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Intervention

The effects of a brief intervention to promote walking on Theory of Planned Behavior constructs: A cluster randomized controlled trial in general practice

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ABSTRACT

Objective: Perceived behavioral control (PBC) is a consistent predictor of intentions to walk more. A previously successful intervention to promote walking by altering PBC has been adapted for delivery in general practice. This study aimed to evaluate the effect of this intervention on Theory of Planned Behavior (TPB) constructs in this context.
Methods: Cluster randomized controlled trial, with $n = 315$ general practice patients. Practice nurses and Healthcare Assistants delivered a self-regulation intervention or information provision (control). Questionnaires assessed TPB variables at baseline, post-intervention, 6 weeks and 6 months. Walking was measured by pedometer.
Results: The control group reported significantly higher subjective norm at all follow-up time points. There were no significant differences between the two groups in PBC, intention, attitude or walking behavior. TPB variables significantly predicted intentions to walk more, but not objective walking behavior, after accounting for clustering.
Conclusion: The lack of effect of the intervention was probably due to a failure to maintain intervention fidelity, and the unsuitability of the behavior change techniques included in the intervention for the population investigated.
Practice implications: This previously successful intervention was not successful when delivered in this context, calling into question whether practice nurses are best placed to deliver such interventions.

1. Introduction

Low levels of physical activity are associated with numerous chronic health conditions. The UK government currently recommends that adults aged 19–64 years should aim to be active daily, achieving at least 150 min of moderate intensity activity, or 75 min of vigorous intensity activity, spread across the week to gain protective health benefits [1]. However, only 66% of men and 56% of women aged 19–64 years in England report meeting these new recommendations [2].

Developing effective interventions to increase physical activity is therefore important for population health. Walking is especially promising as a public health intervention because of its acceptability and accessibility, particularly among populations who are the most physically inactive [3]. Furthermore, walking offers considerable health benefits [4]; including reduced body weight, increased fitness [5], and lower cardiovascular and cancer risk [6,7].

Despite this a recent review from the National Institute of Health and Clinical Excellence (NICE) concluded that, although there is considerable randomized controlled trial evidence for the benefits that accrue from walking, there is a shortage of effective interventions that can be offered to patients in general practice [8]. The advantages of the general practice setting are that this is

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where most of the population has regular contact with the healthcare system, and often in circumstances where they are receptive to advice to alter their behavior. The general practice setting therefore provides substantial opportunity for health behavior change [9,10].

For optimum effectiveness, an intervention should have a sound theoretical basis, allowing the appropriate determinants of behavior change to be targeted and effective intervention techniques to be identified [11]. The Theory of Planned Behavior [TPB: 12] has been researched extensively in relation to the prediction of behavior, and the efficacy of the TPB to predict physical activity intentions and behavior has been consistently demonstrated [13,14].

According to the TPB the proximal determinants of behavior are an individual's intention to perform that behavior, and their perceived behavioral control (PBC) i.e. a person's belief that performance of the behavior is within his/her control [12]. Intention is, in turn, hypothesized to be determined by the individual's attitude toward the behavior (evaluation of the outcomes of the behavior), subjective norm (perception of whether significant others believe they should perform the behavior), and PBC. Ajzen [15] has described how PBC is similar, if not identical, to the concept of self-efficacy within Social Cognitive Theory [16]. Self-efficacy is defined as 'the belief in one's capabilities to organize the courses of action required to produce given attainments' [17, page 3]. Self-efficacy is one of the most consistent predictors of both the adoption, and maintenance, of physical activity [18].

However, the efficacy of the TPB is less clear when research focuses on walking, rather than general physical activity. Whilst TPB *variables* have been consistently good predictors of walking intentions, with PBC a consistently strong predictor of intentions to walk more [19–21], two studies have indicated that TPB *variables* do not predict objectively measured walking [22,23].

