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Predicting actual weight loss: A review of the determinants according to the theory of planned behaviour

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Abstract

Weight reduction that corresponds with lifestyle modification is difficult to foster. The theory of planned behaviour has been actively cited in explaining health-related behaviour. This review evaluated the application of the theory of planned behaviour to weight-loss behaviour. Among the three reviewed papers, cross-sectional survey designs and subjective outcome measurements were commonly applied. All of the studies recruited obese female adults as participants, limiting the generalisability of the studies' findings. The theory of planned behaviour can be effectively applied in weight-reduction programmes targeting female obese patients. This review confirmed critiques citing the limitations of experimental studies, the subjective measurement of behaviour and short follow-up periods.

Keywords

obesity, review, theory of planned behaviour, weight loss, weight reduction

Introduction

The worldwide prevalence of obesity more than doubled between 1980 and 2008. Statistics from the World Health Organization (2013) showed that 34 per cent of men and 35 per cent of women were overweight (body mass index (BMI) ≥ 25 kg/m²) and that 10 per cent of men and 14 per cent of women were obese (BMI ≥ 30 kg/m²). In addition, Ogden et al. (2006) showed that obesity provides a 30 per cent greater contribution to childhood and adolescent mortality rates than to the mortality rates of young and mature adults (Biro and Wein, 2010). Although attention has been drawn to this global epidemic and to obesity-related health concerns, some obese people experience difficulty in losing weight because of their failure to adhere to healthy diet and exercise recommendations. Overweight and obese people who seek to lose weight must change their lifestyles to improve their energy balance. Energy balance can be improved by engaging in regular physical activity and avoiding energy-dense foods with low nutrient content (Kremers et al., 2006; Rey-Lopez et al., 2008). However, weight reduction through lifestyle modification has been difficult to foster in both developed and developing countries (World Health Organization, 2002). Studies have focused on weight-management motivation and cognitive-motivational factors such

as beliefs, attitudes and perceptions, which have been found to influence the nutritional behaviour of obese people. Behavioural mediator constructs have been developed on the basis of several conceptual theories such as the health-belief model (HBM), self-determination theory (SDT), social-cognitive theory (SCT), transtheoretical model (TTM) and theory of planned behaviour (TPB). Theory-based models are designed to understand the cognitive psychology of a person within the context of that person's social environment as well as other constructs such as motivation and intentions (Nigg et al., 2002). Theory-based interventions help people reflect on their decisions and develop strong intentions to achieve their target behaviour (Baranaowski et al., 1997; Goldstein et al., 2004). These theories provide different theoretical perspectives on health-behaviour research. For example, the HBM is described as a belief-attitude theory because it comprises core beliefs for predicting the likelihood of a

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behavioural occurrence. The model proposes that the likelihood of a person performing a health-related action is motivated by a series of perceptions (e.g. perceived severity, perceived susceptibility, perceived threat or risk, perceived benefits, perceived barriers, self-efficacy and cues to action). SCT is described as a competence-based theory because it specifies the factors of a person required for acquiring competencies that can influence physical and emotional well-being and the self-regulation of health habits (Bandura, 1998). Control-based theories such as the SDT concern the psychological needs for autonomy, competence and relatedness. SDT suggests that the motivation of self-initiated behaviour is based on the satisfaction of these basic psychological needs and support from the social environment (Ryan and Deci, 2000). The TTM is considered a decision-making theory and suggests that health-behaviour adoption and maintenance occurs at discrete stages within a process (Biddle and Nigg, 2000). SCTs such as the TPB, however, focus on how likely it is that individuals intend to engage in a behaviour. Intention is considered the ultimate mediator of behaviour, and Armitage and Conner (2001) found that reported intentions were reliably and moderately correlated with certain health actions.

In early studies examining health promotion and disease prevention, SCT was described and appraised as a more comprehensive approach with a broader range of sociocognitive determinants compared with other theories such as the HBM and TPB (Bandura, 1998). SCT is useful, but places emphasis on collective support, which is sometimes beyond the control of an individual. This emphasis limits SCT application, especially in studies focusing on self-influence rather than a sense of support. The HBM's constructs are broadly used in health studies. However, the HBM is under conceptual critique; specifically, the operational definitions of its constructs are not clear, making comparison among studies difficult (Abraham and Sheeran, 2005). Although this model can predict behaviour significantly, the effects are usually small (Sheeran and Abraham, 1996). By contrast, the TPB was found to be economical compared with the HBM, which has more constructs and items stemming from its various constructs (Sutton, 1998). The TPB facilitates explaining the determinants of a person's intention to change one's food choices and nutritional behaviour (Contento, 2011). The TPB includes perceived behavioural control (PBC) as a construct to accommodate people's volitional control. However, controversies arise over the distinction between self-efficacy and PBC. Norman and Hoyle (2004) suggested that people with a strong sense of self-efficacy are likely to perform a target behaviour and used PBC as proxy measure of behavioural control over environmental constraints. Studies have related self-efficacy and PBC to exercise and dietary behaviours, supporting the separation of these two constructs (Armitage and Connor, 1999; Terry and O'Leary, 1995). In contrast to the TTM, which assumes that people move through discrete

