DOI: 10.5114/areh.2023.133105
Original article
Advances in Rehabilitation, 2023, 37(4), 1–11

A – Research concept and design
B – Collection and/or assembly of data
C – Data analysis and interpretation
D – Writing the article
E – Critical revision of the article
F – Final approval of article

Received: 2023-07-10
Accepted: 2023-11-16
Published: 2023-11-21

The indirect effects of basic psychological needs on the relationship between physical activity and mental health in adults with disabilities: A cross-sectional study

Roxy Helliker O'Rourke*[A-F], Catherine M. Sabiston[A,E-F], Linda Trinh[A,E-F], Kelly P. Arbour-Nicitopoulos[A,E-F]

[1]Faculty of Kinesiology and Physical Education, Mental Health and Physical Activity Research Centre, University of Toronto, Toronto, Canada

Corresponding author: Roxy Helliker O'Rourke; Faculty of Kinesiology and Physical Education, Mental Health and Physical Activity Research Centre, University of Toronto, Toronto, Canada; email: roxy.orourke@mail.utoronto.ca

Abstract

Introduction: Poor mental health is a common secondary health condition for adults with disabilities. The mental health benefits of moderate-to-vigorous intensity physical activity (MVPA) are well-documented. Few studies have empirically tested the relationship between MVPA and mental health among persons with disabilities. Additionally, theoretically-informed factors that may mediate the relationship are not commonly tested among persons with disabilities. The primary aim of this study was to examine the cross-sectional relationship between MVPA and mental health in adults with disabilities. A secondary aim was to explore the indirect effects of the three psychological needs (autonomy, competence, relatedness) on the MVPA-mental health relationship.

Material and methods: Participants (n = 100; mean age = 36.61; 54% women; 84% physical disability) completed an online questionnaire to assess MVPA, mental health, autonomy, competence, and relatedness. The associations between MVPA, psychological needs, and mental health were explored descriptively and in a multiple mediation regression model.

Results: The bivariate association between MVPA and mental health was significant (r_s = 0.34, p = 0.01), as were the associations between the three psychological needs and MVPA (r_s = 0.24–0.43) and mental health (r_s = 0.61–0.82). MVPA had a significant indirect effect on mental health through autonomy (β = 0.05, 95% CI = 0.00–0.12), competence (β = 0.16, 95% CI = 0.08–0.25) and relatedness (β = 0.08, 95% CI = 0.02–0.17).

Conclusions: The results of this study add to limited research documenting the relationship between MVPA and mental health in adults with disabilities by highlighting the potential benefits of autonomy, competence, and relatedness. Future prospective research is needed to investigate the mediating effects of autonomy, competence and relatedness on the relationship between MVPA and mental health in adults with disabilities.

Keywords: autonomy, competence, disability, relatedness, well-being

Introduction

Approximately 1 billion (15%) people among the global adult population are living with a disability [1–3]. Persons living with disabilities remain at risk of experiencing poor mental health [4,5]. For example, depression prevalence as high as 22.2% has been reported in adults with spinal cord injury [6]. As per the dual continuum model, mental health ranges from high (*flourishing*) to low (*languishing*) levels of well-being [7].

High levels of well-being represent flourishing, which is an index of positive mental health marked by an individual's ability to function optimally [8]. Ill-being, on the other hand, is indicative of languishing, which is often referred to as poor mental health [9]. Given the long-term health risks and mental health challenges associated with experiencing languishing, efforts have been focused on how to alleviate languishing and foster flourishing.

One strategy for enhancing mental well-being is participation in physical activity (PA). Internationally, the World Health Organization has PA guidelines for adults with and without disabilities. Recognizing the range of capabilities depending on impairment type, and the many unique barriers that adults with disabilities may experience when navigating their PA participation, several disability-specific PA guidelines have also been developed (e.g., for spinal cord injury [10], multiple sclerosis [11], cerebral palsy [12], Parkinson's disease [13], and arthritis [14]) based on extensive analyses of the available scientific evidence, in collaboration with disability-specific experts and community partners. Within these disability-specific guidelines, MVPA has been deemed most effective for improvements in health and cardiorespiratory fitness [10–14]. An overarching gap acknowledged within the body of research on PA guidelines (disability- and non-disability-specific) is the limited evidence on the relationship between MVPA and mental health for persons with disabilities.

Lubans et al. [15] proposed a conceptual framework for identifying three possible mechanisms of the relationship between MVPA and mental health, specifically cognitive function, well-being, and ill-being. These mechanisms are grouped into psychosocial (e.g., opportunities for increased independence, mastery, and social connectedness), behavioural (e.g., sleep volume and quality, coping and self-regulation skills), and neurobiological (e.g., grey matter volume and activation, neurotrophin gene and protein expression). Within the conceptual framework put forward by Lubans et al. [15], the psychosocial mechanisms mediate the relationship between PA and well-being, and as such, the psychosocial mechanisms are the focus of this study. The psychosocial mechanism aligns with the three basic psychological needs of self-determination theory (SDT [15,16]), where autonomy, competence, and relatedness form the foundation of self-motivation and, consequently, behaviour [16]. Autonomy is defined by feelings of agency and behaving with volition, authorization, readiness, and choice [17]. Competence is characterized by the drive to control the outcome of situations and the surrounding environment to experience mastery [16]. Relatedness is defined by the desire to feel connected, and the will to interrelate with others [16], and is, therefore, associated with feelings of belonging [18,19]. Specific to PA, all three basic psychological needs have been associated with mental health outcomes in adults with [20–23], and without [15,24] disabilities. Participating in PA may provide people with increased opportunities to satisfy their need for autonomy, competence, and relatedness, and thus, may be associated with improved well-being [25].

