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**ARTICLE**

# 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

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**STUDY DESIGN:** Single blind, two-group randomized controlled trial.
**OBJECTIVES:** To evaluate the efficacy of the *SCI Get Fit Toolkit* delivered online on theoretical constructs and moderate-to-vigorous physical activity (MVPA) among adults with SCI.
**SETTING:** Ontario and Quebec, Canada.
**ELIGIBILITY:** Inactive, English- and French-speaking Canadian adults with traumatic SCI with Internet access, and no self-reported cognitive or memory impairments.
**METHODS:** Participants ($N = 90$ $M_{age} = 48.12 \pm 11.29$ years; 79% male) were randomized to view the *SCI Get Fit Toolkit* or the Physical Activity Guidelines for adults with SCI (PAG-SCI) online. Primary (intentions) and secondary (outcome expectancies, self-efficacy, planning and MVPA behaviour) outcomes were assessed over a 1-month period.
**RESULTS:** Of the 90 participants randomized, 77 were included in the analyses. Participants viewed the experimental stimuli only briefly, reading the 4-page toolkit for approximately 2.5 min longer than the 1-page guideline document. No condition effects were found for intentions, outcome expectancies, self-efficacy, and planning ($\Delta R^2 \leqslant 0.03$). Individuals in the toolkit condition were more likely to participate in at least one bout of 20 min of MVPA behaviour at 1-week post-intervention compared to individuals in the guidelines condition (OR = 3.54, 95% CI = 0.95, 13.17). However, no differences were found when examining change in weekly minutes of MVPA or comparing whether participants met the PAG-SCI.
**CONCLUSIONS:** No firm conclusions can be made regarding the impact of the *SCI Get Fit Toolkit* in comparison to the PAG-SCI on social cognitions and MVPA behaviour. The limited online access to this resource may partially explain these null findings.

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## INTRODUCTION

Numerous health and fitness benefits of moderate-to-vigorous intensity physical activity (MVPA) for persons with spinal cord injury (SCI) are known[1] and valued by the SCI community.[2] Yet, the majority of adults with SCI are not sufficiently active to achieve these benefits.[3] Research examining the predictive utility of social cognitions for increasing MVPA among the Canadian SCI population has shown outcome expectancies, intentions, self-efficacy and planning to differ among active versus inactive individuals with SCI.[4–8] These social cognitions are salient constructs to target in physical activity interventions for this population.

Informational approaches are a type of intervention that can be used to target MVPA-related social cognitions to motivate and enable individuals to be more physically active.[9] For example, television advertisements that highlight the benefits of MVPA (for example, improved cardiovascular fitness and reductions in anxiety) illustrate an informational intervention strategy to change people's outcome expectancies. Informational approaches have the advantage of reaching a larger population through versatile delivery modes (for example, internet, mass mail outs) in a cost-effective manner, than intensive, face-to-face behavioural interventions.[9] This broad reaching approach is critical when working with the Canadian SCI population because individuals are often sparsely distributed across the country.[10] Only one study has tested the effects of a physical activity-related informational intervention on the social cognitions of adults with SCI. Bassett-Gunter *et al.*[11] demonstrated that targeted, health and physical activity informational messages delivered online over a two-day period resulted in large-sized, positive effects on intentions for MVPA behaviour. Whether the positive effects of informational interventions can extend to other salient social cognitions and MVPA behaviour within the SCI population requires further inquiry.

One practical informational resource designed to target the most salient social cognitions that are predictive of MVPA

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behaviour within the SCI population[4–8] is the *SCI Get Fit Toolkit*. This four-page resource was developed in consultation with experts and consumers with SCI,[12] with the objective of teaching inactive adults with SCI about evidence-based strategies (for example, planning[7,13] and eliciting social support[6,8,14]) on how to adopt and maintain regular MVPA participation. A key feature of the *SCI Get Fit Toolkit* is its versatile methods of delivery (for example, internet, mail outs, in-person consultations with healthcare professionals), making it a useful resource for broad reach within the Canadian SCI population.[10]

The purpose of this randomized controlled trial was to extend the findings on informational interventions within the SCI population by comparing the efficacy of two physical activity resources (the *SCI Get Fit Toolkit* and the Physical Activity Guidelines for Adults with SCI (PAG-SCI)[15] information sheet) on targeted social cognitions and MVPA behaviour among inactive Canadian adults with SCI using an online delivery method. The primary hypothesis was that adults who received the *SCI Get Fit Toolkit would report more positive intentions than those who were* given the standard PAG-SCI information sheet. Our secondary hypothesis was that adults with SCI who received the *SCI Get Fit Toolkit* would report more positive outcome expectancies and self-efficacy, and greater action planning and MVPA behaviour than those who received the standard PAG-SCI information sheet.

## MATERIALS AND METHODS

### Participants

English- and French-speaking Canadian adults with SCI were recruited from a variety of sources including: a pre-exisiting SCI participant database, the databases and websites of community partners with SCI Action Canada (a Canadian-based research-community SCI and physical activity initiative), Adaptavie (a community-based organization in Québec whose goal is to facilitate physical activity in persons with disabilities), and Moelle-Epinière et Motricité Québec (a community organization representing adults with SCI in Québec). Participants were eligible if they: had a traumatic SCI (any severity and injury level); were 18–64 years of age; were not meeting the PAG-SCI;[15] had internet access; were capable of completing an online questionnaire; were able to read in English or French; and had no self-reported cognitive or memory impairments. A sample size of 80 participants (40 per condition) was needed to have 80% power to detect a significant large-sized effect for the primary outcome of intentions (partial $\eta^2 = 0.14$) with alpha at 0.05. A large-sized effect was anticipated based on previous research showing positive effects of health messaging on MVPA intentions in inactive adults with SCI.[11]

### Design

A two-group (toolkit and guidelines), prospective randomized controlled trial was used with four assessment points (baseline, 24-h post-baseline, 1-week and 1-month post-intervention). Institutional research ethics approval was obtained in Fall 2013 from the University of Toronto and McGill University.