stages in the preparation and execution of behavioural change, the TPB is regarded as a continuous model (Lippke et al., 2005). The constructs of the TPB and TTM share common conceptual similarities and some of them overlap. For example, the construct of attitude in the TPB was found to entail individual beliefs regarding decisional balance (Kosma et al., 2007), and the stage of change in the TTM is reflected by intention followed by behavioural change in the TPB. Therefore, Yoo (2009) suggested that self-efficacy and attitude be integrated with PBC and decisional balance, respectively. Nevertheless, the TPB's unique construct of social influence was found to be absent from the TTM (Yoo, 2009). Evidence shows that approximately two-thirds of TPB-based interventions (Hardeman et al., 2002) and 13 of 17 HBM-based interventions exerted significant impacts on health behaviours (Abraham and Sheeran, 2005). Regarding the balance between advantages and disadvantages, the TPB seems to be more parsimonious and efficient in its use of constructs and, therefore, has been applied frequently in predicting health behaviour.

TPB

The TPB is an extended form of the theory of reasoned action (Ajzen and Fishbein, 1980) and was developed to predict behavioural change on the basis of cognitive components (Ajzen, 1988, 1991). The TPB reveals the underlying actions and motivations for behavioural change by emphasising the value of establishing strong intentions through attitudes, normative beliefs and perceived control. Determinants of changes in attitude, subjective norms and greater perceived control predict intention and thereby promote health-related behaviour (Armitage and Conner, 2001; Godin and Kok, 1996). The TPB considers behaviour a goal achieved by a group of participants. The mediator of behaviour is intention, which is the perceived likelihood that an action is performed to achieve a targeted behaviour. According to the theory, attitude refers to a person's positive or negative judgement of the intended approach. A subjective norm is applied to the approval or disapproval of the participant group to achieve the targeted behaviour. Finally, a person's PBC provides evidence of his or her control over the environmental barriers that require changing. These three mediators have been used to determine the potential contributing influence of certain established factors. For example, whereas behavioural beliefs and outcome evaluation are bases for predicting attitude, normative beliefs and the motivation to comply are the foundations for projecting subjective norms, and control belief is the major correlate to PBC. The TPB has been cited frequently (Ajzen, 2011) and widely adopted to explain health-related behaviour such as smoking, mammography screening, voluntary HIV counselling and testing, exercise, food choice, family meal frequency and fruit and vegetable intake (Abamecha et al., 2013; Carter-Parker

et al., 2012; Eto et al., 2011; Fila and Smith, 2006; Griva et al., 2013; Lohse et al., 2011; Shepherd, 1999). However, Gardner and Hausenblas (2005) critiqued the theory as unviable for predicting exercise and diet behaviour in a group of overweight women. Recently, the TPB, despite being applied in numerous correlational studies and indicating prospective associations between cognitions and behaviour (Noar and Zimmerman, 2005), has been dismissed because of its limited predictive validity and utility in robust studies (Sniehotta et al., 2014). Through a systematic review, McEachan et al. (2011) found that the strongest TPB predictor was the construct of intention, which exhibited a variability of 19.3 per cent regarding health behaviour. This 19.3 per cent variability, based on 237 prospective studies, was considered low. Other criticisms addressed the TPB's 'shortitudinal' instead of longitudinal designs in application, insufficiency in predicting behaviour and small effect sizes of behavioural change, particularly when the studies reported behaviour over a long period (Sniehotta et al., 2014). In addition, self-reported outcome measures and rare experimental designs were found (Sniehotta et al., 2014). These findings elicit concerns over whether an intervention can be developed according to the TPB and whether the theory can provide effective techniques for translating cognitive change into behavioural change (Sniehotta, 2009). These findings also raise the question of whether the TPB can be applied in designing and developing intervention methods for weight-reduction programmes.