In line with previous research on the bi-directional positive relationship between MVPA and mental health in adults without disabilities [26], a positive relationship between MVPA and mental health was hypothesized. Consistent with previous evidence on PA and the three basic psychological needs [25], positive relationships between MVPA and both autonomy and competence were hypothesized. While a relationship between MVPA and relatedness was hypothesized, it was suspected that this relationship would be weaker than those with autonomy and competence [25]. Positive relationships were also hypothesized between all three basic psychological needs and mental health [27]. Guided by Lubans et al. [15], it was also hypothesized that all three basic psychological needs would have indirect effects on the relationship between MVPA and mental health.

Guided by the conceptual model of Lubans et al. [15] and using a cross-sectional design, this study aimed to address the gap in theory-driven, mechanistic PA-mental health research in adults with disabilities by exploring, as its primary aim, (a) the relationship between MVPA and mental health, and as its secondary aim, (b) the potential mediating effects of the three basic psychological needs on the MVPA-mental health relationship.

Materials and methods

Participants

Institutional research ethics board approval was granted in July 2019 in accordance with the Declaration of Helsinki Protocol, Ethics Committee approval number 37857. Individuals were eligible if they met the following inclusion criteria: I) being between the ages of 18 and 64 (i.e., ages of adulthood; [28]), II) self-identifying as having a chronic congenital or acquired (> 12 months post-diagnosis) disability that is not mental health-related, and III) being capable of understanding and reading or speaking English. Exclusion criteria consisted of: I) being younger than 18 or older than 64 years of age, II) having no self-disclosed chronic disability diagnosis, III) having a primary disability diagnosis that is mental health-related (e.g., major depressive disorder), IV) being incapable of understanding and

reading or speaking English, V) having a cognitive and/or memory impairment, and VI) requiring a caregiver to complete the questionnaire on their behalf.

A power analysis to determine a sufficient sample size to test the bivariate relationship between MVPA and mental health was conducted a priori in G*Power [29], with an alpha of 0.05, a power of 0.80, and based on a moderate size relationship (r = 0.30). Based on these assumptions, the projected sample size was 84 participants. Purposeful sampling methods were initially used to recruit participants (n = 27) through targeted emails sent to specific Canadian community organizations specializing in programming and services (e.g., PA, healthy living) for adults with disabilities (e.g., Special Olympics Ontario, SCI Action Canada). With minimal uptake, convenience sampling was used by the lead author to recruit the remaining participants (n = 73, total of n = 100 participants). The lead author directly contacted previously known individuals working with adults with disabilities. Snowball sampling methods were also used, where these external contacts working within disability sport were asked to recruit potential participants within their networks, and existing study participants forwarded study details to other potential participants.

Procedure

An online survey was made available from September 2019 to January 2020 through the secure institutional data management system Research Electronic Data Capture (REDCap©). Prior to recruitment, several iterations of pilot-testing were conducted by an associate professor of disability and PA, and graduate students (n = 9) within the student investigator's lab. All students who assisted in the pilot-testing had previously conducted research in disability and PA. The purpose of pilot-testing was to increase the accessibility of the questionnaire (e.g., images and wording, usability of the text-to-voice function on the REDCap© survey). An adult with a visual impairment was also asked to pilot the questionnaire. The selected individual had extensive experience (over 5 years) instructing individuals with chronic disabilities on electronic accessibility, and, thus, was deemed an appropriate person to pilot the electronic questionnaire. Feedback was received on the accessibility of the questionnaire. All suggestions provided during this pilot-testing stage (e.g., to ensure all images include plain text descriptions) were applied by the student investigator.

Following the pilot testing, all prospective participants were screened for eligibility by the lead author via e-mail. All participants provided written informed consent prior to study participation. Participants were offered offline delivery options to complete the survey, including via telephone, on paper, or in person, to obtain a more diverse sample of adults with varying abilities. Participants took, on average, 20 minutes and 45 seconds to complete the questionnaire. Participants were compensated with an electronic gift card worth $15.

Measures

Demographics

Participants were asked to report their age, gender, ethnicity, education, marital and employment status, living situation, and impairment type(s). Participants were also asked to report on their current and previous PA status (i.e., athlete or recreational sport participant), and personal history of mental illness.

Moderate-to-vigorous physical activity

The Leisure-Time Physical Activity Questionnaire for People with Spinal Cord Injury (LTPAQ-SCI [30]) was used to measure MVPA. The LTPAQ-SCI is a psychometrically sound self-report measure of leisure-time PA behaviour (i.e., activity one chooses to do during one's free time). Participants were asked to recall the frequency (number of days) and duration (minutes per day) of their engagement in moderate (some physical effort) and heavy (maximal effort) intensity aerobic and strength-based PA over the past seven days. The LTPAQ-SCI was then scored by multiplying the frequency and duration for each intensity, and the scores for both types of PA were summed (scored with a summary score of minutes/week of MVPA). The LTPAQ-SCI has previously been validated against indirect calorimetry in adults with a spinal cord injury [30] and has demonstrated test-retest reliability (Cronbach's $\alpha > 0.60$) over a period of seven days [31]. While effectively capturing leisure-time PA participation within individuals with a spinal cord injury [32], the LTPAQ-SCI has previously been used to measure PA within adults with cerebral palsy [33].

Mental health

Mental health was measured using the Mental Health Continuum-Short Form (MHC-SF [34]). The MHC-SF consists of 14 items across three subscales: emotional well-being (three items; e.g., happy), social well-being (five items; e.g., social contribution), and psychological well-being (six items; e.g., self-acceptance). Participants reported how often they had experienced the feelings identified in each item during the past month. Items were scored on a scale of 0 (*never*) to 5 (*every day*). The MHC-SF was scored as a continuous variable, with a positive sum ranging from 0 to 70 [34]. A higher score represents an elevated level of well-being. The MHC-SF was also scored as a categorical variable,

with a binary variable (flourishing, not flourishing) and a multi-categorical variable (flourishing, moderately mentally healthy, languishing) for descriptive purposes [34]. The MHC-SF has been validated in adults with [35] and without [36] disabilities, and has demonstrated moderate test-retest reliability in adults with a mental illness (Cronbach's $\alpha > 0.76$ [35]). Internal consistency (Cronbach's α) of the MHC-SF for the current study sample was 0.93.

