*Review*

# The association between the constructs of social cognitive theory and physical activity in adults with disabilities: A meta-analysis

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Received: 18th November 2022; Accepted: 6th November 2023; Published: 28th May 2024

**Abstract:** With the inconsistency regarding the association between the constructs of social cognitive theory (SCT) and physical activity (PA) in adults with disabilities, the purpose of the current study was twofold: a) to examine the association between constructs of SCT and PA in adults with disabilities using meta-analysis procedures, and b) to identify moderators for the association between the SCT constructs and PA among adults with disabilities. With predetermined inclusion criteria, a total of 15 studies were included in the current review. The pooled associations under the random-effect model between SCT variables and PA in adults with disabilities were calculated. Moderator analyses were also conducted with potential moderators, including types of SCT variables, different PA intensities, PA measurement types, disability types, and participants' age. The overall exploratory effect size of SCT variables on PA in adults with disabilities was small under the random effects model ($r = .26$, 95% confidence interval = .23 - .29, $p < .001$). Moderator analysis indicated that SCT variables ($Q(5)=25.86$, $p <.001$), PA intensities ($Q(2)=21.41$, $p <.001$), and PA measure types ($Q(1)=16.13$, $p <.001$) were significant moderators. The SCT may be an appropriate framework to explain PA in adults with disabilities. The moderators should be considered when explaining their PA and developing PA interventions.

**Keywords:** behaviours; exercise; multiple sclerosis; rehabilitation; self-regulation; spinal cord injury; visual impairment

## Introduction

Ample evidence indicates that physical activity (PA), especially regular participation of moderate-to-vigorous intensity of PA provides various health benefits such as preventing cardiovascular diseases and strengthening bone density and muscles (Center for Disease Control and Prevention, 2020). Participating in PA is particularly important for adults with disabilities because they are at a greater risk for preventable secondary conditions such as fatigue, pain, or obesity and poorer health-quality of life (CDC, 2019). Specifically, Motl and McAuley (2014) found that PA levels were a significant predictor for physical function, vitality, and social function six-month after the end of a PA intervention among adults with multiple sclerosis. Nooijen and colleagues (2012) indicated that participating in PA also improves cardiorespiratory fitness, muscle strength, body composition, and reduces cardiovascular risk in adults with spinal cord injury. In addition to the physical health benefits, adults with disabilities can benefit from PA participation such as managing depression (Carotenuto et al., 2021) and anxiety (Frontini, Mathos, fand Antunes, 2021). PA participation is also significantly and positively associated with quality of life in adults with visual impairment (Haegele & Zhu, 2021).

Even though PA engagement provides various benefits to adults with disabilities, they are a group that experiences physical, psychological, and environmental barriers to participate in PA. These barriers include but are not limited to disability-related symptoms (Mat Rosly et al., 2018), lack of support (Mahy et al., 2010), inaccessible facilities (Mat Rosly et al., 2018), and social influences (Orr et al., 2020) . Moreover, they also experience cultural and societal barriers, such as *iconography* and *supercrip* (Silva & Howe, 2012), lack of professionals knowing how to work with adults with disabilities in PA settings, and lack of accessible PA facilities (Bodde & Seo, 2009). These barriers may limit the PA opportunities for adults with disabilities. Specifically, researchers from multiple studies indicated that adults with disabilities including multiple sclerosis, spinal cord injury, and visual impairment participated in less PA than their counterparts without disabilities (Cai et al., 2021; Griffin et al., 2016; Jörgensen et al., 2017; Klaren et al., 2013). With these PA barriers and physical inactivity among adults with disabilities, it is important to promote PA behaviours.

Researchers have been exploring PA in individuals with disabilities by using a theory as a framework (Sur & Shapiro, 2022). The social cognitive theory (SCT) may be an appropriate framework to promote PA for adults with disabilities. The SCT describes human behaviours being influenced by multiple factors such as individual characteristics and environment (i.e., social, physical, economic, and policy) (Bandura, 1989). Specifically, the theory highlights reciprocal determinism between personal characteristics, behaviour, and environment. Simply, if one factor influences another factor, the affected factor also influences the influencing factor. The main constructs of SCT include knowledge, perceived self-efficacy, outcome expectation, goal formation, social support and socio-structural factors (Bandura, 1989). Knowledge and outcome expectation toward PA may influence individual's self-efficacy, which may lead to goal formation related to PA. By adhering to the formed goal, individuals may participate in PA, and social support and socio-structural factors may influence their participation. SCT has been widely used to explain and predict PA behaviours among adults with and without disabilities (Young et al., 2014).

A study conducted by Motl and colleagues (2007) may be the first study using SCT as a framework in explaining PA behaviours in adults with disabilities. Motl and colleagues (2007) used two SCT constructs, social support and self-efficacy, to explain the PA levels of adults with multiple sclerosis and found a significant positive association between social support and PA. In a follow up study with adults with multiple sclerosis, Suh and colleagues (2011) found that 40% of variance in PA in adults with multiple sclerosis were explained by five constructs of SCT, including the three outcome expectations. More recently, a qualitative study reported that targeting constructs of SCT, such as autonomy and competence, may be helpful in promoting PA among adults with multiple sclerosis (Fasczewski, Gill, and Rothberger, 2018). Other studies have used SCT to explain PA in adults with other disabilities, such as spinal cord injury (Martin Ginis et al., 2011) and visual impairment (Haegele et al., 2017; Haegele & Zhu, 2021).

