A Test of Social Cognitive Theory to Explain Men's Physical Activity During a Gender-Tailored Weight Loss Program

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Abstract

Physical inactivity is a leading contributor to the burden of disease in men. Social-cognitive theories may improve physical activity (PA) interventions by identifying which variables to target to maximise intervention impact. The objective of this study was to test the utility of Bandura's Social Cognitive Theory (SCT) to explain men's PA during a 3-month weight loss program. Participants were 204 overweight/obese men (mean (SD) age: 46.6 (11.3) years; BMI: 33.1 (3.5) kg/m^2). A longitudinal, latent variable structural equation model tested the associations between SCT constructs (i.e. self-efficacy, outcome expectations, intention, & social support) and self-reported moderate-to-vigorous PA (MVPA) and examined the total PA variance explained by SCT. After controlling for Time 1 cognitions and behaviour, the model fit the data well ($\chi^2 = 73.9$, $df = 39$, $p < 0.001$; Normed $\chi^2 = 1.9$; CFI = 0.96; SRMR = 0.059) and explained 65% of the variance in MVPA at Time 2. At Time 2, self-efficacy demonstrated the largest direct and total effects on MVPA ($\beta_{direct} = 0.45$, $p < 0.001$; $\beta_{total} = 0.67$, $p = 0.002$). A small effect was observed from intention to MVPA, but not from outcome expectations or social support. This study provides some evidence supporting the tenets of SCT when examining PA behaviour in overweight and obese men. Future PA and weight loss interventions for men may benefit by targeting self-efficacy and intention, but the utility of targeting social support and outcome expectations requires further examination.

Key words: Social Cognitive Theory, Physical Activity, Weight Loss, Male, Self-efficacy, Structural Equation Modeling

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Almost one third of adults worldwide are considered inactive (Hallal et al., 2012), which increases their risk of heart disease, diabetes, some cancers and premature death (Lee et al., 2012). Decreasing physical activity (PA) levels have also contributed to rising global obesity levels, which have doubled in the past 30 years (Finucane et al., 2011). Increasing PA levels is a vital strategy for achieving weight loss (Donnelly et al., 2009) and many other physical and psychological health benefits (Anokye, Trueman, Green, Pavey, & Taylor, 2012; Lee et al., 2012), but evidence in adults suggests that PA interventions are only moderately effective (Conn, Hafdahl, & Mehr, 2011). The evidence has also been limited by a clear under-representation of males (Bottorff et al., 2015; George et al., 2012), resulting in a dearth of meaningful data to illuminate which psychological, behavioural, or social factors are most important to target when designing PA interventions for men.

Bandura's Social Cognitive Theory (SCT) (Bandura, 1986, 1997, 2004) is a prominent behaviour change theory that has been widely applied in the development and evaluation of PA interventions (Luszczynska & Schwarzer, 2005). In Bandura's most recent conceptualisation of the model (Bandura, 2004), he proposes a causal framework with four major constructs that is hypothesised to explain people's participation (or non-participation) in health-enhancing or health-damaging behaviours (Figure 1). The most important construct in this SCT model is *self-efficacy*, which represents the confidence people have in their ability to exercise control over their own health habits (Bandura, 2004). Self-efficacy is the pivotal construct in SCT and is hypothesised to exhibit a direct effect on behaviour and indirect effects through all other model constructs. The prominent position of self-efficacy in SCT is supported by an extensive body of research showing perceived efficacy to be one of the strongest and most consistent correlates of PA (McAuley & Blissmer, 2000; Rhodes &

Nigg, 2011). *Outcome expectations* are the second SCT construct and represent one's judgements of the likely consequences that will occur as a result of performing, or not performing, a particular behaviour.

The third construct described in SCT is *socio-structural factors* (Bandura, 2004), which encapsulates the various barriers or facilitators one perceives in relation to achieving their goals. Although this construct is considerably difficult to operationalise in a single model (Luszczynska & Schwarzer, 2005), previous SCT models have represented this construct with measures of social support, perceived barriers, functional limitations or perceptions of the built environment (Young, Plotnikoff, Collins, Callister, & Morgan, 2014). SCT also suggests that self-efficacy, outcome expectations, and socio-structural factors all indirectly affect health behaviour by influencing one's *goals* (Bandura, 2004). These goals can be distal, to serve as a general guide, or proximal, to inform current actions (Luszczynska & Schwarzer, 2005). According to SCT, people with greater self-efficacy for PA, who expect more favourable outcomes from PA and perceive fewer social and structural impediments are hypothesised to set stronger goals and participate in greater levels of PA.

