



PERSPECTIVE

Lifestyle physical activity in manual wheelchair users – an overlooked public health opportunity

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Public health guidelines and health promotion efforts have traditionally focused on weekly accumulation of moderate to vigorous physical activity (MVPA) via structured exercise. There has been a recent paradigm shift towards the organic incorporation of MVPA in daily leisure and non-leisure time, termed “Lifestyle Physical Activity” (LPA). However, this paradigm shift and the underlying research has neglected manual wheelchair users (MWCUs) with spinal cord injury (SCI), who could benefit from LPA. This article argues for expanding the LPA paradigm shift into research and health promotion efforts involving MWCUs with SCI. We suggest a working definition of LPA for MWCUs and candidate metrics for quantifying LPA. This is followed by brief overviews of LPA correlates, outcomes/consequences, and interventions and the need for theory based approaches to study these domains. We lastly suggest an approach for mitigating potential negative outcomes of increased LPA in MWCUs and suggest a research agenda.

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INTRODUCTION

Physical activity guidelines for adults with and without disabilities typically advocate for achieving weekly minimums of moderate-to-vigorous physical activity (MVPA) via participation in intentional, structured, and planned exercise training [1]. However, barriers to participation in “intentional, structured, and planned exercise training” are many and underlie the low numbers of adults with and without disabilities who achieve recommended physical activity levels. Accordingly, there has been a paradigm shift towards organic incorporation of MVPA in daily life, termed “Lifestyle Physical Activity” (LPA). LPA promotion among ambulatory adults living with disabilities [2] builds upon efforts to increase Leisure Time Physical Activity (LTPA) [3] which is a specific type of LPA. However, there is a notable absence of recommendations regarding LPA for the estimated 65 million wheelchair users worldwide [4]. These individuals have increased risks chronic disease and could benefit from LPA to complement or adjuvant structured exercise training and/or LTPA. As with physical activity guidelines, LPA recommendations should be general enough to enable development and implementation tailored to the needs of specific groups. This paper applies the concepts of LPA to those who use manual wheelchairs as a primary or only means of mobility (e.g., spinal cord injury, multiple sclerosis, cerebral palsy, and spina bifida). This is accomplished through suggestion of a working definition of LPA for manual wheelchair users (MWCUs) and LPA metrics and followed by brief discussion of LPA correlates, consequences, interventions, and safe movement considerations. We intend this paper to initiate discussion of a research agenda on LPA in MWCUs.

DEFINITION OF LPA FOR MWCUS

LPA is formally defined as “self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life [5].” LPA also includes transport. LPA is MVPA integrated into daily routines as LTPA and/or as non-leisure time physical activities (Supplementary Fig. 1, Supplemental file). Defining LPA as MVPA does not neglect light intensity physical activity [6], but rather aligns with guidelines to achieve health benefits [7]. The diversity and flexibility of LPA allows for interventions focused on small, incremental replacements of sedentary time with MVPA, to move towards achieving physical activity guidelines. LPA is characterized by being: (1) selected by a person rather than prescribed, (2) occurring spontaneously and planned and (3) accumulated in minor bouts during the day and over the weeks naturally integrated in an individual’s everyday activities [2, 5]. We emphasize the importance of self-selected activities integrated into daily activities that can be performed in multiple short bouts or a single long bout. LPA has not been systematically defined for MWCUs, but would include any behaviors chosen by MWCUs that require energy expenditure in the moderate to vigorous range (i.e. ≥ 3.0 metabolic equivalents). This could include traditional exercise such as hand cycling, but also community transport via wheelchair propulsion.

CANDIDATE METRICS TO CAPTURE LPA IN MWCUS

The study of LPA correlates, consequences, and interventions in MWCUs can only occur if metrics that capture LPA are

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Table 1. Proposed research agenda.