Although SCT is often applied to explain PA in adults with disabilities, research findings regarding the association between SCT constructs and PA have been inconsistent. (Baird et al., 2021; Ensari et al., 2017). For example, Baird and colleagues (2021) indicated that all constructs of SCT were significantly associated with PA in adults with multiple sclerosis, but other study targeting the similar sample has shown that the association could be altered based on the psychological factors of the participants (Ensari et al., 2017). The inconsistency provides professionals with difficulties in developing an overarching SCT-based intervention for PA in adults with disabilities. To effectively develop the intervention, synthesizing results of SCT studies is necessary (i.e., providing high levels of evidence). Thus, it is essential to identify the overall exploratory effects of these constructs. Additionally, to explain their PA more comprehensively, it is important to examine moderators for the association between constructs of SCT and PA in adults with disabilities. These includes types of SCT variables (Young et al., 2014), levels of PA intensity (Baird et al., 2022), types of PA, disability types, and participants' age (Young et al., 2014). Thus, the purpose of the current study was twofold: a) to examine exploratory effects of constructs of SCT on PA in adults with disabilities using meta-analysis procedures and b) to identify moderators for the association between the SCT constructs and PA in adults with disabilities.

## Materials and Methods

The current meta-analysis followed the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) guidelines (Moher et al., 2009)], which provided a standardized framework for reporting meta-analysis. This guideline promoted transparency, rigor, and consistency in reporting the results of a meta-analysis review (Moher et al., 2009).

### Search strategy

Three databases including Psycinfo, PubMed and Web of Science were used to search for articles related to the topic of the current study. The following keywords were used for each database search: social cognitive theory AND ("physical activit*" or "sport*" or "exercise*") AND ("disabilit*" or "learning disabilit*" or "autism" or "emotional disturbance" or " speech impairment" or "language impairment" or "visual impairment" or "blindness" or "deafness" or "hearing impairment" or "deaf-blindness" or "orthopedic impairment" or "intellectual disability" or "traumatic brain injury" or "multiple disabilities"). In addition to the database searches, manual search of Google Scholar, and the bibliography of two published review articles (Motl, Pekmezi, et al., 2018; Wilroy & Knowlden, 2016) related to theory, PA, and disability were reviewed. A total of 274 articles were identified from the three databases. Two authors of the current study (B.M.K, W.L), who were trained in meta-analysis procedures, PA, and disability, independently identified duplicates of the articles. After removing duplicates, the same authors independently screened titles and abstracts of found articles. Afterwards, they also independently conducted full-text review. In each stage, they discussed the articles relevance to the inclusion criteria until a consensus was achieved when a disagreement occurred. As a result of this systematic review process, a total of 15 studies were included in the current study. Figure 1 depicts the all-search strategies with calculated inter-rater reliability (Cohen's kappa) between the two authors in each stage.

### Eligibility criteria

Studies meeting the pre-determined inclusion criteria were included in the current meta-analysis. The inclusion criteria were the following: (a) participants had disabilities, (b) SCT components were measured, or study mentioned SCT as research framework, (c) PA were measured (i.e., devise-based or subjective measure), (d) studies examined correlations between PA and at least one SCT variable or statistical information included the number of sample size and correlation, regression, or pathway analysis coefficient for calculating effect sizes, and (e) studies were published in peer-review journals and written in English. Even if an SCT-related component (e.g., self-efficacy) was measured, if a study did not indicate that it used SCT as a research framework, the study was excluded from the current study in order to distinguish between SCT-studies and self-efficacy theory studies.

