are important to me would approve of me performing testicular self-examination in the next month	
	Most people who are important to me would want me to perform testicular self-examination in the next month. (7-point scale: extremely unlikely – extremely likely)	
PBC	Whether or not I perform testicular self-examination in the next month is entirely up to me	
	Performing testicular self-examination in the next month is beyond my control (r)	
Self-efficacy	I am confident that I can perform testicular self-examination in the next month	0.82
	I believe I have the ability to perform testicular self-examination in the next month	
	I feel capable of performing testicular self-examination in the next month	
	(7-point scale: strongly disagree – strongly agree)	
	Performing testicular self-examination in the next month would be ...	
	(7-point scale: extremely difficult – extremely easy)	
Susceptibility	My chances of getting testicular cancer are great if I fail to perform testicular self-examination	0.85
	My physical health makes it more likely that I will get testicular cancer if I fail to perform testicular self-examination	
	I feel that my chances of getting testicular cancer in the future are good if I fail to perform testicular self-examination	
	There is a good possibility that I will get testicular cancer if I fail to perform testicular self-examination	
	I worry a lot about getting testicular cancer if I fail to perform testicular self-examination	
	Within the next year I will get testicular cancer if I fail to perform testicular self-examination (7-point scale: strongly disagree – strongly agree)	
Severity	The thought of testicular cancer scares me	0.85
	When I think about testicular cancer, I feel nauseous	
	If I had testicular cancer, my career would be endangered	
	When I think about testicular cancer, my heart beats faster	
	Testicular cancer would endanger my marriage (or significant relationship)	
	Testicular cancer is a hopeless disease	
	My feelings about myself would change if I got testicular cancer	
	My financial security would be endangered if I got testicular cancer	
	I am afraid to even think about testicular cancer	
	Problems I would experience with testicular cancer would last a long time	
	If I got testicular cancer, it would be more serious than other diseases	
	If I had testicular cancer, my whole life would change (7-point scale: strongly disagree – strongly agree)	
Benefits	I have a lot to gain by doing testicular self-examinations	0.75
	Testicular self-examinations can help me find lumps in my testicles	
	If I do monthly self-examinations, I may find a lump before it is discovered by regular health check-ups (7-point scale: strongly disagree – strongly agree)	

Table I. *Continued*

Component	Item	α
Barriers	It is embarrassing for me to do monthly examinations	0.85
	In order to do monthly testicular examinations, I have to give up quite a bit	
	Testicular self-examinations can be painful	
	Testicular self-examinations can be time consuming	
	My family would make fun of me if I did testicular self-examinations	
	The practise of testicular self-examinations interferes with my activities	
	Doing testicular self-examination would require starting a new habit, which is difficult	
	I am afraid I would not be able to do testicular self-examinations (7-point scale: strongly disagree – strongly agree)	
Health motivation	I eat a well balanced diet	0.72
	I always follow medical orders because I believe they will benefit my state of health	
	I frequently do things related to my health	
	I take vitamins when I don't eat good meals	
	I search for new information in relation to my health	
	I have the recommended yearly physical examination in addition to visits related to illness	
	I have recommended periodic dental examinations in addition to visits for a specific problem	
	I exercise regularly-at least three times a week (7-point scale: strongly disagree – strongly agree)	
Cues to action	Doctor/nurse recommendations prompted me to do testicular self-examination	0.79
	Campaigns (e.g. posters, media -press, TV, radio etc) prompted me to do testicular self-examination. Symptoms (e.g. soreness, size/shape change) prompted me to do testicular self-examination	
	Personal experience with testicular cancer prompted me to do testicular self-examination	
	Family/friends with testicular cancer prompted me to do testicular self-examination (7-point scale: strongly disagree – strongly agree)	
Self-efficacy	If you are going to do testicular self-examination how easy is it for you to do it correctly?	0.71
	How difficult would it be for you to perform testicular self-examination in the next few months if given the chance? (7-point scale: extremely difficult – extremely easy)	
	I can perform testicular self-examination even if I feel awkward about it	
	I can perform testicular self-examination even if I have to seek out information about how	
	to do it correctly (7-point scale: strongly disagree – strongly agree)	

(r), reverse coded.

weight matrix allows for weaker assumptions regarding the distribution of the observed variables and results in improved fit and test statistics as it represents a more accurate estimate of the population matrix [45, 47]. Of the 195 participants, 44 had incomplete responses. The missing data (1% overall) were imputed using the expectations maximisation (EM) algorithm. Bunting *et al*. [48] demonstrated the benefits of using the EM algorithm to treat missing data over traditional methods such as listwise and pairwise deletion.