There are several possible reasons why TPB *variables have* been less predictive of walking behavior. First, studies of walking have employed objective measures of behavior, yet previous research has demonstrated that more variance is accounted for in self-reported than objective behavior [24,25]. Second, Scott et al. [22] employed a military sample in their study, which all substantially exceeded the recommended amount of physical activity for good health. Given this, the results are unlikely to generalize to general public samples that are more sedentary. Third, Hardeman and colleagues [23] used a physiological measure of physical activity i.e. energy expenditure instead of a behavioral measure of walking, which might have influenced the ability of the study to provide a fair test of the association between TPB variables and walking behavior.

Nevertheless a brief intervention to promote walking, based on an "extended" TPB incorporating post-intentional volitional processes, did demonstrate the efficacy of the TPB in explaining objectively measured walking behavior [26,27]. Specifically, changes in PBC mediated the effects of a behavior change intervention on large increases in objectively measured walking behavior in healthy adult volunteers. Both tests of the intervention support the proposition that TPB variables do indeed predict objectively measured walking behavior, in contrast to previous research in this area [22,23].

However, this walking intervention was delivered by a researcher, and was delivered to healthy adult volunteers in both studies. Given the present lack of effective interventions to promote walking available within primary care [8], it was considered important to evaluate whether this intervention can also be delivered successfully within this setting by health professionals. A recent cluster randomized controlled trial of a revised version of the same walking intervention in general practice found no significant differences in objectively measured walking behavior between patients who received the adapted walking intervention and those who received a control intervention [28].

The first aim of this study, therefore, is to examine why the walking intervention, which has been proven to be effective in previous studies [26,27], was unsuccessful in changing objectively measured walking behavior in this population in this setting. It is possible there was no change in the hypothesized mediators of objectively measured walking behavior i.e. TPB [12] variables, resulting in a lack of change in behavior. Alternatively, it is possible that there were changes in the proposed mediators, as expected, but no change in behavior.

Additionally, the present study aims to investigate the role of TPB *variables* in predicting intention and objective walking behavior in a sedentary general practice population.

2. Methods

2.1. Design

Data for this study were derived from a two-arm cluster randomized controlled trial (RCT) of a brief intervention to promote walking within general practice [28,29]. Data on the main outcomes of the trial i.e. walking behavior and economic analysis are reported elsewhere [28]. Practices were randomized to intervention or control, stratified by median practice size over four Primary Care Trusts, and index of deprivation scores [30].

2.2. Participants

Twenty-one general practices in a geographically and socially diverse sub-region of central England were recruited (Fig. 1). Patients were identified from GP practices registers in which the study was based, and a random sample was invited. Patients were eligible for inclusion in the study if they were (a) aged between 16 and 65 years, (b) had one or more chronic conditions for which increasing physical activity would have a positive effect on health status, and (c) were sedentary, in terms of not meeting governmental physical activity guidelines. Further information is provided in the published study protocol [29].

2.3. Procedure

Patients received one of two interventions: (a) self-regulation walking intervention, or (b) information provision plus pedometer intervention. Patients completed a Theory of Planned Behavior questionnaire at baseline (*t*1), immediately after receiving their allocated intervention (*t*2), at six weeks (*t*3), and at six months post-intervention (*t*4). All patients wore a pedometer for 7 days at each measurement point.

Patients in both arms of the study received an information pack containing two leaflets promoting walking, with a specific focus on the benefits of walking [31,32].

2.3.1. Self-regulation Intervention

Patients in the "self-regulation intervention" arm received a theory-based self-regulation intervention delivered by their own practice nurse or HCA. The intervention consisted of two face-to-face sessions of up to 30 min in duration, with a 20 min follow-up session.

To ensure acceptability within general practice the original walking intervention was adapted [26] based on feedback from practice nurses and patients [29]. Intervention content was adapted based on a systematic review with meta-analysis that examined which behavior change techniques (BCTs) were associated with improvements in self-efficacy for lifestyle physical