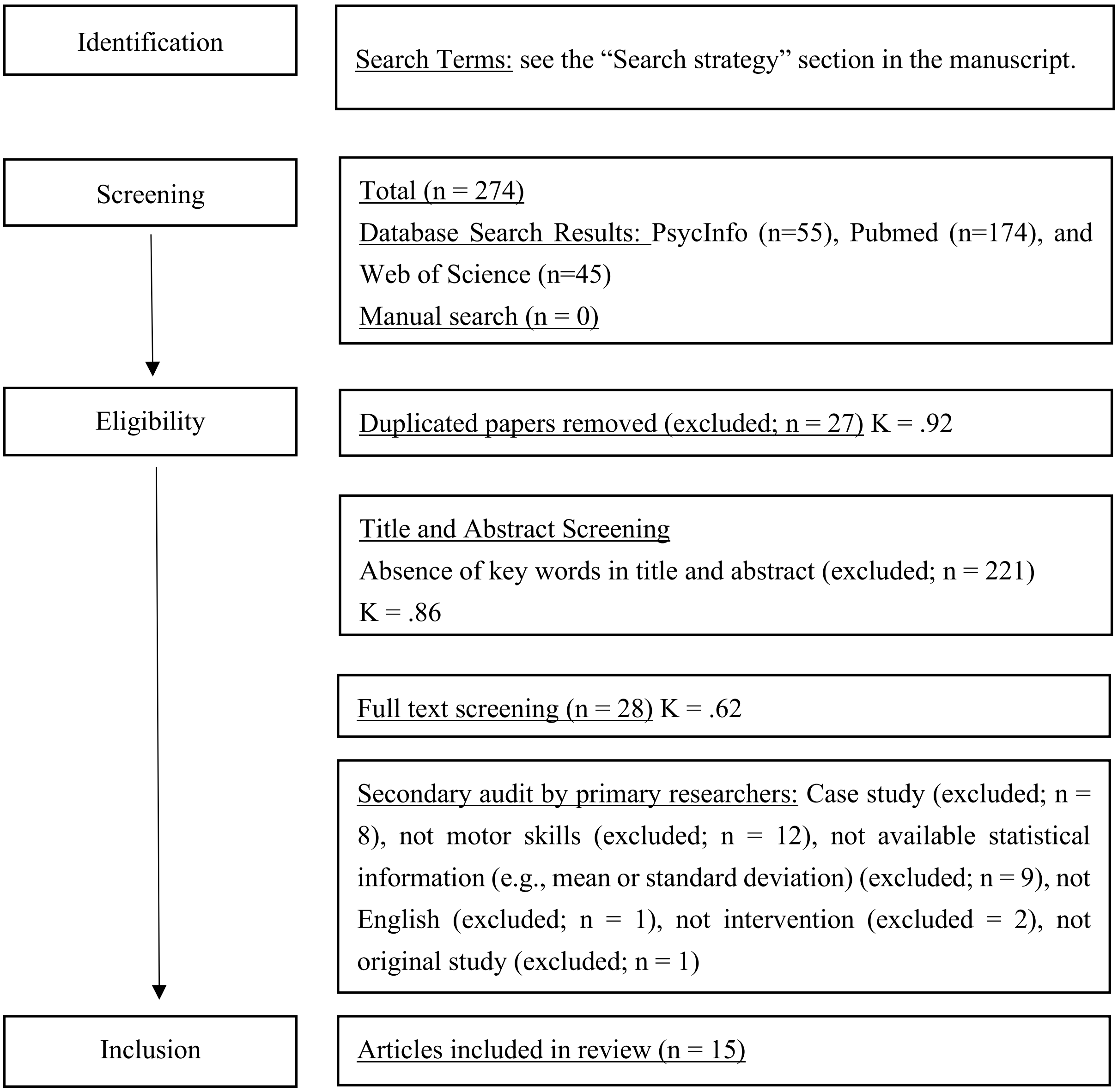


**Figure 1**.Search process.

## Data extraction

An author of the current study (B.M.K) independently extracted characteristics of studies, including author name, published date, sample size, participants' sex, disability types, study design, measures of SCT variables with reported validity and reliability evidence, measures of PA with validity and reliability evidence, and main results (i.e., correlation, regression coefficient, pathway correction, etc.). The same author also independently extracted statistical data for calculating effect size, which included, correlation, regression, or pathway analysis coefficients between SCT variables and PA levels. The extracted data were reviewed by another author (W.L) independently. Disagreements were resolved by discussion until consensus was reached.

## Statistical analysis

The Comprehensive Meta-Analysis Software Version 3.0 was used to calculate pooled associations under the random-effect model between SCT variables and PA among adults with disabilities. The bivariate correlations, standardized regression or standardized pathway analysis coefficients with sample size were entered into the software. The software transformed coefficients to the standardized Fishers Z values before determined the overall coefficient and correlations under the random-effects approach. This approach has been used in a previous study examining the association between the SCT and PA in individuals without disabilities (Young et al., 2014). The following Cohen's criteria were used as the effect size metric to identify the association between SCT variables and PA levels (Pearson's *r*): small (>0.10), moderate (>0.30) and large (>0.50) effect sizes (Cohen, 1992)]. To examine potential moderators, multiple moderator analyses were conducted for each of the following categorical variables: types of the SCT variable (goal setting, outcome expectation, planning, self-efficacy, self-regulation, and social support), levels of PA intensity (low-to-vigorous intensity PA, low intensity PA, and moderate-to-vigorous PA), types of PA measure (devise-based measure and self-reported questionnaire), disability types (i.e., multiple sclerosis, spinal cord injury, and visual impairment), and participants' age (younger than a pooled sample average age and older than a pooled sample average age) with the same meta-analysis software. These moderators were selected based on a previous study examining the association between the SCT variables and PA in individuals without disabilities (Young et al., 2014).

## Publication bias

The following three statistical approaches were implemented to identify publication bias among the included studies: Duval and Tweedie's Trim and Fill test (Duval & Tweedie, 2000), Fail-safe N (Rosenthal, 1995), and Kendall's tau (Field & Gillett, 2010). A funnel plot was also used as visual inspections of the data. Based on guidelines (Sterne & Harbord, 2004), symmetry within the funnel plot was interpreted as an unbiased range of effect size, while asymmetric plot was interpreted publication bias. These approaches have been used in other meta-analyses regarding PA and individuals with disabilities (Ku & Sung, 2022; Sung et al., 2022).

## Study quality

The Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields (Kmet et al., 2004) was used to assess the quality of the included studies. The original criteria include 14 questions evaluating the quality of a study. For experimental studies , all questions were used. However, of the 14 questions, three questions were only applicable to interventional studies (e.g., "if interventional and blinding of investigators to intervention was possible, is it reported?"). Therefore, the three questions were not used for cross-sectional exploratory studies. Each question in the assessment tool had three response options (yes, partial, and no). To calculate the total quality scores of a study, the following equation was used: (number of "yes" * 2) + (number of "partials" * 1) based on a guideline (Kmet et al., 2004). Thus, the maximum score was 28 for interventional study and 22 for cross-sectional exploratory study. A higher score refers to better quality. The questions from the assessment included but were not limited to: "method of subject selection or source of information or input variables is described and appropriate", "If interventional and blinding of investigators to intervention was possible, is it reported?", and "controlled for confounding". Two authors [B.M.K & W.L] of the current study independently reviewed and scored each study.

# Results

## Characteristics of studies

The current study categorized characteristics of included studies into five categories: demographic information, study design, SCT variable measures, PA measures, and main findings. The total number of participants across the included studies was 2655. Among the participants, there were 1991 female participants and 664 male participants. Among the 15 included studies, types of disability included multiple sclerosis (n = 9; 60%), visual impairment (n = 3; 20%), spinal cord injury (n = 2; 13.33%), and physical disability (n = 1; 6.67%). Cross-sectional studies were the most common study design (n = 13), and then experimental studies (n = 2).

PA was measured by self-reported questionnaires such as the Godin Leisure-Time Exercise Questionnaire (n = 9), International PA Questionnaire-Short Form (n = 4), own developed questionnaire (n = 1), and PA scale for individuals with physical disabilities (n = 1). One study measured PA by conducting interviews (Martin Ginis et al., 2011). Other studies used devices such as accelerometer (n = 3) and pedometer (n = 1). Because some studies used more than one measure, the total number of PA measures does not equal the total number of included studies.

