Peer-delivered physical activity interventions: an overlooked opportunity for physical activity promotion

Kathleen A Martin Ginis,¹ Claudio R Nigg, PhD,² Alan L Smith, PhD³

¹Department of Kinesiology,
McMaster University, 1280 Main
Street West, Ivor Wynne Centre
E212, Hamilton, ON L8S 4K1,
Canada

²Department of Public Health
Sciences, John A. Burns School of
Medicine,
University of Hawaii at Manoa,
Honolulu, HI, USA

³Department of Kinesiology,
Michigan State University, East
Lansing, MI, USA

Correspondence to: K Ginis
martink@mcmaster.ca

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Abstract

The purpose of this systematic review was to catalogue and synthesize published studies that have examined the effects of peer-delivered physical activity interventions on physical activity behavior. Ten published studies were identified that met the inclusion criteria. The following information was extracted from each study: study design and duration; characteristics of the sample, peers, and interventions; and physical activity outcomes. In all articles reporting within-groups analyses, peer-delivered interventions led to increases in physical activity behavior. When compared to alternatives, peer-delivered interventions were just as effective as professionally delivered interventions and more effective than control conditions for increasing physical activity. Only three studies included measures of social cognitive variables, yielding some evidence that peers may enhance self-efficacy and self-determined forms of motivation. Based on these findings, interventionists are encouraged to include peer mentors in their intervention delivery models. Investigators are encouraged to pursue a more comprehensive understanding of factors that can explain and maximize the impact of peer-delivered activity interventions.

Keywords

Exercise, Fitness, Peer mentors, Social influence, Social cognitive theory, Self-determination theory

BACKGROUND

Previous research has shown that regular physical activity (PA) contributes to the prevention of overweight/obesity [1–3], decreases risk for obesity-related illnesses [4, 5], and is associated with decreased risk for coronary heart disease [6], hypertension, type 2 diabetes mellitus [1, 2], and cancer at several sites [7]. These benefits have also been reported in subpopulations such as older adults [8] and persons with disabilities [9]. Unfortunately, most adults do not perform PA at the recommended level to experience such health benefits [10, 11]. Indeed, 39 % of adults are completely sedentary [11], and the rate of inactivity increases with age [8, 12] and physical impairment (e.g., [13]).

Although health care professionals often hold a role of trusted counselor or health mentor for their

Implications

Practice: Peer mentors are viable physical activity intervention delivery agents who can provide various types of support including assistance with problem solving, opportunities for information sharing, motivation, encouragement, and realistic observation and feedback.

Policy: When developing staffing plans, physical activity prescription is typically the responsibility of professionals; however, the implementation of those prescriptions can be administered by peers, an approach that may ultimately enhance the reach of physical activity interventions.

Research: Further theory-driven research is needed to determine the mechanisms by which peers exert influence over physical activity behavior and to understand the factors that can maximize the impact of peer-delivered interventions.

patients [14, 15], it is not always easy or practical for clinicians to deliver physical activity interventions during a routine office visit. Indeed, there are numerous barriers including limited time, a lack of coding options for health behavior counseling, and minimal training in physical activity and counseling. Furthermore, there are shortages of nurses, physicians, clinicians, and fitness professionals [16, 17], thus limiting the number of professionals who can deliver physical activity interventions. These limitations speak to the need to explore other approaches to intervention delivery.

In recent years, there has been considerable interest in the utility of physical activity intervention delivery through passive electronic strategies (e.g., texts and websites [18]). Although these methods certainly have their advantages, they also have inherent limitations. In particular, the type and amount of information cannot always be precisely tailored to the user's needs at a particular moment. Conversely, interactive me-

diums of intervention delivery—such as discussion groups, educational, or counseling sessions [19]—can provide information as needed or, at minimum, direct people to additional resources. Interactive modes also provide personal contact, which may be particularly important for people in the early stages of behavior change. Indeed, a scoping review and focus group study of physical activity informational preferences among people with spinal cord injury [19, 20] revealed that individuals prefer interactive, face-to-face intervention delivery methods when they are first learning to become more physically active; passive, electronic intervention approaches become more appealing once individuals have some experience being active. Interestingly, the scoping review and focus group study also found that while health care professionals are a preferred source of physical activity information, peer mentors are also considered highly valued and credible messengers for delivering physical activity interventions.

Peer Mentors and Health Intervention Delivery

Peer mentors are individuals who have successfully faced a particular experience and can provide good counsel and empathic understanding to help others, with similar salient population characteristics, through a comparable experience [21, 22]. Given the mentor's experiential knowledge, the mentor is able to provide support that matches the needs of the recipient, along with role modeling, and an opportunity for believable hope [23]. Thus, the essence of peer mentorship is mutual identification (i.e., between the mentor and the support recipient) and the sharing of experiential knowledge [26].