Despite being a widely researched social cognition model (Luszczynska & Schwarzer, 2005), a recent systematic review of 55 published tests of SCT in the PA domain concluded that the overall quality of evidence was poor (Young, Plotnikoff, et al., 2014). Common methodological flaws included a lack of adjustment for past behaviour, small sample sizes and insufficient evidence of measurement reliability. Men were also clearly underrepresented in these studies, with 78% of the models testing SCT with predominantly female samples and no models investigating the utility of SCT in men only (Young, Plotnikoff, et al., 2014). The review also noted that only 40% of previous SCT theory tests included all of the specified predictor variables and many studies tested the theory with multiple regression analyses, which do not allow for simultaneous analyses of all hypothesised pathways. In a conceptual review of multiple behaviour change theories, Rhodes and Nigg (2011) described the focus on self-efficacy at the expense of the other SCT constructs to be the most notable limitation of SCT research in the PA field and proposed that the most important goal for future SCT research was to test the full SCT model as proposed by Bandura (2004). These limitations indicate that a methodologically rigorous and appropriately specified test of SCT to explain PA in men would be a valuable contribution to the literature.

The aim of the current study was to investigate the utility of the full SCT to explain the PA behaviour of men during a weight loss program. As this was a confirmatory analysis of Bandura's (2004) SCT structure (Bandura, 2004) (Figure 1), the following five hypotheses were tested:

1. The SCT structure proposed by Bandura (2004) would represent a good fit to the data and would explain a significant proportion of the variance in PA.
2. Self-efficacy would demonstrate a direct effect on PA change in addition to an indirect effect through outcome expectations, intention (i.e., proximal goals), and social support.
3. Outcome expectations would demonstrate a direct effect on PA in addition to an indirect effect through intention.
4. Social support would demonstrate an indirect effect on PA through intention.
5. Intention would demonstrate a direct effect on PA.

Methods

Study design

This study used data from the *SHED-IT Weight Loss Maintenance Study*, which is described in detail elsewhere (Young, Collins, et al., 2014). In brief, a community sample of 209 overweight and obese men was recruited from the Hunter Region of New South Wales, Australia. In the Hunter Region, adult rates of physical inactivity (63%) and overweight and obesity (70%) are higher than the national averages (57% and 63%, respectively) (National Heart Foundation of Australia, 2015). In 2013, the Hunter Valley Research Foundation noted that "high levels of obesity, fuelled by a decrease in physical activity" was an area requiring urgent improvement in the region (Hunter Valley Research Foundation, 2013). To be eligible for participation, men were required to be between 18 – 65 years of age with a body mass index between 25 - 40 kg/m^2. Men were excluded if: they were not available for all assessments, did not have internet or mobile phone access, were participating in any other weight loss intervention, were taking medication to lose or gain weight, or had experienced weight loss of 5% of more in the previous 6 months (Young, Collins, et al., 2014). The data in this study were drawn from Phase I of the trial, which used a pre-post design. In this phase, all participants were assessed before and after receiving the 3-month *SHED-IT Weight Loss Program*, which is a gender-tailored program that has been successfully tested in previous research (Morgan et al., 2013; Morgan, Lubans, Collins, Warren, & Callister, 2009). The study was approved by the University of Newcastle's Human Research Ethics Committee and was prospectively registered with the Australia New Zealand Clinical Trials Registry (ACTRN12612000749808).

The SHED-IT Program

The SHED-IT Weight Loss Program used in this study was a standardised package that did not include any face-to-face, phone consultation, or email contact and no individualised intervention components. The program included: (i) the *SHED-IT Weight Loss Handbook for Men*; (ii) the *SHED-IT Weight Loss Logbook for Men* (which included key SCT-based activities to complete); (iii) the *SHED-IT Weight Loss DVD for Men*; (iv) access to a study website to document PA and energy intake; and (v) self-monitoring tools including a pedometer and tape measure. The resources were specifically designed to appeal to men with attention given to both surface-structure components to engage men (e.g. use of malespecific research findings, pictures and anecdotes) and deep-structure components to address men's values (e.g. a frank approach, a focus on scientific rigour and encouragement of autonomy and choice) (Resnicow, Baranowski, Ahluwalia, & Braithwaite, 1999). To increase the likelihood of sustained behaviour changes, the program targeted the core constructs of Bandura's SCT. Extensive details of the *SHED-IT Weight Loss Program* used in this trial are reported elsewhere (Young, Collins, et al., 2014).

Measures

Data were collected in August 2012 (Time 1) and November 2012 (Time 2). At both assessments men completed a questionnaire containing validated scales for self-efficacy (Plotnikoff, Blanchard, Hotz, & Rhodes, 2001), outcome expectations (Plotnikoff et al., 2001), social support (Sallis, Grossman, Pinski, Patterson, & Nader, 1987), and intention (as a proximal goal) (Rhodes, Courneya, Blanchard, & Plotnikoff, 2007). As noted previously, a measure of intention was deemed appropriate to represent the goal construct given the considerable conceptual overlap between the two constructs (Bandura, 2004).