### Randomization and blinding

Participants were randomly assigned to the toolkit or guidelines condition using a random numbers tables. An allocation ratio of 1:1 was used to randomize participants, according to their order of study entry. A certified statistician who was independent from the research team generated the allocation sequence and condition assignments which were then enclosed in sealed envelopes and mailed to the research assistant (SJ). The research assistant then assigned participants to either the toolkit or guidelines condition. Participants were unaware of the two study conditions until the completion of the trial.

### Outcomes

The following instruments were used to assess changes in the primary and secondary outcomes. All instruments were administered in English or French and have been previously used to assess predictors of MVPA behaviour among adults with SCI.[4–8] All instruments demonstrated acceptable ($\alpha > 0.80$) internal consistency in the present study.

*Primary outcome*. Intentions were measured using two items pertaining to the PAG-SCI ('*In the next month, I intend to… (a) engage in at least 20 min of moderate to vigorous intensity aerobic physical activity two times per week*' and (b) '*engage in three sets of 8–10 repetitions of strength-training exercises for each muscle group two times per week.*'). Both items were rated using a seven-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*), with a mean score calculated for the items at each time point.

*Secondary outcomes*. Outcome expectancies were assessed using six adjective pairs (for example, good/bad) that were all preceded by the statement, '*To what extent do you think that participating in the PAG-SCI for adults with SCI in the next month would be…*'. Items were rated on a seven-point scale using the term *extremely* at the anchor points. Mean scores were calculated across the items measured at baseline and 24-h post-baseline.

Self-efficacy for meeting the PAG-SCI and for overcoming SCI-specific physical activity barriers were assessed using one (*not at all confident*) to seven (*completely confident*) rating scales. For task self-efficacy, participants were asked, '*…how confident are you that you could physically do the following amounts of moderate/vigorous intensity physical activity without stopping for…(10 min/20 min/30 min/45 min/60 min)*'. Each of the question stems were preceded with the statement, '*Over the next month, if you had all of the resources that you needed, such as specialized equipment or an assistant….*'. For barrier self-efficacy, participants were asked, '*…how confident are you that you could meet the PAG-SCI over the next month even if…you feel tired or fatigued/you get busy or have limited time/you have transportation problems/you have pain or soreness/the weather is very bad/ you do not have someone to help you*'. Each of the question stems were preceded with the statement, '*Assuming you were very motivated…*' to account for differences in motivation.[16] Mean task and barrier self-efficacy scores were then calculated separately based on their respective items for each time point.

Action planning was assessed using four items related to the extent to which detailed plans were formed regarding when, where, how often, and what types of physical activities to do to meet the PAG-SCI over the next month. Items were rated on a one (*definitely false*) to seven (*definitely true*) scale. Mean scores were calculated for the items at each time point.

MVPA behaviour was assessed using the previously validated self-report, seven-day Leisure-Time Physical Activity Questionnaire for Adults with SCI (LTPAQ-SCI[17]). Participants indicated the frequency (days) and duration (minutes) of time they engaged in moderate (*require some physical effort that make you feel like you are working somewhat hard but you feel like you can keep going for a long time*) and vigorous (*require a lot of physical effort that make you feel like you are working really hard, almost at your maximum, and you can only do the activity for a short period of time before getting tired*) intensity leisure-time physical activity over the last 7 days. Total weekly minutes of MVPA were then calculated for each time point.

*Demographic outcomes*. Baseline characteristics were gathered on participants' age, gender, ethnicity, education, marital status, years post-injury, injury level, cause of injury and primary mode of mobility.

### Experimental conditions

*Physical activity guidelines for adults with spinal cord injury (PAG-SCI) information sheet (guidelines condition)*. Participants assigned to the guidelines condition read through a one-page information sheet online using the FluidSurveys platform. This resource provides detailed information on the the recommended aerobic and strengthening MVPA guidelines for adults with SCI.[15] These guidelines state that adults (aged 18–64 years) engage in a minimum of 2 days per week of aerobic MVPA for at least 20 min per bout and at least 2 days per week of strengthening MVPA consisting of three sets of 8–10 repetitions for each major muscle group.[15] This 1-page information sheet was developed specifically for consumers and health care professionals (available in both English and French) to provide information on how to achieve the guidelines (that is, how often, how much, how hard and how to).

*SCI Get Fit Toolkit (toolkit condition)*. Participants in the toolkit condition read through a four-page, evidence-based physical activity toolkit online

using the FluidSurveys platform. This toolkit was developed in consultation with experts and consumers with SCI[12] and is available online in both English and French. The content within the toolkit consists of the following: an outline of the PAG-SCI, suggested aerobic/resistence activities that are appropriate for manual and power wheelchair users (targeting *task self-efficacy*), SCI-specific benefits of MVPA (targeting *outcome expectancies*), details on how to form action plans (targetng *action planning*), and common MVPA barriers for persons with SCI, along

