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Physical activity self-management interventions for adults with spinal cord injury: Part 2 – Exploring the generalizability of findings from research to practice

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Part 2 – Exploring the generalizability of findings from research to practice

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Physical activity self-management interventions for adults with spinal cord injury:

Abstract

Despite the benefits associated with regular participation in physical activity, individuals with spinal cord injury (SCI) remain insufficiently active. The ability to self-manage participation may increase physical activity levels, but only if self-management interventions can be implemented in the ‘real world’. The purpose of this review was to examine the degree to which authors of published studies of LTPA self-management interventions for individuals with SCI have reported on factors that could increase the likelihood of translating this research into practice. A systematic search of five databases was conducted, yielding 33 eligible studies representing 31 interventions. Each intervention was assessed using the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) Framework and the PRECIS-2 (PRagmatic-Explanatory Continuum Indicator Summary) tool. The most commonly reported RE-AIM dimensions were Effectiveness (51.0% of interventions) and Reach (18.5%), followed by Implementation (14.2%), Maintenance (13.8%), and Adoption (4.0%). Overall, interventions were scored as primarily explanatory in five of the nine PRECIS-2 domains (*recruitment, primary analysis, organization, flexibility [delivery], follow-up*) and primarily pragmatic in one domain (*setting*). These findings suggest that while some LTPA self-management interventions for individuals with SCI are intended to be translated to real world settings, limited information is available to understand the degree to which this has been accomplished. Enhanced reporting of factors that could increase the likelihood of translating these interventions into practice is recommended.

Keywords: spinal cord injury, knowledge translation, intervention, leisure time physical activity, evaluation, systematic review, RE-AIM, PRECIS-2

Highlights

- *Effectiveness* was the most commonly reported RE-AIM dimension (48.5%)
- The authors of only one study reported an *adoption* variable (setting adoption rate)
- Lack of reporting on *representativeness* makes generalizability difficult
- Interventions were scored as primarily pragmatic in only one PRECIS-2 domain (*setting*)
- Enhanced reporting is needed to facilitate translation of research into practice

Part 2 – Exploring the generalizability of findings from research to practice

A spinal cord injury (SCI) results from trauma or disease that damages the spinal cord, leading to partial or complete paralysis (Rick Hansen Institute, 2017). Research has shown that participation in leisure time physical activity (LTPA) among persons with SCI is associated with numerous benefits including improvements in physical health (Fernhall, Heffernan, Jae, & Hedrick, 2008), psychological well-being (Martin Ginis, Jetha, Mack, & Hetz, 2010), and quality of life (Tomasone, Wesch, Martin Ginis, & Noreau, 2013). Despite these benefits, and given the pervasive and ongoing barriers that can impede regular LTPA participation in this population (Martin Ginis, Ma, Latimer-Cheung, & Rimmer, 2016), individuals with SCI remain largely inactive (Martin Ginis et al., 2010).

To improve physical activity rates in this population, researchers have integrated *self-management skills* into LTPA interventions delivered to persons with SCI (e.g., Arbour-Nicitopoulos, Tomasone, Latimer-Cheung, & Martin Ginis, 2014; Brawley, Arbour-Nicitopoulos, & Martin Ginis, 2013). Self-management has been defined as “...the individual’s ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with a chronic condition” (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002, p. 178). Effective self-management, which ideally encompasses five critical skills (i.e., decision-making, appropriate resource utilization, forming a partnership with a health-care provider, taking necessary actions, and problem solving; Lorig & Holman, 2003), is an important consideration in—and arguably an essential component of—any intervention targeting behavior change among persons with long-term diseases (Taylor et al., 2014) including those with SCI (Wolfe et al., in preparation).

In an effort to shed light on the potential theoretical mechanisms by which LTPA self-management interventions can foster behavior change among adults living with SCI, our research team (Tomasone et al., 2018) conducted a comprehensive systematic review of 26 studies using the Behaviour Change Technique Taxonomy version 1 (BCTTv1; Michie et al., 2013). Results revealed that the most commonly used BCTs reported in the studies corresponded to the core components of self-management, and the use of these BCTs appeared to be positively related to LTPA outcomes.

To date, and based on the studies reviewed by our team (Tomasone et al., 2018), it appears that minimal consideration has been given to intervention transferability, or the generalizability of findings from LTPA self-management intervention research conducted with adults with SCI, into regular practice settings. For example, of the 31 interventions included in the systematic review, the authors of only one (Arbour-Nicitopoulos et al., 2014) reported extensively on external validity factors such as sample representativeness of the target population and intervention effectiveness across sample sub-groups. In other instances in which researchers reported on external validity or generalizability factors (e.g., Brawley, Arbour-Nicitopoulos, & Martin Ginis, 2013; Latimer, Martin Ginis, & Arbour, 2006), they were typically noted briefly and framed as study limitations. This poses challenges for both researchers and practitioners; in order for research to inform and support the implementation of effective ‘real life’ interventions, it is important that it is conducted in representative settings with representative samples (Glasgow, Bull, Gillette, Klesges, & Dzewaltowski, 2002) and that such information is reported in the literature. In short, there seems to be a gap in our understanding of the degree to which variables associated with the translation of this body of research into regular practice have been considered and/or reported on.

Various tools and frameworks have been developed and used by researchers which reflect a growing shift in perspective from intervention efficacy to intervention generalizability and dissemination (Lewis, Napolitano, Buman, Williams, & Nigg, 2017). One tool that focuses on both internal and external validity factors is the RE-AIM Framework (Gaglio & Glasgow, 2012; Glasgow, Vogt, & Boles, 1999; Klesges, Estabrooks, Dzewaltowski, Bull, & Glasgow, 2005). RE-AIM was developed by Glasgow and colleagues (1999) to measure the public health impact of an intervention via the assessment of five dimensions (Reach, Effectiveness, Adoption, Implementation, Maintenance). Since its inception, RE-AIM has evolved to include distinct sets of criteria, typically referred to as “items”, that are grouped together to represent each of the five dimensions (e.g., Gaglio & Glasgow, 2012; Glasgow, Nelson, Strycker, & King, 2006; Kessler et al., 2013). Thus, RE-AIM can be used as an evaluation tool to assess and promote the reporting of each of these dimensions and to understand the extent to which interventions contain elements of external validity (Glasgow, Vogt, & Boles, 1999; Harden, Burke, Haile, & Estabrooks, 2015). Researchers can also use RE-AIM during study planning and design phases to enhance an intervention’s potential for research to practice translation (Klesges et al., 2005).

Another tool, the PRagmatic–Explanatory Continuum Indicator Summary (PRECIS), was developed by Thorpe and colleagues (2009) to assist researchers with matching study design decisions with the intended use of trial results (Loudon et al., 2015). An improved and validated version of the tool (PRECIS-2) was published by Loudon and colleagues (2015). The general purpose of PRECIS-2, which serves as both a study design and evaluation tool, is to assess the *applicability* of an intervention which, according to Loudon et al., “...affect[s] the ease with which the trial results can be applied to and by the usual community of users of the intervention in the settings in which the trial designers envision it being used” (2015, p. 2). Using PRECIS-2,

the position of intervention characteristics is evaluated in nine domains (i.e., eligibility, recruitment, setting, organization, flexibility [delivery], flexibility [adherence], follow-up, primary outcome, and primary analysis) on a pragmatic-explanatory continuum whereby pragmatic refers to the question, “*Does this work under usual conditions?*” and explanatory denotes, “*Can this work under ideal conditions?*” (Loudon et al., 2015).

Researchers have reviewed bodies of literature in a variety of areas to identify the extent to which different fields have considered the components of both RE-AIM and PRECIS-2 (e.g., Craike, Hill, Gaskin, & Skouteris, 2017; Harden, Burke, et al., 2015; McGoey, Root, Bruner, & Law, 2015). The focus on and publication of this research in reputable academic journals represents notable progress towards translating knowledge from research into practice as these studies can provide information about the external validity of interventions, draw attention to the need for enhanced reporting and the domains that ought to be focused on/improved, and establish recommendations for future intervention studies. As such, and given the findings reported in the abovementioned review conducted by our research team (Tomasone et al., 2018), using this methodology in the field of LTPA self-management interventions for adults with SCI will serve to address important knowledge gaps in this area of research.

The purpose of this review was to examine the degree to which authors of published studies of LTPA self-management interventions for individuals with SCI have reported on factors that could increase the likelihood of translating this research into practice. Specifically, we conducted a secondary analysis of the studies included in a recent systematic review (Tomasone et al., 2018) to examine: a) the level of reporting on the five RE-AIM dimensions; and b) the position of these interventions on each of the PRECIS-2 domains across the pragmatic-explanatory continuum.

Methods

Full details regarding the literature search strategy and selection, inclusion/exclusion criteria, and screening process are reported in Tomasone et al. (2018). The following sections contain a brief overview of the methods used for both reviews, as well as those that are unique to this study.

Literature Search Strategy and Selection

A comprehensive search strategy, developed in consultation with a university health sciences librarian, combined controlled vocabulary and keywords relevant to SCI, physical activity, self-management, and interventions. The systematic search strategy was executed in five electronic databases: MEDLINE, EMBASE, PsycINFO, CINAHL, and the Cochrane Central Register of Controlled Trials. Hand-searching methods (e.g., scanning the table of contents of relevant journals) were also employed, and limits related to language (English), date of publication (1980-September 2017) and subjects (human) were applied.