The behavioural referent of the scales was standardised across the scales. This referent referred to 'achieving regular PA', defined as 'at least 60 minutes of PA (at a moderate intensity or greater) on 5 or more days per week' (i.e. at least 300 minutes per week). Although the new Australian PA guidelines for adults recommend achieving between 150-300 minutes of moderate-to-vigorous PA (MVPA) per week (Department of Health, 2014), the American College of Sports Medicine have suggested that the full 300 minutes may be required for long-term weight loss maintenance (Donnelly et al., 2009). The description of moderate PA used matched the following definition from the *Australian Physical Activity Guidelines for Adults* (Department of Health and Ageing, 1999): *"Moderate-intensity activity will cause a slight, but noticeable, increase in your breathing and heart rate. A good example of moderate-intensity activity is brisk walking, that is at a* *pace where you are able to comfortably talk, but not sing. Other examples include mowing the lawn, digging in the garden, or medium-paced swimming or cycling".*

Prior to completing the cognitions, men were asked to read an information page which included the above definition of 'regular PA'. In addition, to standardise the measures and reduce potential confusion, the term 'regular PA' was used to replace 'regular exercise' or 'exercise' in the social cognitive measures. The scales were previously tested in a sample of overweight and obese Australian men (n = 22, mean (SD) age 39.7 (14.8) years; BMI 29.1 (5.1) kg/m^2) (Young, Collins, et al., 2014). The internal consistency (α) and test-retest reliability (ICC) values for each scale are reported in the next section.

Physical activity. The primary outcome of the current SCT model of PA was leisure time MVPA, which was measured with a modified version of the validated Godin Leisure-Time Exercise Questionnaire (GLTEQ) (Godin & Shephard, 1985). In the original GLETQ, participants are asked to indicate how many times in the past month they engaged in moderate intensity PA (e.g. not exhausting, light perspiration) and vigorous intensity PA (e.g. heart beats rapidly, sweating) in bouts of at least 10 minutes. In the current study this was modified so that participants also estimated the average session duration for each category. Duration and frequency responses were then multiplied for both categories and summed to provide a measure of minutes spent in MVPA in the past month. This approach has been validated in previous research (Plotnikoff et al., 2006).

Self-efficacy. Self-efficacy was measured with a validated 8-item scale (α = 0.96; ICC = 0.88) (Plotnikoff et al., 2001) that has been used extensively in previous research (Young, Plotnikoff, et al., 2014). This scale measured participant's confidence to achieve regular PA in the following 3 months when faced with a series of barriers (e.g. when they have competing demands). Response options ranged from 1 (not at all confident) to 5 (completely confident).

Outcome expectations. Outcome expectations were measured with the validated 5-item exercise pros subscale ($\alpha = 0.78$; ICC = 0.74) (Plotnikoff et al., 2001). This scale measured the degree to which participants expected that participating in regular PA in the following 3 months would decrease stress, help control weight, improve sleep, improve their outlook and make them feel more confident about their health. Response options ranged from 1 (strongly disagree) to 5 (strongly agree).

Socio-structural factors: Socio-structural factors were represented with a validated 10-item measure of family social support for PA ($\alpha = 0.95$; ICC = 0.96) (Sallis et al., 1987). Social support was chosen for this model as it: (i) features prominently in the SCT literature (Bandura, 1986); (ii) has been noted as an important correlate of PA in adults (Bauman et al., 2012); and (iii) was a specified intervention target in the *SHED-IT Weight Loss Program* (Young, Collins, et al., 2014). The scale measures how often participants received various types of support for PA from their family in the previous month (e.g. encouragement to stick to PA program, reminders to be active, co-participation in PA). Response options ranged from 1 (never) to 5 (always). Of note, the original measure also included a 'friend' social support scale, but this was not used in the current study as the distribution was highly skewed, with 56% of men reporting average scores of rare or non-existent support for PA from their friends.

Intention. For the purposes of this study, the goals construct was captured with a measure of intention. This proxy-measure was deemed to be appropriate given that Bandura (1997, p. 285) has noted proximal goals share a conceptual overlap with intentions and are more likely to promote behaviour changes than distal goals. Intention was assessed with a two item scale ($\alpha = 0.92$; ICC = 0.92), which captured intention to achieve regular PA in the following three months (Rhodes et al., 2007). Following the recommendations of Rhodes et al.'s recommendations, intention was measured without the use of the word 'intend', given its conceptual overlap with the 'planning' construct (Rhodes, Blanchard, Matheson, & Coble, 2006). Response options ranged from 1 (extremely unmotivated/undetermined) to 7 (extremely motivated/determined).