Within health promotion contexts, peer mentors are typically recruited by health professionals or community program developers and receive training to enable the use of their experiential knowledge and unique understanding of the target population to advance program objectives (e.g., increase awareness and change health practices) [26]. They are considered a “created” source of social support because they provide emotional, appraisal, and information support that recipients may not be able to obtain from their natural support networks of friends, family members, and others who lack the peer mentor's experiential knowledge [26]. Specific examples of peer mentor support can include providing assistance in problem solving, opportunities for information sharing, motivation, encouragement, and realistic observation and feedback [24].

There are important distinctions between peer mentors and other types of people who provide social support in health contexts. In particular, peer mentors differ from laypersons/advisors in three key ways: (1) laypersons/advisors are often neighbors, friends, or coworkers and thus are not part of a *created* social network; (2) experiential knowledge and mutual identification are not defining attributes of the support provided by laypersons/advisors; and (3) laypersons/

advisors generally do not work in professional or community programs [26]. Peer mentors are also distinct from community health workers, health coaches, and health promoters—individuals who typically receive specialized training (e.g., how to screen for diseases, navigate the health care system, and access health insurance) beyond how to share experiential knowledge [24]. In her concept analysis of peer support, Denis [26] noted that peers who receive such specialized training may be perceived as professionalized (i.e., “paraprofessionals”), thus diminishing their mutual identification with clients and shifting their accountability from the population to the health care system. As such, peer mentors are distinguished from other “paraprofessional” support providers on the basis of their training.

Although peer mentoring was originally developed and implemented in business and educational settings [24], emerging literature suggests that it has a role in health care (e.g., [25, 26]). For instance, a review of peer mentor interventions in cardiac rehabilitation settings [25] concluded that such programs have the potential to enhance patient recovery and to lighten the financial burden on the health care system. Other research points to the value of peer-delivered interventions for helping patients learn skills that will aid in their recovery or management of a chronic condition—skills such as using a wheelchair [27] or controlling blood glucose levels [28].

With regards to physical activity, Webel and colleagues [29] conducted a systematic review of the effectiveness of peer-based interventions on various health-related behaviors. They included five studies with measures of physical activity and reported significant effects for three of these studies. However, in two of the studies [30, 31], the interventions were delivered by laypersons, not peers. Of the remaining three studies, none included an intervention specifically designed to increase physical activity—one intervention was designed to increase self-efficacy after myocardial infarction [32] and the other two were disease self-management programs [33, 34]. Given these limitations, it is impossible to draw any conclusions about the effectiveness of peer-delivered physical activity interventions from the review of Webel et al.

Theoretical Rationale to Apply Peer Interventions to Physical Activity

There is a strong theoretical case for the potential benefits of peer-delivered physical activity interventions. Social cognitive theory [35] specifies that individuals learn behaviors by observing and imitating others, a process referred to as observational learning or modeling. This process has been extensively studied in motor skill learning and educational contexts (e.g., see [36, 37]). Aside from an individual possessing the fundamental capacity to produce an observed behavior, learning a behavior is dependent on the degree to which one attends to relevant elements of a model's behavior, retains

those elements, and is motivated to produce the action. Characteristics of the model can influence aspects of the modeling process, with perceived similarity of the model being an important consideration [38]. Based on the tenets of social cognitive theory, delivery of physical activity information by a similar peer should facilitate attention, retention, and motivation to act on that information.

A central construct within social cognitive theory is self-efficacy. Self-efficacy is one's confidence to execute specific behaviors in a given situation and is an important predictor of behavioral choice, effort/performance, and persistence [35]. A similar construct, perceived competence, plays a central role in several other theories of motivation. For example, according to self-determination theory [39, 40] and competence motivation theory [41, 42], stronger perceptions of competence lead to more adaptive motivational and related outcomes. Of relevance to the issue of peer-delivered physical activity interventions, these theoretical perspectives link social processes to the generation of self-efficacy or competence perceptions. For example, social cognitive theory stipulates that vicarious experiences (e.g., observing others coping with barriers to physical activity) and feedback and reinforcement from others are primary sources of self-efficacy [38]. Competence motivation theory specifies that reinforcement, modeling, and approval of mastery attempts by others enhance competence perceptions [41, 42]. Self-determination theory specifies that autonomy-supportive social exchanges are especially likely to fulfill the basic need for competence. Peers can be important providers of all of these theoretically important forms of social influence on motivational processes.

Purpose

Peer-delivered physical activity interventions are desired by inactive persons [19, 20], have the potential to reduce health care costs [25], and are theoretically tenable (e.g., [38]). An important next step is to determine whether such interventions are effective. Accordingly, the purpose of this systematic review was to synthesize research that has examined the effects of peer-delivered physical activity interventions on physical activity behavior in order to assess the viability of this intervention approach and to provide future directions for practice and research.