Psychosocial mechanisms

Autonomy, competence, and relatedness were measured using the Basic Psychological Need Satisfaction Scale in General (BNSG-S [37]). The BNSG-S consists of 21 items that address overall basic need satisfaction. The items compose three subscales assessing autonomy (seven items; e.g., I feel like I am free to decide for myself how to live my life), competence (six items; e.g., People I know tell me I am good at what I do), and relatedness (eight items; e.g., I get along with people I come into contact with). All items were scored on a scale of 1 (*not at all*) to 7 (*very true*). The BNSG-S is most commonly scored and reported using its three-subscale format [38]. To score by subscale, the negatively worded items were reverse scored, and the average of the items for each relevant need was calculated. Higher scores were indicative of greater needs satisfaction. Internal consistency (Cronbach's α) of the subscales for the current study sample was 0.72 for autonomy, 0.79 for competence, and 0.88 for relatedness.

Statistical analysis

Data were analyzed using SPSS version 26.0 (IBM Corp.) with statistical significance set to a *p*-value of <0.05. Data were assessed for missing values (0%) and statistical outliers, which were corrected for at ± 3 standard deviations around the mean [39]. Statistical assumptions were tested using descriptive statistics (means and standard deviations) and Shapiro-Wilk tests. Assumptions of normality were not met for MVPA, the three basic psychological needs, and mental health (i.e., skewness and kurtosis values demonstrated non-normality, and Shapiro-Wilk tests were not significant at $p < 0.05$). As a result, non-parametric tests were used to analyze the data.

Descriptive statistics, including medians and ranges, were calculated to describe the sample based on demographic characteristics, MVPA, and mental health. Bivariate Spearman's rho (r_s) correlations were run to examine the relationship between MVPA and mental health, as well as the independent relationships between (a) MVPA and autonomy, competence, and relatedness, and (b) mental health and autonomy, competence, and relatedness. The strength of the association was interpreted, using the correlation coefficient (r_s), as small (0.10 to 0.29), moderate (0.30 to 0.49), or strong (>0.50) [40].

The PROCESS Macro [41] was used to explore potential mediating (indirect) effects of the three basic psychological needs on the MVPA-mental health relationship. With 10,000 bootstrap samples, significant indirect effects were determined at the bias-corrected 95% confidence interval if the confidence interval did not include 0. The three basic psychological needs were input into a single model to control for one another.

Results

The mean (SD) age of the 100 participants was 36.61 (11.51) years (range 18 to 61 years), and 54% were women. 83% were White, 1% Hispanic or Latino, 1% Black or African American, 1% Native American or American Indian, 4% Asian/Pacific Islander, and 9% 'other' [42]. The majority of the sample reported having finished college/university (55%), and many were employed full-time (21%) or part-time (22%). The majority of the sample reported being single/never married (46%) or married/common law (41%). The study-specific demographic variables are provided in detail in Table 1.

Descriptives of MVPA and mental health status

Table 2 provides summary descriptive statistics for MVPA and mental health outcomes. Approximately 29% of the sample met the World Health Organization's PA guideline of at least 150 minutes of MVPA per week. Using the MHC-SF's two category diagnosis of positive mental health, 53% of the sample was categorized as flourishing, and 47% as not flourishing (i.e., languishing).

Bivariate relationships between MVPA, mental health, and the psychological needs

Table 3 provides the descriptive statistics of the three basic psychological needs and the bivariate Spearman's rho correlations for the independent relationships between the three needs and weekly MVPA and mental health, respectively. The results showed a significant positive moderate relationship between MVPA and mental health ($r_s = 0.34$, $p = < 0.01$), indicating that greater weekly MVPA participation was associated with higher levels of flourishing. Significant positive relationships, ranging from small to moderate in magnitude, were shown between MVPA and autonomy, competence, and relatedness ($r_s = 0.24$, $p < 0.05$; $r_s = 0.43$, $p < 0.01$; $r_s = 0.29$, $p = < 0.01$, respectively). These positive relationships indicate that higher weekly MVPA

Tab. 1. Descriptive statistics reported by demographic characteristic (n = 100)

Study-specific demographic characteristic	n (%)
Disability Onset	
Congenital	36 (36.0)
Acquired	64 (64.0)
Acquired Disability Age of Onset (M ± SD) (n = 58)	24.17 ± 11.38
Self-Reported Disability	
Developmental	6 (6.0)
Autism	2 (2.0)
Intellectual Disability	3 (3.0)
Other	2 (2.0)
Sensory	27 (27.0)
Hearing Impairment	9 (9.0)
Visual Impairment	14 (14.0)
Blind	6 (6.0)
Other	2 (2.0)
Physical	84 (84.0)
Amputation	10 (10.0)
Traumatic Brain Injury	4 (4.0)
Cerebral Palsy	5 (5.0)
Arthritis	5 (5.0)
Multiple Sclerosis	8 (8.0)
Muscular Dystrophy	2 (2.0)
Neuromuscular Disorder	8 (8.0)
Spina Bifida	4 (4.0)
Spinal Cord Injury	15 (15.0)
Stroke	2 (2.0)
Other	27 (27.0)
Mental Illness History (n = 99)	
Yes	35 (35.0)
No	64 (64.0)
PA Participation	
Athlete, Currently	44 (44.0)
Sports	45 (45.0)
General Physical Activity	68 (68.0)

M – mean, SD – standard deviation, n = 100 for all demographic characteristics unless otherwise specified. Participants had the option of self-reporting more than one type of disability; therefore, the total frequency of self-reported disabilities may not be equal to the total number of participant responses.

