

Review Article

EFFECTIVENESS OF TELEPHONE-DELIVERED INTERVENTIONS FOR INCREASING PHYSICAL ACTIVITY LEVELS IN PERSONS WITH TYPE 2 DIABETES OR HYPERTENSION: A SYSTEMATIC REVIEW

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ABSTRACT

Objective: Telephone calls can potentially be an accessible and cost-effective modality for delivering physical activity (PA) interventions to primary care patients. This review aims to evaluate the effectiveness of telephone counseling to increase PA levels in persons with type 2 diabetes (T2D) or hypertension.

Methods: A systematic search (to May 2014) was conducted on the following databases, CINHAL, EMBASE, MEDLINE, Pub Med, and Psych INFO. Articles were included if they contained a control group, included participants with T2D or hypertension, implemented predominantly a PA intervention, included PA as a primary outcome measure, and used telephone calls as a predominant delivery method for the intervention.

Results: Thirteen articles that reported on eight studies were included in the final review. All eight studies assessed PA levels at the end of the intervention (post-intervention), and five studies assessed PA levels at follow-up. Post-intervention, 5/8 studies produced a significant effect on PA outcomes (with increases in PA favoring the experimental group). Large effect sizes (Cohen's $d > 0.8$) were calculated for three studies, and a medium (Cohen's $d: 0.5-0.79$) and small effect sizes (Cohen's $d: 0.2-0.49$) were calculated for one study. At follow-up, 3/5 studies produced a significant effect on PA outcomes. One study reported a large effect size and two studies reported a small effect size.

Conclusions: Telephone calls show promise for delivering PA interventions for persons with T2D. No conclusions can be made regarding the effectiveness of telephone calls for persons with hypertension (only one study reported the number of patients with hypertension).

Keywords: Physical activity, Exercise, Telephone, Type 2 Diabetes, Hypertension.

INTRODUCTION

Over 300 million people worldwide have diabetes [1] and 972 million are living with hypertension [2]. With rising obesity rates and increasingly sedentary lifestyles, these numbers are projected to increase [2, 3]. Type 2 diabetes (T2D) and hypertension (HTN) are commonly co-occurring conditions; approximately 70% of patients with T2D are diagnosed with HTN [4]. Both conditions gradually damage the vascular system, and when left unmanaged can result in debilitating long-term complications including, cardiovascular disease (CVD), neuropathy, kidney damage, and retinopathy.

The health benefits of physical activity (PA) in the management of T2D and HTN are well established and include decreases in insulin resistance, blood pressure, mortality due to CVD, and overall mortality [5-8]. Nonetheless, levels of physical inactivity persist in persons with T2D and HTN [9, 10]. In Canada, approximately 60% of middle-aged adults and 75% of older adults with diabetes are not sufficiently active to receive these health benefits [9]. In addition, approximately 58% of Canadians with hypertension are physically inactive [10].

Telephone calls are a highly accessible, cost-effective modality for delivering PA interventions [11-13]. A recent review assessing the effectiveness of telephone calls for delivering PA and dietary interventions found that phone calls were a viable modality, resulting in effects comparable to in-person instruction and online interventions [13]. To date no review has evaluated the efficacy of this modality for increasing PA levels specific to persons with T2D or HTN. As a result, the purpose of this review is to evaluate the effectiveness of telephone-delivered PA interventions for increasing PA levels in persons with T2D or HTN.

Methods

Search strategy

An electronic search was conducted in May 2014 using CINHAL (May 2014), EMBASE (1996 to May 2014), MEDLINE (1946 to May 2014),

Pub Med (May 2014), and Psych INFO (May 2014). Keyword searching was performed using the following terms: (telephone OR phone) AND (physical activity OR exercise) AND (hypertension OR high blood pressure OR type 2 diabetes OR NIDDM OR non-insulin dependent diabetes). Additional terms were applied when databases identified a preferred term (e. g. in Pub Med "motor activity" was searched in addition to "exercise" and "physical activity"). A detailed example of the full electronic search strategy for Psych INFO is provided (table 1). In addition, the references of articles meeting the inclusion criteria from the electronic search were screened for additional articles.