There were six measured constructs of SCT among the included studies: self-efficacy (n = 15), outcome expectation (n = 11), social support (n = 11), planning (n = 9), goal setting (n = 7), and self-regulation (n = 3). Of the 15 studies, seven studies did not report the validity of SCT measures. The primary focus of 12 out of 15 studies was to investigate the exploratory effects of SCT variables on PA behaviours in individuals with disabilities. Two other studies examined the effects of SCT-based intervention (Motl, Dlugonski, Wójcicki, et al., 2011; Suh et al., 2015) and one additional studies investigated the validity of a developed SCT survey (Wilroy et al., 2018). Characteristics of all included studies are displayed in Tables 1 and 2.

**Quality of studies**

Out of the total scores of 28 for studies with experimental designs, the two included studies with experimental designs received the score of 24 and 21, respectively (Suh et al., 2015; Motl et al., 2011). Suh and colleagues (2015) received high scores for utilizing a double- or single-blind approach and having an appropriate sample size, as demonstrated by their power analysis. Similarly, Ensari et al. (2017) and Silveira et al. (2021) received high scores for explicitly detailing the measurements of outcomes, participants' characteristics, and for controlling confounding variables. The study quality scores for included cross-sectional exploratory studies ranged from 16 and 21 out of 22. This result indicated that the included studies in the current study had moderate quality (Zhang et al., 2019). Exact scores of quality studies can be found in table 1.

**The association between all SCT variables and PA**

The association between all SCT variables and PA in adults with disabilities was small under the random effects model (r=.26, 95% CI = .23 - .29, p <.001). This means that variables of SCT were significantly associated with PA behaviours in individuals with disabilities to a small degree. However, there was heterogeneity among the effect sizes of the included studies (Q=463.91, df=117, $I^2$=74.78, p <.001), indicating the effect size may vary depending on moderators.

**Table 1.** Description of included studies.

| Study | Sample (n) | Females (n) | Mean age (years) | Age SD (years) | Disability type | Study design | Study quality |
|---|---|---|---|---|---|---|---|
| Baird et al., 2021 | 180 | 147 | 65.2 | 4.7 | MS | CSS | 16 |
| Ensari et al., 2017 | 551 | 479 | 50.3 | 11.70 | MS | CSS | 21 |
| Martin Ginis et al., 2011 | 160 | 42 | 47.4 | 12.9 | SCI | CSS | 18 |
| Haegele et al., 2017 | 92 | 50 | 46.88 | 13.91 | VI | CSS | 17 |
| Haegele et al., 2018 | 147 | 96 | 44.5 | N/A | VI | CSS | 19 |
| Haegele et al., 2021 | 176 | 115 | 44.77 | 15.30 | VI | CSS | 16 |
| Kasser & Kosma, 2018 | 319 | 275 | 49 | 10.85 | MS | CSS | 17 |
| Motl et al., 2007 | 196 | 173 | 46.1 | 9.80 | MS | CSS | 18 |
| Motl et al., 2011 | 54 | 21 | 46.1 | 10.44 | MS | ES | 21/28 |
| Silveira et al., 2021 | 205 | 156 | 49.4 | 13.20 | MS | CSS | 21 |
| Stapleton et al., 2016 | 95 | 61 | 34.36 | 12.41 | PD | CSS | 18 |
| Suh et al., 2011 | 218 | 197 | 43.5 | 10.0 | MS | CSS | 17 |
| Suh et al., 2014 | 68 | 56 | 49.1 | 8.8 | MS | CSS | 17 |
| Suh et al., 2015 | 68 | 56 | 49.1 | 8.8 | MS | ES | 24/28 |
| Wilroy et al., 2018 | 126 | 45 | 42.8 | 13.7 | SCI | CSS | 17 |

Note. CSS = Cross-sectional study, ES = Experimental study, MS = Multiple Sclerosis, SCI = spinal cord injury, VI = visual impairment, PD = physical disability, the study quality was out of 22 for the cross-sectional studies, and 28 for the experimental studies.

**Table 2.** Measures of physical activity and social cognitive theory variables.

| Study | PA measure | SCT variables (name of measure) |
|---|---|---|
| Baird et al., 2021 | GLTEQ | SE, OE, SS, GS |
| Ensari et al., 2017 | GLTEQ | SE, OE, SS, GS |
| Martin Ginis et al., 2011 | Interview | Task SE, self-regulatory efficacy, SS, OE, SR |
| Haegele et al., 2017 | IPAQ-SF | SS, SR |
| Haegele et al., 2018 | IPAQ-SF | SE |
| Haegele et al., 2021 | IPAQ-SF | SE |
| Kasser & Kosma 2018 | GLTEQ | SS, OE, SE |
| Motl et al., 2007 | Accelerometer, GLTEQ | SS, SE |
| Motl et al., 2011 | Accelerometer, GLTEQ | SE, OE, GS |
| Silveira et al., 2021 | A single item | SS, SE, OE, GS |
| Stapleton et al., 2016 | GLTEQ, IPAQ | Task SE, OE, SR, self-regulatory efficacy, SS |
| Suh et al., 2011 | Accelerometer, GLTEQ | SE, physical OE, social OE, self-evaluative OE, GS |
| Suh et al., 2014 | GLTEQ | SE OE, SS, GS |
| Suh et al., 2015 | GLTEQ | SE, OE, SS, GS |
| Wilroy et al., 2018 | PASIWPD | SR, self-regulatory efficacy, task SE, SS, OE |

Note. PA = physical activity, SCT = Social Cognitive Theory, GLTEQ = Godin Leisure-Time exercise questionnaire, IPAQ-SF = International PA questionnaire-short form, PASIWPD = PA scale for individuals with physical disabilities, SE = Self-efficacy, OE = outcome expectation, SS = Social support, GS = goal setting, SR = self-regulation

## Publication Bias

Duval and Tweedie's Trim and Fill adjusted point estimate with random effect was δ = .26, 95% CI = .23 – .29. From the Classic Fail-Safe N test, an additional 7,159 studies showing no effect are required to increase the p-value above the alpha level, indicating a low risk of publication bias. Kendall's tau with continuity correction also indicated that significant result differences were not found, suggesting that studies with small sample sizes may be publishable in SCT related study area (p = .26). In addition, based on the visual inspection of the funnel plot, symmetry was between the study correlation coefficients in the funnel plot, indicating no publication bias were found among the included studies (Figure 1).