The first model represented the TPB in relation to TSE and is shown in Fig. 1.

This model specified attitudes, subjective norms, PBC and self-efficacy as predictors of behavioural intention, which in turn predicts behaviour. Behaviour was also specified to be directly predicted by PBC and self-efficacy.

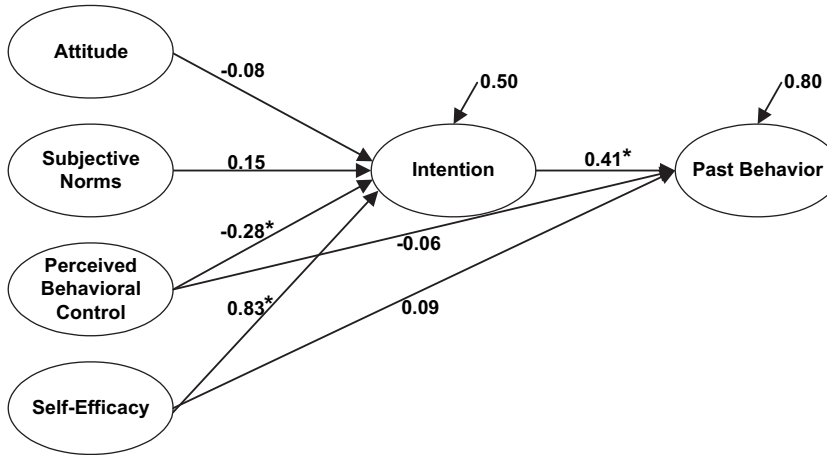

Fig. 1. Model for predicting TSE using the TPB; *$P < 0.05$.

The second model represented the HBM in relation to TSE and is shown in Fig. 2.

A third model was tested which represents the HBM in relation to TSE with inclusion of self-efficacy and is shown in Fig. 3.

The six predictor variables were specified to indirectly predict behaviour through the mediating variable of intention. Following the guidelines suggested by Hoyle and Panter [49], the goodness of fit for each model was assessed using the chi-square (the Satorra–Bentler scaled chi-square), the goodness of fit index—GFI [50], the incremental fit index—IFI [51] and the comparative fit index—CFI [52]. Non-significant chi-squares and values >0.95 for the GFI, IFI and CFI are considered to reflect acceptable model fit. In addition, the root mean square error of approximation—RMSEA [53] with 90% confidence intervals (CIs) were reported, where a value <0.05 indicates close fit and values up to 0.08 indicate reasonable errors of approximation in the population [54]. The standardized root mean square residual [50] has been shown to be sensitive to model misspecification and its use recommended by Hu and Bentler [55]. Values <0.08 are considered to be indicative of acceptable model fit. To ensure that models would be accepted as having the best fit simply due to having relatively more parameters, the parameters to variable ratio for Models 1, 2 and 3 were calculated. The ratios were 2.00, 2.50 and 2.55, respectively, which shows that the models are similar in terms of complexity and so can be fairly compared.

Results

Intention and past behaviour

The possible scores on the intention to self-examine scale ranged from 1 to 7 with higher scores indicating a greater intention to self-examine. The mean score was 4.92 (SD = 1.45) indicating that, on average, the participants stated that they were more likely to self-examine rather than not. While 62% demonstrated a positive intention to self-examine, the strength of the intention was not strong. The self-reported frequency of self-examination during the previous year indicated that almost half of the sample (41%) never self-examined, 5% self-examined once a month or more and 5% self-examined 10 or 11 times per year; 61% reported that they knew how to perform TSE.

The mean scores and standard deviations (SDs) for all the variables are presented in Table II.

Model testing

Table III reports the fit indices for the three models.