Anthropometrics and demographics. Weight was measured in light clothing, without shoes on a digital scale to 0.01 kg (CH-150kp, A&D Mercury Pty Ltd., Australia). Height was measured to 0.1 cm using the stretch stature method on a calibrated stadiometer (Veeder-Root (VR) High Speed Counter, Harpenden/Holtain, Mentone Education). Body Mass Index was calculated using the standard equation (weight [kg]/height[m]^2). Socio-demographic variables were collected by questionnaire including age, employment status, country of birth, marital status and education. To obtain a measure of socio-economic status, participants' postcodes of residence were cross-referenced with the Australian Socio-Economic Indexes for Areas (SEIFA) database. This database considers income, education, employment, occupation and housing data to rank postal areas by relative socio-economic advantage and disadvantage (Australian Bureau of Statistics, 2008).

Data treatment and analysis

Data were analysed in SPSS 21 (SPSS Inc., Chicago, IL, USA) and AMOS Graphics 21. A structural equation model using maximum likelihood estimation and single indicator latent variables was created to test the hypothesised model structure. Given the sample size, this analysis method was deemed to be most appropriate as it minimises model parameters, while still allowing all hypothesised pathways to be assessed simultaneously and all constructs to be assessed free of measurement error (Bollen, 1989). As Bollen (1989) recommends, the error variances were fixed to one minus the reliability of the measure multiplied by the variance (i.e. $(1 - \alpha) \times SD^2$) in order to estimate the model. As modelled in recent PA theory tests (Ball et al., 2012), PA was also treated as an unobserved variable to account for the inherent measurement error in the PA self-report measure, with the test-retest reliability of the measure used in place of the internal consistency when fixing the error variance. A cross-lagged model structure was employed where cognitions and PA at 3 months (Time 2) were controlled for baseline values (Time 1). These time-lagged pathways were only estimated between the same variable at each time point (e.g. self-efficacy at baseline to self-efficacy at follow-up), with the other time-lagged pathways fixed to zero. This analysis aligns with recent theory tests which have tested the assumptions of SCT in the PA domain (Phillips & McAuley, 2013; Plotnikoff, Lubans, Penfold, & Courneya, 2014; White, Wójcicki, & McAuley, 2012). As age and weight are commonly associated with PA behaviour (Bauman et al., 2012), the model was adjusted for these factors at both time points.

Model fit was assessed with several indices. As recommended for all structural equation models, the χ^2 test was used to test absolute model fit. As this test is highly sensitive to sample size, the normed χ^2 index of model parsimony was also examined. This test of model fit divides the χ^2 test statistic by the degrees of freedom in the mode to adjust for model complexity (acceptable fit: $1 < \chi^2/\text{df} < 3$) (Kline, 2005). Model fit was also assessed with the Comparative Fit Index (CFI; acceptable fit: > 0.95) and the Standardised Root Mean Residual (SRMR; acceptable fit: < 0.06) (Hu & Bentler, 1999), which are incremental fit indices. According to Hu and Bentler (1999), these additional indices are preferred for evaluating models with latent structures as they resulted in the smallest sum of Type I and Type II error rates when tested against other combinations of fit indices.

As the assessors were instructed to check completed questionnaires for missed items, complete data were recorded for all measures at baseline. As a result of loss to follow up, 22% of the data for all measures were missing at the 3-month assessment. When the missing data were examined, Little's MCAR test failed to reject the assumption that the data were missing completely at random ($\chi^2 = 33.5$, $df = 32$, $p = 0.40$), and no significant baseline differences were observed between completers and drop-outs for (i) PA outcomes, (ii) social-cognitive measures or (iii) any of the measured socio-demographic characteristics (all $p > 0.05$). As such, the missing data were imputed using the expectation maximisation procedure in SPSS.

Initial analyses in SPSS indicated skewness in the MVPA outcome measure at Time 1. As data transformations are not recommended for structural equation modelling, the skewness was reduced by retracting univariate outliers to within 3.29 standard deviations of the mean (Tabachnick & Fidel, 2007). Inspection of the Mahalanobis distance statistic for each participant indicated the presence of five multivariate outliers. To improve the multivariate normality of the data, which is an assumption of maximum likelihood estimation, these participants were removed leaving a final sample of 204 participants (i.e. 98% of the total study sample). To further improve the robustness of the analysis against univariate and multivariate skewness, the bootstrapping procedure was employed in AMOS and bias-corrected regression coefficients are reported. Following Ferguson's (2009) recommendations, beta coefficients were interpreted as 0.5 (moderate) and 0.8 (large). The minimum effect required to represent 'practical' significance was set at 0.2 (Ferguson, 2009).

Results

Descriptive statistics and bivariate correlations

Baseline characteristics for the 204 men included in the final analysis are reported in Table 1. The mean age of the sample was 46.6 years (SD = 11.3; range = 18 - 65) and mean weight was 105.7 kg (SD = 14.1; range = 75.6 – 144.9). Overall, 79% of the men were obese, 88% were working either part- or full-time and 85% were born in Australia. As seen in Table 2, significant associations were observed between all socio-cognitive measures and behaviour at Time 2, which ranged from $r = 0.20$ (social support/MVPA) to $r = 0.58$ (self-efficacy/MVPA).