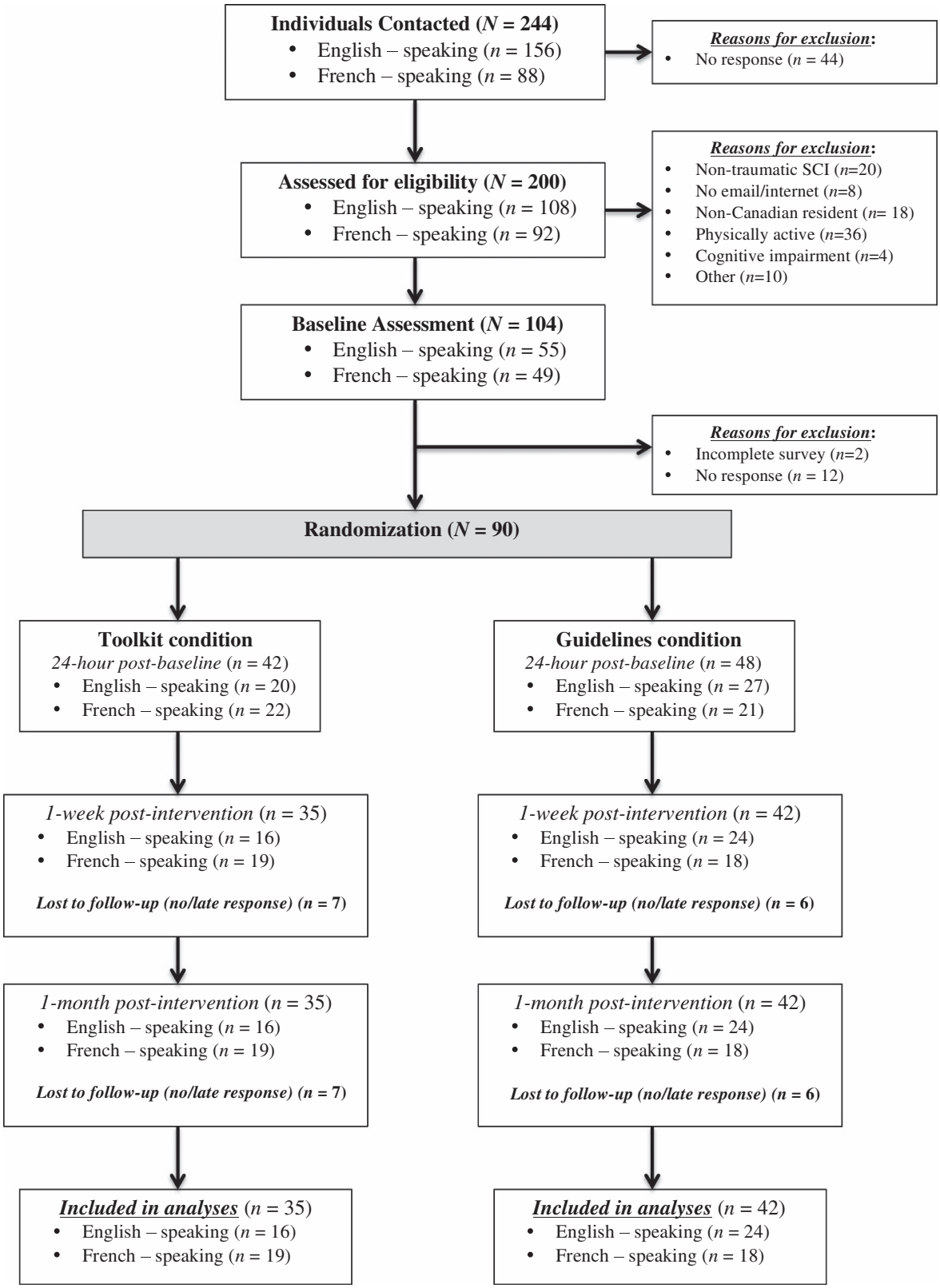


**Figure 1.** Flowchart of Randomization and Data Collection Procedures. Participant flow chart throughout the recruitment, randomization and data collection procedures. PAG-SCI, Physical Activity Guidelines for Adults with SCI.

with some suggested coping strategies and safety tips (targeting *barrier self-efficacy*).

## Procedure

Figure 1 provides a graphical representation of the study protocol and participant flow. All prospective participants were screened for eligibility via telephone by an English (SJ) or French (CS) speaking research assistant. If eligible, verbal informed consent was obtained followed by administration of the demographic questionnaire. At the end of the screening, participants were emailed instructions and an invitation to participate in the online study that was administered through a fee-based survey platform called FluidSurveys.

*Baseline testing*. On accepting the study invitation, participants were directed to the online questionnaire to asssess the targeted social cognitions and MVPA behaviour. Participants took ~17 min to complete this online questionnaire. Randomization occurred immediately following this time point.

*Intervention and 24-h post-baseline testing*. Participants in both conditions were emailed a link 24-h post-baseline directing them to the FluidSurveys platform. On the basis of the randomization, participants read an online version (in English or French) of either the *SCI Get Fit Toolkit* (toolkit condition) or the PAG-SCI information sheet (guidelines condition). Participants were instructed to read through their assigned resource in detail after which they clicked onto a separate page of the website where they were required to respond to six resource-specific comprehension questions (Table 1). These questions were developed by authors KAN and SJ to determine whether participants were able to recall some of the key messages of their assigned resource. They then completed the questionnaire related to outcome expectancies, task and barrier self-efficacy, and intentions. Action planning was not assessed at this time point as participants assigned to the toolkit condition had just read information about action planning and, therefore, they would not have time to implement this strategy. No ongoing access to the assigned resource was provided over the remaining 1-month study period. On completion of the 24-h post-baseline questionnaire, participants were emailed a $10 electronic gift card. Time to complete the 24-h post-baseline assessment was ~13 min for the toolkit condition and 11 min for the guidelines condition.

*1-week and 1-month post-intervention testing*. Participants were emailed a FluidSurveys link to complete the task and barrier self-efficacy, intentions, action planning and MVPA behaviour measures at 1-week and 1-month post-intervention. On completion of each of the two post-intervention online assessments, participants were entered into a draw to win one of five $100 electronic gift cards. Time to complete the 1-week and 1-month follow-up assessments was ~10 min and 7 min, respectively.

## Statistical analysis

All analyses were conducted using SPSS v.23. Data cleaning procedures were conducted to examine univariate outliers and normality. Any identified univariate outlier was reduced to the next highest, acceptable value.[18] Missing data were examined to identify if they were missing at least at random, using the Little's MCAR test and subsequently imputed using expectation maximization. Using chi-square and *t*-test analyses, the two conditions were compared on the demographic variables. These same variables were also compared between English- and French-speaking participants to detect any language differences.

In line with Vickers[19] recommendations, the main analyses for the primary and secondary social cognition outcomes were conducted with multiple regressions to assess both immediate and long-term exposure effects. For immediate exposure effects, a series of multiple regressions were conducted, controlling for baseline scores (Block 1), to examine the immediate effects of reading the physical activity resources (Block 2: condition variable) on the residual changes score of intentions, outcome expectancies, and task and barrier self-efficacy. For longer-term exposure effects, a series of multiple regressions were conducted, controlling for baseline scores (Block 1), on 1-week and 1-month time points to examine whether there were any longer-term effects of reading the physical activity resources (Block 2: condition variable) on residual change score of intentions, task and barrier self-efficacy and action planning. Significance was reported with 95% confidence intervals (CI) and effect size with the unique variance contribution of the condition variable (that is, $\Delta R^2$).