Table 1: Keyword search strategy performed in PsychINFO (May2014)

1	Telephone.mp.
2	Phone.mp.
3	exp Exercise/
4	exp Aerobic Exercise/
5	exp Physical Activity/
6	exp Hypertension/
7	High blood pressure.mp.
8	Type 2 diabetes.mp.
9	NIDDM.mp.
10	Non-insulin dependent diabetes. mp.
11	1 or 2
12	3 or 4 or 5
13	6 or 7 or 8 or 9 or 10
14	11 and 12 and 13

Study selection and eligibility criteria

Two reviewers (CD, EM) independently screened the search results. A third reviewer (JR) was consulted in the case of discrepancies.

Only full text, peer-reviewed, primary research articles were reviewed. To assist with the comparison of results, similar inclusion criteria were applied as those used in a recent review evaluating telephone counseling for PA and diet [12, 13]. Articles were included if they 1) described a randomized controlled trial or quasi-experimental design with a control group, 2) included participants with type 2 diabetes or hypertension, 3) implemented a predominately PA intervention (i.e. PA only, or PA in addition to one other intervention), 4) included PA as a primary outcome measure, 5) used telephone calls as a predominant delivery method (i.e. a minimum of 50% of total contacts were conducted over the phone), 6) reported a mean age >40 y, and 7) were published in English. Studies were excluded if they included participants without HTN or T2D.

Data extraction and Quality assessment

Two reviewers (CD, EM) used a pre-tested standardized form to extract data from the reviewed studies, independently extracted data related to the study population (medical conditions, diagnostic criteria for T2D and HTN, age, sex, recruitment setting), study design, intervention components in addition to phone calls, study length, follow-up, attrition, characteristics of phone calls (frequency, duration, theory, individuals delivering phone call), comparison group conditions, and outcomes. The quality of studies included in the final review was assessed independently by the same two reviewers (CD, EM) using the Delphi list [14], a set of criteria for assessing the quality of RCTs to be included in systematic reviews.

Data analysis

Standardized mean differences (Cohen's d) were calculated for PA outcomes to determine the effect to which telephone counseling was able to influence increases in PA among study participants. The following criteria were applied when determining the effect size: small: 0.2-0.49; medium: 0.5-0.79; large: >0.8 [15]. If multiple PA outcome measures were provided for a study, calculations were conducted using objective measures (i.e. accelerometers, pedometers) over subjective measures (i.e. self-report measures). If total PA and moderate to vigorous physical activity (MVPA) were both reported, effect size was calculated using MVPA since MVPA is the intensity of exercise recommended for this population. Lastly, if measures from an accelerometer and pedometer were both available, calculations were conducted using values from the accelerometer since accelerometers are able to determine the intensity of physical activity.

RESULTS

Initial database searching generated 850 possible articles. Six hundred and thirty three articles remained after duplicates were removed and 113 articles were retrieved for full text screening. Reasons for exclusion at the full text stage are provided in fig. 1. One article met the inclusion criteria from screening references. In total, thirteen articles were included in the final review. These thirteen articles reported on eight different studies, which included seven RCTs [16-27] and one quasi-experimental trial (pre-and post-test design) with a control [28]. Of the nine items assessing methodological quality, the number of items met ranged from 4/9 to 6/9 items. The most common item not reported was whether outcome assessors were blinded. Details on methodological quality are shown in table 2.

Characteristics of study participants

The eight studies included in this review are summarized in table 3. All eight studies had an inclusion criterion for a diagnosis of T2D. One study had an inclusion criterion of HTN in addition to T2D [17, 18], however hypertension was reported among participants in four studies [15-18, 21, 23-25]. Two studies reported criteria for establishing T2D diagnosis [23-26]. One study [26] specified cut-offs for fasting blood glucose (>7.0 mmol-L-1) and HbA1c% levels (>6.5%), while the other [23-25] used established criteria from the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus [28]. The study recruiting participants with HTN did not report how diagnosis was established [17, 18]. Six studies excluded persons with known CVD [15, 16, 27]. One study excluded participants completing 150 min of moderate to vigorous physical activity a week [19, 20], another study only included participants who intended but were not meeting this recommendation [23-25].

The mean ages of participants ranged from approximately 53 y to 63 y, and the percentage of women included ranged from 31% to 51.28%. In addition to T2D and HTN, other conditions reported by participants were obesity [15-21, 23-27] and myocardial dysfunction [21]. Participants were recruited primarily from outpatient clinics, and primary care practices. One study recruited patients from multiple sources including, hospital and community clinics, pharmacies, diabetes education center, the Canadian Diabetes website and newsletters, TV broadcasts, newspaper ads, and participants from a previous study [22].