Inclusion/Exclusion Criteria

To be included in the systematic review, studies had to: a) be published in a peer-reviewed journal; b) contain an intervention or utilize strategies that had a behavioral component targeting LTPA behavior and/or LTPA self-management skills in any setting (e.g., health care, community, home); c) include adults (18 years or older) with traumatic or non-traumatic SCI; and d) report quantitative data related to LTPA and/or its antecedents (e.g., self-efficacy, goal setting, action planning, etc.; Tomasone et al., 2018). Studies were excluded if they: a) reported qualitative analyses/data only; b) used retrospective or case study designs; c) were an editorial, commentary, abstract, conference abstracts/proceedings, and dissertations; d) included ≤ 3

participants with SCI; and e) did not report the results for participants with SCI separately from those of other participants.

Screening Process

All references resulting from the database searches were exported and managed using the Covidence online systematic review tool. Two authors (AA, BB, and/or CC) independently screened each article by title and abstract. Eligible full texts were then retrieved and examined independently by two authors (AA, BB, and/or CC) using the abovementioned inclusion/exclusion criteria. Disagreements at all levels of screening were resolved through discussion and consensus among author reviewers.

RE-AIM Evaluation and PRECIS Assessment

In line with its overall aim, the RE-AIM framework was used to determine the degree to which authors of peer-reviewed publications in this area reported on important program elements (including external validity) across five broad dimensions, as it is expected that more robust reporting enhances the potential for intervention replicability and translation (Gaglio, Phillips, Heurtin-Roberts, Sanchez, & Glasgow, 2014). The PRECIS-2 tool, on the other hand, was used to assess specific research design components with a focus on an *applicability*, or the degree to which trials were more pragmatic (i.e., “undertaken in the ‘real world’ and with usual care...”) or explanatory (i.e., “undertaken in in an idealised setting, to give the initiative under evaluation its best chance to demonstrate a beneficial effect”) (Loudon et al., 2015, p. 1). Together, the use of these tools allow for a comprehensive evaluation of the potential for generalizability of findings from research to practice (Gaglio et al., 2014).

Data pertaining to the RE-AIM and PRECIS-2 dimensions were gathered using an extraction tool developed by Harden, Burke, et al. (2015), modified to reflect the use of PRECIS-

2 rather than the original PRECIS tool. All extractions were performed independently by one author (AA) and subsequently reviewed and verified by a second author (DD) to reduce error and bias. When disagreements occurred (i.e., < 3.0% for both the RE-AIM evaluation and PRECIS-2 assessment), they were resolved through discussion, and in some instances, via consultation with a third author (EE).

First, eligible studies were assessed using a RE-AIM coding system that has been used and modified in previous research (Glasgow, Klesges, Dzewaltowski, Bull, & Estabrooks, 2004; Kessler et al., 2013; Klesges et al., 2004), whereby 31 different items related to the five broad RE-AIM dimensions were considered and assigned a score of 1 (“yes”) or 0 (“no”). The number and percentage of interventions that reported on each of the 31 items were then calculated, as well as the overall mean and standard deviation for items reported per intervention (see Table 1 for the specific items that correspond to each of the five RE-AIM dimensions).

Second, eligible studies were assessed for each of the PRECIS-2 domains using the adapted extraction tool. The nine PRECIS-2 categories, a brief description of each, and their mapping alongside the related RE-AIM dimensions are presented in Table 1. A 5-point Likert scale was used to assign a score for each intervention on all nine PRECIS-2 domains, whereby 1 was “very explanatory”, 2 was “rather explanatory”, 3 was “equally pragmatic and explanatory”, 4 was “rather pragmatic”, and 5 was “very pragmatic” (Loudon et al., 2015); these scale descriptors are used throughout the current review. We have also referred to the PRECIS-2 domains as *primarily explanatory* (i.e., scores of 1 or 2) or *primarily pragmatic* (i.e., scores of 4 or 5) to enhance reporting and ease of understanding regarding the location of intervention components on the respective ends of the continuum. In addition to individual intervention scores, the overall means and standard deviations of PRECIS-2 scores for each domain, across

all 31 interventions, were calculated (see Table 1). When interpreting the mean scores for each of the PRECIS-2 domains, values > 3.50 were also deemed to be primarily pragmatic, values between 2.50 and 3.50 were deemed to be equally pragmatic and explanatory, and values < 2.50 were described as primarily explanatory.

A PRECIS-2 “wheel”, a key component of both PRECIS (Thorpe et al., 2009) and PRECIS-2 (Loudon et al., 2015), was also generated for each study to visually display the results of the PRECIS-2 scoring. Within the wheel, each domain is represented by a line and arranged around a central point (resembling a ‘web’), with the explanatory pole (1) placed proximally (i.e., close to the center of the wheel) and the pragmatic pole (5) placed distally (i.e., farthest from the center of the wheel). As such, based on the scores assigned to each study using PRECIS-2, a tighter web indicates that an intervention is more explanatory, and a wider web indicates that it is more pragmatic (Loudon et al., 2015; Thorpe et al., 2009).

When coding, and to assist with achieving consensus when necessary, the two reviewers regularly consulted the PRECIS-2 definitions outlined by Loudon and colleagues (2015). It should be noted that there was some initial confusion regarding the definition of “usual care” in the context of LTPA self-management interventions for adults with SCI. To address this confusion and to minimize the potential for errors and discrepancies, a preliminary evidence- and expert-informed definition of usual care was developed by the authors prior to scoring.¹

Discussions also took place with regard to the primary outcomes of interest used in the Tomasone et al. (2018) review, as the relevance of such outcomes to participants constitutes the *primary outcome* domain of PRECIS-2. For the purpose of the present review, consensus was achieved and LTPA was assigned a score of 4 (i.e., rather pragmatic), as it was assumed to be

¹ Although somewhat unconventional, this step was justified given that other researchers have reported similar issues during the application of PRECIS-2 (e.g., Johnson et al., 2016).

important and relevant for some individuals but not necessarily all adults with SCI. LTPA antecedents, on the other hand, were assigned a score of 2 (i.e., rather explanatory), given that it was assumed that such variables may have less known relevance for (or be “less recognizably important”; Loudon et al., 2015, p. 9) to most adults with SCI.

Results

Description of Studies

As noted in the first review conducted by our team (Tomasone et al., 2018), a total of 33 articles were included in the systematic review, representing 31 different interventions.² Most studies were conducted in North America, with the exception of three (de Oliveira et al., 2016; Nooijen et al., 2016; van der Ploeg et al., 2007). Study designs included prospective pre-post ($n = 16$), randomized controlled trials ($n = 12$), and quasi-experimental ($n = 3$). A number of intervention settings were also reported, including, but not limited to, home-based ($n = 16$), community-based ($n = 4$), hospital or inpatient-based ($n = 2$), and camp-based ($n = 1$). A detailed description of all studies can be found in Supplementary Table S2.

RE-AIM Evaluation and PRECIS Assessment

The results and specific values pertaining to the RE-AIM and PRECIS-2 assessments are detailed in Table 1. In addition, three exemplar PRECIS-2 wheels, as well as a summary wheel representing the average PRECIS-2 scores across all 31 interventions, are depicted in Figure 1.

RE-AIM evaluation. Across all interventions, the inclusion rate of individual RE-AIM items was 15.5%. The overall average number of RE-AIM items reported per intervention was 4.77 (± 2.65), with a reporting range across interventions of 1–14 items (out of a possible 31 items; see Table 1). The RE-AIM items that were most often reported by study authors were

² Despite the inclusion of 33 studies in the review, only 31 unique interventions were assessed; as such, 31 was used in all calculations throughout the manuscript.

those in the Effectiveness (51.0% of interventions), Reach (18.5%), and Implementation (14.2%) dimensions. Together, items within the Maintenance categories (individual and setting) were reported in 13.8% of interventions, and items within the Adoption categories (setting and staff) were reported in 4.0% of interventions.

With regard to specific RE-AIM items, the most commonly reported were *measure of primary outcome* and *measure of short-term attrition*, both found within the Effectiveness dimension. More specifically, all interventions included reporting related to the measurement of a primary outcome related to LTPA, 11 of which compared the LTPA-related findings to a public health goal such as physical activity guidelines for wheelchair users or individuals with SCI. Insofar as short-term attrition information was concerned, authors reported either a specific attrition rate (1 intervention), the number of individuals lost to follow up and a valid denominator (allowing for a rate calculation; 19 interventions), or both types of information (4 interventions).

Exclusion criteria, a RE-AIM item within the Reach dimension, was also highly reported. Such criteria included, but were not limited to, health contraindications for participating in physical activity (10 interventions), cognitive impairments (5 interventions), and language requirements (4 interventions).

The *use of qualitative methods* was reported to varying degrees, with researchers most commonly reporting the use of such methods to understand Implementation, such as the assessment of the least and most beneficial intervention components. The *measurement of broader outcomes* item (i.e., negative outcomes or quality of life) and the *robustness across study groups* item, both within the Effectiveness dimension, were addressed in more than one quarter of the interventions included in the review. All remaining RE-AIM items (across all categories) were reported in less than 17.0% of interventions.