To test the impact of the two resources on MVPA behaviour (that is, secondary outcome), logistic regression analyses were conducted given the high presence of zeros, and consequently, the non-normal distribution of this variable (see additional details in Results section). MVPA was dichotomized in two ways: (a) engaging versus not engaging in at least 20 min of MVPA/week; and (b) meeting versus not meeting the PAG-SCI. These two dichotomizations were chosen to examine whether reading the *SCI Get Fit Toolkit* predicted the likelihood of participants either *adopting* some MVPA (that is, $\geqslant$20 min of MVPA/week, approximating one bout of MVPA in the PAG-SCI) or *meeting* the PAG-SCI.[15] Separate binary logistic regressions were conducted for 1-week and 1-month post-intervention, where baseline MVPA behaviour was controlled in Block 1, followed by the

**Table 1.** Description of the Condition-Specific Physical Activity Resource Comprehensive Questions and the Proportion of the Sample Providing a Correct Response

| *Resource-specific comprehension question* | *Correct response* | |
|---|---|---|
| | *N* | *%* |
| *SCI Get Fit Toolkit* (*N* = *35*) | | |
| 1. What are the minimum duration and frequency of moderate-vigorous aerobic activity per week recommendations for adults with a SCI? | 15 | 42.86 |
| 2. What is the recommended number of sets and repetitions for a strengthening activity for adults with SCI? | 26 | 74.29 |
| 3. What kind of manual chair exercise(s) is/are available for adults with SCI? | 33 | 94.29 |
| 4. What are some of the benefits of engaging in physical activity for adults with SCI? | 34 | 97.14 |
| 5. What are three tactics mentioned in the *SCI Get Fit Toolkit* for staying focused on your Action Plan and maintaining regular physical activity? | 13 | 37.14 |
| 6. What is/are the most appropriate strategy(ies) for overcoming a lack of support or access to physical activities? | 27 | 77.14 |
| *PAG-SCI Information Sheet* (N = *42*) | | |
| 1. What are the minimum duration and frequency of moderate-vigorous aerobic activity per week recommendations for adults with a SCI? | 23 | 54.76 |
| 2. What is the recommended number of sets and repetitions for a strengthening activity for adults with SCI? | 31 | 73.81 |
| 3. How many times is it recommended that adults with SCI try to engage in strength training per week? | 33 | 78.57 |
| 4. What is the recommended intensity of strength training for adults with a SCI? | 22 | 52.38 |
| 5. Repetitions are the number of times you lift and lower a weight? | 37 | 88.10 |
| 6. Resistance should be heavy enough that you can barely finish the predetermined number of repetitions? | 23 | 54.76 |

Abbreviations: SCI, spinal cord injury; PAG-SCI, Physical Activity Guidelines for Adults with SCI.

condition variable in Block 2. To examine changes from baseline to 1-month post intervention in the number of individuals who (a) engaged/did not engage in at least 20 min of MVPA/week and (b) met/did not meet the guidelines, a series of Cochrane's Q tests were conducted for each condition separately.

## RESULTS

### Participant demographics

A total of 200 participants were assessed for eligibility of which 104 (52%) met the study criteria. Reasons for ineligibility included: having a non-traumatic SCI ($n = 20$), no email/internet access ($n = 8$), non-Canadian resident ($n = 18$), meeting the PAG-SCI ($n = 36$), cognitive impairment ($n = 4$) and other ($n = 10$).

Of the 104 eligible individuals, 90 (86.5%) completed the baseline questionnaire and were randomized to either the toolkit ($n = 42$) or guidelines ($n = 48$) condition (Figure 1). Among the 90 participants randomized, 77, 72 and 75 completed the 24-h post-baseline, and 1-week and 1-month post-intervention assessments, respectively. Given that the 24-h post-baseline assessment was the specific time point for which both conditions were exposed to their assigned physical activity resource, the analyses only involved the 77 participants who completed this time point. No significant differences were found between participants who did ($n = 77$) versus did not ($n = 13$) complete the 24-h post-baseline questionnaire (all $ps > 0.13$) on the measured demographic characteristics, social cognitions, or MVPA behaviour variables.

Sample demographic characteristics for the two conditions are provided in Table 2. Participants were, on average, in their mid-to-late 40s ($M = 48.03$ (s.d. = 10.39) years), English-speaking (52%), White (96%), and male (78%). The majority of participants had tetraplegia (56%), were manual wheelchair users (57%), and had been living with their SCI for an average of 17.5 (s.d. = 11.98) years. No significant differences were found between the two conditions on any of the measured demographic characteristics (all $ps > 0.15$)

### Manipulation check

Overall, the 77 participants responded correctly to a mean of 4.12 (s.d. = 1.39) of the resource-specific comprehension questions (Table 1). Total time spent reading the assigned resource and completing the 24-h post-baseline questionnaire was 13.34 (s.d. = 7.23) minutes for the toolkit condition versus 10.80 (s.d. = 6.96) minutes for the guidelines condition, $t(73) = 1.54$, $P = 0.13$, $d = 0.36$, suggesting that participants assigned to read the toolkit spent slightly more time reviewing the resource than those assigned to read the guidelines information sheet.

### Preliminary analyses for the MVPA and social cognition outcomes

All 77 participants responded to the baseline MVPA behaviour measure, while 94% and 97%, respectively, responded to the 1-week and 1-month post-intervention MVPA behaviour measure. For the social cognitions variables, 94% of participants responded to all of the measures across all four assessments (range = 94–100% with complete data). Missing data appeared to be at least missing at random (Little's MCAR test: $\chi^2(36) = 48.05$, $P = 0.09$).

Univariate outliers were reduced to the next highest, acceptable value for measures of MVPA behaviour at baseline ($n = 3$), and 1-week ($n = 2$) and 1-month ($n = 1$) post-intervention. No other univariate outliers were found. All of the social cognition primary and secondary outcomes were normally distributed (skewness range = −0.85 to 0.80; kurtosis range = −1.18 to 1.45). MVPA behaviour was not normally distributed, with nearly half of the participants reporting zero minutes at baseline (46%), and 1-week (47%) and 1-month (44%) post-intervention.