METHOD

The first and second authors developed the search strategy, which involved searching relevant key words and MeSH terms (*peer mentors*, *peer mentoring*, *peer delivery*, *peer mentor program*, *physical activity*, *exercise*, and *physical fitness* individually and in varying combinations) on six databases: PsycINFO, PubMed (MEDLINE), Embase (European and international medical content), CINAHL (nursing, applied health, and health care), Social Sciences Citation Index (social science, science, and technology), and Social Sciences

Abstracts (applied and theoretical social sciences). Searches were performed for all previous years through February 2012. In addition, the authors of this review searched their personal databases and searched reference lists from retrieved articles for additional relevant articles. The primary author and a research associate reviewed titles and abstracts to determine if the study met the following inclusion criteria: (1) published study reporting on the delivery of a physical activity intervention, that is, an informational, behavioral, or social approach designed to increase habitual participation in physical activity [43]; (2) the intervention was delivered by someone whom the original study authors defined as a "peer" and who possessed either similar "experiential knowledge of a specific behavior or stressor..." or "similar characteristics of the target population" ([26], p. 329); and (3) the study reported behavioral physical activity data. For studies that met the inclusion criteria, the following information was extracted: study design, study duration, sample characteristics, peer characteristics, intervention characteristics (including theoretical basis), and physical activity-related outcomes (behavioral and social cognitive).

RESULTS

The computerized search yielded a total of 925 records. After removing 288 duplicates, the titles and/or abstracts of the remaining articles were scanned. Twelve published studies were identified that reported on a peer-delivered physical activity intervention. In addition, one study involving deaf children in physical education classes [52] and another involving adults with developmental disabilities [53] were identified in which peers were systematically recruited and trained to deliver a physical activity intervention in collaboration with a non-peer (i.e., a teacher [52] or professional with expertise in developmental disabilities [53]). As these studies were consistent with the spirit of our inclusion criteria, but the developmental status of the study populations made it infeasible for the intervention to be exclusively delivered by peers, the studies were retained. The remaining studies (623) did not meet our inclusion criteria. Primary reasons for excluding studies were as follows: the study did not include an intervention component, the intervention did not target physical activity, the intervention was not delivered by a peer, and the intervention targeted *performance* of a single sport or motor skill rather than *participation* in physical activity. Four of the 14 studies were subsequently excluded because behavioral physical activity data were not provided, leaving a total of ten studies submitted for data extraction (see Table 1).

Study Characteristics

Six of the studies employed a randomized, controlled experimental design, one study was quasi-experimental (no random assignment to experimental conditions), two studies employed a pre-post study design, and one

Table 1 | Characteristics of studies included in the systematic review

Study	Study design and duration	Participants	Peers	Intervention overview and theoretical framework	Results/PA-related outcomes
Bazzano et al. [51]	Pre-post; 7 months	431 men and women with developmental disabilities (aged 18–29 years)	11 adults with developmental disabilities (PA experience not indicated)	- Peer + professional delivery of 7-month intervention: 2 times/week, 2-h group sessions 50-min interactive health education 10-min snack break 1-h PA - Social cognitive theory	- Significant increases in % of participants exercising 3 times/week, exercise frequency, min/wk of exercise and exercise scheduling self-efficacy - Nonsignificant ($p < .10$) increases in self-efficacy for stretching and exercising at a moderate–heavy intensity
Buman et al. [46]	RCT; 2 conditions (peer-delivered PA intervention vs. peer-delivered health intervention); 16-week intervention with 18-month follow-up	91 older adults (aged 50 years plus)	7 older adults (physically active)	- Group sessions of support for PA behavior change - Weeks 1–3: build trust, rapport - Weeks 4–10: semi-structured, provide support and teach self-management skills for PA initiation and maintenance, encourage a variety of lifestyle PA - Weeks 10–16: relapse prevention skills and develop specific plan to transition to home- or community-based exercise - Social cognitive theory and self-determination theory	- At 16 weeks, both groups significantly increased self-reported MVPA, no between-group differences. In a subset ($n = 22$), PA intervention condition tended ($p = .06$) to have greater accelerometer-derived MVPA than the control condition - At 18 months, the PA intervention condition reported significantly more min/week of MVPA than the control condition - No significant changes in barrier and exercise self-efficacy for either condition at 16 weeks (no 18-month follow-up data reported) - PA intervention condition reported significantly greater self-determined exercise motivation at 16 weeks and 18 months of follow-up than the control intervention condition
Castro et al. [45]	RCT; 3 conditions (peer-delivered vs. professional staff-delivered vs. attention control); 12 months	181 older adults (aged 50 years plus)	12 physically active older adults (performed at least 150 min of MVPA/week)	- Telephone-delivered PA advice 12-month intervention: contact 2 times/month for the first 2 months, then monthly for a total of 14	- At 6 and 12 months, peer- and professional-delivered conditions reported significantly more min/week of MVPA than controls - At 6 months, peer- and professional-delivered conditions performed more accelerometer-derived min/h of MVPA

Table 1 | (continued)