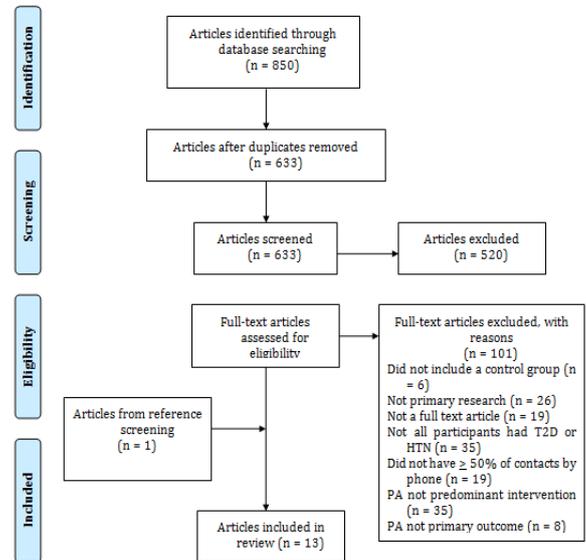


Fig. 1: PRISMA flow diagram detailing inclusion and exclusion of articles for review

Characteristics of intervention

Interventions ranged from three to eighteen months. Five studies included a follow-up period; length of follow-up was six-months for four studies [15-20, 27], and one-month for one study [23-25]. In addition to phone contacts, five studies involved at least one in-person session [15, 16, 21-26], six employed a pedometer [15-20, 22, 26, 27], three provided print material [17, 18, 23-25, 27], and five utilized activity logs [15, 16, 19, 20, 22, 26, 27]. Six studies reported use of a theoretical framework. One study [27] was informed by an Integrated Stage Model, which applied constructs from the following theories: Theory of Planned Behaviour (TPB), the Health Belief Model (HBM), Protection Motivation Theory (PMT), Social Cognitive Theory (SCT), and the Transtheoretical Model (TTM). The TTM (22-25) and the SCT (17-20) each informed content of two studies, and the Cognitive Behaviour Theory (CBT) [15, 16] and Social Ecological Model (SEM) [17, 18] each informed one study. The goal of all but one study [15, 16] was to have participants achieve 150 min of moderate to vigorous activity per week; two studies set a higher goal for participants with the goal that overshooting the guidelines would ensure that 150 min of moderate to vigorous activity were met [12, 19, 26]. Details on the study intervention for each study are provided in table 3.

Both objective and subjective measures were used to assess physical activity levels for participants in all studies. Objective measures included the 3-day pedometer step count (ICC > 0.8) [29], accelerometer (ICC = 0.62-0.80) [30], and heart rate monitor (ICC > 0.8) [31]. The subjective measures include the International Physical Activity Questionnaire (ICC = 0.68) [32], the Active Australia Survey (ICC = 0.64) [32], 7 d PA recall (ICC = 0.8-0.9) [33], and the God in Leisure Time Exercise Questionnaire (ICC = 0.62-0.81) [34]. Both the subjective and objective measures have also been determined to have an acceptable reliability (ICC: poor < 0.40, fair: 0.40-0.59, good: 0.60-0.74, excellent: 0.75-1) [35].

Table 2: Assessment of methodological quality using the Delphi list

Articles	1. Treatment allocation		2. Were the groups similar at baseline regarding the most important prognostic indicators?	3. Were the eligibility criteria specified?	4. Was the outcome assessor blinded?	5. Was the care provider blinded?	6. Was the patient blinded?	7. Were point estimates and measures of variability presented for the primary outcome measures?	8. Did the analysis include an intention to treat analysis?
	a) Was a method of randomization performed	b) Was the treatment allocation concealed?							
De Greef <i>et al.</i> Van Dyck <i>et al.</i> [15, 16]	Yes	Don't know	Yes	Yes	Don't know	No	No	Yes	Yes
Eakin <i>et al.</i> [17, 18]	Yes	Don't know	Yes	Yes	Don't know	No	No	Yes	Yes
Eakin <i>et al.</i> [19, 20]	Yes	Don't know	Yes	Yes	Yes	Don't know	Don't know	Yes	Yes
Hordern <i>et al.</i> [21]	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Kim <i>et al.</i> [22]	Yes	Don't know	Yes	Yes	Don't know	No	Don't know	Yes	Don't know
Kirk <i>et al.</i> (23-25)	Yes	No	Yes	Yes	Don't know	No	Yes	Yes	Yes
Marios <i>et al.</i> [26]	Yes	Don't know	Yes	Yes	Don't know	No	Don't know	Yes	Yes
Plotnikoff <i>et al.</i> [27]	Yes	Yes	Yes	Yes	Don't know	Don't know	No	Yes	Yes