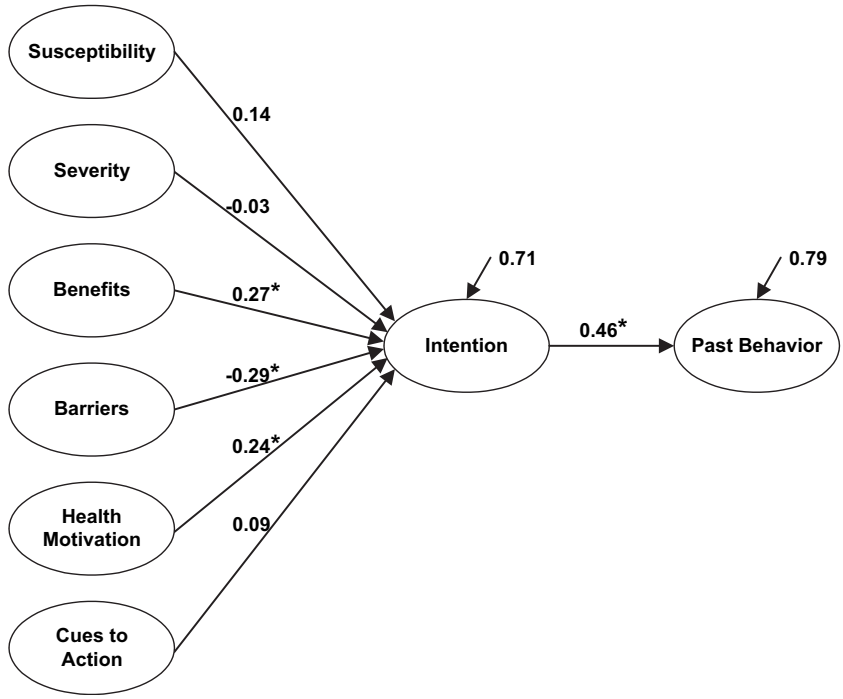

Fig. 2. Model for predicting TSE using the HBM; *$P < 0.05$.

On the basis of all the fit indices, the TPB model is an excellent description of the data as GFI, IFI and CFI are all >0.95 and the chi-square and Satorra–Bentler-scaled chi-square are non-significant. The HBM was a poorer description of the data with the chi-square and Satorra–Bentler-scaled chi-square failing to reach acceptable levels. In addition to fit indices, the adequacy of models can also be considered in terms of the parameter estimates, that is, whether the parameter estimates are consistent with theory and which model has the greatest explanatory power.

For the TPB model, the paths from self-efficacy ($\beta = 0.83$, $P < 0.05$) and PBC ($\beta = -0.28$, $P < 0.05$) to intention were statistically significant, as was the path from intention to behaviour ($\beta = 0.41$, $P < 0.05$). The variance explained in intention and behaviour was 50 and 20%, respectively (see Fig. 1). For the HBM, without the inclusion of self-efficacy, the paths from benefits ($\beta = 0.27$, $P < 0.05$), barriers ($\beta = -0.29$, $P < 0.05$) and health motivation ($\beta = 0.24$, $P < 0.05$) to intention were statistically significant, as was the path from intention to behaviour ($\beta = 0.46$, $P < 0.05$). The explained variance in intention and behaviour was 29 and 21%, respectively (see Fig. 2). With self-efficacy included as a construct in the model, the paths from self-efficacy ($\beta = 0.58$, $P < 0.05$) and health motivation ($\beta = 0.21$, $P < 0.05$) to intention were statistically significant, as was the path from intention to behaviour ($\beta = 0.45$, $P < 0.05$). The explained variance in intention and behaviour was 56 and 21%, respectively (see Fig. 3). This suggests that the models have similar explanatory power when self-efficacy is added to the HBM.