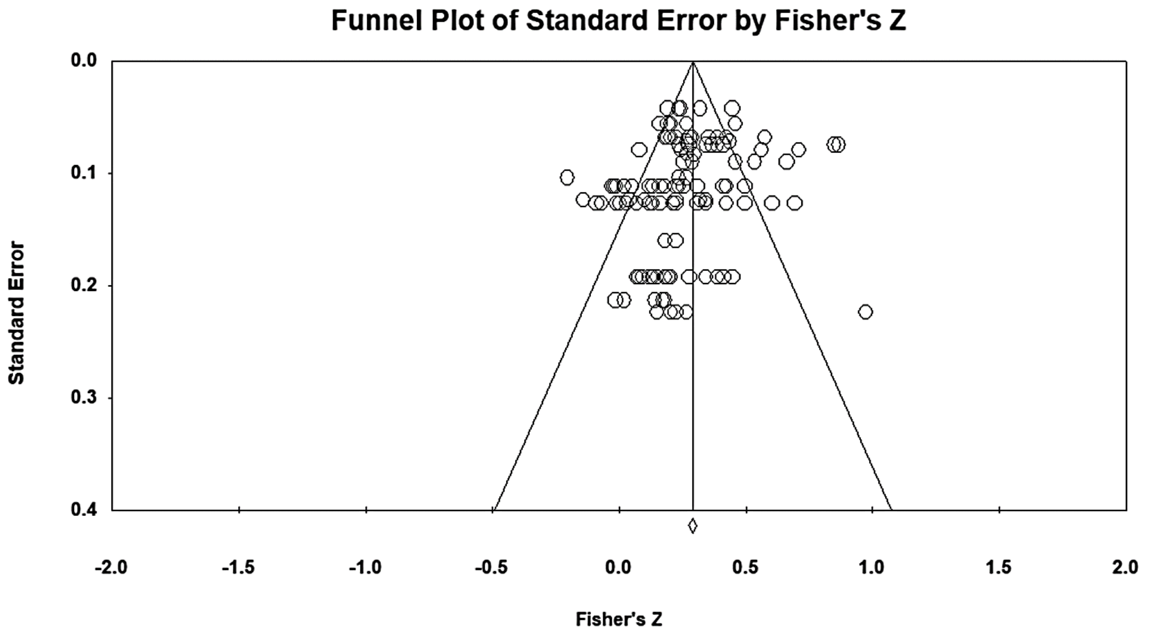


**Figure 1.** Funnel plot of the study correlation coefficients.

## Moderator analysis

To investigate heterogeneity of the effect size, moderator analysis was conducted with the following moderators: types of the SCT variable, PA type, intensities of PA, types of PA measurements, disability types, and participants' age. Moderator analysis revealed that types of the SCT variable ($Q(5)= 25.86$, $p <.001$), PA intensities ($Q(2)=21.41$, $p <.001$), and types of PA measurements ($Q(1)= 16.13$, $p <.001$) were significant moderators for the association between SCT and PA among individuals with disabilities. Among the six variables of SCT, goal setting had the largest pooled correlation ($r = .37$, $p <.001$), followed by self- efficacy ($r = .36$, $p <.001$), outcome expectation ($r= .22$, $p <.001$), and social support ($r= .21$, $p <.001$). If the number of correlations for each of the variables within the moderator was less than 10, the variable was not included in the moderator analysis (e.g., planning and self-regulation) due to potential bias (Borenstein et al., 2011). Among the three intensities of PA, low-to-vigorous intensity PA had the largest pooled correlation ($r = .29$, $p <.001$), followed by moderate-to-vigorous PA ($r = .28$, $p <.001$). Among the two types of PA measures, self-reported PA questionnaires had higher correlations ($r = .31$, $p <.001$) compared to device-based PA measures ($r = .18$, $p <.001$). Detailed results of moderator analysis can be found in Table 3.

**Table 3.** The results of moderator analysis.

| Moderator | Effect size | | | | Heterogeneity | | |
|---|---|---|---|---|---|---|---|
| | k | r | 95% CI | p | Q | df | p |
| SCT Variables | | | | | 25.86 | 5 | <.001 |
| Goal Setting | 17 | .37 | .33 - .41 | <.001 | | | |
| Outcome expectation | 34 | .22 | .20 - .25 | <.001 | | | |
| Planning | 9 | .14 | .05 - .23 | .001 | | | |
| Self-Efficacy | 36 | .36 | .33 - .38 | <.001 | | | |
| Self-Regulation | 3 | .45 | .35 - .54 | <.001 | | | |
| Social Support | 19 | .21 | .18 - .25 | <.001 | | | |
| PA Intensities | | | | | 21.41 | 2 | <.001 |
| LPA | 18 | .06 | -.03 - .16 | .11 | | | |
| MVPA | 27 | .28 | .21 - .34 | <.001 | | | |
| All PA Intensity | 73 | .29 | .25 - .33 | <.001 | | | |
| PA Measure | | | | | 16.13 | 1 | <.001 |
| Device-based measure | 49 | .18 | .12- .23 | <.001 | | | |
| Self-report measure | 69 | .31 | .27 - .35 | <.001 | | | |
| Disability Type | | | | | 5.19 | 2 | .08 |
| Multiple sclerosis | 104 | .25 | .21 - .28 | <.001 | | | |
| Spinal cord injury | 10 | .37 | .27 -.46 | <.001 | | | |
| Visual impairment | 4 | .25 | .06 - .42 | .01 | | | |
| Age | | | | | 2.14 | 1 | .14 |
| Younger participants | 39 | .29 | .24 - .35 | <.001 | | | |
| Older participants | 79 | .24 | .20 - .28 | <.001 | | | |

Note. Self-regulation = goal setting or planning. LPA = Low intensity physical activity. MVPA = Moderate-to-vigorous physical activity. PA = Physical activity.