Study	Study design and duration	Participants	Peers	Intervention overview and theoretical framework	Results/PA-related outcomes
				telephone calls • Social cognitive theory and transtheoretical model	than controls
Dorgo et al. [47]	RCT; 2 conditions (peer mentor vs. student mentor); 35 weeks ^a	60 older adults (aged 60 years plus)	30 older adults (most were previously active, none recently active)	• Mentors instructed participants to follow exercise prescription, guided exercise sessions, assisted in execution, and provided motivation; exercise sessions were 3 times/week for 75 min • No theory	• No significant between-groups differences in exercise class retention rates • Class attendance was greater in the student mentor vs. peer mentor condition (significance not indicated)
Dorgo et al. [48]	RCT; 2 conditions (peer mentor vs. student mentor); 14 weeks ^a	60 older adults (aged 60 years plus)	30 older adults (most were previously active, none recently active)	• Mentors instructed participants to follow exercise prescription, guided exercise sessions, assisted in execution, and provided motivation; exercise sessions were 3 times/week for 75 min • No theory	• Better exercise class retention in the peer mentor condition (significance not indicated), but significantly better attendance in the student mentor condition
Dorgo et al. [49]	RCT; 2 conditions (peer mentor vs. student mentor); 14 weeks	131 older adults (aged 60 years plus)	30 older adults (most were previously active, none recently active)	• Mentors instructed participants to follow exercise prescription, guided exercise sessions, assisted in execution, and provided motivation; exercise sessions were 3 times/week for 75 min • No theory	• Better exercise class retention in the peer mentor condition (significance not indicated)
Lieberman et al. [53]	Single-subject delayed multiple baseline design; 5 months	2 cohorts of participants 8 deaf children (aged 10–12 years)	8 gender-matched, trained hearing peers (peers participated in the physical education class)	• Peers used cueing and modeling and gave physical assistance and sign language feedback • 45-min class, 2 times/week, 32 classes total • No theory	• No significant between-groups differences in class attendance • All participants had an increase in directly observed time spent on MVPA during the physical education classes (increases ranged from 19–38 %)

Table 1 | (continued)

Study	Study design and duration	Participants	Peers	Intervention overview and theoretical framework	Results/PA-related outcomes
Parent and Fortin [50]	RCT; 2 conditions (peer mentor vs. control); 4 weeks	56 male patients undergoing coronary artery bypass graft surgery (aged 40–69 years)	3 former male CABG patients aged 40–69 years (peers had a healthy and active lifestyle)	- Peers visited patients three times to give emotional and informational support at 24 h presurgery, 5 days postsurgery, and 4 weeks postsurgery - Social cognitive theory	5 days postsurgery, self-reported walking and performance of general activities as well as self-efficacy for general activities, walking, and climbing were significantly greater in the peer condition vs. control condition - At 4 weeks postsurgery, the peer condition reported more general activities than control condition
Thomas and Ward [52]	Pre-post (pre-semester/post-semester survey)	Middle school children	High school students (PA experience not indicated)	- Small, group-based PA educational sessions delivered by peers 2–3 times/week - No theory	Significant increase in self-reported days/week of moderate intensity PA
Tudor-Locke et al. [44]	Quasi-experimental (intervention without randomization); 2 conditions (peer-led vs. professional-led); 16 weeks	220 inactive adults (achieving <8,800 steps/day) with type 2 diabetes (aged 40–70 years)	6 adults with type 2 diabetes (peers drawn from a previous professionally led 16-week walking program and were successful at increasing their steps/day)	- Peers led education group meetings 1 time/week - Social cognitive theory	- Both groups significantly increased number of pedometer-determined steps/day - No significant between-groups differences

PA physical activity, RCT randomized controlled trial, M/T/D moderate to vigorous physical activity, CABG coronary artery bypass graft

^a Same study

study utilized a single-subject multiple baseline design. In the seven studies with experimental or quasi-experimental designs, peer-delivered intervention conditions were compared with the following control conditions: professionally delivered physical activity intervention condition [44, 45]; attention control conditions (peer-delivered *health* education [46] and professional-delivered nutrition advice [45]); non-peer, student-delivered PA intervention [47–49]; and no intervention [50].

Various physical activity behavioral measures were employed including self-reported activity [45, 46, 50–52], accelerometry [45, 46], pedometry [44], attendance and retention at fitness classes [47–49], and direct researcher observation [53]. In the final column of Table 1, we present the results for every physical activity measure reported and analyzed in each study. The social cognitive measures assessed different types of self-efficacy (e.g., barrier, scheduling, and climbing stairs) and self-determined exercise motivation.

Participant Characteristics

The studies focused on a variety of populations: adults with development disabilities, older adults (five studies), deaf children, middle-school students, male coronary artery bypass graft (CABG) surgery patients, and adults with diabetes. Study sample sizes ranged from 8 to 431, and average n was 138. Note that one study did not report a sample size [52].