Table 3: Summary of included studies containing a telephone delivered physical activity intervention

Source	Characteristics of participants	Intervention components in addition to phone calls/comparison group/study length/follow-up/attrition	Characteristics of phone calls: frequency/duration/deliverer/theory	Physical activity outcome measure
DeGreef (2011) Van Dyck [15, 16] (2013) Belgium n=92	T2D 62 (9) years 31% female Recruited from endocrinology department of a university hospital	In-person counselling session, pedometer, logbook Control: usual care 24 w intervention Follow-up at 1 y 4.35% attrition at follow-up	7 total calls, once every 2 w for first 4 w, and every 4 w for the next 20 w 15-20 min Psychologist Cognitive Behavioural Theory	3-day pedometer step count Accelerometer International PA Questionnaire
Eakin [17, 18] (2009, 2010) Australia n= 434	T2D or HTN 58.2 (11.8) years 61% female Recruited from primary care practices	Workbook, pedometer Control: usual care, brief written feedback after each assessment, newsletter, and brochures on PA and diet 12 mo intervention Follow-up at 18 mo 27.4 % attrition at follow-up	18 calls over 12 mo, tapered schedule of biweekly, then monthly Mean call duration of 18.2 (4.1) minutes Master's student in nutrition Social Cognitive Theory, Social Ecological Model	CHAMPS Active Australia Survey Two items from U. S National Health Interview Survey
Eakin [19, 20] (2013, 2014) Australia n= 302	T2D 58 (8.6) years 44% female Recruited from primary care practices	Logbook, pedometer, scale Control: usual care, standard diabetes self-management brochures, brief written feedback after each assessment 18 mo intervention Follow-up at 24 mo 17.5% attrition at follow-up	27 phone calls over 18 mo, 4 initial weekly calls, fortnightly calls for 5 mo, monthly calls for 12 mo 24.6 (10.6) minutes Research staff Social Cognitive Theory	Accelerometer
Hordern [21] (2009) Australia n=223	T2D 55.55 y 45% females Recruited from hospital clinics and community	Initial 4 w supervised gym-based exercise training Control: usual care, standard risk factor intervention for diabetes 12 mo intervention No follow-up 21% attrition	23 phone calls over 12 mo, 9 wly for 1 st 3 mo, biweekly for next 3 mo, then monthly for 6 mo Not reported Not reported	The Active Australia Survey

Kim [22] (2004)	T2D 53.29 (10.21) years 37.8% female	Initial in-person counselling session, exercise test to develop action plan, logbook, pedometer	Phone calls twice per week for 3 mo 10-30 min per call	Adapted 7-day PA recall
South Korea n=45	Recruited from outpatient diabetic center at large university hospital	Control: usual care, educational advice 3 mo intervention No follow-up 0% attrition	Researcher Transtheoretical Model	
Kirk (23-25) (2003, 2004, 2004)	T2D 57.6 (7.9) years 50% female	In-person counselling at baseline and 6 mo, provided standard exercise leaflet	Phone calls at 1, 3, 7, and 9 mo Not reported	7-day PA recall Accelerometer
Scotland n=70	Recruited from diabetes outpatient clinics	Control: usual care, provided standard exercise leaflet, phone calls discussing topics unrelated to exercise 9 mo intervention Follow-up at 12 mo 15.71% attrition at follow-up	Exercise science graduate Transtheoretical Model	
Marios [26][22] (2012)	T2D 63.42 y 51.26% female	2 in-person counselling sessions, walking program, pedometer, logbook, HR monitor	Phone calls weekly for 6 mo 5-15 minute duration	Logged hours of PA on HR monitors for intervention group, and in logbook for control group
Australia n= 39	Recruited from ads posted in endocrinologist's and GP's office, and university's website	Control: walking program, goal of 180 min/week of PA, taught to take pulse by hand, logbook 6 mo intervention No follow-up 33.33% attrition	Exercise physiologist Not reported	
Plotnikoff [27] (2012)	T2D 61.6 y 46.1% female	Standard print educational PA material, stage specific PA print material, pedometer, logbook	Phone calls weekly for 1 st month, biweekly for 2 nd month, and monthly for 10 mo	Modified Godin Leisure Time Exercise Questionnaire 3-day pedometer step count
Canada n= 287	Recruitment from multiple sources (community pharmacies, main community centers)	Control: usual care, standard print PA educational material, goal of minimum 150 min of MVPA/week 12 mo intervention Follow-up at 18 mo 13.59% attrition at follow-up	15 min per call Graduates in health promotion or psychology Integrated Stage Model	