Discussion

The results from this study suggest that the TPB is a better model than the HBM in predicting intention towards, and self-reported previous frequencies of

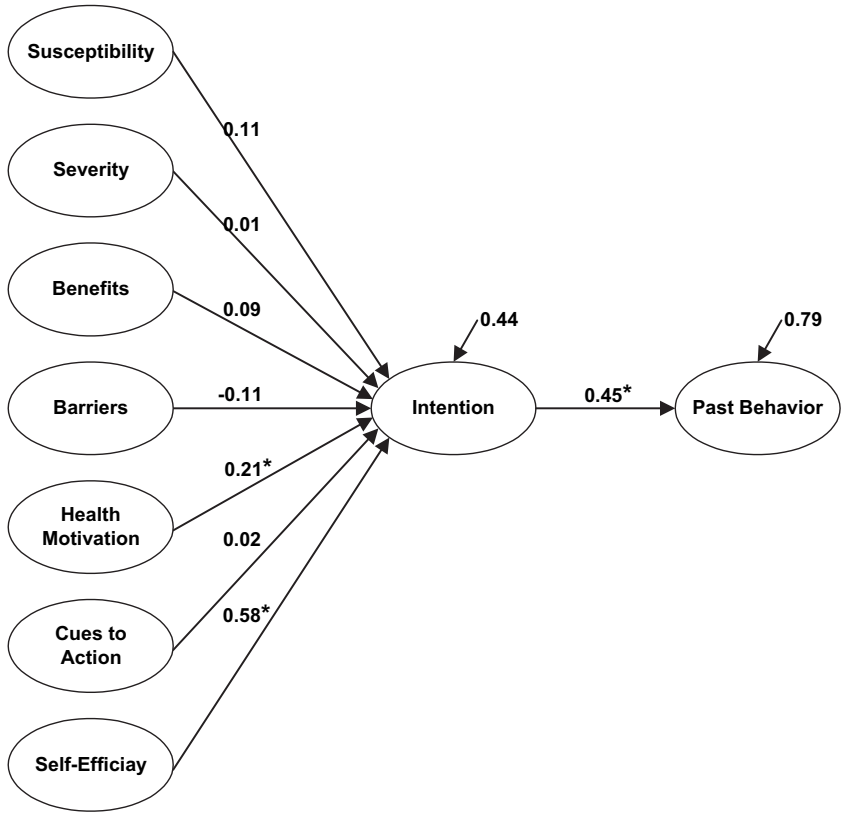

Fig. 3. Model for predicting TSE using the HBM including self-efficacy; *$P < 0.05$.

TSE. On the basis of the range of fit indices reported in Table III, the TPB was a better explanation of the sample data than the HBM. However, the quality of both the TPB and the HBM (with self-efficacy) was good. The TPB accounted for 50% of the variance in intention and 20% in behaviour, while the HBM (with self-efficacy) explained 56 and 21%, respectively.

Behaviour was measured by asking the respondents to state how many times during the last year they had performed TSE. Of the young men, 61% suggested that they knew how to perform TSE and 62% demonstrated a positive intention to do so, while only 5% reported that they performed TSE once a month and a further 3% reported that they performed TSE 10 or 11 times a year. As Lechner *et al*. [56] suggest from the results of their study in which 2% of their 15- to 19-year old respondents reported performing TSE and 42% demonstrated a positive intention to do so, the questionnaire, along with the brief introduction accompanying it, may act as a powerful intervention.

The TPB constructs in the present study accounted for 50% of the variance in TSE behavioural intention with self-efficacy and perceived control (in that order) as the only significant predictors. Meanwhile, 22% of the variance in TSE behaviour was explained by intention, supporting Bandura's claim that intention should fully mediate the influence of self-efficacy on behaviour [25, 26].

The HBM explained 56% of the variance in TSE intention with self-efficacy, and (general) health motivation (in that order) significantly predicting intention. Without the inclusion of self-efficacy,

29% of the variance in TSE intention was accounted for by the remaining predictor variables. Behavioural intention explained 21% of the variance in TSE behaviour.

These results are in line with findings from other studies on TSE. Self-efficacy significantly predicted TSE intention in the study by Lechner *et al.* [56]. In Brubaker and Wickersham's study [31], attitude and subjective norm (in that order) predicted 38% variance in intention, however, when TSE, self-efficacy and knowledge were added, the variance increased to 52%. On the other hand, McCaul *et al.* [33] found that perceived control was a better predictor of TSE intention than self-efficacy. Self-efficacy has also played a major role in studies investigating the determinants of BSE intention and behaviour [12, 24, 57].