Tab. 2. Descriptive statistics for moderate-to-vigorous physical activity (MVPA) behaviours and mental health (n = 100)

Item	Median (IQR) or n (%)
MVPA (minutes per week)	
Moderate	60.00 (180.00)
Vigorous	0.00 (90.00)
Moderate-to-vigorous	77.50 (330.00)
Meeting World Health Organization PA guidelines [n(%)]	29.00 (29.00)
Mental health	
Mental health continuum – continuous score	49.00 (19.50)
Two-category diagnosis of positive mental health	
Flourishing [n(%)]	53.00 (53.00)
Not flourishing [n(%)]	47.00 (47.00)
Three-category diagnosis of positive mental health	
Flourishing [n(%)]	53.00 (53.00)
Moderately mentally healthy [n(%)]	38.00 (38.00)
Languishing [n(%)]	9.00 (9.00)

IQR – interquartile range. While the LTPAQ-SCI uses the term 'heavy' PA, vigorous was selected to align with the World Health Organization's PA guidelines. Outliers were replaced with values ± 3 standard deviations from the mean. The number of outliers identified for each intensity of PA was four for moderate MVPA, and one for vigorous PA. No outliers were identified for mental health.

was associated with greater levels of autonomy, competence, and relatedness. Significant positive strong relationships were also found between mental health and autonomy, competence and relatedness, indicating that greater perceived needs were associated with greater mental health (i.e., flourishing).

Mediating effects of the basic psychological needs on the MVPA-mental health relationship

The results from the mediation analysis are shown in Figure 1. The model accounted for 74% of the variance in mental health (R^2 = 0.74, F(4,88) = 63.1, p < .001). Autonomy, competence, and relatedness each explained a portion of the MVPA-mental health relationship, with a total standardized indirect effect of β = 0.29, 95% CI = 0.15 to 0.43. The indirect effects between MVPA and mental health were significant for all three psychological needs: autonomy (β = 0.05, 95% CI = 0.00 to 0.12),

Tab. 3. Descriptive statistics and bivariate spearman's (r_s) correlations between the basic psychological needs and moderate-to-vigorous physical activity (MVPA), and mental health

Item	1	2	3	4	Median	IQR
Basic psychological needs						
1. Autonomy	–				5.14	1.25
2. Competence	0.58**	–			5.00	1.50
3. Relatedness	0.64**	0.70**	–		5.38	1.13
MVPA						
4. MVPA (minutes per week)	0.24*	0.43**	0.29**	–	77.50	330.00
Mental health						
5. MHC-CS	0.61**	0.82**	0.76**	0.34**	49.00	19.50

IQR – interquartile range. Possible scores for the basic psychological needs range from 1 to 7, and the MHC-CS ranges from 0 to 70; * Correlation coefficient significant at $p < 0.05$ (two-tailed); ** Correlation coefficient significant at $p < 0.01$ (two-tailed).

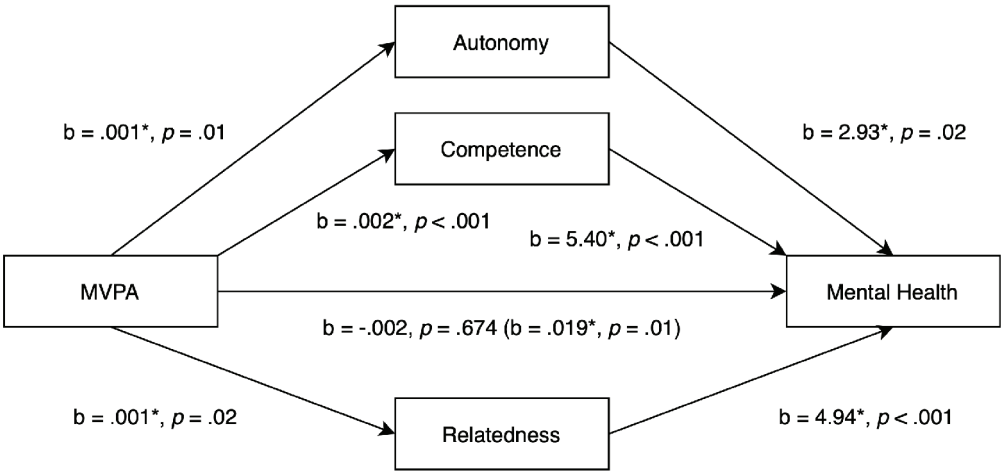

Fig. 1. Model of the mediating effects of autonomy, competence, and relatedness on the relationship between MVPA and mental health

competence ($\beta = 0.16$, 95% CI = 0.08 to 0.25) and relatedness ($\beta = 0.08$, 95% CI = 0.02 to 0.17).

Discussion

This cross-sectional study focused on elucidating the relationship between MVPA and mental health and the potential mediating effects of autonomy, competence, and relatedness in a sample of adults with disabilities. Overall, a moderate positive relationship was found between MVPA and mental health. This positive relationship is similar in magnitude to values reported in previous cross-sectional and longitudinal studies in adults without disabilities [43,44]. Additionally, the study results show a potential role for the basic psychological needs in mediating the relationship between MVPA and mental health in adults with disabilities. The small to moderate positive correlations shown between the three basic psychological needs and MVPA support not only the previously documented MVPA–psychological needs relationships in adults without disabilities [25] but also the growing body of research that points to the benefits of PA environments that foster an individual sense of autonomy, competence, and relatedness for adults with disabilities [45–47].