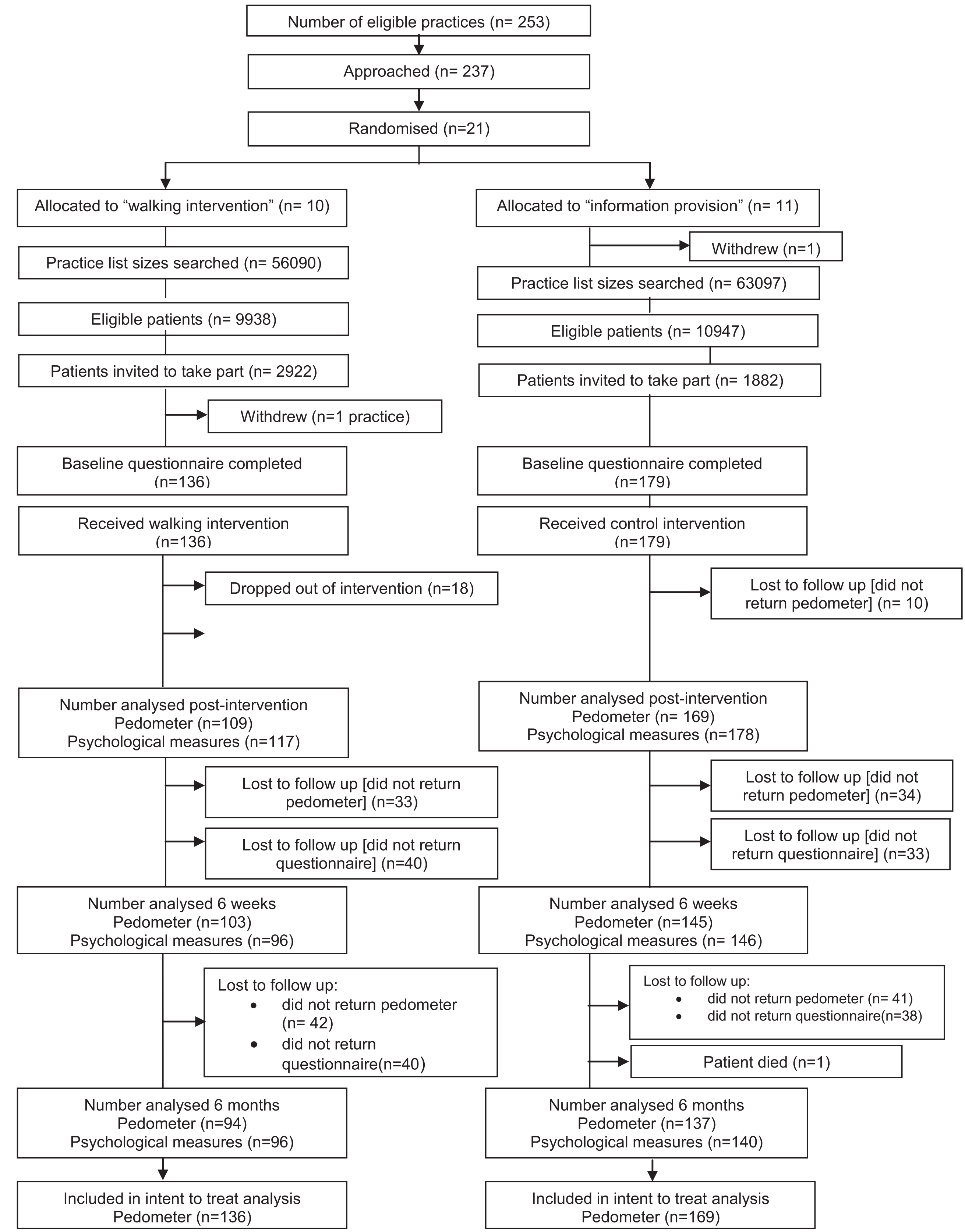

Fig. 1. CONSORT flow diagram of participants through the study.

activity [33]. Consequently, an additional effective BCT was included in the walking intervention i.e. provide feedback on performance. A BCT that was found to be associated with lower self-efficacy was removed i.e. barrier identification.

Intervention session one consisted of two motivational techniques designed to enhance PBC/self-efficacy [12,17], and two volitional techniques to translate intentions into behavior. Patients set goals and completed specific action plans detailing when, where, how and with whom they would fit their extra walking goal into their daily life [34,35]. Patients reviewed their progress in the second intervention session, received positive feedback, and revised goals and action plans.