Model results

The fit indices indicated that the proposed model provided a good fit to the data (χ^2 = 73.9, *df* = 39, *p* < 0.001; Normed χ^2 = 1.9; CFI = 0.96; SRMR = 0.059) and no further modifications were made. After adjusting Time 1 cognitions and Time 1 behaviour, the cross-lagged model explained 65% of the variance in MVPA at Time 2 (Hypothesis 1).

Self-efficacy demonstrated a significant direct effect on MVPA (β_{direct} = 0.45, *p* <0.001) as well as a significant indirect effect ($\beta_{indirect}$ = 0.21, *p* = 0.01) through its influences on outcome expectations (β_{direct} = 0.49, *p* <0.001), intention (β_{direct} = 0.56, *p* <0.001) and social support (β_{direct} = 0.30, *p* <0.001) (Hypothesis 2). Of all SCT constructs, self-efficacy demonstrated the largest total effect on MVPA (β_{total} = 0.67, *p* = 0.002).

Contrary to expectations, outcome expectations did not exhibit a direct influence on MVPA (β_{direct} = -0.00, *p* = 0.95) (Hypothesis 3). A significant indirect effect was observed from outcome expectations to MVPA ($\beta_{indirect}$ = 0.06, *p* = 0.04), via its influence on intention (β_{direct} = 0.18, *p* = 0.05), but this pathway did not reach the criteria for practical significance. Similarly, social support demonstrated significant, but non-meaningful indirect effect on MVPA ($\beta_{indirect}$ = 0.06, *p* = 0.02) via an influence on intention (β_{direct} = 0.21, *p* = 0.003) (Hypothesis 4). A significant small-to-medium direct effect was observed from intention to MVPA (β_{direct} = 0.31, *p* = 0.02) (Hypothesis 5). When examining the model covariates, a significant, direct effect was observed between age and MVPA at Time 1 (β_{direct} = -0.24, *p* = 0.01), but not at Time 2 (β_{direct} = -0.13, *p* = 0.09). Weight was not significantly associated with MVPA at either time point, though it approached significance at Time 2 (β_{direct} = -0.13, *p* = 0.07). For additional information on model pathways, see Table 3.

Discussion

The aim of the current study was to investigate the utility of the full SCT to explain the PA behaviour of men during a weight loss program. The fit indices indicated that the model provided a good fit to the data and the explained 65% of the variance in PA. After controlling for T1 cognitions and behaviour, self-efficacy demonstrated the largest direct and total effects on PA (β_{direct} = 0.45, p <0.001; β_{total} = 0.67, p = 0.002). A small effect was also observed from intention to PA (β_{direct} = 0.31, p = 0.02), but not from outcome expectations or social support.

In support of the first set of hypotheses, SCT provided a good fit to the data and explained a large proportion of the variance in the PA of the 204 overweight and obese men during the *SHED-IT Weight Loss Program* (Hypothesis 1). In a meta-analytic review of SCT models of PA, Young et al. (2014) reported that, overall, the SCT models accounted for 31% of the variance in PA, which was less than half of the R^2 for PA reported in the current paper. This difference may be explained by the methodological strengths of the current study which have clearly addressed many of the limitations of previous studies, including use of a longitudinal design, high retention rates, an appropriate sample size, use of valid and reliable measures of PA and SCT cognitions, use of structural equation modelling, and adjustment for past cognitions and behaviour. Study quality was a significant moderator of the meta-analysed effect size for PA in Young et al.'s (2014) review of SCT models, with higher quality studies explaining more variance than lower quality studies.

The results also supported the second hypothesis regarding self-efficacy. As anticipated, self-efficacy demonstrated a small-to-moderate direct effect on PA and a small indirect effect, which combined to form a moderate-to-large total effect. This is in line with an established body of evidence indicating that self-efficacy is an important contributor to PA behaviour (McAuley & Blissmer, 2000). This study also identified that self-efficacy exhibited a significant total indirect effect on changes in PA via an influence on outcome expectations, intention and social support. In line with the tenets of SCT, men who increased self-efficacy for PA also increased their positive expectations of the benefits of PA, strengthened their intention to achieve regular PA and reported more social support for PA from their family. This is an important finding, as the majority of previous SCT models of PA have either tested the model with multiple regression analysis, which cannot determine indirect effects. In those studies which have examined the indirect effect, the evidence has been mixed. For example, some studies have reported a significant indirect effect of self-efficacy on PA (e.g., (Anderson-Bill, Winett, Wojcik, & Winett, 2011)), but others reported a non-significant effect (e.g., (Anderson-Bill, Winett, & Wojcik, 2011)). This study provides novel evidence to support Bandura's (1997, 2004) assertion that self-efficacy exhibits an indirect effect on PA through an influence on all other model components.