Within the Maintenance-individual category, five of the 31 interventions reported the use of *primary outcome measures* (i.e., follow-up ≥ 6 months after the last intervention contact). Of these, four provided information for the *long-term attrition* item, two reported *measurement of long-term robustness across study groups*, and one reported the use of *qualitative methods for understanding maintenance outcomes*. With respect to Maintenance-setting items, the authors of two studies reported that their *intervention programs were ongoing* at the time of publication. These studies reported *long-term adaptations* as well as *some discussion of program sustainability*. Despite not constituting ongoing programs at the time of publication, we felt it noteworthy that the authors of two additional interventions reported that the resources developed for each intervention were translated into publicly available manuals, videos, and guides.

PRECIS-2 assessment. Using the PRECIS-2 criteria, the most pragmatic domain across all studies was *setting*, whereas the domains deemed to be primarily explanatory were *recruitment, primary analysis, organization, flexibility (delivery), and follow-up*. Domains deemed equally pragmatic and explanatory included *eligibility criteria, primary outcome, and flexibility (adherence)*. Means and standard deviations for each domain are presented in Table 1, and a wheel depicting the mean scores for all nine PRECIS-2 dimensions across all interventions is shown in the bottom right quadrant of Figure 1.

With regard to *eligibility criteria*, 12 interventions were evaluated to be primarily pragmatic, 11 were deemed primarily explanatory, and eight were judged to be equally pragmatic and explanatory. Interventions found to be primarily pragmatic tended to have broader and more inclusive eligibility criteria (e.g., the presence of any SCI and absence of cognitive impairments). In contrast, eligibility criteria that was coded as primarily explanatory included

strict parameters (i.e., tighter exclusion criteria) with regard to current physical activity levels or the use of multiple inclusion criteria.

With respect to *recruitment*, 14 interventions were evaluated as very explanatory in their approaches, reporting the use of such strategies as research databases or targeted media and mailing advertisements. Seven interventions were found to be very pragmatic in terms of the reported recruitment of participants, reporting efforts such as recruitment through outpatient clinics, rehabilitation centres, or clinician referrals.

As noted above, *primary outcomes* included LTPA behavior and LTPA antecedents, or a combination of the two. Twenty-three interventions scored in the middle of the PRECIS-2 continuum in this category given the combination of measures reported.

We were unable to assess *primary analysis* for six interventions due to insufficient information provided in the studies. However, 16 interventions were scored as primarily explanatory because only the data of participants who completed intervention components and provided outcome data were analyzed, or outliers were removed from the dataset prior to analysis.

The majority of study *settings* were assigned scores on the pragmatic end of the PRECIS-2 continuum, with only two study settings deemed to be primarily explanatory. The settings on the explanatory end of the continuum included a university facility with specialized equipment and a two-day wheelchair sports camp. On the other hand, home-based interventions were considered to be very pragmatic, and comprised the main setting in 18 interventions. Two home-based interventions were assessed as rather pragmatic as they included a one-day workshop outside of the home.

Nineteen interventions were scored as primarily explanatory with respect to *organization*, four interventions were assigned scores in the middle of the continuum, and eight interventions scored as primarily pragmatic. Explanatory components in the organization domain included the use of graduate students, research assistants/staff, researchers, and specially-trained interventionists to deliver the intervention and monitor participant progress.

None of the studies were assessed to be very pragmatic regarding their *flexibility in intervention delivery*. Rather, 24 out of the 31 interventions were scored as having a primarily explanatory delivery model, 15 of which were scored as being very explanatory in their approach. Most often, these intervention components, formats, and schedules appeared to be quite time- and resource-intensive. For example, one study reported several components including a scripted 90-minute home visit by a nurse (including motivational interviewing, goal setting, and personal action planning), 10 pages of written material related to lifestyle activity and shoulder protection, and several follow-up phone calls.

The *flexibility in intervention adherence* domain was judged as not applicable for eight interventions, as they were delivered over a short period of time (i.e., a single session or within a few days). Of the 23 remaining interventions, 15 were scored as primarily explanatory, with frequent contact between participants and interventionists and the reported use of daily or weekly self-monitoring tools. Six interventions were deemed to be primarily pragmatic, involving participants working through intervention components at their own pace or using a case management approach to encourage and monitor adherence.

Lastly, for the purpose of the current review, *follow-up* included all intervention contacts (active delivery and encouragement/check-ins) including data collection points. This domain was deemed not applicable for four studies due to the short time frame for follow-up (i.e.,

approximately seven days or less). The interventions that were scored as primarily explanatory in terms of follow-up ($n = 16$) reported frequent (e.g., weekly) follow-up contacts over the study period. Ten interventions were deemed to be primarily pragmatic and had fewer, staggered (e.g., every 3-4 weeks), or multi-purpose (i.e., for both encouragement and data collection) follow-ups.

Discussion

The results presented above suggest that overall, within published studies of LTPA self-management interventions for persons with SCI, there is limited information available on factors that could increase the likelihood of research-to-practice knowledge translation. This review represents the first examination of the literature in this area with regard to the level of reporting on the five RE-AIM dimensions, as well as the applicability of these interventions across the nine PRECIS-2 domains. As noted above, the purposes of each tool are distinct yet complementary; whereas we used RE-AIM to understand the extent to which factors related to external validity were reported on across interventions (Gaglio & Glasgow, 2012; Glasgow, Vogt, & Boles, 1999; Klesges et al., 2005), we used PRECIS-2 to understand how applicable these interventions are to the intended end-users (Loudon et al., 2015; Thorpe et al., 2009).

Overall, the average inclusion rate of individual RE-AIM items in the present study was less than 16%, with a range of items reported across interventions. Variation in and underreporting of RE-AIM dimensions—particularly those related to external validity factors—have also been noted in other systematic reviews, including those focused on behavioral interventions (Harden, Gaglio, et al., 2015), obesity prevention and dietary interventions (Klesges, Dzewaltowski, & Glasgow, 2008; Schlechter, Rosenkranz, Guagliano, & Dzewaltowski, 2016), and physical activity interventions (Galaviz et al., 2014; Harden, Burke, et al., 2015).

The RE-AIM items that were most often reported in the interventions included in this review were those within the Effectiveness and Reach dimensions, followed by Implementation, Maintenance and lastly, Adoption. These findings are also not unique to this body of literature; similar patterns have been noted in reviews of a number of areas (e.g., Allen et al., 2011; Galaviz et al., 2014; Harden, Burke, et al., 2015), as well as among studies in which the authors have claimed to have used RE-AIM (Kessler et al., 2013). It should be noted that while the average inclusion rate of RE-AIM items in the present review is comparably low, with the exception of one study, the authors of the studies included in this analysis did not report the use of the RE-AIM Framework in the design or evaluation of the interventions. Thus, expecting that all or most of the RE-AIM items would be addressed in these studies is likely unrealistic.

Within the Reach dimension of RE-AIM, whereas nearly half of the studies included in the review reported on exclusion criteria, only four studies reported on participation rate and/or representativeness. Lack of reporting in these areas is problematic given that this information is critical for assessments regarding the generalizability of interventions across settings, populations, and/or time (Schlechter et al., 2016). Misclassification of and errors associated with this dimension has been documented elsewhere (Gaglio, Shoup, & Glasgow, 2013; Harden, Gaglio, et al., 2015; Kessler et al., 2013). Further, in light of inaccuracies noted in the wide range of behavioral interventions included in their review, Harden, Gaglio, and colleagues (2015) suggested that researchers consider the use of multiple indicators (i.e., number, proportion, and representativeness at individual-, staff-, and setting-levels) to address the Reach and Adoption dimensions of RE-AIM.

Five items within the Adoption and Maintenance dimensions of RE-AIM were not reported in any of the 31 interventions, including *setting representativeness*, *staff*

representativeness, the use of qualitative methods to understand setting adoption, the use of qualitative methods to understand staff participation, and the use of qualitative methods to understand setting-level institutionalization. Interestingly, the lack of reporting on *representativeness* at both the individual and setting levels found in this review has been noted in other behavioral intervention research (Akers, Estabrooks, & Davy, 2010; Dziewaltowski et al., 2004; Harden, Burke et al., 2015). Unfortunately, this gap in reporting precludes our ability to draw conclusions about the generalizability of the current body of literature on LTPA self-management interventions for persons with SCI, and also makes it difficult for a practitioner to determine whether such interventions are relevant to their skills or expertise, organization, and/or patient group (Harden, Burke, et al., 2015). Additionally, low levels of reporting on *measures of outcomes at ≥ 6 month follow-up* found in the present review is problematic given that the aim of most interventions is to promote and foster physical activity as a sustained and lifelong behavior. As such, additional investigations of the long-term effects of LTPA self-management interventions for individuals with SCI are needed. It would also be useful for researchers who publish protocol papers or articles containing short-term results to identify all completed and planned data collection points, and to note in their published articles any future plans for the collection and/or publication of longer-term intervention data.

As part of the continued evolution of the RE-AIM framework, the importance of using qualitative and mixed-methods approaches has been increasingly recognized (Gaglio & Glasgow, 2012; Glasgow, Nelson, Strycker, & King, 2006; Kessler et al., 2013). In the current study, the use of qualitative methods was used most often to understand Implementation, whereas their use to understand reach/recruitment (Reach) and long-term outcomes (Maintenance-individual) were reported in only one study each. Interestingly, as noted above, no

studies reported the use of qualitative methods to understand staff participation, setting adoption, or setting-level institutionalization. Thus, in an effort to gather additional and contextual information about reasons for participation and nonparticipation, and to improve our understanding of these interventions, researchers are encouraged to consider the use of qualitative measures in addition to the more commonly used quantitative measures for individual- and setting-level characteristics. Specific recommendations regarding the most appropriate means of collecting such information (e.g., focus groups, interviews, etc.) have not been proposed, although such methods would be expected to differ depending on the project (Estabrooks & Allen, 2012).