Because effective and sustainable weight loss stems from a change in lifestyle, investigating whether the TPB facilitates weight loss is valuable to health psychologists. The TPB is newer than other health theories. Because of increasing evidence regarding its effectiveness and ineffectiveness, identifying potential determinants of weight reduction in existing literature is crucial. In preparation for clinical trials on how to achieve sustainable weight loss, this review evaluated recent applications of the TPB to weight-loss behaviour.

Methods

Search strategies

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were adopted in a systematic and structural search of the literature (Moher et al., 2009). We searched original research articles written in English and published between 1980 (when the TPB was first theorised and published by Ajzen and Fishbein) and March 2013. The databases used for the literature searches were PsycINFO, Cochrane, CINAHL, MEDLINE, PubMed and ScienceDirect. The search keywords included 'weight loss', 'weight reduction', 'body mass index', 'weight control' and 'obesity'. Bibliographies of relevant studies were examined to identify additional studies. A 'grey' literature

search of other databases such as Google Scholar was conducted to identify additional relevant studies.

Selection criteria

For inclusion in this review, studies were required to (1) be original, (2) use primary data sources, (3) apply interventions to determine the effects of the TPB on weight loss and (4) accept all age groups. Because this review focused on the effect of TPB interventions on weight reduction, articles having clear operational definitions for outcome variables relevant to weight reduction were included. Definitions of outcome measurements, namely, body weight, body circumference, body fat percentage and BMI, were included. Because this review focused on interventions based on the TPB framework, papers that used the HBM, the precaution-adoption process model and SDT were excluded. Unpublished studies and conference papers were also excluded because of the difficulties involved in locating the full papers. To ensure the quality of this review, non-peer-reviewed journal articles were excluded.

Review analysis

Data extracted from studies applying the TPB as an intervention for weight reduction and meeting the aforementioned criteria were tabulated for further analysis. The data extracted included the source of the study, study design, study sample, outcome measurements, instruments and results.

Results

In total, 14 studies were identified through database searches (Figure 1). Studies that tested theories on binge eating (Porzeli et al., 1995; Smith et al., 1995) or weight loss in a hospital setting (Rodgers and Brawley, 1993) were excluded. After manual screening, 11 papers were preliminarily selected. One of these papers was ultimately excluded because it focused on the 'maintenance of weight loss' rather than 'weight loss or reduction' (McConnon et al., 2011). The paper also explored the cognition underlying weight regain, which was not the defined behaviour examined in this review. New extensions of the TPB, such as self-representation, need perception and moral norms, have been advanced by various studies (Abraham and Sheeran, 2000; Payne et al., 2004; Raats et al., 1995), but were excluded from the scope of this review. In addition to its focus on need perception as a new TPB extension, the study by Payne et al. (2004) was excluded because it evaluated exercise and diet adherence as behavioural outcomes and, therefore, deviated from weight loss as a targeted outcome. Among the seven remaining studies, four related to obesity were finally excluded (Table 1). In these four studies, obese or overweight participants were recruited as participants. Plotnikoff (2013) identified physical activity as the targeted behaviour,