## Discussion

Given the varied results on how SCT predicts PA in adults with disabilities, the goals of this meta-analysis were to a) synthesize findings from existing studies using meta-analytical methods, and b) determine moderators influencing the relationship between SCT constructs and PA among this population. Among many findings of the current study, one finding was that the overall predictive effect of SCT on PA in adults with disabilities was small but significant under the random effects model. This result revealed that the combined SCT variables were significantly associated with PA in adults with disabilities to a small degree. In addition, the current meta-analysis showed that SCT variables accounted for 23% of the variance in PA among adults with disabilities. This result aligns with findings from a previous meta-analysis by Young and colleagues (2014), which reported that SCT variables explained 31% of PA in individuals without disabilities. These findings suggest that SCT is a suitable framework for explaining PA among both adults with and without disabilities.

In the current meta-analysis, there were significant moderators found on the associations between SCT and PA among people with disabilities, including the types of SCT variables, PA intensities, and the types of PA measurement. This finding revealed that the association between the SCT variables and PA in adults with disabilities varied depending on the moderators. For the type of SCT variables, the correlation coefficient of goal-setting and self-efficacy were higher compared to other SCT variables, social support, and outcome expectation. This result was consistent with the main principles of SCT, indicating a direct association between self-efficacy and PA behaviours. Potentially, goal setting acted as a moderator between PA and other SCT variables (Beauchamp et al., 2019). For example, individuals who received social support for their PA participation and believed in the benefits of PA were more likely to set goals that promote PA. Future studies are needed to examine the association and the effect of social support and perceive benefit on goal settings on PA participation. The current results are consistent with those of a previous meta-analysis, which indicated that self-efficacy and goal setting are reliable predictors of physical activity among individuals without disabilities (Young et al., 2014). However, outcome expectations and social support were not significant factors (Young et al., 2014). It is important to note that the current review did not discuss the correlations between physical activity and both planning and self-regulation because fewer than ten studies addressed these factors, indicating weak evidence. (Borenstein et al., 2011).

Another significant moderator was the intensity of PA. Even though the SCT variables were statistically significantly associated with overall PA levels and moderate-to-vigorous PA engagement in adults with disabilities, no statistically significant association was found with low intensity PA levels. This may be due to the characteristics of low intensity PA. Examples of low intensity PA include slow walking, stretching, fishing, light housework such as cooking and dusting (Anindya et al., 2022). These types of physical activities are relatively easier to participate in compared to moderate-to-vigorous physical activities such as brisk walking, swimming, dancing, and mountain climbing (Frömel et al., 2022). In addition, low intensity PA may be a part of adults' daily life. Walking, gardening, and calisthenics are common physical activities among individuals with disabilities (Weikert et al., 2011). Thus, as the low intensity physical activities may not be goal-directed activities, the SCT variables may not explain the behaviours. But, low intensity physical activities provide various benefits such as managing chronic conditions and psychological health (Hanson & Jones, 2015), other frameworks (e.g., Bird et al., 2018; Williams, 2008) are needed to explain low intensity PA in adults with disabilities. Overall, adults with disabilities should participate in PA that best suit their needs and abilities.

The type of PA measurement moderated the association between SCT and PA among people with disabilities. This meta-analysis revealed that correlation coefficients between SCT variables and PA levels from device-based measures were significantly lower compared to those from self-report measures. One possible explanation for this finding is the over-correlation between SCT variables and PA when using self-report measures (Dyrstad et al., 2014). Typically, PA and SCT variables are measured within the same self-report questionnaire, potentially influencing each other. Another explanation is that device-based measures may not fully capture PA in individuals with disabilities. For example, Kayes and colleagues (2008) found that accelerometers had poor test-retest reliability for measuring free-living activities in individuals with MS. Similarly, another study reported poor criterion validity for accelerometers (Coote and O'Dwyer, 2012). Therefore, future studies should examine the validity and reliability of PA measures in individuals with disabilities.

In addition to the primary meta-analytical findings, it is important to discuss the measures of PA and the SCT variables for future studies. When measuring PA among adults with disabilities, especially for adults with multiple sclerosis, the frequently used questionnaire was the Godin's Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985). Of the nine studies including adults with multiple sclerosis in this current meta-analysis, eight studies used the GLTEQ to measure PA. The validity of the questionnaire has been well-established (Gosney et al., 2007). Specifically, in the study by Gosney and colleagues (2007) the scores of the questionnaire were moderately associated with the scores of accelerometers and pedometer ($r = .37$; concurrent validity). Despite the well-established psychometric properties of the GLTEQ, it was not possible to determine if participants met the current physical activity guidelines using this tool. Therefore, a health contribution scoring system has been added to the updated version of the GLTEQ (Motl, Bollaert, et al., 2018). This addition provides status on guideline achievement as well as information on leisure time PA. The updated GLTEP provides good criterion validity ($r = .46$). Thus, it is recommended to use the updated GLTEQ when measuring PA in individuals with multiple sclerosis.