Table 2 provides a comparison of the demographic variables by condition. The means and s.d. by condition for all measured variables are provided in Table 3.

Baseline values of all measured demographic characteristics, social cognitions, and MVPA behaviour variables were also compared between those who received the English versus French physical activity resources. Language differences were only found for years post-injury, $t(75) = 2.26$, $P = 0.03$, whereby French-speaking individuals had fewer years since their injury ($M = 14.38$ (s.d. = 11.99) years) than English-speaking individuals ($M = 20.40$ (s.d. = 11.37) years).

### Main analyses

*Differences by condition in the targeted social cognitions*. A series of three-way (condition × language × time) mixed model ANOVAs revealed no significant interactions, $Fs < 0.70$, $ps > 0.50$, etas $< 0.02$, suggesting that language of the resources did not interact with the assigned condition. Therefore, the data were collapsed across the two languages for the remaining analyses.

*Immediate exposure effects*. At 24-h post-baseline, there were no condition effects on residual change of intentions (primary outcome), B = 0.17, 95% CI = −0.41, 0.74, $\beta = 0.05$, $\Delta R^2 < 0.01$. No condition effects were found for the secondary psychosocial

**Table 2.** Demographic Information by Physical Activity Resource Condition

| *Variables* | *Guidelines* (n = *42*) | *Toolkit* (n = *35*) | *Statistical test* | | *Effect sizes* | |
|---|---|---|---|---|---|---|
| | | | t-*test* | $X^2$ | *Hedge's g* | *Φ* |
| Age (in years), *M* (s.d.) | 48.79 (10.59) | 47.11 (10.23) | 0.70 | – | 0.16 | – |
| Years since injury, *M* (s.d.) | 17.88 (11.62) | 17.06 (12.56) | 0.30 | – | 0.08 | – |
| % Male | 69 | 89 | – | 4.23* | – | 0.23 |
| % Married-common law | 67 | 54 | – | 1.23 | – | 0.13 |
| Ethnicity (% White) | 98 | 94 | – | 0.57 | – | 0.09 |
| Education | | | | 2.79 | – | 0.19 |
| % High-school | 36 | 23 | – | | – | – |
| % Post-secondary | 45 | 43 | – | | – | – |
| % Post-graduate and other | 19 | 34 | – | | – | – |
| Mobility mode, % manual | 52 | 63 | – | 1.04 | – | 0.12 |
| Cause of SCI, % MVA | 40 | 51 | – | 0.98 | – | 0.12 |
| Level of injury, % with paraplegia | 41 | 49 | – | 0.51 | – | 0.08 |

Abbreviations: *Φ*, phi contingency coefficient for chi square statistics; Hedge's *g*, effect size for t-statistics; M, mean; MVA, motor vehicle accident; SCI, spinal cord injury; s.d., standard deviation; $X^2$, Pearson's chi square association test; . *$P < 0.05$.

**Table 3.** Means, s.d. and multiple regressions models for the social cognitive variables across the four time periods

| *Variables* | | *Baseline (M, s.d.)* | *24-hours post (M, s.d.)* | *1-week post (M, s.d.)* | *1-month post (M, s.d.)* | *Block 1: Baseline B (95% CI) [$_{adj}R^2$]* | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | *24-hour Model* | *1-week Model* | *1-month Model* |
| Action planning | E | 3.02 (2.27) | – | 2.99 (2.15) | 3.18 (2.29) | – | .77 (0.63, 0.91) [0.62] | .78 (0.62, 0.94) [0.56] |
| | C | 2.79 (1.91) | – | 3.21 (1.97) | 2.08 (2.11) | | | |
| Intentions | E | 4.10 (2.03) | 4.37 (1.86) | 3.99 (2.16) | 3.68 (2.24) | 0.66 (50, 0.82) [0.48] | 0.70 (0.53, 0.86) [0.49] | 0.65 (0.44, 0.87) [0.33] |
| | C | 4.41 (1.58) | 4.74 (1.58) | 4.35 (1.39) | 4.24 (1.90) | | | |
| Task self-efficacy | E | 4.06 (2.04) | 3.84 (1.73) | 3.93 (2.01) | 3.66 (1.95) | 0.74 (0.62, 0.87) [0.65] | 0.87 (0.77, 0.97) [0.80] | 0.79 (0.(0.67, 0.91) [0.84] |
| | C | 4.55 (1.68) | 4.55 (1.67) | 4.23 (1.61) | 4.00 (1.59) | | | |
| Barrier self-efficacy | E | 3.97 (1.54) | 4.18 (1.83) | 3.80 (1.73) | 3.86 (1.69) | 0.78 (0.61, 0.98) [0.49] | 0.64 (0.45, 0.83) [0.37] | 0.71 (0.49, 0.92) [0.36] |
| | C | 4.24 (1.44) | 4.60 (1.49) | 4.35 (1.31) | 4.21 (1.80) | | | |
| Outcome expectancies | E | 5.13 (1.26) | 5.30 (0.99) | – | – | 0.40 (0.24, 0.55) [0.25] | – | – |
| | C | 5.19 (1.18) | 5.67 (0.91) | – | – | | | |

Abbreviations: B, unstandardized coefficient; E, SCI Get Fit Toolkit (toolkit) condition; C, SCI Physical Activity Guideline (guidelines) condition; CI, confidence interval; *s.d.*, standard deviation; $_{adj}R^2$, adjusted variance. Block 2 results are presented in the Results section. *$P < 0.05$.

outcomes of outcome expectations, B = 0.34, 95% CI = − 0.03, 0.72, β = 0.18, $\Delta R^2 = 0.03$, task self-efficacy, B = 0.36, 95% CI = − 0.11, 0.83, β = 0.10, $\Delta R^2 = 0.01$, and barrier self-efficacy, B = 0.20, 95% CI = − 0.36, 0.75, β = 0.06, $\Delta R^2 < 0.03$ (see Table 3 for Block 1 results).