Peer Characteristics

In all studies, the peers were similar to the participants on one or more key demographic characteristics (e.g., gender and age). For instance, in the studies focusing on older adults, the peers were also older adults. In the study targeting male CABG patients, the peers were male former CABG patients. Very little information was provided about the peers' activity levels. In three studies, peers were described as regularly active at the time of the intervention [44–46], and in another study, peers were described as having a “healthy and active lifestyle” [50]. In three studies, there was no indication of peer physical activity status [51–53]. The remaining three studies [47–49] indicated that they employed peers who were previously active, but not recently active. All but one study [44] provided detailed information on the training that peer mentors underwent prior to taking on their role in the intervention. Three studies [45, 46, 53] had protocols for monitoring/evaluating the implementation of mentorship activities.

Intervention Characteristics

Interventions ranged in duration from 4 weeks to 12 months. Five studies included a description of a theoretical base that guided intervention development. Three interventions were framed within social cognitive theory [44, 50, 51], one [46] was framed in a combination of social cognitive and self-determination theories, and one was framed in a combination of social cognitive theory and the transtheoretical model [45].

Peers were engaged in intervention delivery in a variety of ways. In four studies, peers delivered group educational sessions [44, 46, 51, 52] designed to teach the skills needed to start and maintain an activity regimen (e.g., self-management and relapse prevention). Of note, this subset of studies included the three theory-based interventions. In three other studies, peers led exercise classes [47–49]. In another study, peers participated alongside participants and gave feedback during a physical education class [53]. A single study employed peers to provide telephone-delivered physical activity advice [45], whereas one study employed peers to conduct face-to-face visits with CABG patients in order to provide emotional and informational support [50]. Further intervention details are provided in the fifth column of Table 1.

Effectiveness

All five studies incorporating within-group analysis of behavior change reported significant increases in physical activity in the peer-delivered intervention groups. Three of these studies also included measures of self-efficacy [46, 50, 51], but only one [50] found a significant increase.

Seven studies provided between-groups comparisons of behavior change. Peer-delivered interventions were just as effective at increasing physical activity as professionally delivered interventions [44, 45]. Peer-delivered interventions were more effective at increasing activity than both a professionally led attention control condition (i.e., nutrition advice [45]) and a no-intervention control condition [50]. When comparing a peer-delivered activity intervention with an attention-control health intervention [46], in the shorter-term (16 weeks), both interventions were equally effective at increasing physical activity. However, by the 18-month follow-up, participants in the peer-delivered activity intervention condition performed significantly more minutes per week of activity than the control participants. The three studies that compared a peer-delivered exercise program to a university student-delivered program for older adults produced mixed findings [47–49]. Two of the studies showed better *retention* (i.e., completion of program) of participants in the peer-delivered conditions [48, 49], whereas two of the studies reported better *adherence* (i.e., number of sessions attended) in the student-delivered program [47, 48].

Only two studies offered between-groups comparisons of social cognitive variables. Parent and Fortin [50] found that CABG patients who received a peer-delivered intervention had greater self-efficacy for general activities, walking, and climbing stairs than those in a no-intervention control condition. Buman et al. [46] found no differential effects of a peer-delivered activity intervention versus an attention-control health intervention on barrier or exercise self-efficacy in their study of older adults. However, those who received the peer intervention reported greater self-determined exercise motivation at 16 weeks and 18 months than controls.

DISCUSSION

This systematic review describes and synthesizes published studies that have examined the effects of peer-delivered physical activity interventions on physical activity behavior. Although research on this topic is relatively sparse, peer-delivered interventions consistently show positive effects on physical activity behavior. Furthermore, peer-delivered interventions were just as effective for increasing physical activity as professionally delivered interventions and were significantly more effective than attention and no-intervention control conditions. Taken together, these findings suggest that peers can play an important role in physical activity intervention delivery.

What role should peers play in intervention delivery? In the reviewed studies, peers were responsible for delivering behavioral skills training sessions [44, 46, 51, 52], providing advice, feedback, and social support [45, 50, 53], and even leading fitness classes [47–49]. Given the impact of behavioral skills, information, and social support on theory-based determinants of motivated behavior [38–42], the peer's role is probably best characterized as motivational. A motivational role is consistent with our theoretical case for peer-delivered interventions, as outlined in the “Introduction” section in this paper. That is, by teaching behavioral skills and providing informational and social support, peer mentors are an important source of social influence [24] that can impact theoretically relevant motivational determinants of behavior such as self-efficacy [38], perceptions of competence [41, 42], and self-determination [39, 40]. Thus, in the larger health care context, physical activity prescription is probably best left to physicians, physiotherapists, and fitness professionals, whereas peers are probably best suited for the delivery of physical activity interventions and assisting with activity planning, implementation, and maintenance. This conceptualization allows diagnosis and prescription to remain within the professional/medical model while facilitating a substantial increase in intervention delivery capacity through peers. Specifically, peers can teach physical activity behavior change skills and deliver support in a manner that others in the health care system have neither the time nor the training to provide. Given that health professional shortages are known to complicate the delivery of health promotion efforts [16, 17], peer-delivered interventions could have considerable, positive public health implications in terms of expanding the reach of such efforts.