Hypothesis 3 regarding the role of outcome expectations within the SCT model was not supported as outcome expectations did not exhibit a direct effect on PA. A significant effect was observed from outcome expectations to PA via intention, but effect was deemed too small to be considered meaningful (Ferguson, 2009). These results are consistent with two recent reviews, which reported that outcome expectations have demonstrated a mixed effect (Williams, Anderson, & Winett, 2005) or null effect (Young, Plotnikoff, et al., 2014) on PA. Bandura (1997, p. 24) has previously addressed this issue in relation to behaviours where outcomes are inextricably linked to performance, such as PA, by suggesting that '*when differences in efficacy beliefs are controlled, the outcomes expected for given performances make little or no independent contribution to prediction of behaviour*'. The current model supports this assertion, given that the significant association between outcome expectations in the correlational analyses no longer existed when the construct was situated in the complete SCT model. This finding suggests that the role of outcome expectations in the SCT model, when specifically predicting PA, may need to be re-evaluated. However, it is important to acknowledge that the current model used a general measure of outcome expectations rather than measuring the three major classes Bandura (1997) specifies (i.e. physical, social and self-evaluative), which may have affected the results.

This study did not support Hypothesis 4 regarding the hypothesised indirect effect of social support on PA, via intentions. The indirect pathway reached statistical significance, but the strength of the association was too small to be considered meaningful. This was an unexpected finding, as research shows that family support, particularly from female partners, has an important bearing on men's health behaviours (Sharpe, 2002; Wirth, James, Fafard, & Ochipa, 2013). The finding may be explained in part by the sociological perspectives of men's health and masculinity, which suggest that men experience greater social pressure to model independence, strength and self-reliance (Courtenay, 2000). In the context of weight loss, men are generally reluctant to seek social support in fear appearing 'helpless or weak' (Lewis, Thomas, Hyde, Castle, & Komesaroff, 2011) and have demonstrated poor compliance with activities designed to foster support networks (Morgan et al., 2014). Although it is reasonable to expect that social support does have an important influence on men's physical activity, this effect may have been diminished in the current model if these social influences affected the men's responses to the self-report questionnaire. Future research should consider whether objective measures of social support (e.g., marital status) or other socio-structural factors (e.g., perceptions of the built environment, access to training facilitates) are more strongly associated with men's PA.

It is also important to acknowledge that the location of social support within SCT models has varied. For example, Anderson and colleagues have reported on a number of equally well-fitting SCT models where social support operates on PA indirectly through constructs including self-efficacy (Anderson-Bill, Winett, & Wojcik, 2011; Anderson-Bill, Winett, Wojcik, et al., 2011). In contrast to his recent work, Bandura has previously proposed that social support may operate on behaviour through self-efficacy (Bandura, 1997). As such, it is apparent that further research is required to establish the importance of the social support construct within SCT, particularly in relation to men.

Hypothesis 5 regarding the direct effect of intention on PA was supported. The effect was small, but was consistent with the broader research of the link between intentions and PA behaviour (Hagger, Chatzisarantis, & Biddle, 2002). The predictive capacity of the intention construct may have been somewhat limited in this study as the participants may have been highly motivated at baseline with strong intentions to increase their activity, which may have decreased once men had a greater understanding of the effort this would involve (i.e., response shift bias) or as they approached their weight loss goal. A recent review noted that intention stability over time was the most important factor in determining whether one's intentions aligned with one's behaviour (Rhodes & Dickau, 2013). If the participants in this study reported unrealistically high intentions to achieve the MVPA guidelines at baseline, and these intentions became more realistic over time, this discordance would have limited the predictive capacity of the intention construct. This explanation is supported by the masculinities literature, which indicates that most men: (i) prefer to focus on PA instead of dieting to lose weight (Jackson, Ball, & Crawford, 2001; Lewis et al., 2011) and (ii) intend to take substantive actions for weight loss (Egger, 2000), which are not generally sustainable (Morgan, Warren, Lubans, Collins, & Callister, 2011). Although the SHED-IT Weight Loss Program advises men to take a more measured approach to weight loss efforts, the participants would not have been exposed to this education prior to completing their baseline questionnaires.

As previously noted, this study addressed many of the weaknesses of the previous studies examining SCT models of PA (Young, Plotnikoff, et al., 2014), including use of a longitudinal design, high retention rates, a relatively large sample size, use of a valid and reliable measures of PA and SCT cognitions, use of structural equation modelling and adjustment for past behaviour and cognitions. In addition, this was one of the very few studies to assess all major SCT constructs according to Bandura's (2004) most recent model conceptualisation. This study also provides unique information into the utility of SCT to explain PA behaviour in men, who are notably underrepresented in theoretical research (Young, Plotnikoff, et al., 2014), PA research (George et al., 2012), and weight loss research (Young, Morgan, Plotnikoff, Callister, & Collins, 2012).