To ensure intervention fidelity practice nurses and HCAs were observed by the research team, ahead of the trial beginning. Their competence was assessed using a 20-point checklist of the intervention techniques [36]. Practice nurses and HCAs were required to achieve a minimum level of competence of delivery, which was that 12/14 intervention components were delivered correctly.

2.3.2. "Information provision" (control) intervention

Patients received the information pack detailed above, and were also offered the opportunity to discuss their own walking with the practice nurse or HCA.

Both interventions, the rationale behind their development, and the associated training and fidelity assessment procedures for each, have been detailed elsewhere [26,28,29].

2.4. Main outcome measures

2.4.1. Theory of Planned Behavior measures

A 26-item version of this TPB questionnaire was completed by all participants in the present study prior to receiving the intervention and at 6 months, and included three attitude, subjective norm, perceived behavioral control and intention items. This questionnaire also measured control beliefs and associated perceived power to inhibit/facilitate behavior in relation to walking for at least 30 min on average a day over the next 7 days (all Cronbach's α = .597–.916).

A shorter six-item TPB questionnaire was used immediately post-intervention and at 6 weeks post-intervention, to prevent patient attrition and fatigue. This six-item measure included one attitude item ("Walking for 30 min on average a day over the next 7 days will be Unpleasant/Pleasant"), one subjective norm item ("Most people who are important to me will themselves walk for 30 min on average a day over the next 7 days") and one intention item ("I intend to walk for 30 min on average a day over the next 7 days"). Three PBC items were also included (Cronbach's α = .674–.798). This shortened questionnaire was based on one previously developed [37] and validated [26,38] in studies of walking behavior with adult volunteer samples.

The single-item and three-item measures of attitude (r = .84), subjective norm (r = .81) and intention (r = .87), delivered at baseline, were all highly correlated (all $p < .001$).

2.4.2. Walking behavior

Objective walking behavior was assessed using the valid New Lifestyles NL-1000 pedometer (New-Lifestyles Inc., Lees Summit, Missouri, USA) [39], consistent with the trial of the original walking intervention [26]. The intensity threshold was set at level 4–9, representing moderate and vigorous physical activity.

2.4.3. Demographics

Personal data on age, gender and BMI was recorded by the practice nurse or HCA. Ethnicity, employment status, education level was recorded using standardized questionnaire measures at the same appointment.

2.5. Statistical analysis

A series of independent samples t-tests and chi-squared tests were conducted to compare the two intervention groups at baseline.

Planned comparisons of the differences between the two intervention groups in Theory of Planned Behavior variables (i.e. attitude, subjective norm, intention, PBC) at baseline, post-intervention, 6 weeks and 6 months were conducted. Mixed effects linear models were fitted to compare the groups with a random practice effect to allow for clustering, adjusting for baseline Theory of Planned Behavior variables.

Mixed effects linear models were also used to assess the contribution of TPB variables to the prediction of intentions to walk more, and objective walking behavior, allowing for clustering at the practice level. For all analyses, intervention group was included in the model at step 1, as is good practice for running cohort analyses on trial data [40].

Where less than five minutes walking was recorded for any particular day, the reading for that day was treated as missing, and not used in calculating mean daily duration of walking. Missing values were imputed based on the baseline characteristics of the practice and individual, using predictive mean matching [41].

All analyses were completed using SPSS version 20.0.

3. Results

A total of 315 patients were allocated to receive one of the two interventions. Of those n = 136 received the self-regulation intervention and n = 179 received information provision. Of these 315 patients, 94% (n = 295) completed the Theory of Planned Behavior questionnaire immediately post-intervention, 77% (n = 242) completed this at 6 weeks, and 75% (236) completed this at 6 months. Some 88% of patients (n = 278) returned their pedometer immediately post-intervention, 78% returned this at 6 weeks (n = 248), and 73% returned this at 6 months. Fig. 1 shows the flow of patients through the study.

The mean age of the patients was 55.2 (SD = 9.30) years. Mean BMI was 30.03 (SD = 5.4) and the majority of patients were female (64.8%). Most patients self-categorized as British white (83.5%). Twenty-nine per cent of patients were employed full time, and 25% held a degree or postgraduate qualification.