With regard to PRECIS-2, results showed that overall, interventions were scored as primarily pragmatic in only the *setting* domain. Most of the LTPA self-management interventions included in this review were home-based, reducing many of the barriers to access that individuals with SCI face (e.g., weather, transportation, accessibility; Martin Ginis et al., 2016). In addition to home-based settings, researchers might be encouraged to plan and evaluate a greater number of interventions in community or rehabilitation settings in an effort to facilitate the translation of this research into ‘real life’ practice settings.

According to Loudon and colleagues (2015), the primary function of PRECIS-2 is to plan and/or assess the level of pragmatism across nine domains related to study design, and to ensure that these design characteristics line up with the aim of the research. It is assumed that an important goal for researchers who have devoted time, resources, and expertise to the development, implementation, and/or evaluation of LTPA self-management interventions for adults with SCI is to be able to apply their programs, if effective, to patients in usual care practice settings. In the present study, variation in the level of pragmatism was observed across

the interventions, as can be seen in the studies selected as exemplars (Figure 1). Interestingly, all three of these studies—containing interventions scored as primarily explanatory (Brawley et al., 2013; top left quadrant), primarily pragmatic (de Oliveira et al., 2016; top right quadrant), and equally pragmatic and explanatory (Block et al., 2010; bottom left quadrant)—demonstrated effectiveness (see Tomasone et al., 2018, for a full review of these interventions). Further, in our systematic review of the literature, our team reported that the use of BCTs related to core self-management components appeared to be related to positive LTPA outcomes (Tomasone et al., 2018). Thus, despite the high risk of bias noted in our previous review for many of these studies, it is apparent that researchers are designing a wide variety of comprehensive and promising LTPA self-management interventions for adults with SCI. Taken together, the results of these two reviews provide evidence for the conclusion that while intervention effectiveness has been tested in this area, additional research and reporting is needed to understand: a) the specific elements that constitute effective interventions and the mechanisms by which they can lead to behavior change; and b) the study design characteristics and variables that are important for the translation of this knowledge into regular practice.

Implications and Future Directions

At this point, it is unclear how effective LTPA self-management interventions are for adults with SCI in clinical or community practice settings. The current review contains preliminary evidence which has led to a number of considerations and recommendations for researchers interested in the design, implementation, and evaluation of real world interventions. To summarize, we suggest that researchers aim to report more transparently and accurately on all dimensions of RE-AIM, particularly on items within Adoption (e.g., setting and staff exclusions, staff participation rate), Implementation (e.g., consistency across settings/staff/subgroups,

intervention costs across all dimensions; Estabrooks & Allen, 2012), and Maintenance (e.g., measure of broader outcomes such as quality of life and potential adverse events at follow-up). It is also recommended that researchers in this area carefully plan and consider their study design choices in—and the consistency in which such decisions are made across—each of the nine PRECIS-2 domains, with a particular focus on those found to be primarily explanatory (i.e., recruitment, primary analysis, organization, flexibility [delivery], and follow-up). It is also critical that researchers and practitioners from both clinical and community-based settings, as well as individuals with SCI, work collaboratively in the design of and decision-making related to interventions, and fundamental intervention principles, that are deemed necessary to enhance the likelihood of their translation into real life care settings.

We recognize that most academic journals have word and page restrictions, and that presenting the results of RE-AIM (including the use of mixed-methods approaches) and PRECIS-2 evaluations can be lengthy. We also acknowledge that not all elements of RE-AIM and PRECIS-2 will be appropriate for or realistic to assess or report on in all research studies and for all trial types. For example, when considering an efficacy trial, experts in the use of RE-AIM have suggested that while the assessment of items within certain dimensions (e.g., Adoption and/or Maintenance-setting) may not be relevant, providing detailed Reach information is important for all study designs. These researchers suggest that “...a detailed description of the resources available in the intervention deliver[y] setting and the expertise and characteristics of those delivering the intervention is still valuable information that can aid in future translation from research to practice” (Estabrooks & Allen, 2012, p. 69). Thus, we also urge researchers in this area, and in the fields of sport and exercise psychology more generally, to: a) carefully plan and decide which elements of RE-AIM and PRECIS-2 (or any other implementation science

model) are important for their studies, trial types, and research programs (Estabrooks & Allen, 2012); b) report on such elements in publications, in multiple papers if necessary (Harden, Gaglio, et al., 2015); and c) consider the use of appendices, tables/figures, and online supplementary materials to convey this information to readers and reviewers.

Finally, it should be noted that the current review includes studies dating back to 2000, just after the release of the seminal RE-AIM manuscript (Glasgow, Vogt, & Boles, 1999) and prior to the PRECIS and PRECIS-2 publications (Thorpe et al., 2009; Loudon et al., 2015). A brief analysis of mean RE-AIM scores assigned to the interventions in the present review suggest that overall reporting of RE-AIM items has increased over time. An interesting future direction would be for researchers in this area, and other fields within sport and exercise psychology, to systematically explore the inclusion of RE-AIM and PRECIS-2 dimensions in various bodies of literature over time. Interestingly, Gaglio and colleagues (2013) conducted a systematic review to examine the use of RE-AIM (in any area of research) from 1999 to 2010 and found that while an increasing number of study authors reported the use of the RE-AIM framework over time, very few reported on all dimensions or items.

Strengths and Limitations

As noted above, this review represents an initial glimpse into the generalizability and potential applicability of LTPA self-management interventions for adults with SCI using two valid and complementary implementation science models. Additional strengths of this study are the use of multiple coders and a high level of consensus in using the RE-AIM and PRECIS-2 tools. The expert-informed definition of “usual care” for the SCI population that was created and used by our team is also viewed as a strength in that it served as a consistent reference point in the coding and interpretation of items.

A limitation that is applicable to many areas of research within and beyond sport and exercise psychology is the lack of consensus around the use of frameworks and checklists across scientific fields and journals. A number of tools exist currently as mechanisms to describe intervention components and/or report on various components of internal and external validity. While we carefully selected and utilized two frameworks that have been used extensively in the health literature (e.g., Harden, Gaglio, et al. 2015; Loudon et al., 2015), it is unknown how our results might have differed if we had selected other evaluation and implementation science models (Kessler et al., 2013). A second limitation of the current review is that although all data extractions were reviewed and verified by a second author, only one author independently coded the relevant RE-AIM and PRECIS-2 information from studies using the extraction document.

Conclusion

While many LTPA self-management interventions for persons with SCI are intended to be translated to real world contexts, limited information is available to understand the degree to which this has been accomplished, thus limiting their generalizability. Within the current body of literature, several domains of RE-AIM and PRECIS-2 have been reported less often and deemed to be more explanatory, respectively. This leaves a gap in our understanding of how scalable these interventions may be in practice settings. The recommendations outlined in this paper regarding the design of interventions that have real-world impact, as well as other reporting issues and suggestions, are important considerations for researchers and interventionists if the ultimate aim is to improve LTPA participation in this population on a larger scale. Future work is needed to deliver, evaluate, and report on the external validity and applicability of these interventions.

Table 1. *Inclusion of RE-AIM and PRECIS-2 Elements Across All Interventions (N = 31)*

RE-AIM Dimension and Items	% (n)	Interventions	PRECIS-2 Indicator	Mean ^b (SD)
Reach	18.5		Eligibility criteria	3.06 (1.12)
1. Exclusion criteria	45.2 (14)	4 6 8 10 11 13 14 19 21 23 25 27 30 31	<i>The participants selected for the trial and whether they differ from those in usual care.</i>	
2. Participation rate ^a	12.9 (4)	2 4 5 27		
3. Representativeness	12.9 (4)	2 10 17 26		
4. Use of qualitative methods to understand reach and/or recruitment	3.2 (1)	31		
Effectiveness	51.0		Recruitment	2.48 (1.70) ^c
5. Measure of primary outcome	100.0 (31)	1-31	<i>How participants are recruited and whether this requires more effort than what is necessary in usual care settings.</i>	
6. Measure of broader outcomes (i.e., QOL, negative outcomes)	29.0 (9)	1 7 8 11 14 17 19 23 24		
7. Measure of robustness across subgroups	25.8 (8)	2 3 5 6 8 20 22 27	Primary outcome	2.94 (0.51)
8. Measure of short-term attrition ^a	83.9 (26)	1-4 7 8 11-14 16-31	<i>The extent to which the primary outcomes are directly relevant to participants.</i>	
9. Use of qualitative methods/data to understand outcomes	16.1 (5)	4 6 11 14 28		
Adoption-Setting	2.4		Primary analysis	2.28 (1.51) ^d
10. Setting exclusions	3.2 (1)	8	<i>The extent to which all data are included in analyses.</i>	
11. Setting adoption rate ^a	6.5 (2)	8 12		
12. Setting representativeness	0.0 (0)	--		
13. Use of qualitative methods to understand adoption at setting level	0.0 (0)	--		
Adoption-Staff	1.6		Setting	4.47 (0.97) ^d
14. Staff exclusions	3.2 (1)	8	<i>The setting in which the trial is conducted and the extent to which it differs from usual care settings.</i>	
15. Staff participation rate ^a	3.2 (1)	8		
16. Staff representativeness	0.0 (0)	--		
17. Use of qualitative methods to understand staff participation	0.0 (0)	--		
Implementation	14.2		Organization	2.26 (1.46)
18. Delivered as intended	16.1 (5)	10 12 14 16 26	<i>The resources/expertise/organization of care required to deliver the intervention and whether they differ from those available in usual care.</i>	
			Flexibility (delivery)	1.80 (1.00) ^e
			<i>How the intervention should be</i>	