Steps	Guidance
Step 1: Definition of LPA	This line of research might adopt qualitative methodology for developing the meaning, definition, and examples of LPA among MWCUs, and then engage experts in the field through focus groups for further refining the definition and identifying exemplars of the LPA for MWCUs. This includes defining PA domains (e.g. transport, leisure, work, household, etc.) and target intensities (i.e. light, moderate, vigorous).
Step 2: Metrics of LPA	This line of research should focus on examining the psychometric properties of measures for capturing LPA in MWCUs. This research would be informed by a refined definition of LPA, and then proceed directly with the development of new measures or application of existing measures for capturing LPA in MWCUs. Such research might focus on the validity, reliability, and responsiveness of self-report and device-based measures of LPA in MWCUs.
Step 3: Current Levels of LPA	The definition and measurement of LPA might permit a better quantification of LPA in MWCUs. Such measurement is critical for identifying a basal level of LPA in MWCUs that can benchmark the existing level of this behavior, and inform the degree of importance and opportunity for changing LPA in MWCUs.
Step 4: Correlates of LPA	This line of research should examine general determinants of LPA, and adopt models of behavior change for examining correlates of LPA. The first line of research should be informed by categories identified in the general population and this would identify general modifiable and non-modifiable correlates of LPA in MWCUs. The built environment might be particularly relevant in MWCUs. This research should further adopt behavior change theories for examining LPA in MWCUs, as such theory identifies direct targets for the design of interventions. Such design would include the identification of behavioral change techniques that align with theory for optimizing behavior change.
Step 5: Consequences of LPA	The ultimate goal of interventions for changing LPA is meaningful benefits for MWCUs. To that end, researchers might adopt a cell through society perspective when examining the consequences of LPA in MWCUs, as this would provide evidence on the range and extent of possible pleiotropic effects of LPA in MWCUs.
Step 6: Interventions for LPA	If the first 5 steps of this agenda are undertaken carefully, then the research community will be well positioned for undertaking the process of developing behavioral interventions for changing LPA and examining the outcomes in MWCUs. We suggest that such research begin with feasibility trials and then proceed with pilot, efficacy trials that will inform effectiveness and implementation research. Effectiveness trials may include comparing LPA behavioral interventions against more traditional structured exercise. The targets of the interventions should be informed by aligning theory and behavior change techniques, and the outcomes should be informed by evolving research on consequences of LPA in MWCUs.

operationally defined. Physical activity measurement methods specific for MWCUs include activity time, daily energy expenditure estimates, and spatiotemporal movement [8]. We suggest metrics that are easily understood by MWCUs and that have ambulatory analogs may be best suited for translation into public health campaigns. This would include mobility metrics such as daily distance pushed (analogue for distance walked) and/or number of pushes per day (analogue for steps per day). However, mobility metrics may not capture indoor moderate-vigorous activities that do not require pushes such as household chores. Ideally, MWCUs could use the same commercially available activity trackers as ambulatory friends and family members, and select a different algorithm for outcome detection. The accuracy of commercially available device algorithms for detecting user and/or wheelchair movement may be sufficient for the purposes of self-monitoring or public health promotion. However, movement targets must be validated against objective measures of LPA energy expenditure. The relationship between movement and energy expenditure among MWCUs is likely influenced by complex interactions among factors including the health impairment resulting in wheelchair use, if the movement is being used to operate the wheelchair, movement speed, and the terrain over which the wheelchair is moving.

THEORY BASED IDENTIFICATION OF LPA CORRELATES OR DETERMINANTS OF LPA IN MWCUS

To date, few studies have examined correlates or determinants of LPA in MWCUs. Personal factors such as age, health status, sex, disability status, disability duration, secondary conditions, and psychological health are significant physical activity determinants. The built environment has also been identified as a barrier to physical activity participation. Studies examining these correlates generally have not been grounded in a theoretical models of behavior change, which limits their utility in developing effective

LPA interventions. Research identifying correlates/determinants of LPA in MWCUs and their connection to theoretical models is necessary to inform behavior change and health promotion interventions tailored to the needs of MWCUs overall and those with SCI. Such theories of behavior change include, but are not limited to Social Cognitive Theory, Transtheoretical Model of Behavior Change, and Theory of Planned Behavior [9].