3.1. Randomization check

There were significant differences in one of variables examined between the groups at baseline; the control group were slightly older (M = 56.22, SD = 8.32) than the intervention groups (M = 53.88, SD = 10.31; $t(254) = -2.178$, p = .030). No significant differences were found in the other nine variables examined (gender, BMI, ethnic group, employment status, education level, attitudes, subjective norm, perceived behavioral control, intention) suggesting randomization was successful.

3.2. Differences between groups in Theory of Planned Behavior variables over time

Table 1 shows group differences between intervention and control groups, controlling for baseline, in terms of Theory of Planned Behavior constructs. Significant differences were found between groups immediately post-intervention, with patients in the control group having higher subjective norms (F = 12.834, $t = -3.582$, p = .004). Subjective norm was still significantly higher in the control group compared to the intervention group at 6 weeks (F = 8.098, $t = -2.846$, p = .005) and 6 months (F = 6.167, $t = -2.483$, p = .028).

3.3. Predictors of intention

Theory of Planned Behavior variables at $t2$ significantly predicted intentions to walk more immediately post-intervention

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Table 1
Comparison of mean scores (with standard deviations) between groups on objective walking behavior psychological outcome measures at one week, 6 weeks and 6 months post-intervention.

	Intervention mean (SD)	Control mean (SD)	*p*-Value for difference	*F*-Value	*t*-Value
Objective walking behavior (min)[a]					
Post-intervention	27.16 (9.15)	26.08 (9.61)	.352	.925	.962
6 weeks	28.07 (8.01)	27.87 (9.84)	.845	.040	.200
6 months	20.44 (5.73)	19.50 (5.26)	.132	2.283	.132
Intention					
Baseline	5.93 (1.18)	5.96 (1.41)	.891[b]	.020	.140
Post-intervention	5.88 (1.67)	6.25 (1.42)	.061[c]	4.722	−2.173
6 weeks	5.67 (1.6)	5.69 (1.65)	.992[d]	.000	−.010
6 months	5.36 (1.42)	5.58 (1.44)	.652[e]	.215	−.463
Attitude					
Baseline	5.44 (1.46)	5.79 (1.54)	.169[f]	2.185	−1.478
Post-intervention	6.03 (1.04)	6.09 (1.37)	.735[g]	.115	−.339
6 weeks	5.56 (1.22)	5.69 (1.34)	.649[h]	.217	−.465
6 months	5.40 (1.32)	5.52 (1.58)	.625[i]	.253	−.503
Perceived behavioral control					
Baseline	6.02 (1.14)	6.01 (1.27)	.948[j]	.004	.065
Post-intervention	5.76 (1.27)	5.98 (1.32)	.135[k]	2.247	−1.50
6 weeks	5.57 (1.29)	5.67 (1.43)	.673[l]	.186	−.432
6 months	5.58 (1.26)	5.66 (1.37)	.667[m]	.189	−.435
Subjective norm					
Baseline	4.78 (1.45)	5.00 (1.46)	.175[n]	1.847	−1.359
Post-intervention	4.07 (1.85)	4.90 (1.93)	**.004**[o]	12.834	−3.582
6 weeks	3.88 (1.85)	4.56 (1.86)	**.005**[p]	8.098	−2.846
6 months	4.54 (1.30)	5.06 (1.34)	**.028**[q]	6.167	−2.483

Number of patients included in each analysis:
[a] 315,
[b] intervention—135, control—177,
[c] intervention—114, control—171,
[d] intervention—92, control—142,
[e] intervention—87, control—129,
[f] intervention—135, control—178,
[g] intervention—116, control—176,
[h] intervention—96, control—144,
[i] intervention—90, control—135,
[j] intervention—135, control—177,
[k] intervention—117, control—175,
[l] intervention—96, control—144,
[m] intervention—84, control—123,
[n] intervention—135, control—178,
[o] intervention—117, control—175,
[p] intervention—95, control—145,
[q] intervention—90, control—135.