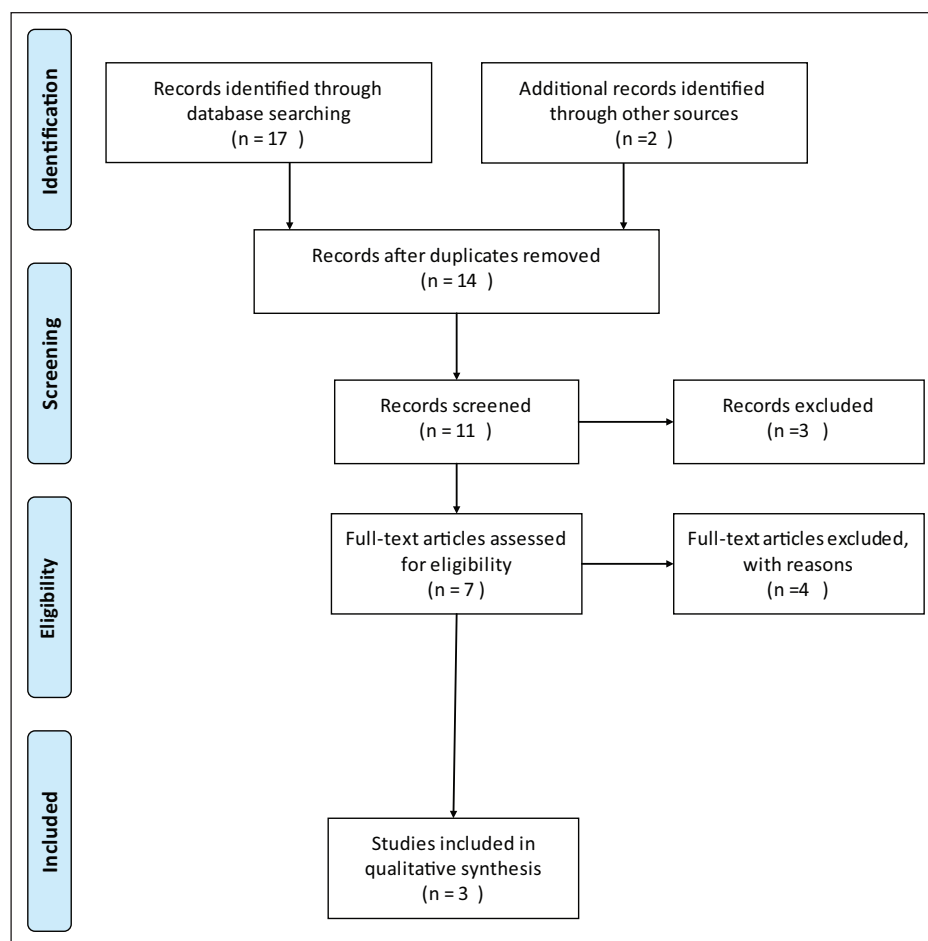


Figure 1. PRISMA flow diagram.

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

and the TPB constructs that resulted were significantly associated with physical activity levels among overweight and obese adolescents. Only the studies conducted by Gardner et al. (2005) and Duangchan et al. (2010) addressed BMI as a measured outcome. However, Gardner et al. examined exercise and healthy eating behaviour instead of the objective parameters measured by BMI and the waist-to-hip ratio. Although Duangchan et al. (2010) applied BMI as a weight-loss measure, they did not consider the effect of the TPB on weight reduction, but rather evaluated the effect of physical activity and a healthy eating intervention programme into which TPB constructs were incorporated.

Finally, only three papers that fit the inclusion criteria for exploring TPB construct correlations and targeted weight-reduction behaviour were found. The details on these papers are summarised in Table 2.

Discussion

Although the TPB has been heavily applied in studies that predict exercise and healthy eating habits, few of these studies have addressed weight-reduction behaviour.

Healthy eating and physical activity are considered key elements in weight loss. However, studies thus far have been predominantly cross-sectional rather than experimental. In addition, correlation analysis of the major determinants of overweight and obese groups (Gardner and Hausenblas, 2005; Schifter and Ajzen, 1985) has commonly been applied in investigating the associations of TPB constructs with weight-loss behaviour. Although it was statistically reasonable to identify the correlates affecting the intention to lose weight, we found that it was questionable whether these associations could help obese participants lose weight, especially when their behaviour was subjectively measured according to their level of physical activity or healthy eating. Furthermore, few of the studies measured change in body weight as a true behavioural outcome (Gardner and Hausenblas, 2013; Schifter and Ajzen, 1985). Instead, participants were asked to report their expected body weight or their intended weight loss in the near future. The determinants of attitudes, subjective norms, PBC and intention were analysed to predict the participants' expected body weight, which could have been relevant to their implementation plans. However, we also questioned

Table 1. Summary of excluded research studies related to the application of the theory of planned behaviour (TPB) to obesity..