PHYSICAL AND MENTAL HEALTH OUTCOMES OF LPA IN MWCUS

Cross-sectional evidence supporting LPA as a significant correlate of physical and mental health in MWCUs is equivocal. Some research suggests that physical activity can significantly improve International Classification of Functioning, Disability and Health (ICF) outcomes in MWCUs including body functions (mental, cardiovascular, neuromuscular, and sensory) and participation (quality of life), and perhaps mitigate disease progression and improve body structures and activities. However, a recent systemic literature review examining correlates of physical activity using the ICF model in persons with spinal cord injury (SCI) determined there is insufficient evidence to support supporting meaningful conclusions regarding the relation between body functions, body structures, health conditions and physical activity [10]. The presence of positive outcomes is necessary for the provisions of behavioral interventions targeting LPA in MWCUs. Identification of such outcomes is dependent in part on identifying metrics to measure LPA in MWCUs.

INTERVENTIONS FOR CHANGING LPA BEHAVIOR IN MWCUS

Few LPA intervention have promoted organic changes in planned or unplanned daily physical activity among MWCUs with SCI. For example, one multi-center randomized controlled trial evaluated if a 16-week, structured self-management intervention ($N = 33$) could increase LPA in MWCUs with chronic SCI versus a limited

attention control ($N = 31$) [11]. The intervention was informed by the transtheoretical model and included one home visit, five individual sessions, five group sessions, and a self-help booklet promoting an active lifestyle. The control arm included one group session and the same self-help booklet. This intervention did not improve LPA behavior in MWCUs with SCI, nor did it alter transtheoretical correlates of LPA. The authors posit that the LPA metric suffered from ceiling effects, limiting their ability to detect change. They further suggest future interventions should address transportation barriers to improve accrual and retention. We suggest a failure to define LPA metrics and correlates among MWCUs may have contributed to the null effects. Furthermore, we re-emphasize the importance of using behavior change theories to inform development of interventions to increase LPA among MWCUs with SCI. Interventions utilizing \geq three behavior change techniques are more effective than those using fewer than three [12]. Not surprisingly, interventions grounded in behavioral change theories utilize more behavior change techniques than non-theory approaches [12].

ATTENUATING THE IMPACT OF INCREASED UPPER EXTREMITY LOADING WHEN LPA INCREASES

LPA promotion in MWCUs will increase upper extremity use, which could accelerate onset of disabling pain and pathology. The natural history of upper extremity pain and pathology among MWCUs is poorly defined. Cross-sectional research suggests severe shoulder and wrist pathology (i.e. rotator cuff tears and carpal tunnel syndrome) occurs after 20 years of being a MWCUs [13]. Pain onsets much sooner, with $>50\%$ of MWCUs reporting shoulder, elbow, or wrist pain [14]. LPA promotion among MWCUs need not conflict with preservation of upper extremity health if integrated into a multi-focal program that includes longitudinal monitoring of the upper extremity, approaches to facilitate healthy movement, and interventions to manage emergent pain and pathology. A comprehensive healthy movement program would address the ergonomics of propulsion and transfers; include stretching and strengthening of the shoulder girdle; and reduce the frequency of activities occurring at or above shoulder height (e.g. through home modifications, standing wheelchairs (or seat elevation), and task modifications) [15].

PROPOSED RESEARCH AGENDA

We propose a new research agenda on LPA among MWCUs with SCI agenda as a challenge to the prevailing zeitgeist. Table 1 provides an overview of this agenda with appropriate guidance for benchmarking LPA in MWCUs. This agenda is a suggestion, not a rigid sequence, as Steps 3–5 may be completed in parallel.

Collectively, the time is ripe to focus on LPA and holistic incorporation of PA into the daily lives of MWCUs with SCI rather than continued emphasis on structured exercise training alone among MWCUs. We believe that we have planted the seed for thought on this research direction, and offered directions on future research steps. If the community accepts our challenge and addresses our agenda, we might provide a new opportunity for changing the lives of MWCUs with SCI through LPA promotion.

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COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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