There are also some limitations to acknowledge. First, the current model reports on a self-report measure of PA only. Although this was a validated tool (Godin & Shephard, 1985), self-reported PA measures are subject to common methods bias, where associations between SCT constructs and behaviour are inflated due to the shared measurement method (i.e., a paper-based survey) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). As the data for this study were sourced from a weight loss trial, the sample did not include any healthy weight participants, which may have restricted the variance in the model constructs. The study did not include any additional follow-up after the post-test assessment to measure maintenance of study effects. Finally, for model parsimony the socio-structural factors construct was limited to family social support only. With a larger sample size this construct could be expanded to include other factors such as perceived environmental variables or perceived barriers, which may increase the variance explained in PA.

Recommendations for research

1. To the authors' knowledge, this was one of the few SCT theory tests that represented all core SCT constructs and analysed the model according to the hypothesised sequence (Bandura, 2004). To generate more valid data regarding the utility of SCT to explain PA, it is crucial that future studies include measures for all constructs in appropriately specified structural equation models and report the direct, indirect and total effects of all variables.
2. This study was conducted in the Hunter Region of Australia, which is a large regional city in Australia featuring environmental conditions that are generally conducive to physical activity. Support for the theory could be strengthened with replication studies

with samples of men from diverse cultures, demographic groups and environmental conditions. Further, the current findings need to be validated with objective measures of PA such as pedometry or accelerometry.

3. It is important to acknowledge that psychological variables alone cannot provide a complete explanation of human behaviour (Baranowski, Anderson, & Carmack, 1998). Future research should examine how the SCT explanation of behaviour can be situated within broader ecological models, which consider the effect of the environment in combination with individual and social factors. Given the established influence of institutional, built environment and policy factors on physical activity levels (Sallis, Floyd, Rodriguez, & Saelens, 2012), testing comprehensive models that combine both approaches is an important goal for future research.

Recommendations for practice

1. Currently, there is limited evidence available to inform the design of engaging and effective physical activity and weight loss interventions for men (Bottorff et al., 2015; George et al., 2012; Young et al., 2012). This study suggests that researchers may increase the effectiveness of their programs by drawing on the psychological (e.g., (Olander et al., 2013)) and sociological (e.g., (Courtenay, 2000; Wirth et al., 2013)) literature to create innovative programs that target men's self-efficacy and intention to perform physical activity.
2. This study suggests that social support and outcome expectations may not be as important to target in PA programs for men, but this hypothesis requires further validation.

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Figure Captions

Figure 1. The Social Cognitive Theory model of health behaviour (Bandura, 2004).

Figure 2. Social Cognitive Theory model of moderate-to-vigorous physical activity in overweight and obese men. Significant paths are represented by bold coefficients and solid arrows. Non-significant paths are represented by non-bold coefficients and dotted lines. For clarity, stability coefficients have been greyed and indicator variables, covariates and error terms are not displayed.

Table 1.
Baseline demographic and anthropometric characteristics of study sample (n = 204).

Characteristic	Mean	SD
Age (years)	46.6	11.3
Height (cm)	178.5	6.8
Weight (kg)	105.7	14.1
BMI (kg/m^2)	33.1	3.5
	n	**%**
BMI category [a]		
Overweight	42	21
Obese I	100	49
Obese II	62	30
Socio-economic status [b]		
1-2 (most disadvantaged)	11	5
3-4	23	11
5-6	84	41
7-8	62	30
9-10 (most advantaged)	24	12
Born in Australia	174	85
English spoken at home	199	98
Currently employed	180	88
Currently studying	31	15
Married	154	76
Obtained post-school qualifications	166	81

Note: BMI, body mass index; SD, standard deviation
[a] Overweight (25 – 29.9 kg/m^2); Obese I (30.0 – 34.9 kg/m^2); Obese II (35.0 – 39.9 kg/m^2). [b] Socio-economic status by population decile for SEIFA Index of Relative Socio-economic Advantage and Disadvantage.

Table 2.

Descriptive statistics and correlations among model constructs

	Time 1 (0 months)					Time 2 (3 months)				
	1. MVPA	2. SE	3. OE	4. INT	5. SS	6. MVPA	7. SE	8. OE	9. INT	10. SS
Time 1 (0 months)										
1. MVPA	1.00									
2. Self-efficacy (SE)	0.24**	1.00								
3. Outcome expectations (OE)	0.04	0.06	1.00							
4. Intention (INT)	0.19*	0.61**	0.28**	1.00						
5. Social Support (SS)	0.15*	0.18*	0.14	0.23**	1.00					
Time 2 (3 months)										
6. MVPA	0.34**	0.22**	0.15*	0.23**	0.04	1.00				
7. Self-efficacy (SE)	0.20**	0.57**	0.18**	0.38**	0.09	0.58**	1.00			
8. Outcome expectations (OE)	0.15*	0.25*	0.62**	0.39**	0.16*	0.35**	0.48**	1.00		
9. Intention (INT)	0.25**	0.42**	0.23**	0.41**	0.20**	0.52**	0.70**	0.53**	1.00	
10. Social Support (SS)	0.04	0.27**	0.18*	0.20**	0.62**	0.20**	0.33**	0.28**	0.44**	1.00
Mean	89.8	3.06	4.32	5.88	2.29	190.6	3.05	4.25	5.44	2.62
SD	112.7	0.71	0.48	0.74	0.89	129.7	0.82	0.46	1.11	0.96