Autonomy, the sense of having choice and being in control, has been identified as a key component in the PA behaviours of adults, specifically impacting motivation to continue PA involvement [17,48,49]. The concept of autonomy, however, may look different, or be valued differently, in persons with disabilities [50,51]. Some individuals with disabilities experience a lack of control due to their level of functioning (e.g., needing assistance to change into PA clothing) or environmental conditions that interact with their impairment (e.g.,

inaccessible curbs on sidewalks to go into a gym [52]). Adults with disabilities also experience lack of choice within PA environments due to inaccessible equipment (e.g., the location of machines in fitness facilities) or inadequately trained PA staff [53,54]. Future studies should be conducted to explore adults with disabilities' perceptions of how autonomy can be fostered within different PA environments.

Competence is an important correlate of PA in adults with disabilities [55], and longitudinally influences adherence to PA in adults without disabilities [47,56]. Specific to research on PA in persons with disabilities, moderate positive relationships between PA and competence have previously been reported among young adults with physical disabilities (r = 0.36) [47]. As such, the moderate positive correlations shown between MVPA and competence in this study further support previous findings. Two facets of perceived feelings of competence in adults with disabilities may affect MVPA: social and activity competence [55,57]. Lower levels of social competence are associated with peer exclusion and social isolation [58]. While social competence may not be directly related to PA, peer exclusion and social isolation may lead to barriers to PA [58]. This may directly contribute to lower participation in MVPA, which, in turn, may limit activity competence [59]. Fostering social competence, therefore, may facilitate MVPA engagement, which, in turn, may increase activity competence, leading to greater involvement in MVPA. Further explorations pertaining to how the social environment can facilitate competence in different PA contexts are therefore warranted. Additionally, future research should explore whether social and activity competence both contribute equally to PA participation.

Contrary to evidence from studies that include adults without disabilities, the positive relationship between relatedness and MVPA in the current study suggests relatedness may play a key role in MVPA participation of adults with disabilities. Relatedness has been identified as a distal component influencing PA participation in adults without disabilities [25]; however, among adults with disabilities there may be an increased need to satisfy relatedness [22]. Aspects of relatedness (e.g., social support, peer acceptance) have been explored in samples of veterans with disabilities and Special Olympics athletes [22,60]. Veterans with acquired physical disabilities highlighted relatedness as a crucial need to be satisfied within PA settings due to the desire to relate to others with similar lived experiences [22]. There may, therefore, be an innate need to experience feelings of similarity to foster social connections and peer acceptance in some disability populations [61]. This notion is supported by findings within Special Olympics programs where athletes reported friendships as the primary motivation to participate in Special Olympics, with relatedness highlighted as an important element in establishing quality PA experiences [60]. Relatedness is characterized by feelings of a 'shared understanding', which may be particularly relevant for persons with disabilities with shared commonalities in the disability experience [62]. Specifically, having peer similarities contributes to feelings of relatedness, which, in turn, may facilitate involvement in PA [63,64]. Given the highlighted need for relatedness, further explorations of the effects of relatedness on MVPA in adults with disabilities are warranted. Specifically, exploring which elements within PA programming contribute to a sense of relatedness, and how this may differ within different PA settings (e.g., group PA programming vs. individual PA environments) may be a fruitful area of future research in adults with disabilities.

In line with the tenets of SDT [65], the large positive correlations observed in this study for the independent relationships between the three basic psychological needs and mental health support the notion that autonomy, competence, and relatedness are inherently linked with well-being (i.e., flourishing) [66,67]. For adults with disabilities, social participation and quality of life are associated with self-determination [68,69]. Adults with disabilities for whom all three basic psychological needs are satisfied are more likely to be self-determined, leading to increased social participation and improved overall quality of life [69]. Greater social participation and quality of life are associated with improved well-being and overall mental health [70]. The relationship between social participation and quality of life on the one hand, and well-being and mental health on the other, are consistent with the current findings of large positive correlations between the three basic psychological needs and mental health, supporting the increased importance of need satisfaction in improving mental health outcomes in adults with disabilities compared to adults without disabilities.

Results from the exploratory mediation analysis showed that all three basic psychological needs had a significant effect on the MVPA-mental health relationship. These mediation results also extend the conceptualization of psychosocial mechanisms within the MVPA and mental health relationship from Lubans et al. [15] to adults with disabilities. Notably, however, 29% of the current sample reported meeting the PA guideline of at least 150 minutes of MVPA per week [71]. Referring to existing disability and PA research, this is a higher percentage of active individuals than anticipated (e.g., 50% of adults with spinal cord injury report doing no leisure-time PA [72]), indicating the current sample is a relatively active subsample of adults with disabilities.

Future research should explore the need for autonomy, competence, and relatedness within specific PA settings (i.e., need satisfaction in PA, rather than in general), and within subgroups that meet vs. do not meet the PA guidelines (disability and non-disability specific). Within the selected measures (i.e., BNSG-S, MHC-SF), the scales selected were not specific to PA, which potentially reduced the measurement correspondence. As such, the correlations between MVPA and the psychological needs may have been stronger if domain-specific PA measures had been selected. Ultimately, the outcome of interest was mental health, not specific to PA, and therefore global measures were selected for the three psychological needs. An exploration of need satisfaction in PA could focus on whether certain psychological needs are valued more than others to assist in determining which need(s) to prioritize within PA interventions for adults with disabilities. Given the exploratory nature of the mediation analysis, further examination of the indirect effects of autonomy, competence, and relatedness on the MVPA-mental health relationship in adequately powered studies is warranted in adults with disabilities. While research could narrow in on impairment type and additional key demographic characteristics to understand the mechanisms underlying the MVPA-mental health relationship, the results of this study indicate the overwhelming need to focus on MVPA and mental health outcomes in adults with disabilities.