(see Table 2). PBC was the only significant unique predictor in this model ($\beta = .716$, $t = 11.36$, $p < .001$). Similarly, PBC contributed unique variance to the model at time 3 ($\beta = .772$, $t = 10.708$, $p < .001$). Employment status also contributed unique variance in this model ($\beta = -.117$, $t = -2.112$, $p < .05$), those who were employed intended to walk more compared with those who were unemployed or self-employed. The TPB variables predicted intentions at *t*4, with both attitude ($\beta = .239$, $t = 3.67$) and PBC ($\beta = .510$, $t = 7.223$) contributing unique variance to this model (both $p < .001$).

3.4. Predictors of objective walking behavior

TPB variables did not predict objective walking behavior at any time point (all $p > .05$), as assessed by mixed linear effects modeling (see Table 3).

4. Discussion and conclusion

4.1. Discussion

There were no positive effects of the walking intervention on the proximal determinants of intentions to perform the behavior i.e. attitude, subjective norm and PBC. The control arm reported significantly higher subjective norm at post intervention ($p = .004$), 6 weeks and 6 months post-intervention ($p = .005$ and $p = .028$, respectively). The TPB variables predicted intentions to walk more, with PBC the largest predictor of intentions. The TPB variables did not predict objective walking behavior at any time point.

The findings in relation to the prediction of walking behavior are in line with those of the second study reported by Scott et al. [22], and those of Hardeman et al. [23], in which TPB variables failed to predict objectively measured walking behavior. Taken together, these three studies show that the TPB failed to significantly predict objectively measured walking behavior. These findings are in opposition to that found for general physical activity behavior, and call into question the utility of the theory in explaining this specific type of behavior. Indeed there has been recent debate regarding the ongoing usefulness of this theory in behavior change research [42]. One argument centers on the inability of the theory to predict large amounts of variance in behavior, specifically objectively-measured behavior. Furthermore, there is meta-analytic evidence that the use of both Social Cognitive Theory [16] and the Theory of Planned Behavior [12], in the design of interventions does not significantly enhance effectiveness [43]. The present study findings are consistent with this line of argument. By contrast it should be noted that the results are in line with the Theory of Planned Behavior [12] whereby a lack of positive change in the hypothesized intervention mediators resulted in a lack of change in outcomes.

Table 2
Mixed effects linear model analysis of intentions to walk, from TPB variables immediately post-intervention, 6 weeks and 6 months follow up.

Step	Variable entered	Beta	Standard error	*t*-Value	*p*-Value
Time 2 intention					
1	Intervention group	−.245	.166	−1.50	.180
2	Age	.008	.009	.861	.390
	Gender	−.041	.153	−.270	.787
	BMI	−.005	.014	−.379	.705
	Ethnic group	.043	.035	1.259	.218
	Employment status	−.007	.050	−.142	.887
	Education level	.039	.043	.908	.365
3	T2 attitude	.063	.072	.887	.376
	T2 subjective norm	−.009	.039	−.249	.803
	T2 PBC	.716**	.063	11.36	<.001
Time 3 intention					
1	Intervention group	.184	.167	1.103	.271
2	Age	.014	.011	1.348	.179
	Gender	.014	.172	.080	.936
	BMI	−.023	.016	−1.462	.145
	Ethnic group	−.027	.040	−.658	.511
	Employment status	−.117*	.055	−2.112	.036
	Education level	.003	.047	.057	.954
3	T3 attitude	.079	.080	.984	.326
	T3 subjective norm	.069	.045	1.531	.127
	T3 PBC	.772**	.072	10.708	<.001
Time 4 intention					
1	Intervention group	−.073	.212	−.346	.738
2	Age	.003	.010	.295	.769
	Gender	.195	.172	1.129	.260
	BMI	−.024	.015	−1.614	.108
	Ethnic group	−.045	.046	−.971	.335
	Employment status	.019	.056	.334	.739
	Education level	.026	.050	.532	.595
3	T4 attitude	.239**	.065	3.67	<.001
	T4 subjective norm	.063	.068	.934	.352
	T4 PBC	.510**	.070	7.223	<.001

* $p < .05$.
** $p < .001$ (2-tailed).