Source	Sample	Study design	Measurements	Results
Payne et al. (2004)	286 UK employees in a company	Cross-sectional survey	(1) Intention to exercise (number of hours of exercise); (2) exercise behaviour (type of exercise and the time taken to complete the exercise); (3) intention to eat healthy (7-point scale); (4) healthy eating behaviour (7-point scale); (5) attitude (five semantic differential items, each with a 7-point scale); (6) subjective norm (7-point scale); (7) PBC (6 items derived from a study by Sparks et al. (1997), each with a 7-point scale); perceived need (single item with a 7-point scale).	For exercise, PBC had the highest correlation with intention ($r = .43, p < .001$). Attitude and the subjective norm explained 14% of the variance in intention and PBC explained 10%. For healthy eating, attitude had the highest correlation with intention ($r = .47, p < .001$). Attitude and the subjective norm explained 27% of the variance in intention and PBC explained 2%. Perceived need failed to account for further variance in exercise, but accounted for a further 3% variance in healthy eating.
Gardner and Hausenblas (2005)	117 overweight women	Cross-sectional survey	(1) BMI; (2) waist-to-hip ratio; (3) personal history; (4) TPB questionnaire: four measures of attitude (7-point scale), six belief-based measures of attitude (7-point scale), three measures of the subjective norm (7-point scale), three measures of PBC (7-point scale), 1-item measure of intention; (5) exercise behaviour by exercise class attendance; (6) diet behaviour by daily adherence to ± 100 calories of the 1500-calorie goal.	The direct measure of PBC was the only significant determinant of exercise intention ($\beta = .69, p < .001$). Intention did not explain the significant variance in exercise behaviour ($p = .19$). PBC contributed significantly to diet intention ($\beta = .28, p < .05$). However, intention did not explain a significant amount of the variance in diet behaviour.
Duangchan et al. (2010)	21 overweight or obese schoolchildren aged 9–11 years with a BMI-for-age ≥ 85 th percentile	A pre-post-experimental design without a control group	(1) Knowledge about obesity-related Type 2 diabetes (15 questions); (2) healthy eating behaviour (11-item food questionnaire); (3) healthy eating self-efficacy (questionnaire with 11 items, each with a 5-point scale); (4) healthy eating self-control (questionnaire with 14 items, each with a 5-point scale); (5) BMI.	DM knowledge, healthy eating self-efficacy, healthy eating self-control and healthy eating behaviour significantly increased from the baseline. However, BMI significantly decreased from the baseline only for healthy eating intervention. The BMI mean was not significantly different when combined with the physical activity intervention.
Plotnikoff et al. (2013)	560 overweight and obese adolescents from 37 school boards	A self-administered Web-based survey	(1) Brief constructs of TPB: attitude (2-item measure with 5-point semantic differential scales for each measure), subjective norm (a single item with a 5-point scale), PBC (4 items, each with a 5-point scale), intention (a single item with a 5-point scale); (2) physical activity with the Physical Activity Questionnaire for Older Children (PAQ-C) (Kowalski et al., 1997). Responses were given on a 5-point scale, with higher scores representing greater physical activity levels.	Significant intercorrelations ($p < .01$) were observed among the tested TPB constructs. All of the tested constructs were associated with physical activity ($p < .01$).

PBC: perceived behavioural control; BMI: body mass index; DM: diabetes mellitus.

Table 2. Summary of research studies that applied the theory of planned behaviour (TPB) to weight reduction.

Source	Sample	Study design	Study duration	Measurements	Results
Schifter and Ajzen (1985)	83 female college students	Quantitative; cross-sectional	6 weeks	(1) Adapted questionnaire with background questions (age, height, weight, past success at decreasing weight, considered ideal weight, age at which the subject became overweight and weight after 6 weeks); semantic differential 7-point scales reflecting attitude during weight decrease over 6 weeks; four questions with 7-point scales reflecting the subjective norm of weight loss; 4 items with 7-point scales measuring the intention to lose weight; two questions addressing perceived control on a scale of 0–100 in relation to the subject's ability to lose weight. (2) Open-ended questions determining the subject's actual plan to lose weight. The content analysed ranged from 0 to 16, with one point reflecting one actual plan.	(1) Perceived control was the best single predictor of the amount of weight lost over the 6-week period ($r=0.41$, $p<0.01$). (2) The amount of weight reduction was significantly correlated with intention ($r=0.25$, $p<0.05$). (3) The amount of weight reduction was poorly correlated with attitude ($r=0.10$) and the subjective norm ($r=0.05$).
Palmeira et al. (2007)	142 overweight and obese women	Quantitative; experimental	16 weeks	(1) The TPB is a theoretical model used for weight-loss comparison. (2) 18 items measuring weight-management constructs (4 items measuring intention; 5 items measuring attitude; 3 items measuring the subjective norm; 6 items measuring perceived behavioural control).	(1) Attitude and perceived behavioural control were associated with weight change ($p<0.001$). (2) The TPB explained 17.6% ($p<0.001$) of the variance in weight change, with attitude and perceived behavioural control showing similar correlation values (around 4%, $p<0.05$).
Luszczynska et al. (2007)	50 overweight or obese women aged 18–26 years.	Quantitative; randomised controlled trial	2 months	(1) Change in body weight and BMI from pre-intervention to 2-month follow-up. (2) Self-reported frequency of planning from pre-intervention to 2-month follow-up.	(1) Participants in the implementation intention prompt (IIP) lost 4.2 kg (95% CI = 3.19, 5.07). Participants in the control group lost 2.1 kg (95% CI = 1.11, 3.09). (2) Among the IIP participants, 65.2% lost 3 kg or more, and 54.2% lost at least 5% of their initial body weight. Among the participants in the control group, 28.6% lost 3 kg or more and 8.3% lost at least 5% of their initial body weight.