Given these non-significant results, we also explored (*post hoc*) possible changes in these scores from baseline to 24-h post-baseline with paired sample *t*-tests, regardless of condition. Significant change in outcome expectancies was found, with participants reporting more positive expectations for engaging in the PAG-SCI from baseline to 24-h post-baseline, $M_{baseline} = 5.16$ (s.d. = 1.22), $M_{24\text{-hour}} = 5.47$ (s.d. = 0.96), $t(76) = 2.42$, $P = 0.02$, Cohen's $d = 0.28$. Near significant positive changes in barrier self-efficacy were found, $M_{baseline} = 4.09$ (s.d. = 1.49), $M_{24\text{-hour}} = 4.37$ (s.d. = 1.69), $t(76) = 1.98$, $P = 0.05$, Cohen's $d = 0.23$, and intentions, $M_{baseline} = 4.24$ (s.d. = 1.83), $M_{24\text{-hour}} = 4.54$ (s.d. = 1.74), $t(76) = 1.88$, $P = 0.06$, Cohen's $d = 0.22$. No time effects were found for task self-efficacy, $t(76) = -0.91$, $P = 0.47$, Cohen's $d = -0.11$.

*Longer-term exposure effects*. At 1-week post-intervention, no condition effects were found for residual change in the primary outcome of intentions, B = 0.15, 95% CI = − 0.46, 0.76, β = 0.04, $\Delta R^2 < 0.01$ and secondary outcomes of task self-efficacy, B = − 0.14, 95% CI = − 0.51, 0.25, β = − 0.04, $\Delta R^2 < 0.01$, barrier self-efficacy, B = 0.38, 95% CI = − 0.19, 0.94, β = 0.12, $\Delta R^2 = 0.01$, and action planning, B = 0.40, 95% CI = − 0.18, 0.98, β = 0.10, $\Delta R^2 = 0.01$ (see Table 3 for Block 1 results). At 1-month post-intervention, no condition effects were found for residual change in the primary outcome of intentions, B = 0.36, 95% CI = − 0.44, 1.15, β = 0.09, $\Delta R^2 = 0.01$, and secondary outcomes of task self-efficacy, B = − 0.05, 95% CI = − 0.51, 0.41, β = − 0.01, $\Delta R^2 < 0.001$, barrier self-efficacy, B = 0.17, 95% CI = − 0.47, 0.81, β = 0.05, $\Delta R^2 < 0.01$ and action planning B = 0.09, 95% CI = − 0.59, 0.76, β = 0.02, $\Delta R^2 < 0.001$ (see Table 3 for Block 1 results).

Given these non-significant results, we also explored (*post hoc*) possible changes in these scores from baseline to 1-week post-intervention and baseline to 1-month post-intervention with paired sample *t*-tests, regardless of condition. Significant time effects were found for task self-efficacy. Participants reported a decrease in confidence to engage in MVPA from baseline to 1-week post-intervention, $M_{baseline} = 4.28$ (s.d. = 1.89), $M_{1\text{-week}} = 4.07$ (s.d. = 1.83), $t(76) = -2.18$, $P = 0.03$, Cohen's $d = 0.11$, and 1-month post-intervention, $M_{1\text{-month}} = 3.81$ (s.d. = 1.79), $t(76) = -3.86$, $P < 0.001$, Cohen's $d = 0.26$. No other significant changes were found, $-1.45 < t(76) < 1.24$, $p > 0.05$, $-0.17 < d < 0.14$.

*MVPA behaviour*. After controlling for baseline MVPA behaviour, $OR_{baseline\ MVPA} = 30.44$, 95% CI = 8.27, 112.8, participants in the toolkit condition were 3.54 (95% CI = 0.95, 13.17) times more likely to participate in at least one bout of 20 min of MVPA behaviour at 1-week post-intervention compared with the guidelines condition. The lower confidence interval, although close to 1, does cross 1 and the confidence interval is relatively wide. Accordingly, the effect is tenuous and may or may not be replicated in a similar study. One month following the intervention, participants in the toolkit condition were 1.82 times (95% CI = 0.58, 5.71) more likely to engage in at least 20 min of MVPA in the past week compared to participants in the guidelines condition. Given the lower confidence interval is under and relatively far from 1, the likelihood of replicating this odds ratio is low. No changes were found in the number of participants who engaged in at least 20 min of MVPA over the past week from baseline to 1-month post-intervention for the guidelines, Q(2) = 0.55, $P = 0.76$, and toolkit Q(2) = 1.00 $P = 0.61$, conditions.

In the logistic regression analysis, condition was not a significant predictor for meeting the PAG-SCI at either 1-week (OR = 0.74, 95% CI = 0.15, 3.73), or 1-month (OR = 1.42, 95% CI = 0.37, 5.41) post-intervention, when controlling for baseline MVPA behaviour (OR = 10.38, 95% CI = 2.05, 52.58 and OR = 8.87, 95% CI = 2.02, 39.03, respectively). No changes were found in the number of participants meeting the PAG-SCI from baseline to 1-month post-intervention for the toolkit, Q(2) = 1.56, $P = 0.46$, or guidelines, Q(2) = 0.33, $P = 0.85$, conditions.

## DISCUSSION

This study examined the immediate and longer-term effects of online exposure to two physical activity resources—the *SCI Get Fit Toolkit* and the PAG-SCI information sheet—on intentions (primary outcome) and other targeted social cognitions and MVPA behaviour (secondary outcomes) within a sample of inactive Canadian adults living with SCI. Contrary to our primary and secondary hypotheses, no condition effects were found (either immediate or longer-term) on any of the five social cognitions that are targeted within the *SCI Get Fit Toolkit*. Although our power analysis was based on previous research demonstrating a large-sized effect for brief health information messages on MVPA intentions in inactive adults with SCI,[11] we were not able to replicate such large-sized effects for any of the five targeted social cognitive variables in the toolkit. Posthoc analyses demonstrated small, yet significant, improvements across both conditions for outcome expectancies, along with small, non-significant improvements in intentions and barrier self-efficacy, suggesting that the content from both resources had elicited positive perceptions related to these constructs. However, unexpected small, yet significant decreases were reported from baseline to 1-week and

1-month following the single exposure to either resource on participants' task self-efficacy. Similar decreases have been reported in earlier MVPA and SCI intervention studies,[8,13] illustrating the optimism that many novice SCI exercisers have for adopting a physically active lifestyle.