Alternatively, whilst research has supported the proposition of similarity between self-efficacy and PBC constructs [44,45], it has also been argued that PBC can be split into self-efficacy and control components [46]. Moreover, the recent Integrated Model of

Table 3
Mixed effects linear model analysis of objective walking behavior, from TPB variables immediately post-intervention, 6 weeks and 6 months follow up.

Step	Variable entered	Beta	Standard Error	*t*-Value	*p*-Value
Time 2 walking					
1	Intervention group	.921	1.22	.755	.451
2	Age	−.014	.077	−.183	.855
	Gender	−1.52	1.25	−1.214	.226
	BMI	−.067	.108	−.621	.535
	Ethnic group	−.273	.268	−1.018	.310
	Employment status	−.665	.408	−1.631	.104
	Education level	−.534	.353	1.513	.131
3	T2 PBC	−.033	.607	−.054	.957
	T2 intention	1.08	.512	.211	.833
Time 3 walking*					
1	Intervention group	.260	.145	.179	.861
2	Age	−.001	.088	−.011	.991
	Gender	−.221	1.41	−.157	.875
	BMI	−.078	.125	−.625	.533
	Ethnic group	.245	.340	.721	.473
	Employment status	−.547	.448	−1.22	.223
	Education level	.634	.388	1.64	.103
3	T3 PBC	.912	.683	1.335	.183
	T3 intention	.251	.561	.447	.655
Time 4 walking					
1	Intervention group	1.119	.922	1.214	.248
2	Age	.003	.054	.062	.950
	Gender	.392	.902	.434	.665
	BMI	−.136	.079	−1.730	.085
	Ethnic group	−.186	.227	−.821	.414
	Employment status	.074	.291	.254	.799
	Education level	.312	.254	1.227	.222
3	T4 PBC	.106	.393	.270	.787
	T4 intention	.686	.357	1.922	.056

* BC added significantly to the model at *t*3 ($\beta = 1.179$, $p = .018$) when intention was removed.

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Behavioral Prediction [IMBP: 47] posits the importance of self-efficacy, rather than PBC, in influencing intentions to perform the behavior. In the present study self-efficacy was not measured, therefore it possible that the inclusion of self-efficacy measures in addition to PBC measures might have resulted in significant prediction of behavior in the present trial.

The findings in relation to the failure of the intervention to change behavior are inconsistent with previous evaluations of an earlier version of the same intervention with a volunteer population [26,29]. It is possible that the modifications made to the intervention may have been responsible for this difference, specifically the removal of barrier identification and the inclusion of providing feedback on performance. It should be noted however that these modifications were based on developmental work on the intervention, which was otherwise unchanged.

Another possible explanation that we believe is more likely to be responsible for the lack of effects of the intervention on behavior relates to the suitability of the BCTs for the sample recruited. In the present study the mean BMI of the sample was over 30 kg/m^2 and the mean age was over 55 years. The BCTs included in the present intervention were included on the basis of recent reviews of physical activity interventions for adult non-clinical populations [33,49]. Whilst these techniques would be suitable for a younger non-obese population, for which the intervention was originally developed, they may not be suitable for prompting behavior change in the population who were subsequently recruited to this trial. Recent reviews with obese and older adults have reported substantially different behavior change techniques associated with increases in self-efficacy and physical activity [50,51]. In samples of adults over 60 years of age interventions containing self-regulation techniques i.e. action planning and goal setting, were less effective [51]. Nevertheless, no significant differences were found in the ability of TPB constructs to predict walking behavior according to participants' BMI status, as assessed by moderated hierarchical regression analysis. Thus BMI did not act as a moderator of TPB-behavior effects in the present study.

An alternative reason for the lack of changes in behavior in this study concerns a lack of fidelity of intervention delivery. Although each person delivering the intervention needed to reach a set level of competence, previous studies of health behavior change interventions have reported modest adherence to intervention protocols [48]. The lack of any positive changes on hypothesized mediators in even the short term suggests that the intervention was not delivered correctly.