Summary of characteristics of phone calls for all studies

The phone calls addressed exercise behaviour exclusively in six studies, and in three studies diet was also addressed (17-21). Call frequency ranged from weekly to bimonthly, and the duration of phone calls ranged from 5-30 min. The individuals who conducted the phone calls included: research staff [19, 20, 22], a master's student in nutrition [17, 18], an exercise physiologist [26], a psychologist [15, 16], and graduates in exercise science (23-25), health promotion, and psychology [27]. Although all studies involved a telephone counselor only three studies provided training to those delivering the phone calls [17, 18, 27]. Two studies [17, 18] covered the following topics during training: PA promotion, motivational interviewing techniques, and constructs of SCT. The other study [27] included information related to, the TTM, T2D, PA and older adults, the Canadian Diabetes Association PA guidelines, motivational interviewing techniques. Details of the content of the phone calls for each study are provided in the table 3.

Effect of telephone counseling on physical activity levels

All eight studies assessed PA levels at the end of the intervention (post-intervention), and five studies assessed PA levels at follow-up (15-20, 23-25, 27). At post-intervention, 5/8 studies reported a significant effect on PA, and increases in PA favoured participants in the experimental group. Large effect sizes (Cohen's $d > 0.8$) were calculated for three studies (SMD= 0.99 [95% CI: -61.93, 63.91] [26], SMD= 0.89 [95% CI: -634793.14, 634794.92] (23-25), SMD= 1.43 [95% CI: -4.54, 7.40] [22]), a medium effect size (Cohen's d : 0.5-0.79) for one study (SMD= 0.50 [95% CI: -17.41, 18.42] [21]), and a small effect size (Cohen's d : 0.2-0.49) for another study (SMD= 0.34 [95% CI: -27.57, 28.26] [19, 20]). Three studies reported a significant effect on physical activity levels at follow-up, one study reporting a large effect size (Cohen's $d > 0.8$; SMD= 0.83 [95% CI: -671103.89, 671105.54] (23-25)) and two studies reporting a small effect size (Cohen's d : 0.2-0.49; SMD= 0.33 [95% CI: -25.96, 26.62][19, 20], SMD=0.26 [95% CI: -8.18, 8.69] [15, 16].

DISCUSSION

This systematic review evaluated the effectiveness of telephone-delivered interventions to increase PA levels in persons with T2D and/or HTN. Thirteen articles reporting on eight different studies were included in the final review. All eight studies had an inclusion criterion for a diagnosis of T2D. One study had an inclusion criterion of HTN in addition to T2D [17, 18], however hypertension was reported among participants in four studies [15-18, 21, 23-25].

All studies reported participants with levels of blood pressure consistent with diagnosis of HTN (systolic > 140 mm Hg or diastolic > 90 mm Hg). However, while four studies reported hypertension among participants, the number or percentage of participants with hypertension was not reported in three of the four studies reporting hypertensive patients. In addition a subgroup analysis was not conducted to determine if HTN had a moderating effect on PA levels among the four studies including patients with HTN. As a result no conclusions can be made regarding the effectiveness of telephone counseling in this population. In addition to determining the effectiveness of telephone counseling for increasing PA levels in persons with hypertension, it would be important to include this sub analysis given that persons with T2D who are also hypertensive are at an even greater risk of complications.