Similar to the GLTEQ, when measuring PA in adults with spinal cord injury, a valid approach, the PA Recall Assessment for People with Spinal Cord Injury, had been used (Martin Ginis et al., 2005). In the study by Martin Ginis and colleagues (2005), the scores of the measure were moderately associated with indirect calorimetry estimates of PA in adults with spinal cord injury. However, for adults with visual impairment, the non-valid measure of the International PA Questionnaire-Short Form was used to evaluate their PA. Even though the validity of the measure has been well established in adults without disabilities, it has not been well studied among adults with disabilities, including individuals with visual impairment. Evidence regarding the criterion validity of self-reported physical activity questionnaires for individuals with visual impairments is essential for improving study quality. Future research might consider using multiple methods, including both device-based and self-report measures, to accurately and comprehensively capture physical activity.

For the SCT measures, different studies used various measurement tools to evaluate different SCT variables, including self-efficacy, goal setting, social support, outcome expectations, self-regulation, and planning varied depending on purposes of the included studies. This logically makes sense because there is no standard measure for evaluating SCT variables (Young et al., 2014). Among the 64 SCT variables of the 15 included studies, the construct validity evidence of 31 measures were not reported. Even though most of studies reported the construct validity evidence evaluated in previous studies, some studies did not report evidence of construct validities in their respective studies. It is not guaranteed that previously validated measures are valid in another study because of sensitivity of construct validity (Fenn & George, 2020).

Although the current meta-analysis provides important findings, this should be interpreted with the following limitations. The pooled correlations between SCT variables and PA in adults with disabilities may vary depending on other factors. The current meta-analysis conducted moderator analysis to examine the variation with four potential variables. However, other factors such as demographic information and severity of disability were not included in the analysis because of a lack of information and study. When more studies become available, another meta-analysis should be conducted to examine their influences on the pooled correlations. Another limitation was that multiple correlations from the same study were considered as an independent study when calculating the pooled correlations. For example, a study conducted by Silveira and colleagues (2021) used two tools measuring PA in adults with multiple sclerosis and they also divided participants into different groups based on the severity of multiple sclerosis. As a result, the study provided many correlations between PA and SCT variables. Although the correlations were from the same study, they were treated as independent studies. This may influence the significance of the results in the current study. Further study may need to use the multi-level meta-analysis approach to handle this issue (Cheung, 2019). The review protocol of the current study was not registered. Moreover, it is important to note that there was a lack of studies with adults with intellectual disabilities in the current meta-analysis. This may be because difficulties measuring SCT constructs in adults with intellectual disabilities such as longer assessing time and need of additional resources (Frielink Schuengel, & Embregts, 2018). Even though the difficulties may exist, further studies need to target individuals with intellectual disabilities for the research diversity.

## Perspectives

Explaining PA behaviours with a health-related theory is a fundamental step to develop effective PA interventions in the field of adapted PA. The current study provides a meta-analytic overview of physical activity behaviours in adults with disabilities by synthesizing various studies. Specifically, there are three practical implications from this study: 1) SCT explains a small but statistically significant portion of the variance in physical activity among adults with disabilities, 2) Self-efficacy and goal-setting emerged as the most significant factors influencing physical activity among adults with disabilities, and 3) device-based measures of PA were less correlated with SCT variables compared to self-reported PA. When developing PA interventions for adults with disabilities, these implications can be considered. Using constructs of SCT can be helpful in PA interventions. Specifically, professionals need to improve self-efficacy in adults with disabilities by teaching skills to participate in PA and support them to create an achievable PA goal.

**Supplementary Materials:** The validity and reliability evidence for the SCT variables, as well as the main results of each study, are documented in Appendix A.

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**Funding:** This research received no external funding

**Availability of data and materials:** Data available upon request

**Acknowledgments:** The authors of would like to thank other researchers who conducted studies included in the current study.

**Conflicts of Interest:** The authors declare no conflict of interest.

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**Appendix Table 1.** Validity or reliability evidence of SCT variables and main results

| Study | SCT variables (validity or reliability evidence) | Results (Regression coefficients of SCT variables associated with PA in individuals with disabilities) |
|---|---|---|
| Baird et al., 2021 | Self-efficacy (not reported); Goal setting (not reported); Social support (not reported); Outcome expectations (not reported) | 51% of variance in PA were explained by disability status and SCT variables. Self-efficacy ($\beta$ = .51), goal setting; ($\beta$ = .15) |
| Ensari et al., 2017 | Self-efficacy (not reported); Outcome expectations (not reported); Social support (not reported); Exercise goals (not reported) | 23% of the variance of GLTEQ scores were explained by the SCT variables and functional limitations. Self-efficacy ($\beta$ = .05*), goal setting ($\beta$ = .34*), outcome expectations ($\beta$ = .09*) |
| Martin Ginis et al., 2011 | Task self-efficacy ($\alpha$=0.94); Self-regulatory efficacy ($\alpha$=0.90); Social support (a single item); Outcome expectancy (not reported); Self-regulation ($\alpha$=0.96) | 39.4% of the variable in leisure time PA were explained by the social cognitive theory. Self-regulation ($\beta$ = .72*), self-regulatory efficacy ($\beta$ = -.02); task self-efficacy ($\beta$ = .11), outcome expectations ($\beta$ = -.20) |
| Haegele et al., 2017 | Social support (not reported); Self-regulation (not reported) | 29.4% of the variable in PA of adults with visual impairment were explained by social support, self-regulation, age, sex, and visual impairment. Social support ($\beta$ = .22*), self-regulation ($\beta$ = .18) |
| Haegele et al., 2018 | Self-efficacy ($\alpha = 85, \text{Guttman's lamda} = 0.84$ ) | 10.20% of the variance in PA were explained by self-efficacy and demographic variables. Self-efficacy ($\beta$ = .28*) |
| Haegele et al., 2021 | Self-efficacy ($\alpha = .85, \text{Guttman's lamda} = 0.84$ ) | The self-efficacy and PA were positively associated. Self-efficacy ($\beta$ = .26) |
| Kasser & Kosma, 2018 | Social support (not reported);Outcome expectations [physical outcome expectation ($\alpha$= .94) and social outcome expectation ($\alpha$=.89)] Self-efficacy ($\alpha = .92$) | 59% of variables in PA were explained by social cognitive variables. Social support ($\gamma$ = .38*), outcome expectation ($\gamma$ = .14), self-efficacy ($\gamma$ = .48*) |
| Motl et al., 2007 | Social support ($\alpha = .82$); Self-efficacy (genera self-efficacy, $\alpha = .99$, barriers self-efficacy, $\alpha = .93$) | Social support was a significant predictor for PA. Social support ($\gamma$ = .26*) |
| Motl et al., 2011 | Self-efficacy (not reported); Outcome expectations (not reported); Goal setting (not reported) | There were significant interaction (time) effects on PA. There were significant interaction effects (time) on SCT variables. |
| Silveira et al., 2021 | Social support (not reported); Self-efficacy (not reported) ; Outcome expectations (not reported); Goal setting (not reported) | 20% of variances of PA were explained by exercise self-efficacy and exercise goal setting. Exercise self-efficacy ($\beta$ = .28*), exercise goal setting ($\beta$ = .27) |