Those who read the toolkit also had a greater likelihood of engaging in at least one bout of 20 min of MVPA at 1-week post-intervention. However, the wide range of the confidence intervals places high uncertainty in the replication of this result in future studies. Furthermore, no condition effects were found when comparing whether participants met or did not meet the PAG-SCI. Given that both resources included the PAG-SCI, the additional content of the toolkit may explain some of the positive MVPA results. However, these results are tenuous as no condition differences were found for the targeted social cognitions, and participants spent very little time reading and considering the content of either resource, especially the toolkit. On the basis of our analyses and the observation that participants did not fully engage with the two resources, no firm conclusions can be made regarding the effects of the *SCI Get Fit Toolkit* itself on MVPA behaviour in comparison to the PAG-SCI information sheet.

The most likely explanation for these null findings on the social cognitions and MVPA behaviour outcomes is the intervention's mode of delivery. We chose to use an online method for the current informational intervention given that over 60% of adults with SCI report using the Internet,[20] as well as the increased use of this medium within the SCI community and other disability groups, for the delivery of health-based information.[21,22] Despite our strong rationale for using an online delivery mode, this may have been the greatest limitation of our study. While all participants were sent a link to their assigned resource and explicit instructions to read over the online resource in detail, the participants in the toolkit condition spent little time thoroughly reading over the four-page toolkit. This was evident through the manipulation check finding that only 37% of participants correctly answered the question, 'What are three tactics mentioned in the *SCI Get Fit Toolkit* for staying focused on your action plan and maintaining regular physical activity?' (a section that was emphasized on the third page of the toolkit). Furthermore, we only found a 2.5-min difference between the two conditions on the time spent to complete the 24-hour post-baseline session (the assessment period when the intervention was delivered). While participants assigned to read the toolkit took longer to complete this assessment than those assigned to read the PAG-SCI information sheet, this additional time would likely not have been sufficient to effectively read and process all of the content provided in the four pages of the toolkit (versus the one-page PAG-SCI information sheet). This low engagement with the toolkit resource can be compared with other internet-delivered interventions, such as a 9-week online physical activity behaviour change program where cancer survivors had, on average, a 26% completion rate of the weekly modules.[23] These finding underscore a clear need to establish effective methods to deliver physical activity messages before we can determine optimal message content.

An alternative speculation of these null findings may be due to our research methodology wherein our participants were required to read their assigned resources in one sitting. We intended to simulate a situation where a participant would read a paper copy of either the *SCI Get Fit Toolkit* or the PAG-SCI information sheet once. Thus, participants were exposed to a static and time-dependent version of these two physical activity resources. Different outcomes may have emerged if participants were provided with a longer period of time to read over their assigned resource to fully understand and appreciate the information and/or a more dynamic and interactive versions of these resources was made available. Further research is warranted into examining the effects of multiple exposure times as well as the extent to which participants engage and process the materials on their social cognitions and MVPA behaviour.

Although a lack of adequate exposure to the two resources is a critical element underpinning our study findings, other explanations should be considered. For example, other confounding factors such as the discrepancy in the length of the two resources (and not the presence/absence of theoretical content), the possibility of group contamination given that the guidelines condition may have accessed the *SCI Get Fit Toolkit* before and/or during the conduction of this study, or non-equivalent group allocation due to the use of a single randomization method. Moreover, the 'how' information that was provided within the PAG-SCI information sheet (for example, how-hard, how-often) may have been enough information to influence some of the social cognitions that were assessed or prevented larger declines than what may have been exhibited if participants in the guidelines condition were not provided with any information. This may be a possible explanation as to why no between-condition differences were found on the targeted theoretical constructs.

The null finding for action planning was particularly surprising given the focus within the *SCI Get Fit Toolkit* on this self-regulatory strategy. Action plans entail the formation of several specific and detailed components (for example, where one will be active, the types [what] of activities one will engage in[24]); the more detailed (and therefore assumed better quality) an action plan is, the more strongly it is related to physical activity behaviour.[25] The instrument we used to assess action planning asked participants to self-report on the extent to which their action plans incorporated the four components of action planning; participants were not required to provide their actual action plans, nor was there any space provided within the toolkit for individuals to create their own action plans. Therefore, there is no way to determine if action plans were actually created and whether the quality of the action plans of participants who received the *SCI Get Fit Toolkit* differed from those participants who read the PAG-SCI information sheet. Recent studies focusing on action planning behaviour have demonstrated that rates of forming action plans are low when individuals are exposed to a single message/exposure,[26] as was the case in this study. This limitation should be addressed in future research given the importance of action planning to increase MVPA behaviour within the SCI population,[7,13] and consequently, the emphasis of this behaviour change technique within the *SCI Get Fit Toolkit*.[12]

In terms of practical implications, our findings highlight the challenges associated with the use of online resources for sharing information with clients. In the current study, participants had limited (a single exposure) access to the online physical activity resources. In hindsight, this delivery method may not accurately simulate the intended use of the *SCI Get Fit Toolkit*. However, the online method did provide us with an opportunity to reach a larger number of participants (English- and French-speaking) than alternative, more labour-and cost-intensive methods such as face-to-face meetings. When using the *SCI Get Fit Toolkit* to promote physical activity, we recommend practitioners consider reviewing the information presented within the resource in detail with their clients. Furthermore, practitioners should encourage multiple use of the resource given that a single exposure is not associated with large changes in MVPA social cognitions and behaviour.

## CONCLUSIONS

Due largely to limitations of our online information delivery method, no firm conclusions can be made regarding the efficacy of the *SCI Get Fit Toolkit* in comparison to PAG-SCI information sheet on the targeted social cognitions and MVPA behaviour of adults with SCI who are currently not meeting the PAG-SCI. Future intervention research which utilizes ways to evaluate the intended

use of this resource (that is, unlimited access), in combination with other resources, is warranted to provide a more effective evaluation of this evidence and theory-based physical activity resource for the SCI population using a block randomization method to keep groups equal.[27]

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There were no data to deposit.

## COMPETING INTERESTS

The authors declare no conflict of interest.