Study Limitations and Future Directions

Some inherent limitations of the study should be noted. First, it was not adequately powered to make conclusive statements regarding the mediating effects of the basic psychological needs on the MVPA-mental health relationship. The findings from the exploratory mediation analyses, however, provide a direction for future, adequately powered, research conducted on adults with disabilities. Second, the generalizability of this study is limited due to the cross-sectional design, and the demographics of the participants (e.g., diverse impairment types, and the majority of participants being identified as White). Additionally, the sampling methods used could have led to the recruitment of an 'active' sample of participants. The findings of this study, however, could be further built on through longitudinal study designs, as well as intentional recruitment of adults with disabilities from diverse backgrounds (i.e., race, gender). Intentional recruitment could involve community collaborations during the study design and recruitment process to ensure individuals from intersectional minority backgrounds and of different activity levels were recruited for a truly diverse and generalizable sample. The authors would also like to acknowledge that 'other' was included as one of the survey response options for ethnicity. In line with the American Medical Association's [42] recently updated guidelines on the reporting of race and ethnicity, we acknowledge this limitation and will collect detailed data on the ethnicities of all participants in future work. Third, the PA measure, while validated for use with individuals with spinal cord injury and cerebral palsy, is not validated for use with individuals with other disabilities. Additionally, the PA measure only focused on the quantity aspect of behaviours, so future research should also explore the quality aspect of PA participation to fully understand the nuances of the MVPA-mental health relationship in adults with disabilities. Future qualitative work that explores how adults with disabilities may prioritize the basic psychological needs (e.g., autonomy may be more valuable than relatedness) is warranted to foster quality PA experiences. Fourth, the BNSG-S has not been validated for use in persons with disabilities. Future validation research of this measure of need satisfaction within samples of individuals with disabilities is warranted to ensure the measure is accurate and meaningful for use within samples with disabilities. Lastly, none of the variables, including MVPA, autonomy, competence, relatedness, and mental health, were normally distributed. MVPA was positively skewed, while the basic psychological needs and mental health were negatively skewed. Future research should explore these non-normal distributions and determine whether these trends are consistent in larger samples of adults with disabilities.

Conclusions

The study findings provide some theoretical implications specific to PA and the mental health of adults with disabilities. Overall, MVPA and mental health were positively related. The positive associations found between the basic psychological needs and MVPA and mental health suggest that future longitudinal research is needed to examine the role of the three basic psychological needs on the MVPA-mental health relationship in adults with disabilities.

Funding

This research was funded by a SSHRC Institutional Research Grant.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Goodley D. Disability studies: An interdisciplinary introduction. London: Sage Publication Ltd; 2016.

2. Haagsma JA, Graetz N, Bolliger I, Naghavi M, Higashi H, Mullany EC, et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. Inj Prev. 2016; 22(1): 3–18.
3. World report on disability. World Health Organization; 2011.
4. Dunham A, Kinnear D, Allan L, Smiley E, Cooper SA. The relationship between physical ill-health and mental ill-health in adults with intellectual disabilities. J Intellect Disabil Res. 2018; 62(5): 444–53.
5. Tough H, Siegrist J, Fekete C. Social relationships, mental health and wellbeing in physical disability: a systematic review. BMC Public Health. 2017; 17(1): 414.
6. Williams R, Murray A. Prevalence of depression after spinal cord injury: a meta-analysis. Arch Phys Med Rehabil. 2015; 96(1): 133–40.
7. Keyes CL, Dhingra SS, Simoes EJ. Change in level of positive mental health as a predictor of future risk of mental illness. Am J Public Health. 2010; 100(12): 2366–71.
8. Diener E, Wirtz D, Tov W, Kim-Prieto C, Choi DW, Oishi S, et al. New well-being measures: Short scales to assess flourishing and positive and negative feelings. Soc Indic Res. 2010; 97(2): 143–56.
9. Keyes CL. The mental health continuum: from languishing to flourishing in life. J Health Soc Behav. 2002; 43(2): 207–22.
10. Martin Ginis KA, Van Der Scheer JW, Latimer-Cheung AE, Barrow A, Bourne C, Carruthers P, et al. Evidence-based scientific exercise guidelines for adults with spinal cord injury: an update and a new guideline. Spinal Cord. 2018; 56(4): 308–21.
11. Latimer-Cheung AE, Martin Ginis KA, Hicks AL, Motl R, Pilutti L, Duggan M, et al. Development of evidence-informed physical activity guidelines for adults with Multiple Sclerosis. Arch Phys Med Rehabil. 2013; 94: 1829–36.
12. Verschuren O, Peterson MD, Balemans AC, Hurvitz EA. Exercise and physical activity recommendations for people with cerebral palsy. Dev Med Child Neurol. 2016; 58(8): 798–808.
13. Oliveira de Carvalho A, Filho ASS, Murillo-Rodriguez E, Rocha NB, Carta MG, Machado S. Physical Exercise For Parkinson's Disease: Clinical And Experimental Evidence. Clin Pract Epidemiol Ment Health. 2018; 14: 89–98.
14. Austin S, Qu H, Shewchuk RM. Health care providers' recommendations for physical activity and adherence to physical activity guidelines among adults with arthritis. Prev Chronic Dis. 2013; 10: E182.
15. Lubans D, Richards J, Hillman C, Faulkner G, Beauchamp M, Nilsson M, et al. Physical Activity for Cognitive and Mental Health in Youth: A Systematic Review of Mechanisms. Pediatrics. 2016; 138(3): e20161642.
16. Deci EL, Ryan RM. Self-determination theory: A macrotheory of human motivation, development, and health. Can Psychol. 2008; 49(3): 182–85.
17. Ryan RM, Deci EL. Self-determination theory: Basic psychological needs in motivation, development, and wellness. New York: Guilford Press; 2017.
18. Connell JP, Wellborn JG. Competence, Autonomy, and Relatedness: A Motivational Analysis of Self-System Processes. In: GunnarMR, Sroufe LA, editors. Self Processes and Development. Hillsdale: Lawrence Erlbaum Associates Inc; 1991. p. 43–77.
19. Tillery AD, Varjas K, Roach AT, Kuperminc GP, Meyers J. The importance of adult connections in adolescents' sense of school belonging: Implications for schools and practitioners. J Sch Violence. 2013; 12(2): 134–55.
20. Banack HR, Sabiston CM, Bloom GA. Coach autonomy support, basic need satisfaction, and intrinsic motivation of paralympic athletes. Res Q Exerc Sport. 2011; 82(4): 722–30.
21. Evans MB, Shirazipour CH, Allan V, Zanhour M, Sweet SN, Ginis KA, et al. Integrating insights from the parasport community to understand optimal Experiences: The Quality Parasport Participation Framework. Psychol Sport Exerc. 2018; 37: 79–90.
22. Shirazipour CH, Evans MB, Caddick N, Smith B, Aiken AB, Ginis KA, et al. Quality participation experiences in the physical activity domain: Perspectives of veterans with a physical disability. Psychol Sport Exerc. 2017; 29: 40–50.
23. Tomasone JR, Wesch NN, Ginis KA, Noreau L. Spinal cord injury, physical activity, and quality of life: A systematic review. Kinesiol Rev. 2013; 2(2): 113–29.
24. Slemp GR, Vella-Brodrick DA. Optimising employee mental health: The relationship between intrinsic need satisfaction, job crafting, and employee well-being. J Happiness Stud. 2014; 15: 957–77.
25. Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: a systematic review. Int J Behav Nutr Phys Act. 2012; 9: 78.
26. Biddle S. Physical activity and mental health: evidence is growing. World Psychiatry. 2016; 15(2): 176–7.
27. Doré I, Sylvester B, Sabiston C, Sylvestre MP, O'Loughlin J, Brunet J, Bélanger M. Mechanisms underpinning the association between physical activity and mental health in adolescence: a 6-year study. Int J Behav Nutr Phys Act. 2020; 17(1): 9.
28. DiPietro L, Al-Ansari SS, Biddle SJ, Borodulin K, Bull FC, Buman MP, et al. Advancing the global physical activity agenda: recommendations for future research by the 2020 WHO physical activity and sedentary