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19. Adaptations to intervention	16.1 (5)	2 12 13 16 26	<i>delivered and whether flexibility in delivery differs from that expected in usual care.</i>	Flexibility (adherence) 2.52 (1.34)
20. Cost of intervention (time or money)	6.5 (2)	8 25		
21. Consistency of implementation across staff/time/settings subgroups	3.2 (1)	10		
22. Use of qualitative methods to understand implementation	29.0 (9)	6 11 13-16 21 26 28		
Maintenance-Individual	9.0		<i>How often participants are followed up and the extent to which this differs from usual care follow-up.</i>	Follow-up 2.44 (1.55)
23. Measure of primary outcome at ≥6 month follow-up	16.1 (5)	6 8 10 18 19		
24. Measure of broader outcomes (i.e., quality of life, negative outcomes) at follow-up	6.5 (2)	8 19		
25. Measure of long-term robustness across subgroups	6.5 (2)	6 8		
26. Measure of long-term attrition ^a	12.9 (4)	8 10 18 19		
27. Use of qualitative methods to understand long-term effects	3.2 (1)	6		
Maintenance-Setting	4.8			
28. Program ongoing (≥ 6 month post-study funding)	6.5 (2)	2 6		
29. Long-term program adaptations	6.5 (2)	2 6		
30. Some discussion of sustainability of business model	6.5 (2)	2 6		
31. Use of qualitative methods to understand setting-level institutionalization	0.0 (0)	--		
Overall RE-AIM	15.5%			

Notes. RE-AIM = Reach, Effectiveness, Adoption, Implementation, Maintenance (Glasgow, Vogt, & Boles, 1999); PRECIS-2 = PRagmatic-Explanatory Continuum Indicator Summary-2 (Loudon et al., 2015); *SD* = standard deviation.

Interventions: 1 = Arbour-Nicitopoulos, Ginis, Latimer, Martin Ginis, & Latimer, 2009; 2 = Arbour-Nicitopoulos, Tomasone, Latimer-Cheung, & Martin Ginis, 2014; 3 = Arbour-Nicitopoulos et al., 2017; 4 = Bassett-Gunter et al., 2013; 5 = Bassett & Martin Ginis, 2011; 6 = Block, Vanner, Keys, Rimmer, & Skeels, 2010; 7 = Brawley, Arbour-Nicitopoulos, & Martin Ginis, 2013; 8 = de Oliveira et al., 2016; 9 = Foulon & Martin Ginis, 2013; 10 = Froehlich-Grobe et al., 2012, 2014; 11 = Froehlich-Grobe & White, 2004; 12 = Gainforth, Latimer-Cheung, Athanasopoulos, & Martin

Ginis, 2013; 13 = Kosma, Cardinal, & McCubbin, 2005; 14 = Lai, Rimmer, Barstow, Jovanov, & Bickel, 2016; 15 = Latimer-Cheung et al., 2013a; 16 = Latimer-Cheung et al., 2013b; 17 = Latimer, Martin Ginis, & Arbour, 2006; 18 = Myers, Gopalan, Shahoumian, & Kiratli, 2012; 19 = Nooijen et al., 2016, 2017; 20 = Pelletier, Latimer-Cheung, Warburton, & Hicks, 2014; 21 = Piatt, Compton, Sara Wells, & Bennett, 2012; 22 = Radomski et al., 2011; 23 = Rimmer, Wang, Pellegrini, Lullo, & Gerber, 2013; 24 = Sheehy, 2013; 25 = Thomas et al., 2011; Wise et al., 2009; 26 = Tomasone, Arbour-Nicitopoulos, Latimer-Cheung, & Martin Ginis, 2018; 27 = van der Ploeg et al., 2007; 28 = Warm, Belza, Whitney, Mitchell, & Stiens, 2004; 29 = Wickham et al., 2000; 30 = Zahl, Compton, Kim, & Rosenbluth, 2008; 31 = Zemper et al., 2003

^a Either *n* and valid denominator, or percentage

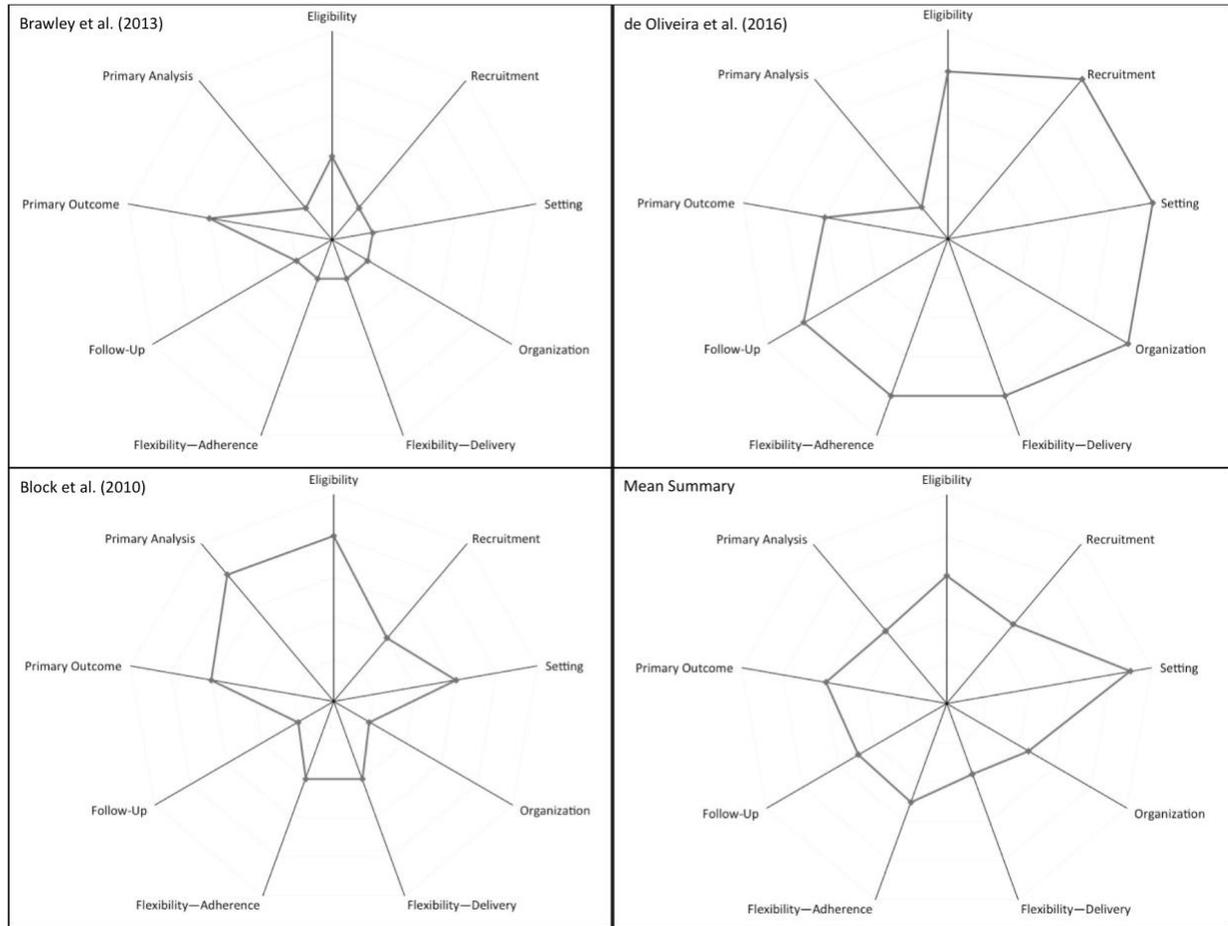
^b A 5-point Likert was used to assign a score on the pragmatic-explanatory continuum, ranging from 1 (“*very explanatory*”) to 5 (“*very pragmatic*”); thus, higher mean scores reflect interventions that have been scored as more pragmatic.

^c Two interventions were assessed as “*unsure*” due to insufficient information provided.

^d Six interventions were assessed as “*unsure*” due to insufficient information provided.

^e One intervention was assessed as “*unsure*” due to insufficient information provided.

Figure 1. *Exemplar and Average PRECIS-2 Ratings.*



Notes. PRECIS-2²⁷ = PRagmatic–Explanatory Continuum Indicator Summary-2 (Loudon et al., 2015). Top left = primarily explanatory; Top right = primarily pragmatic; Bottom left = equally explanatory and pragmatic; Bottom right = mean summary scores across all 31 interventions.