BMI: body mass index; CI: confidence interval.

whether an expected body-weight change could reflect the final weight-loss amount.

Objective outcome measurements

One of our critiques of current literature related to its subjective measurement of weight reduction. This finding echoed a recent challenge to the validity of the TPB regarding the operationalisation of study measures (Snihotta, 2009). Certain studies have analysed anthropometric variables (Gardner and Hausenblas, 2013; Schifter and Ajzen, 1985), yet their designs have been limited regarding the correlation of TPB determinants with weight status rather than weight reduction specifically. By contrast, the three studies we considered in this review applied TPB determinants to explore the differences in actual weight reduction during the designed experimental period or applied TPB determinants during an intervention to test their effectiveness in weight reduction. The results of these studies' objective evaluations of body weight supported theoretical model testing.

Major weight-reduction determinants

In parallel with previous studies, PBC (Palmeira et al., 2007; Schifter and Ajzen, 1985) and intention (Luszczynska et al., 2007; Schifter and Ajzen, 1985) were evidentially supported as significant determinants of actual weight loss. However, we discovered a conflict regarding whether TPB attitudes contributed to actual weight loss. Schifter and Ajzen (1985) reported a poor correlation between attitude and final body-weight changes, whereas Palmeira (2007) found attitude to be associated with body-weight reduction. The high variance among individuals could have accounted for these contrasting results (Armitage and Connor, 2001; Schifter and Ajzen, 1985). We also questioned whether the various instruments used to measure attitude influenced the validity of the findings regarding weight reduction. Such misleading evidence has been reported by other studies; specifically, attitude, subjective norms and PBC were highly predictive of intentions, which are correspondingly predictive of behaviour, in cross-sectional studies, but the assumptions have not been verified by experimental findings (Weinstein, 2007). This critique prompts queries regarding whether weight-loss behaviour corresponds with TPB assumptions and whether attitude is a major determinant in the execution of weight-reduction behaviour.

Generalisability of findings

All of the participants in the included studies were female. Hence, we were cautious in interpreting their findings on the effectiveness of applying the TPB in weight-management programmes because their results were limited only to overweight and obese female adults. This factor certainly

limited their implications and restricted the generalisability of the findings to other populations, such as to obese male adults. In addition, sampling was not conducted using well-developed protocols for reducing sample bias. A test of homogeneity could not be found; the lack of such tests affects the extent to which this review substantiates the quality of the included studies. In addition, the sample sizes in the included studies were small with inadequate justification. This factor also hampered our interpretation of their findings regarding weight-loss behaviour as a function of TPB attributes.

Limitations and recommendations

The TPB emerged in the mid-1980s. Although its theoretical framework has been influential in health-behaviour studies, only a few studies have reported on the application of the TPB to weight reduction; the determinants reviewed here may not be sufficiently thorough to evaluate the effectiveness of the theory in modifying the behavioural intention of obese people attempting to lose weight. Scientific evidence regarding weight-loss behaviour has been relatively primitive (cross-sectional studies and self-reported determinants). Additional quantitative studies, such as randomised controlled trials and longitudinal studies, are required to fill the current knowledge gap. In addition, more studies that focus on populations other than obese females would enrich the applicability of the TPB to weight reduction. Only a representative inclusion of participants can confirm the correlations of TPB constructs with weight-reduction determinants.

Conclusion

The TPB effectively explains the ability of PBC and possibly attitude to increase the intentions of obese females to achieve superior weight-loss results. This review also confirmed critiques citing the limitations of TPB experimental studies, namely, the subjective measurement of behaviour and short follow-up periods.

Implications

The TPB has been shown to be a useful theoretical framework for much health-related behaviour. The determinants provide strong correlations in predicting desirable behaviours. Because obesity is related to a few metabolic syndromes and chronic diseases, effective strategies to reduce body weight are vital to promote. Interventions designed and developed on the basis of the TPB can increase effectiveness in achieving weight loss when the TPB shows a positive correlation with actual weight loss. In this review, the authors found that the evidence provided by the included studies is limited and cannot be generalised to the general population. In addition, the TPB would be more desirable

for designing weight-reduction interventions if study designs that are more robust were used.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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