Table II. *Means and SDs for all variables*

	Mean	SD
Intention	4.92	1.45
Attitudes	5.08	1.09
Subjective norm	4.93	1.33
PBC	5.39	1.31
Self-efficacy	5.23	1.21
Susceptibility	3.10	1.22
Severity	4.04	1.07
Benefits	5.92	0.95
Barriers	2.77	1.18
Health motivation	4.08	1.02
Cues to action	3.17	1.33

Meta-analyses of the application of social cognition models to the prediction of intention and behaviour have generally shown that health-screening behaviours are poorly explained [10, 19, 58]. For example, Shiloh *et al.* [58] looked at four types of health-screening behaviour and found constructs from the HBM explained 42, 20, 7 and 45% of the variance, respectively, for attending for dental check-up, blood pressure and cholesterol screening, pap smear and mammography and concluded that health-screening behaviour is highly specific, with each screening programme characterized by a particular set of beliefs and its own set of predictor variables.

The intention–behaviour link is weak in the present study. TSE frequency over the past year was used as a proxy for behaviour and the study was based on self-report, which, as Millar [59] suggests, may be influenced by memory distortion and/or social desirability. Also, self-report measures are likely to result in greater shared method variance between the TPB/HBM constructs and behaviour compared with more objective methods [7]. Sutton [60] suggests that method effects should be investigated by measuring intentions and behaviour using more than one method, but as Millar [59] states with respect to his study on BSE frequency, it is impossible to measure self-examination behaviour in a non-intrusive way. Research has also indicated that longer time intervals between the assessment of intention and behaviour can lead to lower correlations between intention and behaviour [61]. However, Gollwitzer [62] proposes that

Table III. *Fit indices for the alternative social cognitive models for predicting self-examination*

	Model 1: TPB	Model 2: HBM	Model 3: HBM with self-efficacy
χ^2	21.17	40.11	45.25
df	12	20	23
P	0.05	0.005	0.004
Satorra–Bentler χ^2	17.64	37.50	41.22
P	0.13	0.01	0.01
GFI	0.97	0.96	0.96
IFI	0.99	0.97	0.98
CFI	0.99	0.97	0.98
RMSEA (90% CI)	0.05 (0.00–0.09)	0.07 (0.03–0.10)	0.064 (0.03–0.09)
SRMR	0.03	0.04	0.04

by forming an action plan/implementation intention, intention will be translated into action by changing 'I intend to TSE' to include an implementation intention 'I intend to TSE at a particular time in a particular place'. It is recommended that TSE should be performed regularly (once a month) and Gollwitzer [62] argues that implementation intentions are important when a behaviour is habitual/routine. Steadman and Quine [63] demonstrated that an implementation intention intervention procedure encourages TSE behaviour. Also, as Norman and Conner [64] suggest, self-determination theory [65, 66], which focuses on the importance of intrinsic (autonomous) over extrinsic (or controlled) motivation in health behaviour regulation may also have important implications for strengthening the intention–behaviour link. Norman and Conner [64] argue that intrinsic motivation is associated with, for example, more interest in the behaviour which in turn is related to enhanced performance.

The TPB is not specifically designed to measure health behaviours and yet it proves to be the better overall model in both the present study and in many other studies, e.g. [13, 39, 40]. Furthermore, the TPB is the more parsimonious model given that the HBM has more constructs and more items within each of its constructs [60]. Stroebe W. and Stroebe MS. [67] argue that it is not economical to use health-specific models unless their predictive success is greater than that of non-health-specific models.

There is also some overlap in the components of the two [68, 69]. For example, Bish *et al.* [39] discuss how both have their theoretical basis in expectancy value theory and are phrased in terms of the perceived consequences of action. Although not included in the present study, the TPB also comprises indirect measures in the form of attitudinal beliefs, which consist of the summed products of the individuals' evaluations of each of a set of consequences of performing a given behaviour (outcome evaluation) and the strength of the belief, normative beliefs weighted by the motivation to comply with specific referents and control beliefs, reflecting factors that encourage or prevent performance of the behaviour. These beliefs are elicited from representatives of the target population, and, generally, the most salient beliefs are included in the TPB questionnaire [13].