References

- References marked with an asterisk indicate the studies included in the Tomasone, Flood, et al. (2018) systematic review and used in the current secondary analysis.
- Akers, J. D., Estabrooks, P. A., & Davy, B. M. (2010). Translational research: Bridging the gap between long-term weight loss maintenance research and practice. *Journal of the American Dietetic Association, 110*(10), 1511-1522.
- Allen, K., Zoellner, J., Motley, M., & Estabrooks, P. A. (2011). Understanding the internal and external validity of health literacy interventions: A systematic literature review using the RE-AIM framework. *Journal of Health Communication, 16*(Suppl.3), 55-72.
- *Arbour-Nicitopoulos, K., Martin Ginis, K. A., Latimer, A. E., Martin Ginis, K., & Latimer, A. E. (2009). Planning, leisure-time physical activity, and coping self-efficacy in persons with spinal cord injury: A randomized controlled trial. *Archives of Physical Medicine & Rehabilitation, 90*(12), 2003–2011.
- *Arbour-Nicitopoulos, K. P., Sweet, S. N., Lamontagne, M. E., Martin Ginis, K. A., Jeske, S., Routhier, F., & Latimer-Cheung, A. E. (2017). A randomized controlled trial to test the efficacy of the SCI Get Fit Toolkit on leisure-time physical activity behaviour and social-cognitive processes in adults with spinal cord injury. *Spinal Cord Series and Cases, 3*, 17044.
- *Arbour-Nicitopoulos, K., Tomasone, J. R., Latimer-Cheung, A. E., & Martin Ginis, K. A. (2014). Get in motion: An evaluation of the reach and effectiveness of a physical activity telephone counseling service for Canadians living with spinal cord injury. *PM & R: The Journal of Injury, Function, and Rehabilitation, 6*(12), 1088–1096.
- Barlow, J., Wright, C., Sheasby, J., Turner, A., & Hainsworth, J. (2002). Self-management approaches for people with chronic conditions: A review. *Patient Education and Counseling, 48*, 177-187.
- *Bassett-Gunter, R. L., Martin Ginis, K. A., Latimer-Cheung, A. E., Bassett-Gunter L., R., Martin Ginis, K. A., & Latimer-Cheung E., A. (2013). Do you want the good news or the bad news? Gain- versus loss-framed messages following health risk information: The effects on leisure time physical activity beliefs and cognitions. *Health Psychology, 32*(12), 1188–1198.
- *Bassett, R. L., & Martin Ginis, K. A. (2011). Risky business: The effects of an individualized health information intervention on health risk perceptions and leisure time physical activity among people with spinal cord injury. *Disability and Health Journal, 4*(3), 165–176.
- *Block, P., Vanner, E. A., Keys, C. B., Rimmer, J. H., & Skeels, S. E. (2010). Project Shake-It-Up: Using health promotion, capacity building and a disability studies framework to increase self efficacy. *Disability and Rehabilitation, 32*(9), 741–754.
- *Brawley, L. R., Arbour-Nicitopoulos, K. P., & Martin Ginis, K. A. (2013). Developing physical activity interventions for adults with spinal cord injury. Part 3: A pilot feasibility study of an intervention to increase self-managed physical activity. *Rehabilitation Psychology, 58*(3), 316–321.
- Craike, M., Hill, B., Gaskin, C. J., & Skouteris, H. (2017). Interventions to improve physical activity during pregnancy: A systematic review on issues of internal and external validity using the RE-AIM framework. *British Journal of Obstetrics and Gynaecology, 124*(4), 573-583.
- *de Oliveira, B. I. R., Howie, E. K., Dunlop, S. A., Galea, M. P., McManus, A., & Allison, G. T. (2016). SCIPA Com: Outcomes from the spinal cord injury and physical activity in the community intervention. *Spinal Cord, 54*(10), 855-860.
- Dzewaltowski, D. A., Estabrooks, P. A., Klesges, L. M., Bull, S., & Glasgow, R. E. (2004). Behavior change intervention research in community settings: How generalizable are the results? *Health Promotion International, 19*(2), 235-245.
- Estabrooks, P. A., & Allen, K. C. (2012). Updating, employing, and adapting: A commentary on

- What Does It Mean to "Employ" The RE-AIM Model. *Evaluation and the Health Professions*, 36(1), 67-72.
- Fernhall, B., Heffernan, K., Jae, S., & Hedrick, B. (2008). Health implications of physical activity in individuals with spinal cord injury: A literature review. *Journal of Health and Human Services Administration*, 30(4), 468–502.
- *Foulon, B. L., & Martin Ginis, K. A. (2013). The effects of physical activity vignettes on physical activity-related social cognitions among people with spinal cord injury. *Disability and Rehabilitation*, 35(24), 2073–2080.
- *Froehlich-Grobe, K., Aaronson, L. S., Washburn, R. A., Little, T. D., Lee, J., Nary, D. E., ... Norman, S. E. (2012). An exercise trial for wheelchair users: Project workout on wheels. *Contemporary Clinical Trials*, 33(2), 351-363.
- *Froehlich-Grobe, K., Lee, J., Aaronson, L., Nary, D. E., Washburn, R. A., & Little, T. D. (2014). Exercise for everyone: A randomized controlled trial of project workout on wheels in promoting exercise among wheelchair users. *Archives of Physical Medicine and Rehabilitation*, 95(1), 20-28.
- *Froehlich-Grobe, K., & White, G. (2004). Promoting physical activity among women with mobility impairments: A randomized controlled trial to assess a home- and community-based intervention. *Archives of Physical Medicine and Rehabilitation*, 85(4), 640–648.
- Gaglio, B., & Glasgow, R. E. (2012). Evaluation approaches for dissemination and implementation research. In R. C. Brownson, G. A. Colditz, & E. K. Proctor (Eds.), *Dissemination and implementation research in health: Translating science to practice* (pp. 327-356). New York, NY: Oxford University Press.
- Gaglio, B., Phillips, S. M., Heurtin-Roberts, S., Sanchez, M. A., & Glasgow, R. E. (2014). How pragmatic is it? Lessons learned using PRECIS and RE-AIM for determining pragmatic characteristics of research. *Implementation Science*, 9(1), 96.
- Gaglio, B., Shoup, J. A., & Glasgow, R. E. (2013). The RE-AIM framework: A systematic review of use over time. *American Journal of Public Health*, 103(6), e38-e46.
- *Gainforth, H. L., Latimer-Cheung, A. E., Athanasopoulos, P., & Martin Ginis, K. A. (2013). Examining the effectiveness of a knowledge mobilization initiative for disseminating the physical activity guidelines for people with spinal cord injury. *Disability and Health Journal*, 6(3), 260–265.
- Galaviz, K. I., Harden, S. M., Smith, E., Blackman, K. C., Berrey, L. M., Mama, S. K., ... Estabrooks, P. a. (2014). Physical activity promotion in Latin American populations: A systematic review on issues of internal and external validity. *International Journal of Behavioral Nutrition and Physical Activity*, 11(1), 77.
- Glasgow, R. E., Bull, S. S., Gillette, C., Klesges, L. M., & Dzewaltowski, D. A. (2002). Behavior change intervention research in healthcare settings: A review of recent reports with emphasis on external validity. *American Journal of Preventive Medicine*, 23(1), 62-69.
- Glasgow, R. E., Klesges, L. M., Dzewaltowski, D. A., Bull, S. S., & Estabrooks, P. A. (2004). The future of health behavior change research: What is needed to improve translation of research into health promotion practice? *Annals of Behavioral Medicine*, 27(1), 3-12.
- Glasgow, R. E., Nelson, C. C., Strycker, L. A., & King, D. K. (2006). Using RE-AIM metrics to evaluate diabetes self-management support interventions. *American Journal of Preventive Medicine*, 30, 67-73.
- Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *American Journal of Public Health*, 89(9), 1322–1327.
- Harden, S. M., Burke, S. M., Haile, A. M., & Estabrooks, P. A. (2015). Generalizing the findings from group dynamics-based physical activity research to practice settings: What do we know? *Evaluation and the Health Professions*, 38(1), 3–14.
- Harden, S. M., Gaglio, B., Shoup, J. A., Kinney, K. A., Johnson, S. B., Brito, F., ... & Glasgow,