Recommendations for Future Research

Despite a strong theoretical case for peer-delivered interventions, only half of the reviewed studies employed a guiding theoretical framework; without a guiding theory, researchers often overlook the

study of potential mechanisms that could account for an intervention's effects [54]. Indeed, virtually all of the reviewed studies engaged peers in activities that might be expected to influence key motivational determinants, but only three studies included measures of such variables, and none of them tested for mediating effects. Although two studies yielded preliminary evidence that peer-delivered interventions have positive effects on variables drawn from social cognitive theory (i.e., self-efficacy) and self-determination theory (i.e., self-determined motivation), additional research is needed to confirm the role of these variables. Accordingly, we urge researchers to use theory to guide the design of peer-delivered activity interventions, to incorporate measures of the theories' constructs, and to utilize appropriate tests of mediation. These are important steps towards identifying mechanisms that explain the effects of peer-delivered physical activity interventions.

We also recommend that future studies include measures of participants' perceptions of the peers who deliver the activity intervention as well as perceptions of their social interactions. Although one study [45] included a manipulation check assessment of participants' perceived competence of their peer mentors, no study assessed the quality of the peer mentor–mentee relationship, as expressed in constructs such as perceived similarity, peer acceptance, or conflict. These social relationship constructs could affect the impact of an intervention on motivational outcomes [55]. For instance, from a self-determination theory perspective, mentors that are perceived as having an autonomy-supportive style and who facilitate feelings of connectedness and cohesion may be more successful in eliciting behavioral change than mentors who do not display these leadership characteristics [56].

From a social cognitive theory perspective, the peer mentor's exercise experience may also be important. Given that the essence of peer mentoring is the sharing of experiential knowledge [21, 22, 26], and such vicarious experiences can help to build self-efficacy [38], interventions may be most effective when delivered by physically active peers who can share their experiences and challenges with adopting an active lifestyle. Yet with the exception of one study [45] that reported minutes per week of physical activity performed by peers both at the study initiation and completion, the reviewed studies provided very little, if any, information on the peers' activity levels. Clearly, an important next step for investigators is to identify peer characteristics that moderate the effectiveness of intervention delivery.

Other factors that may moderate intervention effectiveness include peer mentor training and the extent to which the intervention is delivered as intended. Presumably, the impact of peer mentors will

be strongest when they are properly trained to deliver the various components of a physical activity intervention (e.g., self-efficacy enhancing skills, problem solving related to physical activity barriers, and self-monitoring [45]). When reporting on peer-delivered interventions, we urge researchers to provide training details as well as data pertaining to the quality of the peers' delivery and implementation of the intervention (e.g., [45, 53]). Such information will be important for making comparisons across studies and drawing conclusions regarding the effectiveness of peer mentors. We also urge investigators to examine aspects of the intervention context and characteristics of intervention recipients. For instance, peer-delivered interventions may be more effective in one-on-one situations than in groups, so that the peer can tailor information to the recipient's needs. Some people may also be more receptive to peer mentors than others. For example, individuals who are extroverted may find a peer-mentor relationship more appealing than those who tend to be introverted.

CONCLUSION

The results of this systematic review suggest that peer mentors are a viable mechanism of physical activity intervention delivery. Peer-delivered interventions lead to significant increases in physical activity that are similar in magnitude to increases achieved by professionally led interventions. Additional theory-driven research is needed to determine the mechanisms by which peers exert influence over physical activity behavior. Although many research questions remain to be answered, peer mentors do have the potential to fill existing gaps in physical activity intervention delivery. We encourage interventionists to include peer mentors in their intervention delivery models and investigators to develop an understanding of factors that can maximize the impact of peer delivery.