Comparing the two models, Quine *et al.* [13] argue that benefits and barriers signify outcome expectancies in the HBM, but that the model lacks a similar mechanism to that in the TPB which looks at evaluation of consequences. They also point out that the TPB directly focuses on social pressure in the form of normative beliefs and directly measures control, whereas in the HBM normative influences are among other variables in the cues to action component and control beliefs can be found in the benefits/barriers constructs of the HBM. On the other hand, the HBM includes perceptions of susceptibility/vulnerability to, and severity of illness/disease, which the TPB assumes influence behaviour via their effects on behavioural beliefs [13].

The HBM also includes a (general) health motivation component. In the present study, the health motivation items are based on those used by Umeh and Rogan-Gibson [41] in their study of BSE and measure involvement in a range of other health-protective behaviours. However, other past studies have included control over health and perceived health status as measures of health motivation within the HBM [11].

Both the TPB and the HBM are criticized for not incorporating emotional factors. In his study of BSE behaviour using the HBM, Millar [59] hypothesized that emotional responses would have an important impact on BSE frequency. The emotional responses of 140 participants were measured after they had been required to think about performing BSE and their potential reactions to performing BSE and before they completed scales designed to measure HBM variables, BSE knowledge and BSE frequency. Millar [59] found that the inclusion of these reactions increased the ability of the HBM variables to predict BSE intentions and BSE behaviour 3 months later. While the HBM variables accounted for 13% of the variance in BSE frequency, 20% was explained with the addition of the emotional factors. Furthermore, in their study of

TSE behaviour, Lechner *et al*. [56] showed that young men who were anxious about TSE and those who were not anxious had different determinants explaining the variance in intention to perform TSE regularly. Self-efficacy was the most important predictor among those who expected negative emotional consequences and anticipated regret was the strongest predictor among those who did not expect negative emotional consequences.

A few studies have compared the HBM with the TPB and most have shown differences in the predictive power of the two models in favour of the TPB, possibly due to the differences in the way the model components are operationalized. In the TPB, rules are explicit for combining constructs but in the HBM there is no consensus as to how constructs should be combined. However, as more researchers begin directly testing multiple models, it may be possible to begin classifying particular health behaviours according to which models work best at predicting specific health behaviours. Or, if different health behaviours are found to be characterized by particular sets of beliefs and predictor variables across models, it may even be possible to integrate constructs from different models to explain behaviour more fully. Indeed, Armitage and Conner [70] suggest that, given the overlap between various motivational models, they might usefully be combined to more fully predict behaviour.

Effective heath education interventions aimed at increasing regular TSE behaviour depend on the determinants of TSE behaviour being clearly identified, and, while the present findings contribute to the literature on the ability of the TPB and the HBM to identify the determinants of TSE behaviour, a longitudinal study is indicated to include 'future' TSE behaviour. However, in line with past studies emphasizing the importance of self-efficacy to health protective behaviours [19, 21–24, 31], the present study demonstrates that self-efficacy is an important determinant of TSE.

A general criticism of social cognition models is that they fail to provide guidelines on how to change factors found to determine health behaviours. Jeffrey [71] argues that there is little evidence that cognitive variables actually cause behaviour and that they are difficult to change, while a number of reviews have indicated that theory-based interventions are poorly designed [72, 73]. Rejeski [74] suggest that greater attention should be paid to identifying and assessing the mediators of behaviour change and how these fluctuate over time and that theory should be used to test support for behaviour change strategies. Meanwhile, Rothman [75] advocates that more collaboration is necessary between theorists and 'applied behavioural scientists', and, indeed, a Behavioural Change Consortium has been set up to focus on such collaboration across disciplines [76].

That said, Hardeman *et al*. [72] reported that TPB-based interventions had a significant impact on health behaviours in two-thirds of the studies they reviewed, while Abraham and Sheeran [11] found evidence of health behaviour change in 13 out of 17 HBM-based interventions that they identified. Moreover, Norman and Conner [64] suggest that other psychological models such as Bandura's self-efficacy theory [26, 77] and the elaboration likelihood [78] model of persuasion can be looked at for guidance on ways to enhance self-efficacy and for routes of attitude change, respectively.

Conflict of interest statement

None declared.

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