## REFERENCES

1 Hicks AL, Martin Ginis KA, Pelletier CA, Ditor DS, Foulon B, Wolfe DL. The effects of exercise training on physical capacity, strength, body composition and functional performance among adults with spinal cord injury: a systematic review. *Spinal Cord* 2011; **49**: 1103–1127.
2 Foulon BL, Lemay V, Ainsworth A, Martin Ginis KA. Enhancing physical activity guidelines: a needs survey of adults with spinal cord injury and health care professionals. *Adapt Phys Activ Q* 2012; **29**: 329–345.
3 Martin Ginis KA, Arbour-Nicitopoulos KP, Latimer AE, Buchholz AC, Bray SR, Craven C *et al*. Leisure-time physical activity in a population-based sample of people with spinal cord injury Part II: activity types, intensities, and durations. *Arch Phys Med Rehabil* 2010; **91**: 729–733.
4 Martin Ginis KA, Tomasone JR, Latimer-Cheung AE, Arbour-Nicitopoulos KP, Bassett RL, Wolfe DM. Developing physical activity interventions for adults with spinal cord injury. Part 1: a comparison of social cognitions across actors, intenders, and nonintenders. *Rehabil Psychol* 2013; **58**: 299–306.
5 Martin Ginis KA, Arbour-Nicitopoulos KP, Latimer AE, Buchholz AC, Bray SR, Craven C *et al*. Predictors of leisure-time physical activity among people with spinal cord injury. *Ann Behav Med* 2012; **42**: 127–133.
6 Martin Ginis KA, Latimer AE, Arbour-Nicitopoulos KP, Bassett RL, Wolfe DL, Hanna S. Determinants of physical activity among people with spinal cord injury: a test of social cognitive theory. *Ann Behav Med* 2011; **42**: 127–133.
7 Arbour-Nicitopoulos KP, Martin Ginis KA, Latimer AE. Planning, leisure-time physical activity, and coping self-efficacy in persons with spinal cord injury: a randomized controlled trial. *Arch Phys Med Rehabil* 2009; **90**: 2003–2011.
8 Latimer-Cheung AE, Arbour-Nicitopoulos KP, Brawley LR, Gray C, Wilson AJ, Prapavessis H *et al*. Developing physical activity interventions for adults with spinal cord injury. Part 2: motivational counseling and peer-mediated interventions for people intending to be active. *Rehabil Psychol* 2013; **58**: 307–315.
9 Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE *et al*. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med* 2002; **22**: 73–107.
10 Farry A, Baxter D. *The Incidence and Prevalence of Spinal Cord Injury in Canada: Overview and Estimates Based on Current Evidence*. Rick Hansen Institute: Vancouver, BC, 2010.
11 Bassett-Gunter RL, Martin Ginis KA, Latimer-Cheung AE. 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 Psychol* 2013; **32**: 1188–1198.
12 Arbour-Nicitopoulos KP, Martin Ginis KA, Latimer-Cheung AE, Bourne C, Campbell D, Cappe S *et al*. Development of an evidence-informed leisure-time physical activity resource for adults with spinal cord injury: The SCI Get Fit Toolkit. *Spinal Cord* 2013; **51**: 491–500.
13 Latimer AE, Martin Ginis KA, Arbour KP. The efficacy of an implementation intention intervention on promoting physical activity among individuals with spinal cord injury: a randomized controlled trial. *Rehabil Psychol* 2006; **51**: 273–280.
14 Brawley LR, Arbour-Nicitopoulos KP, Martin Ginis KA. 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. *Rehabil Psychol* 2013; **58**: 316–321.
15 Martin Ginis KA, Hicks AL, Latimer AE, Warburton DE, Bourne C, Ditor D *et al*. The development of evidence-informed physical activity guidelines for adults with spinal cord injury. *Spinal Cord* 2011; **49**: 1088–1096.
16 Blanchard CM, Courneya KS, Rodgers WM, Fraser SN, Murray TC, Daub B *et al*. Is the theory of planned behavior a useful framework for understanding exercise adherence during phase II cardiac rehabilitation? *J Cardiopulm Rehabil* 2003; **23**: 29–39.
17 Martin Ginis KA, Phang SH, Latimer AE, Arbour-Nicitopoulos KP. Reliability and validity tests of the Leisure-Time Physical Activity Questionnaire for people with spinal cord injury (LTPAQ-SCI). *Arch Phys Med Rehabil* 2012; **93**: 677–682.
18 Tabachnick BG, Fidell LS. *Experimental Designs Using ANOVA*. Duxbury Press: Belmont, CA, 2007.
19 Vickers AJ. Analysis of variance is easily misapplied in the analysis of randomized trials: a critique and discussion of alternative statistical approaches. *Psychosom Med* 2005; **67**: 652–655.
20 Hogan TP, Hill JN, Locatelli SM, Weaver FM, Thomas FP, Nazi KM *et al*. Health information seeking and technology use among veterans with spinal cord injuries and disorders. *PM&R* 2016; **8**: 123–130.
21 Mattar AAG, Hitzig SL, McGillivray CF. A qualitative study on the use of personal information technology by persons with spinal cord injury. *Disabil Rehabil* 2015; **37**: 1362–1371.
22 Matter B, Feinberg M, Schomer K, Harniss M, Brown P, Johnson K. Information needs of people with spinal cord injuries. *J Spinal Cord Med* 2009; **32**: 545–554.
23 Forbes CC, Blanchard CM, Mummery WK, Courneya KS. Feasibility and preliminary efficacy of an online intervention to increase physical activity in Nova Scotian cancer survivors: a randomized controlled trial. *JMIR Cancer* 2015; **1**: e12.
24 Schwarzer R. Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Appl Psychol* 2008; **57**: 1–29.
25 de Vet E, Oenema A, Brug J. More or better: do the number and specificity of implementation intentions matter in increasing physical activity? *Psychol Sport Exerc* 2011; **12**: 471–477.
26 Sweet SN, Brawley LR, Hatchell A, Gainforth HL, Latimer-Cheung AL. Can persuasive messages encourage individuals to create action plans for physical activity? *J Sport Exerc Psychol* 2014; **36**: 413–423.
27 Efird J. Blocked randomization with randomly selected block sizes. *Int J Environ Res Public Health* 2011; **8**: 15–20.