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- Albright A, Franz M, Hornsby G, et al. American College of Sports Medicine position stand: exercise and type 2 diabetes. *Medicine & Science in Sport & Exercise*. 2000;32(7):1345-1360.
- Grundy SM, Blackburn G, Higgins M, Lauer R, Perri MG, Ryan D. Physical activity in the prevention and treatment of obesity and its comorbidities: evidence report of independent panel to assess the role of physical activity in the treatment of obesity and its comorbidities. *Medicine & Science in Sport & Exercise*. 1999;31(11):1493-1500.
- Hamilton MT, Healy GN, Dunstan DW, Zderic TW, Owen N. Too little exercise and too much sitting: inactivity physiology and the need for new recommendations on sedentary behaviour. *Current Cardiovascular Reports*. 2008;2:292-298.
- Allison DB, Fontaine KR, Manson JE, Stevens J, VanItallie TB. Annual deaths attributed to obesity in the United States. *JAMA : The Journal of the American Medical Association*. 1999;282(16):1530-1538.
- Lee IM, Skerrett PJ. Physical activity and all-cause mortality: what is the dose-response relation? *Medicine & Science in Sport & Exercise*. 2001;33(6):S459-S471. S493-494.
- Manson JE, Hu FB, Rich-Edwards JW, et al. A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *The New England Journal of Medicine*. 1999;341(9):650-658.
- Lee IM. Physical activity and cancer prevention: data from epidemiologic studies. *Medicine & Science in Sport & Exercise*. 2003;35(11):1823-1827.
- Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al. American College of Sports Medicine position stand: exercise and physical activity for older adults. *Medicine & Science in Sport & Exercise*. 2009;41:1510-1530.
- Martin Ginis KA, Hicks AL. Considerations for the development of a physical activity guide for Canadians with physical disabilities. *Canadian Journal of Public Health*. 2007;98(Suppl 2):S135-S147.
- Centers for Disease Control and Prevention. Prevalence of regular physical activity among adults—United States, 2001 and 2005. *Morbidity and Mortality Weekly Report*. 2007;56(46):1209-1212.
- Pleis JR, Lucas JW. Summary health statistics for U. S. adults: National Health Interview Survey. *Vital and Health Statistics Series*. 2009;10:1-159.
- Barnes P. *Physical activity among adults: United States, 2000 and 2005*. Hyattsville: National Center for Health Statistics, US Department of Health and Human Services, CDC; 2007.
- Martin Ginis KA, Arbour-Nicitopoulos KP, Latimer-Cheung AE, et al. Predictors of leisure time physical activity among people with spinal cord injury. *Annals of Behavioral Medicine*. 2012;44:104-118.
- Swinburn BA, Walter LG, Arrol B, Tilyard MW, Russel DG. The green prescription study: a randomized controlled trial of written exercise advice provided by general practitioners. *American Journal of Public Health*. 1998;88:288-291.
- Bolognesi M, Nigg CR, Massarini M, Lippke S. Reducing obesity indicators through brief physical activity counseling (PACE) in Italian primary care settings. *Annals of Behavioral Medicine*. 2006;31:179-185.
- Dellinger SF, Aung N, Campos JA, et al. Formulating Hawaii's public health education needs: input from the health community. *Hawaii Medical Journal*. 2007;66:45-47.
- Juraschek SP, Zhang X, Ranganathan V, Lin VW. United States registered nurse workforce report card and shortage forecast. *American Journal of Medical Quality*. 2012;27:241-249.
- Marcus BH, Ciccolo JT, Sciamanna CN. Using electronic/computer interventions to promote physical activity. *British Journal of Sports Medicine*. 2009;43:102-105.
- Faulkner G, Gorkczynski P, Arbour K, Letts L, Wolfe DL, Martin Ginis KA. Messengers and methods of disseminating health information among individuals with spinal cord injury: a scoping review. In: Berkovsky TC, ed. *Handbook of spinal cord injuries: types, treatments and prognosis*. Hauppauge: Nova; 2010:349-374.
- Letts L, Martin Ginis KA, Faulkner G, Colquhoun H, Levac D, Gorkczynski P. Preferred methods and messengers for delivering physical activity information to people with spinal cord injury: a focus group study. *Rehabilitation Psychology*. 2011;56:128-137.
- Hernandez B, Hayes E, Balcazar F, Keys C. Responding to the needs of the underserved: a peer-mentor approach. *SCI Psychosocial Process*. 2001;14:142-149.
- Veith EM, Sherman JE, Pellino TA, Yasui NY. Qualitative analysis of the peer-mentoring relationship among individuals with spinal cord injury. *Rehabilitation Psychology*. 2006;51(4):289-298.
- Borkman T. Experiential knowledge: a new concept for the analysis of self-help groups. *Social Science Review*. 1976;50:445-455.
- Blosser J, DePompei R. Preparing educational professionals for meeting the needs of students with traumatic brain injuries. *The Journal of Head Trauma Rehabilitation*. 1991;6:73-82.
- Colella TJF, King KM. An under-recognized resource in cardiac recovery. *European Journal of Cardiovascular Nursing*. 2004;3:211-217.
- Dennis CL. Peer support within a health care context: a concept analysis. *International Journal of Nursing Studies*. 2003;40:321-332.
- Standal ØF, Jespersen E. Peers as resources for learning: a situated learning approach to adapted physical activity rehabilitation. *Adapted Physical Activity Quarterly*. 2008;25:208-227.
- Long JA, Jahnle EC, Richardson DM, Loewenstein G, Volpp KG. Peer mentoring and financial incentives to improve glucose control in African American veterans: a randomized trial. *Annals of Internal Medicine*. 2012;156(6):416-424.
- Webel AR, Okonsky J, Trompeta J, Holzemer WL. A systematic review of the effectiveness of peer-based interventions on health-related behaviors in adults. *American Journal of Public Health*. 2010;100(2):247-253.
- Kramish Campbell M, James A, Hudson MA, et al. Improving multiple behaviors for colorectal cancer prevention among African American church members. *Health Psychology*. 2004;23(5):492-502.
- Lamb SE, Bartlett HP, Ashley A, Bird W. Can lay-led walking programmes increase physical activity in middle aged adults? A randomised controlled trial. *Journal of Epidemiology and Community Health*. 2002;56(4):246-252.