- R. E. (2015). Fidelity to and comparative results across behavioral interventions evaluated through the RE-AIM framework: A systematic review. *Systematic Reviews*, 4(1), 155.
- Johnson, K. E., Neta, G., Dember, L. M., Coronado, G. D., Suls, J., Chambers, D. A., ... Glasgow, R. E. (2016). Use of PRECIS ratings in the National Institutes of Health (NIH) Health Care Systems Research Collaboratory. *Trials*, 17(1), 32.
- Kessler, R. S., Purcell, E. P., Glasgow, R. E., Klesges, L. M., Benkeser, R. M., & Peek, C. J. (2013). What does it mean to “employ” the RE-AIM model? *Evaluation & the Health Professions*, 36(1), 44–66.
- Klesges, L. M., Dzewaltowski, D. A., & Glasgow, R. E. (2008). Review of external validity reporting in childhood obesity prevention research. *American Journal of Preventive Medicine*, 34(3), 216-223.
- Klesges, L. M., Estabrooks, P. A., Dzewaltowski, D. A., Bull, S. S., & Glasgow, R. E. (2005). Beginning with the application in mind: Designing and planning health behavior change interventions to enhance dissemination. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, 29 Suppl, 66–75.
- *Kosma, M., Cardinal, B. J., & McCubbin, J. A. (2005). A pilot study of a web-based physical activity motivational program for adults with physical disabilities. *Disability and Rehabilitation*, 27(23), 1435–1442.
- *Lai, B., Rimmer, J., Barstow, B., Jovanov, E., & Bickel, C. S. (2016). Teleexercise for persons with spinal cord injury: A mixed-methods feasibility case series. *JMIR Rehabilitation and Assistive Technologies*, 3(2), e8.
- *Latimer-Cheung, A. E., Arbour-Nicitopoulos, K. P., Brawley, L. R., Gray, C., Wilson, A. J., Prapavessis, H., ... Ginis, K. A. M. (2013). Developing physical activity interventions for adults with spinal cord injury. Part 2: Motivational counseling and peer-mediated interventions for people intending to be active. *Rehabilitation Psychology*, 58(3), 307–315.
- *Latimer, A., Martin Ginis, K. A., & Arbour, K. (2006). The efficacy of an implementation intention intervention for promoting physical activity among individuals with spinal cord injury: A randomized controlled trial. *Rehabilitation Psychology*, 51(4), 273–280.
- Lewis, B. A., Napolitano, M. A., Buman, M. P., Williams, D. M., & Nigg, C. R. (2017). Future directions in physical activity intervention research: Expanding our focus to sedentary behaviors, technology, and dissemination. *Journal of Behavioral Medicine*, 40(1), 112-126.
- Lorig, K. R., & Holman, H. R. (2003). Self-management education: History, definition, outcomes, and mechanisms. *Annals of Behavioural Medicine*, 26(1), 1–7.
- Loudon, K., Treweek, S., Sullivan, F., Donnan, P., Thorpe, K. E., & Zwarenstein, M. (2015). The PRECIS-2 tool: Designing trials that are fit for purpose. *BMJ: British Medical Journal*, 350(04 May-10 May), h2147.
- Martin Ginis, K. A., Jetha, A., Mack, D. E., & Hetz, S. (2010). Physical activity and subjective well-being among people with spinal cord injury: A meta-analysis. *Spinal Cord*, 48(1), 65–72.
- Martin Ginis, K. A., Latimer, A. E., Arbour-Nicitopoulos, K. P., Buchholz, A. C., Bray, S. R., Craven, B. C., ... Wolfe, D. L. (2010). Leisure time physical activity in a population-based sample of people with spinal cord injury part I: Demographic and injury-related correlates. *Archives of Physical Medicine and Rehabilitation*, 91(5), 722–728.
- Martin Ginis, K. A., Ma, J. K., Latimer-Cheung, A. E., & Rimmer, J. H. (2016). A systematic review of review articles addressing factors related to physical activity participation among children and adults with physical disabilities. *Health Psychology Review*, 10(4), 478-494.
- McGoey, T., Root, Z., Bruner, M. W., & Law, B. (2015). Evaluation of physical activity interventions in youth via the Reach, Efficacy/Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework: A systematic review of randomised and non-randomised trials. *Preventive Medicine*, 76, 58–67.
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., ... & Wood,

- C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46*(1), 81-95.
- *Myers, J., Gopalan, R., Shahoumian, T., & Kiratli, J. (2012). Effects of customized risk reduction program on cardiovascular risk in males with spinal cord injury. *Journal of Rehabilitation Research and Development, 49*(9), 1355–1364.
- *Nooijen, C. F., Stam, H. J., Bergen, M. P., Bongers-Janssen, H. M., Valent, L., van Langeveld, S., ... & van den Berg-Emons, R. J. (2016). A behavioural intervention increases physical activity in people with subacute spinal cord injury: A randomised trial. *Journal of Physiotherapy, 62*(1), 35-41.
- *Nooijen, C. F., Stam, H. J., Sluis, T., Valent, L., Twisk, J., & van den Berg-Emons, R. J. (2017). A behavioral intervention promoting physical activity in people with subacute spinal cord injury: Secondary effects on health, social participation and quality of life. *Clinical Rehabilitation, 31*(6), 772-780.
- *Pelletier, C. A., Latimer-Cheung, A. E., Warburton, D. E., & Hicks, A. L. (2014). Direct referral and physical activity counselling upon discharge from spinal cord injury rehabilitation. *Spinal Cord, 52*(5), 392–395. Retrieved from <http://www.nature.com/sc/index.html>
- *Piatt, J., Compton, D. M., Wells, M. S., & Bennett, J. L. (2012). Interventions that effect active living among individuals with spinal cord injury. *Therapeutic Recreation Journal, 46*(1), 9–25.
- *Radomski, M., Finkelstein, M., Hagel, S., Masemer, S., Theis, J., & Thompson, M. (2011). A pilot wellness and weight management program for individuals with spinal cord injury: Participants' goals and outcomes. *Topics in Spinal Cord Injury Rehabilitation, 17*(2), 59-69.
- Rick Hansen Institute (2017). *Facts about SCI*. Retrieved from <http://www.rickhanseninstitute.org/resource/sci/what-is-sci>
- *Rimmer, J. H., Wang, E., Pellegrini, C. A., Lullo, C., & Gerber, B. S. (2013). Telehealth weight management intervention for adults with physical disabilities. *American Journal of Physical Medicine & Rehabilitation, 92*(12), 1084–1094.
- Schlechter, C. R., Rosenkranz, R. R., Guagliano, J. M., & Dzewaltowski, D. A. (2016). A systematic review of children's dietary interventions with parents as change agents: Application of the RE-AIM framework. *Preventive Medicine, 91*, 233-243.
- *Sheehy, S. B. (2013). A nurse-coached exercise program to increase muscle strength, improve quality of life, and increase self-efficacy in people with tetraplegic spinal cord injuries. *Journal of Neuroscience Nursing, 45*(4), E3–E12.
- Taylor, S. J. C., Pinnock, H., Epiphaniou, E., Pearce, G., Parke, H. L., Schwappach, A., ... Sheikh, A. (2014). A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions. PRISMS-Practical Systematic Review of Self-Management Support for long-term conditions. *NIHR Journals Library, 2*(53).
- *Thomas, K., Wise, H., Nietert, P., Brown, D., Sword, D., & Diehl, N. (2011). Interaction with a health care professional influences change in physical activity behaviors among individuals with a spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation, 17*(1), 94–106.
- Thorpe, K. E., Zwarenstein, M., Oxman, A. D., Treweek, S., Furberg, C. D., Altman, D. G., ... Chalkidou, K. (2009). A PRagmatic-Explanatory Continuum Indicator Summary (PRECIS): A tool to help trial designers. *Journal of Clinical Epidemiology, 62*(5), 464–475.
- *Tomasone, J. R., Arbour-Nicitopoulos, K. P., Latimer-Cheung, A. E., & Martin Ginis, K. A. (2018). The relationship between the implementation and effectiveness of a nationwide physical activity telephone counseling service for adults with spinal cord injury. *Disability and Rehabilitation, 40*(5), 527-537.
- Tomasone, J. R., Flood, S. M., Ma, J. K., Scime, N. V., Burke, S. M., Sleeth, L., ... The SCIRE Research Team (2018). Physical activity self-management interventions for adults with spinal cord injury: Part 1 – Use and effectiveness of behavior change techniques.

Psychology of Sport and Exercise.

- Tomasone, J. R., Wesch, N. N., Martin Ginis, K. A., & Noreau, L. (2013). Spinal cord injury and quality of life: A systematic review. *Kinesiology Review, 2*, 113–129.
- *van der Ploeg, H. P., Streppel, K. R. M., Van der Beek, A. J., Van der Woude, L. H. V., Vollenbroek-Hutten, M. M. R., Van Harten, W. H., & Van Mechelen, W. (2007). Successfully improving physical activity behavior after rehabilitation. *American Journal of Health Promotion, 21*(3), 153–159.
- *Warmus, C. A., Belza, B. L., Whitney, J. D., Mitchell, P. H., & Stiens, S. A. (2004). Lifestyle physical activity for individuals with spinal cord injury: A pilot study. *American Journal of Health Promotion, 18*(4), 288–291.
- *Wickham, S. E., Hanson, C. S., Shechtman, O., Ashton, C., Wickham, S. E., Hanson, C. S., ... Ashton, C. (2000). A pilot study: Attitudes toward leisure and leisure motivation in adults with spinal cord injury. *Occupational Therapy in Health Care, 12*(4), 33–50.
- *Wise, H. H., Thomas, J., Nietert, P. J., Brown, D. D., Sword, D. O., & Diehl, N. (2009). Home physical activity programs for the promotion of health and wellness in individuals with spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation, 14*(4), 122–132.
- Wolfe, D. L., Hitzig, S. L., Sleeth, L., McRae, S., Marrocco, S., Jaglal, S., Linassi, G., Shepherd, J. D., Tomasone, J. R., & the SCIRE Research Team (in preparation). *What does self-management support programming look like for persons with SCI? A scoping review.*
- *Zahl, M. L., Compton, D. M., Kim, K., & Rosenbluth, J. P. (2008). SCI/D forum to increase active living: The effect of a self-efficacy and self-affirmation based SCI/D forum on active living in adults with spinal cord injury/disease. *SCI Psychosocial Process, 21*(2), 5–13.
- *Zemper, E. D., Tate, D. G., Roller, S., Forchheimer, M., Chiodo, A., Nelson, V. S., & Scelza, W. (2003). Assessment of a holistic wellness program for persons with spinal cord injury. *American Journal of Physical Medicine & Rehabilitation, 82*(12), 957–968.