Overall, it is likely that telephone counseling is an effective modality for delivering physical activity interventions to persons with T2D. Telephone counseling increased PA levels above that of usual care. Post-intervention, 5/8 studies (19-26) produced a significant effect on PA outcomes at the conclusion of the intervention. In addition, to the five studies that included a follow-up, three studies [15, 16, 19, 20, 23-25] produced a significant effect on PA outcomes at follow-up.

One study [17, 18] that did not produce a significant between-group difference reported significant within-group increases in PA for both the experimental and control groups post-intervention and at follow-up ($p < 0.001$; increases in minutes/week of MVPA post-

intervention 71.19 (14.20), 82.23 (14.91) and follow-up 62.19 (14.20), 74.73 (14.91) for experimental and control group respectively). Increases among participants in the control group may have occurred simply by measuring PA, or because persons choosing to participate were motivated to increase their current levels of PA [17, 18]. Another study [27] that did not produce a significant between-group difference produced an effective post-intervention and at follow-up when the analysis controlled for gender. Women in the treatment group reported larger increases in number of steps compared to controls both post-intervention ($p=0.008$) and at follow-up ($p=0.03$). Post-intervention the mean difference for the 3-day step count was 5,964 steps; 95% CI= 1,540 to 10,388, and at follow-up, 5,044 steps; 95% CI 553 to 9,535.

Age did not have a moderating effect on PA [27]. Of the two studies assessing the effect of gender, one reported a moderating effect for gender on PA [27], and one did not (23-25). In the study reporting an effect [27], a between-group difference was reported in the increase in steps/day for women, favoring the experimental group post-intervention ($p= 0.008$), and at follow-up ($p= 0.03$), while no difference was reported for men ($p= 0.21$). This gender difference may in part be accounted for by a ceiling effect present among men [27]. Men reported higher levels of PA at baseline compared to women, possibly creating a ceiling effect for men [27]. Future studies should include a subgroup analysis for both age and gender to determine whether moderating effects exist for these variables.

Only three studies reported the number of phone calls received by participants (17-20, 27). Reporting the percentage of calls actually received by participants may assist in determining the frequency of calls deemed acceptable and helpful to the participant. Costs associated with providing an excessive number of calls could include loss to follow-up due to invasiveness, and additional financial costs associated with unnecessary phone calls.

Several theories were applied to develop the interventions for the included studies. Currently, there is no consensus with regards to which theory should inform interventions aimed at increasing PA levels. Future studies should conduct interviews to explore which self-management strategies (i.e. action planning, coping planning, goal setting etc.) are found helpful for increasing PA levels.

Telephone counseling is an accessible modality to delivering PA interventions for persons with T2D. Results of this systematic review are similar to findings reported in a review evaluating telephone-delivered PA and dietary interventions for T2D [12, 13]. Fourteen of seventeen studies delivering a PA only intervention produced significant results post-intervention, while 2/8 studies produced significant results at follow-up.

Limitations

Studies were not included if the focus of the intervention was not a PA intervention (i.e. PA only, or PA in addition to one other intervention). This restriction was necessary to isolate the time spent delivering PA related information; however no conclusions can be drawn about the effectiveness of PA interventions as part of a larger multifactorial intervention (i.e. smoking cessation, diet, foot care).

CONCLUSION

Telephone counseling significantly increased PA levels compared to usual care in persons with T2D. Significant effect sizes were reported for 63% of the studies post-intervention, and in 60% of the studies at follow-up. While four studies reported participants with HTN, the number or percentage of participants with hypertension was not reported in three of the four studies reporting hypertensive patients. In addition, a subgroup analysis was not conducted to determine if HTN had a moderating effect on PA levels. As a result no conclusions can be made regarding the effectiveness of this intervention for this population. Future studies should focus on the following:

- Comparison of telephone counselling to in-person instruction and online interventions
- The effect of age and gender on increases in PA
- The relationship between the frequency of phone calls and PA

- Self-management strategies (i.e. action planning, coping planning, goal setting etc.) that increased PA. Currently, there is no consensus with regards to which theory best informs interventions aimed at increasing PA levels, therefore future studies should conduct interviews to explore which self-management strategies (i.e. action planning, coping planning, goal setting etc.) of the theory participants found helpful for increasing their PA levels.

CONFLICT OF INTERESTS

Cara Dhaliwal, Erin Macpherson, and Julie Richardson declare that they have no conflict of interest.

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