32. Carroll DL, Rankin SH. Comparing interventions in older unpartnered adults after myocardial infarction. *European Journal of Cardiovascular Nursing*. 2006;5(1):83-89.
33. Lorig KR, Ritter PL, Gonzalez VM. Hispanic chronic disease self-management: a randomized community-based outcome trial. *Nursing Research*. 2003;52(6):361-369.
34. Fu D, Fu H, McGowan P, et al. Implementation and quantitative evaluation of chronic disease self-management programme in Shanghai, China: randomized controlled trial. *Bulletin of the World Health Organization*. 2003;81:174-182.
35. Bandura A. *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs: Prentice-Hall; 1986.
36. McCullagh P, Weiss MR. Modeling: considerations for motor skill performance and psychological responses. In: Singer RN, Hausenblas HA, Janelle CM, eds. *Handbook of sport psychology*. 2nd ed. New York: Wiley; 2001:205-238.
37. Schunk DH. Peer models and children's behavioral change. *Review of Educational Research*. 1987;57:149-174.
38. Bandura A. *Self-efficacy: the exercise of control*. New York: Freeman; 1997.
39. Deci EL, Ryan RM. *Intrinsic motivation and self-determination in human behavior*. New York: Plenum; 1985.
40. Deci EL, Ryan RM. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*. 2000;11:227-268.
41. Harter S. Effectance motivation reconsidered: toward a development model. *Human Development*. 1978;21:34-64.
42. Harter S. A model of intrinsic mastery motivation in children: individual differences and developmental change. In: Collins WA, ed. *Minnesota symposium on child psychology*, vol. 14. Hillsdale: Erlbaum; 1981:215-255.
43. Kahn EB, Ramsey LT, Brownson RC, et al. The effectiveness of interventions to increase physical activity: a systematic review. *American Journal of Preventive Medicine*. 2002;22(Suppl 4):73-107.
44. Tudor-Locke C, Lauzon N, Myers AM, et al. Effectiveness of the first step program delivered by professionals versus peers. *Journal of Physical Activity and Health*. 2009;6:456-462.
45. Castro CM, Pruitt LA, Buman MP, King AC. Physical activity program delivery by professionals versus volunteers: the TEAM randomized trial. *Health Psychology*. 2011;30(3):285-294.
46. Buman MP, Giacobbi PRJ, Dzierzewski JM, et al. Peer volunteers improve long-term maintenance of physical activity with older adults: a randomized controlled trial. *Journal of Physical Activity & Health*. 2011;8(Suppl 2):S257-S266.
47. Dorgo S, King GA, Bader JO, Limon JS. Comparing the effectiveness of peer mentoring and student mentoring in a 35-week fitness program for older adults. *Archives of Gerontology and Geriatrics*. 2011;52:344-349.
48. Dorgo S, King GA, Brickey GD. The application of peer mentoring to improve fitness in older adults. *Journal of Aging and Physical Activity*. 2009;17:344-361.
49. Dorgo S, Robinson KM, Bader JO. The effectiveness of a peer-mentored older adult fitness program on perceived physical, mental, and social function. *Journal of the American Academy of Nurse Practitioners*. 2009;21(2):116-122.
50. Parent N, Fortin F. A randomized, controlled trial of vicarious experience through peer support for male first-time cardiac surgery patients: impact on anxiety, self-efficacy expectation, and self-reported activity. *Heart & Lung*. 2000;29(6):389-400.
51. Bazzano AT, Zeldin AS, Shihady IR, et al. The Healthy Lifestyle Change Program: a pilot of a community-based health promotion intervention for adults with developmental disabilities. *American Journal of Preventive Medicine*. 2009;37(6S1):S201-S208.
52. Thomas AB, Ward E. Peer power: how dare county, North Carolina, is addressing chronic disease through innovative programming. *Journal of Publ Health Management Practice*. 2006;12(5):462-467.
53. Lieberman LJ, Dunn JM, van der Mars H, McCubbin J. Peer tutors' effects on activity levels of deaf students in inclusive elementary physical education. *Adapted Physical Activity Quarterly*. 2000;17:20-39.
54. Baranowski T, Anderson C, Carmack C. Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine*. 1998;15(4):266-297.
55. Smith AL, McDonough MH, Peers . In: Smith AL, Biddle SJH, eds. *Youth physical activity and sedentary behavior*. Champaign: Human Kinetics. 2008; 295-320.
56. Chatzisarantis N, Hagger M. Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health*. 2009;24(1):29-48.