Table S2

Summary of Studies Included in the Tomasone et al. (2018) Systematic Review

	Study, Country	Study design, Sample size	Purpose	Intervention Setting	Mode of Delivery
Prospective pre-post study designs (<i>n</i> = 15)	Arbour-Nicitopoulos (2014) Canada	Prospective pre-post n = 53; 32	To assess the individual-level impact of a previously tested telephone-based counseling intervention among adults within the SCI community by using the first 2 components of the RE-AIM framework	Home-based	Telephone
	Bassett (2011) Canada	Prospective pre-post n = 62; 62	To examine changes in perceived risk for disease following an individualized health information intervention and to examine changes in perceived risk for disease as a predictor of changes in LTPA	Home-based	Telephone Mail
	Brawley (2013) Canada	Prospective pre-post n = 13; 10	To test the efficacy and feasibility of a group-mediated cognitive-behavioral training intervention for increasing self-managed LTPA among people with SCI who are already somewhat active	Unspecified	Telephone Face-to-face meetings Group meetings
	de Oliveira (2016) Australia and New Zealand	Prospective pre-post n = 85; 40	To determine the effects of the Spinal Cord Injury and Physical Activity in the Community intervention on LTPA and associated outcomes among participants with SCI	Community Fitness centres	Face-to-face meetings Telephone
	Gainforth (2013) Canada	Prospective pre-post n = 104; 66	To examine the reach and effectiveness of an event-based knowledge mobilization initiative that used interpersonal communication to disseminate the guidelines to people with SCI	Unspecified	Face-to-face meetings Group meetings

Lai (2016) United States	Prospective pre-post n = 4; 4	To test the feasibility of a remotely delivered home exercise program for individuals with SCI as determined by (1) implementation of the intervention in the home; (2) exploration of the potential intervention effects on aerobic fitness, physical activity behavior, and subjective well-being; and (3) acceptability of the program through participant self-report	Home-based	Face-to-face meeting Web-based platform
Latimer-Cheung(2013) study 1 Canada	Prospective pre-post n = 7; 7	To examine the effects of a single, telephone-based counseling session on self-regulatory efficacy, intentions, and action plans for LTPA	Home-based	Telephone
Latimer-Cheung(2013) study 2 Canada	Prospective pre-post n = 12; 10	To examine the effects of a home-based strength- training session, delivered by a peer and a fitness trainer, on strength-training task self-efficacy, intentions, action plans, and behavior	Home-based	Face-to-face meetings
Myers (2012) United States	Prospective pre-post n = 26; 10	To determine the influence of a multidisciplinary risk management program on cardiovascular disease risk in persons with SCI	Medical centre- and home-based	Telephone Face-to-face meetings
Pelletier (2014) Canada	Prospective pre-post n = 17; 15	To evaluate the efficacy of referral from a health-care provider to regular exercise combined with counseling support following discharge from inpatient or outpatient SCI rehabilitation	Self-selected by participants	Telephone
Piatt (2012) United States	Prospective pre-post n = 3; 3	To examine the effects of a recreation intervention designed to foster self-efficacy and self-affirmation on increasing active living scores individuals with a SCI	Community-based	Face-to-face meetings
Radomski (2011)	Prospective pre-post	To evaluate the feasibility and impact of a 12-week community-based program for	Community- and home-based	Face-to-face meetings Group meetings

	United States	n = 13; 10	wellness and weight management on weight control and fitness of people with SCI		DVD/video
	Sheehy (2013)	Prospective pre-post	To determine the effects of a nurse-coached exercise program for people with tetraplegic SCI on muscle strength, quality of life, and self-efficacy	Community-based	Face-to-face meetings
	United States	n = 10; 10			
	Tomasone (2016)	Prospective pre-post	The purpose of this study was to explore the implementation correlates of change in LTPA intentions and behavior in the second phase of Get in Motion	Home-based	Telephone
	Canada	n = 46; 25			
	Warms (2004)	Prospective pre-post	To evaluate the acceptability and feasibility of a lifestyle physical activity program for people with SCI	Home-based	Telephone Face-to-face meetings Printed materials
	United States	n = 17; 16			
Experimental study designs (n = 16)	Arbour-Nicitopoulos (2009)	RCT	To examine the effects of action planning only (C) and action and coping planning (E) on LTPA and self-efficacy in exercise among persons with SCI	Home-based	Telephone
	Canada	n _E = 22; 18 n _C = 22; 20			
	Arbour-Nicitopoulos (2017)	RCT	To evaluate the efficacy of the SCI Get Fit Toolkit delivered online on theoretical constructs and moderate-to-vigorous physical activity among adults with SCI	Home-based	Web
	Canada	n _E = 42; 35 n _C = 48; 42			
	Bassett-Gunter (2013)	RCT	To examine the relative effectiveness of chronic disease and psychological health risk information combined with gain (E1) versus loss-framed (E2) LTPA messages for changing perceived personal risk, LTPA response-efficacy, and LTPA intentions among persons with SCI	Home-based	E-mail
	Canada	n _{E1} = 32; 32 n _{E2} = 34; 34 n _C = 28; 28			
	Block (2010)	Quasi-experimental	To assess the influence of a health promotion and capacity building program on self-efficacy	Community-based	Telephone Face-to-face meetings Group meetings
	United States	n _E = 26; 26 (13 SCI)			

		$n_c = 18; 18$			
Foulon (2013)	RCT		To explore the effectiveness of informational portrait vignettes for enhancing physical activity-related psychosocial cognitions in persons with SCI who were classified as being in the motivational (E1, C1) or volitional (E2, C2) phase of behavior change	Home-based	E-mail
Canada		$n_{E1} = 18; 18$ $n_{E2} = 24; 24$ $n_{c1} = 14; 14$ $n_{c2} = 23; 23$			
Froehlich-Grobe (2004)	RCT		To assess the effectiveness of a physical activity and fitness intervention for women with a physical disability	Self-selected by participants	Telephone Face-to-face meetings
United States		$n_E = 42; 32$ (6 SCI) $n_c = 51; 43$ (5 SCI)			
Froehlich-Grobe (2012, 2014)	RCT		To compare the effectiveness of staff-supported (E) versus self-guided (C) home-based behavioral interventions promoting exercise adoption and maintenance for wheelchair users	Home-based	Telephone Face-to-face meetings Mail
United States		$n_E = 69; 51$ (35 SCI) $n_c = 59; 35$ (24 SCI)			
Kosma (2005)	RCT		To assess the efficacy of a web-based LTPA motivational program tailored to inactive adults with physical disabilities	Home-based	Web
United States		$n_E = 101; 46$ (12 SCI) $n_c = 50; 29$ (13 SCI)			
Latimer (2006)	RCT		To evaluate the efficacy of an implementation intentions intervention for promoting physical activity among persons with SCI	Home-based	Telephone E-mail
Canada		$n_E = 26; 19$ $n_c = 28; 18$			
Nooijen (2016, 2017)	RCT		To assess, for people with subacute SCI, if rehabilitation that is reinforced with the addition of a behavioral intervention to promote physical activity leads to (1) a better health, participation, and quality of life and (2) a more active lifestyle than rehabilitation alone	Rehabilitation centre	Face-to-face meetings Telephone
Netherlands		$n_E = 20; 11$ $n_c = 19; 11$			

Rimmer (2013)	RCT	To examine the effects of a low-cost, telephone-based weight management program using a web-based system (Personalized Online Weight and Exercise Response System [POWERS]) for overweight and obese adults with a physical disability, within three conditions: physical activity only (E1), physical activity plus nutrition (E2) and control (C)	Home-based	E-mail
United States	n _{E1} = 32; 32 (7 SCI) n _{E2} = 32; 27 (8 SCI) n _c = 38; 32 (9 SCI)			
van der Ploeg (2007)	Quasi-experimental	To determine the effects of the physical activity promotion programs Rehabilitation & Sports (E1) and Rehabilitation and Sports paired with Active after Rehabilitation (E2) on sport and daily physical activity 1-year after in- or outpatient rehabilitation	Medical centre- and home-based	Telephone Face-to-face meetings
Netherlands	n _{E1} = 315; 224 n _{E2} = 284; 208 n _c = 603; 533			
Wickham (2000)	Quasi-experimental	To determine whether introduction to adapted sports in a wheelchair sports camp causes a measurable change in attitudes and motivation toward leisure physical activity	Camp-based	Face-to-face meetings Group meetings
United States	n _E = 12; 12 n _c = 12; 12			
Wise (2009), Thomas (2011)	RCT	To examine changes in physical activity in persons with SCI through regular participation in a tailored home exercise program	Home-based	Telephone Face-to-face meetings Printed materials DVD/video
United States	n _E = NS; 10 n _c = NS; 11			
Zahl (2008)	Quasi-experimental	To determine the effectiveness a self-efficacy and self-affirmation based educational forum on active living among adults with SCI and spinal cord disease	Unspecified	Face-to-face meetings Group meetings
United States	n _E = 13; 13 n _c = 14; 14			
Zemper (2003)	RCT	To determine the effect of a comprehensive and integrated holistic wellness program among persons with SCI	Hospital-based	Telephone Face-to-face meetings
United States	n _E = 36; 23 n _c = 31; 20			

Note. Sample size: E = experimental condition; C = comparison condition; E1 = first experimental condition; E2 = second experimental condition; C1 = first comparison condition; C2 = second comparison condition. Study Design: RCT = randomized controlled trial. Purpose: SCI = spinal cord injury; LTPA = leisure time physical activity.