In the present study, patients in the control condition reported significantly higher levels of subjective norm at all post-intervention time points. Patients in the control condition engaged in a dialogue in which they were informed that the PN/HCA, i.e. a significant other, thought that they should increase their walking behavior. Furthermore, the individual focus of the intervention may have detracted from the valued social aspects of walking, which has been found to be an important predictor of walking maintenance [52].

The present study has a number of strengths that make it appropriate for meeting its aims. It took place in a clinical setting and involved patients and practice nurses/HCAs from twenty-one general practices in four primary care trusts, all of which were characterized by marked variation in extent of urbanization and social deprivation. Furthermore, we used a reliable objective measure of walking instead of the self-report measures used frequently in other studies [39]. Furthermore, behaviors and measures selected in the current study were specified in terms of the TACT principle for the analyses conducted [53]. That is, the TPB and behavior measures were at the same level of generality i.e. walking for at least 30 min a day on average over the next 7 days.

Another strength is that this intervention is the result of formative research involving a qualitative exploration of the acceptability of the previous version of the walking intervention [26] to those who were to deliver, and receive, the intervention in general practice. A pilot trial to refine and improve the procedures, intervention and measures was also conducted. Furthermore, the intervention was improved based on recent research identifying the most effective techniques for altering self-efficacy beliefs [33,49]. Therefore we are confident that the intervention was acceptable and that the trial was run rigorously.

One limitation of this study is that we are unable to determine the extent to which each intervention technique was delivered by each practice nurse or HCA (in contrast to the pilot study). Furthermore, the influence of comorbidities was not accounted for in the present analysis. Finally, it is possible that the use of single-item measures for TPB constructs might have influenced the ability of the measure to assess significant changes in these variables. However, recent research has reported limited difference in single- and multiple-item measures in terms of predictive validity [56].

4.2. Conclusions

In the present study a previously successful walking intervention failed to change Theory of Planned Behavior variables in a general practice population, suggesting that behavior change techniques were delivered ineffectively. The present study demonstrates the importance of the context within which behavior change are delivered, to ensure these are facilitative to the delivery of theory-based interventions. There are a number of lessons that can be learnt from the present study specifically related to this issue [36]. First, the additional training and workload associated with delivery of the intervention was considered an unwelcome additional burden for providers. Second, financial reimbursement provided to the practices was often not passed on to the individual, thus incentive structures will not ensure correct delivery of such interventions. Finally, nurses' lacked confidence in delivering the theoretical aspects of the intervention [10], in which the patient was required to be active rather than passive in the consultation. This challenged the nurses' previous training (e.g. focusing on making people feel comfortable). Practices nurses and HCAs are thus arguably not best placed to deliver behavior change interventions.

Furthermore, it is essential that behavior change techniques are matched to the population under investigation in order to engender behavior change, as techniques suitable for one population might have a deleterious effect in another [49–51]. It is therefore important that future research pays attention to the suitability of interventions that were developed for one population for a different population.

4.3. Practice implications

The present intervention failed to change objectively measured walking behavior, and its associated psychological mediators i.e. TPB variables. The use of psychological theory in trials of behavior change interventions allows us to understand the reasons why the intervention did not work. Without an assessment of psychological variables it is impossible to delineate whether a) the intervention failed to change mediators of behavior i.e. TPB variables, or b) whether mediators failed to change behavioral outcomes.

Furthermore, whilst health behavior change interventions are increasingly being delivered by practice nurses in general practice in the UK, it is important that future studies assess the appropriateness of this. Evidence is accumulating from several trials of interventions delivered by routinely-employed general practice staff that this is resulting in limited change in health-related behavior

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[9,54,55]. Therefore, whether practice nurses and HCAs are best placed to deliver such interventions remains to be seen. It is possible that having the intervention delivered by a health professional i.e. health trainer external to the general practice might be more appropriate as delivery is less likely to be hindered by organizational issues.

Ethical approval

Ethical approval for the present study was given by Coventry University Ethics Committee and Birmingham East, North and Solihull NHS Research Ethics Committee (Reference: 09/H1206/116).

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

Conflict of interest statement

None.

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