behavior guidelines development group. Int J Behav Nutr Phys Act. 2020; 17(1): 143.
29. Erdfelder E, Faul F, Buchner A. GPOWER: A general power analysis program. Beh Res Meth Instr Comp. 1996; 28: 1–11.
30. Martin Ginis KM, Latimer AE. The leisure time physical activity questionnaire for people with spinal cord injury (LTPAQ-SCI). SCI Action Canada [Internet]. 2007. Available from: http://sciactioncanada.ca/researchpublications.cfm.
31. Martin Ginis KA, Phang SH, Latimer AE, Arbour-Nicitopoulos KP. Reliability and validity tests of the leisure time physical activity questonnaire for people with spinal cord injury. Arch Phys Med Rehabil. 2012; 93(4): 677–82.
32. Martin Ginis KA, Ubeda-Colomer J, Alrashidi AA, Nightingale TE, Au JS, Currie KD et al. Construct validation of the leisure time physical activity questionnaire for people with SCI (LTPAQ-SCI). Spinal Cord. 2021; 59(3): 311–8.
33. McPhee PG, Gorter JW, MacDonald MJ, Martin Ginis KA. The effects of an individualized health-risk report intervention on changes in perceived inactivity-related disease risk in adults with cerebral palsy. Disabil Health J. 2020; 13(2): 100868.
34. Keyes CLM. Brief Description of the Mental Health Continuum Short Form (MHC-SF). Available from: https://www.aacu.org/sites/default/ files/MHC-SFEnglish.pdf.
35. Franken K, Lamers SMA, Ten Klooster PM, Bohlmeijer ET, Westerhof GJ. Validation of the Mental Health Continuum-Short Form and the dual continua model of well-being and psychopathology in an adult mental health setting. J Clin Psychol. 2018; 74(12): 2187–202.
36. Lamers SM, Westerhof GJ, Bohlmeijer ET, ten Klooster PM, Keyes CL. Evaluating the psychometric properties of the mental health continuum□short form (MHC-SF). J Clin Psychol. 2011; 67(1): 99–110.
37. Deci EL, Ryan RM, Gagné M, Leone DR, Usunov J, Kornazheva BP. Need satisfaction, motivation, and well-being in the work organizations of a former eastern bloc country: A cross-cultural study of self-determination. Pers Soc Psychol Bull. 2001; 27(8): 930–42.
38. Johnston MM, Finney SJ. Measuring basic needs satisfaction: Evaluating previous research and conducting new psychometric evaluations of the Basic Needs Satisfaction in General Scale. Contemp Educ Psychol. 2010; 35(4): 280–96.
39. Aguinis H, Gottfredson RK, Joo H. Best-practice recommendations for defining, identifying, and handling outliers. Organ Res Methods. 2013; 16(2): 270–301.
40. Akoglu H. User's guide to correlation coefficients. Turk J Emerg Med. 2018; 18(3): 91–3.
41. Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. 3rd ed. New York: Guilford Press; 2013.
42. Flanagin A, Frey T, Christiansen SL, AMA Manual of Style Committee. Updated guidance on the reporting of race and ethnicity in medical and science journals. JAMA. 2021; 326(7): 621–7.
43. Saxena S, Van Ommeren M, Tang KC, Armstrong TP. Mental health benefits of physical activity. J Ment Health. 2005; 14(5): 445–51.
44. Steinmo S, Hagger-Johnson G, Shahab L. Bidirectional association between mental health and physical activity in older adults: Whitehall II prospective cohort study. Prev Med. 2014; 66: 74–9.
45. Kawanishi CY, Greguol M. Physical activity, quality of life, and functional autonomy of adults with spinal cord injuries. Adap Phys Activ Q. 2013; 30(4): 317–37.
46. Saebu M, Sørensen M. Factors associated with physical activity among young adults with a disability. Scand J Med Sci Sports. 2011; 21(5): 730–8.
47. Saebu M, Sørensen M, Halvari H. Motivation for physical activity in young adults with physical disabilities during a rehabilitation stay: A longitudinal test of self-determination theory. J Appl Soc Psychol. 2013; 43(3): 612–25.
48. How YM, Whipp P, Dimmock J, Jackson B. The effects of choice on autonomous motivation, perceived autonomy support, and physical activity levels in high school physical education. J Teach Phys Educ. 2013; 32(2): 131–48.
49. Ntoumanis N, Quested E, Reeve J, Cheon SH. Need supportive communication: Implications for motivation in sport, exercise, and physical activity. In: Jackson B, Dimmock J, Compton J, editors. Persuasion and Communication in Sport, Exercise, and Physical Activity. Abington: Routledge; 2018. p. 155–69.
50. Arnautovska U, Fleig L, O'callaghan F, Hamilton K. Older adults' physical activity: The integration of autonomous motivation and theory of planned behaviour constructs. Aust Psychol. 2019; 54(1): 46–54.
51. Bigby C, Clement T, Mansell J, Beadle□Brown J. 'It's pretty hard with our ones, they can't talk, the more able bodied can participate': Staff attitudes about the applicability of disability policies to people with severe and profound intellectual disabilities. J Intellect Disabil Res. 2009; 53(4): 363–76.
52. Desai MM, Lentzner HR, Weeks JD. Unmet need for personal assistance with activities of daily living among older adults. The Gerontologist. 2001; 41(1): 82–8.