| Study | SCT variables (validity or reliability evidence) | Results (Regression coefficients of SCT variables associated with PA in individuals with disabilities) |
|---|---|---|
| Stapleton et al., 2016 | Task self-efficacy ($\alpha = .89$); Outcome expectations ($\alpha = .87$) ; self-regulation ($\alpha = .89$); Self-regulatory efficacy ($\alpha = .88$); Social support ($\alpha = .91$) | 12% of variances in competitive status (levels of sports) were explained by the social cognitive variables. Self-regulatory efficacy ($\beta = .26$*), outcome expectations; ($\beta = -.20$), self-regulation ($\beta = .23$) |
| Suh et al., 2011 | Self-efficacy ($\alpha = .99$); Physical outcome expectation ($\alpha = .81$); Social outcome expectation ($\alpha = .81$); Self-evaluative outcome expectation ($\alpha = .87$); Goal setting ($\alpha = .93$) | 40% of the variance in PA were explained by the social cognitive variables. Self-efficacy ($\beta = .49$), physical outcome expectation ($\beta = -.13$), social outcome expectation ($\beta = -.01$), self-evaluative outcome; expectation ($\beta = .19$*), goal setting ($\beta = .48$*) |
| Suh et al., 2014 | Self-efficacy (not reported); Outcome expectations (not reported); Social support (not reported); Goal setting (not reported) | 28% of the variance were explained by the goal setting, self-efficacy, and functional limitations. Self-efficacy ($\beta = .19$*), goal setting ($\beta = .26$*) |
| Suh et al., 2015 | Self-efficacy (not reported); Outcome expectations (not reported); Social support (not reported); Goal setting (not reported) | There was a statistically significant condition-by-time interaction on GLTEQ scores, $F(1, 66) = 5.47$, $P = .02$, $\eta 2$ p = .08. There was a statistically significant condition-by-time interaction on goal setting, $F(1, 66) = 16.88$, $P \leq .01$, $\eta 2$ p = .20. The intervention group reported a statistically significant and large increase in goal setting over time ($d = 0.68$, $P \leq .01$), whereas the control group had a nonsignificant, small reduction in goal setting over time ($d = –0.19$, $P = .14$). No other significant condition-by-time interactions on other variables. |
| Wilroy et al., 2018 | Self-regulation ($r = .76$, $\alpha = .95$); Self-regulatory efficacy ($r = .78$, $\alpha = .96$); Task self-efficacy ($r = .74$; $\alpha = .94$); Social support ($r = .87$, $\alpha = .84$); Outcome expectations ($r = 40$, $\alpha = .92$) | Self-regulation ($r = .43$*), self-regulatory efficacy; ($r = .58$*), task self-efficacy ($r = .49$*), social support ($r = .28$*), outcome expectations ($r = .25$*) |

2 Note. SCT = social cognitive theory, PA = physical activity

**Appendix Table 2.** Risk of Bias scores by each item.

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baird et al., 2021 | 2 | 2 | 1 | 1 | n/a | | | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 16 |
| Ensari et al., 2017 | 2 | 2 | 2 | 1 | n/a | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 21 |
| Martin Ginis et al., 2011 | 2 | 2 | 1 | 1 | n/a | | | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 18 |
| Haegele et al., 2017 | 2 | 2 | 1 | 1 | n/a | | | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 17 |
| Haegele et al., 2018 | 2 | 2 | 1 | 2 | n/a | | | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 19 |
| Haegele et al., 2021 | 1 | 2 | 2 | 1 | n/a | | | 1 | 2 | 2 | 2 | 0 | 1 | 2 | 16 |
| Kasser & Kosma, 2018 | 1 | 2 | 1 | 2 | n/a | | | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 17 |
| Motl et al., 2007 | 2 | 2 | 1 | 2 | n/a | | | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 18 |
| Motl et al., 2011 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 21/28 |
| Silveira et al., 2021 | 2 | 2 | 1 | 2 | n/a | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 21 |
| Stapleton et al., 2016 | 2 | 2 | 1 | 2 | n/a | | | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 18 |
| Suh et al., 2011 | 1 | 2 | 1 | 2 | n/a | | | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 17 |
| Suh et al., 2014 | 2 | 2 | 1 | 2 | n/a | | | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 17 |
| Suh et al., 2015 | 2 | 2 | 1 | 2 | 2 | 2 | 0 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 24/28 |
| Wilroy et al., 2018 | 2 | 2 | 1 | 2 | n/a | | | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 17 |

Note. Three questions (Q5, 6, and 7) are not applicable to cross-sectional studies.