Note: MVPA, moderate-to-vigorous physical activity.
* $p < 0.05$; **$p < 0.01$, ***$p < 0.001$

Table 3. Direct effects, total indirect effects and total effects among Social Cognitive Theory constructs and moderate-to-vigorous physical activity.

Latent variable	Effect [a]	Baseline (0m)					Post-test (3m)				
		1. SE	2. OE	3. SS	4. INT	5. MVPA	6. SE	7. OE	8. SS	9. INT	10. MVPA
Baseline (0m)											
1. Self-efficacy (SE)	Direct	n/a	0.08 ^{ns}	0.20 *	0.69 **	0.38 ^{ns}	0.60 ***	-	-	-	-
	Indirect	n/a	-	-	0.04 ^{ns}	-0.04 ^{ns}	-	0.36 ***	0.30 ***	0.52 ***	0.51 ***
	Total	n/a	0.08 ^{ns}	0.20 *	0.74 **	0.34 ***	0.60 ***	0.36 ***	0.30 ***	0.52 ***	0.51 ***
2. Outcome Expectations (OE)	Direct	-	n/a	-	0.33***	0.04 ^{ns}	-	0.80 **	-	-	-
	Indirect	-	n/a	-	-	-0.02 ^{ns}	-	-	-	0.17 **	0.05 ^{ns}
	Total	-	n/a	-	0.33***	0.02 ^{ns}	-	0.80 **	-	0.17 **	0.05 ^{ns}
3. Social Support (SS)	Direct	-	-	n/a	0.09 ^{ns}	-	-	-	0.63 **	-	-
	Indirect	-	-	n/a	-	-0.01 ^{ns}	-	-	-	0.14 ***	0.04 *
	Total	-	-	n/a	0.09 ^{ns}	-0.01 ^{ns}	-	-	0.63 **	0.14 ***	0.04 *
4. Intention (INT)	Direct	-	-	-	n/a	-0.05 ^{ns}	-	-	-	0.08 ^{ns}	-
	Indirect	-	-	-	n/a	-	-	-	-	-	0.01 ^{ns}
	Total	-	-	-	n/a	-0.05 ^{ns}	-	-	-	0.08 ^{ns}	0.01 ^{ns}
5. MVPA	Direct	-	-	-	-	n/a	-	-	-	-	0.23 *
	Indirect	-	-	-	-	n/a	-	-	-	-	-
	Total	-	-	-	-	n/a	-	-	-	-	0.23 *
Post-test (3m)											
6. Self-efficacy (SE)	Direct	-	-	-	-	-	n/a	0.49 ***	0.30 ***	0.56 ***	0.45 ***
	Indirect	-	-	-	-	-	n/a	-	-	0.15 **	0.21 *
	Total	-	-	-	-	-	n/a	0.49 ***	0.30 ***	0.71 ***	0.67 **
7. Outcome Expectations (OE)	Direct	-	-	-	-	-	-	n/a	-	0.18 *	-0.00 ^{ns}
	Indirect	-	-	-	-	-	-	n/a	-	-	0.06 *
	Total	-	-	-	-	-	-	n/a	-	0.18 *	0.05 ^{ns}
8. Social Support (SS)	Direct	-	-	-	-	-	-	-	n/a	0.21 **	-
	Indirect	-	-	-	-	-	-	-	n/a	-	0.06 *
	Total	-	-	-	-	-	-	-	n/a	0.21 **	0.06 *
9. Intention (INT)	Direct	-	-	-	-	-	-	-	-	n/a	0.31 *
	Indirect	-	-	-	-	-	-	-	-	n/a	-
	Total	-	-	-	-	-	-	-	-	n/a	0.31 *
10. MVPA	Direct	-	-	-	-	-	-	-	-	-	n/a
	Indirect	-	-	-	-	-	-	-	-	-	n/a
	Total	-	-	-	-	-	-	-	-	-	n/a

n/a, not applicable; - (dash), not estimated; MVPA, moderate-to-vigorous physical activity.

[a] Direct effect = the unique effect the variable has on the outcome (i.e. the effect that is unmediated by any other variable in the model). Indirect effect = the total effect of a construct on PA via its influence on other constructs in the model (i.e. sum of mediated effects to PA in model). Total effect = the sum of the direct effects plus indirect effects (i.e. the total effect of the variable on the outcome, directly and through other constructs).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ns = not significant.