53. Calder A, Sole G, Mulligan H. The accessibility of fitness centers for people with disabilities: A systematic review. Disabil Health J. 2018; 11(4): 525–36.
54. Rimmer JH. Use of the ICF in identifying factors that impact participation in physical activity/rehabilitation among people with disabilities. Disabil Rehabil. 2006; 28(17): 1087– 95.
55. Weiss J, Diamond T, Demark J, Lovald B. Involvement in Special Olympics and its relations to self-concept and actual competency in participants with developmental disabilities. Res Dev Disabil. 2003; 24(4): 281–305.
56. Morris J, Oliver T, Kroll T, MacGillivray S. The importance of psychological and social factors in influencing the uptake and maintenance of physical activity after stroke: A structured review of the empirical literature. Stroke Res Treat. 2012; 2012: 195249
57. Sherrill C. Adapted Physical Activity, Recreation and Sport: Crossdisciplinary and Lifespan. 5th ed. Boston: WCB/McGraw Hill; 1998.
58. McCabe PC, Meller PJ. The relationship between language and social competence: How language impairment affects social growth. Psychol Sch. 2004; 41(3): 313–21.
59. Haugen T, Säfvenbom R, Ommundsen Y. Sport participation and loneliness in adolescents: The mediating role of perceived social competence. Curr Psychol. 2013; 32: 203–16.
60. Watson NJ, Parker A. Sports, religion and disability. London: Routledge; 2016.
61. Shirazipour C, Latimer-Cheung A. Promoting participation: Outcomes indicative of a quality physical activity experience for veterans with a disability. Ann Behav Med. 2018; 52 Suppl 1: S225.
62. Goodwin D, Johnston K, Gustafson P, Elliott M, Thurmeier R, Kuttai H. It's okay to be a quad: Wheelchair rugby players' sense of community. Adapt Phys Activ Q. 2009; 26(2): 102–17.
63. D'Eloia MH, Sibthorp J. Relatedness for youth with disabilities: Testing a recreation program model. J Leis Res. 2014; 46(4): 462–82.
64. Orr K, Tamminen KA, Sweet SN, Tomasone JR, Arbour-Nicitopoulos KP. "I've had bad experiences with team sport": Sport participation, peer need-thwarting, and need-supporting behaviors among youth identifying with physical disability. Adapt Phys Act Q. 2018; 35(1): 36–56.
65. Deci EL, Ryan RM. The General Causality Orientations Scale: Self-determination in Personality. J Res Pers. 1985; 19(2): 109–34.
66. Véronneau MH, Koestner RF, Abela JR. Intrinsic need satisfaction and well–being in children and adolescents: An application of the self–determination theory. J Soc Clin Psychol. 2005; 24(2): 280–92.
67. Williams GC, Halvari H, Niemiec CP, Sørebø Ø, Olafsen AH, Westbye C. Managerial support for basic psychological needs, somatic symptom burden and work-related correlates: A self-determination theory perspective. Work Stress. 2014; 28(4): 404–19.
68. McDougall J, Evans J, Baldwin P. The importance of self-determination to perceived quality of life for youth and young adults with chronic conditions and disabilities. Remedial Spec Educ. 2010; 31(4): 252–60.
69. Nota L, Ferrari L, Soresi S, Wehmeyer M. Self□ determination, social abilities and the quality of life of people with intellectual disability. J Intellect Disabil Res. 2007; 51(11): 850–65.
70. Lachapelle Y, Wehmeyer ML, Haelewyck MC, Courbois Y, Keith KD, Schalock R, et al. The relationship between quality of life and self□determination: an international study. J Intellect Disabil Res. 2005; 49(10): 740–4.
71. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020; 54(24): 1451–62.
72. Ginis KA, Hicks AL, Latimer AE, Warburton DE, Bourne C, Ditor DS, et al. The development of evidence-informed physical activity guidelines for adults with spinal cord injury. Spinal Cord. 2011; 49(11): 1088–96.