

The relationship between physical activity facility proximity and leisure-time physical activity in persons with spinal cord injury

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Abstract

Background: Within the general able-bodied population, proximity of one's home to physical activity facilities is modestly associated with physical activity behavior. Currently, no research has examined whether facility proximity is related to physical activity among persons living with disabilities.

Objective: To examine (1) the level of agreement between perceived and actual proximity to accessible physical activity facilities and (2) the relationship between facility proximity (perceived and actual) and leisure-time physical activity (LTPA) among persons with spinal cord injury (SCI). It was hypothesized that (1) perceived and actual proximity measures would exhibit low agreement and (2) a small, positive relationship would emerge between proximity (perceived and actual) and LTPA.

Methods: Data from 50 Ontario residents living with SCI (70% male; 52% tetraplegia) were collected for proximity and LTPA. Perceived facility proximity was determined by a self-report "YES" versus "NO" presence measure, while actual facility proximity was assessed using Geographical Information Systems. An SCI-specific instrument, the PARA-SCI, was used to measure LTPA.

Results: Low agreement levels were found between perceived and actual proximity. LTPA status (active versus inactive) was shown to moderate the relationship, with higher agreement levels found for participants who reported engaging in mild or heavy LTPA versus their inactive counterparts, but only for the 30-minute wheeling boundary. Contrary to hypothesis, people living within a 30-minute wheel from an accessible facility were less likely to engage in heavy LTPA than were people who did not have an accessible facility located within a 30-minute wheel. No significant associations were found between LTPA and perceived proximity.

Conclusions: Living in close proximity to a facility that provides accessible programming and equipment does not necessarily translate into greater physical activity behavior. Crown Copyright © 2009 Elsevier Inc. All rights reserved.

Keywords: Physical activity facilities; Spinal cord injury; Proximity; Accessibility

Accumulating evidence suggests that the proximity of one's home to physical activity facilities is modestly associated with physical activity behavior [1–8]. In general, people who live in close proximity to fitness and recreational centers report greater physical activity than do people who do not. However, these conclusions are derived from studies that were conducted in persons without disabilities. It is unknown whether proximity to physical activity facilities plays a significant role in leisure-time physical activity (LTPA) among individuals living with a disability. Therefore,

the current study examined the relationship between proximity to accessible physical activity facilities and LTPA among persons with a specific type of disability—a spinal cord injury (SCI).

Proximity to physical activity facilities has generally been assessed using two types of measures: (1) subjective perceptions and (2) quantitative instruments that are based on direct observation or existing Geographical Information Systems (GIS) databases [9]. Subjective perceptions of proximity are useful for providing information on people's awareness of existing physical activity facilities and perceptions regarding barriers and facilitators to using these facilities [10]. Meanwhile, quantitative instruments provide researchers with objective data on the actual location of the facilities relative to people's residences. Given the reported difficulties of subjectively estimating distance [11,12], quantitative instruments are increasingly being used, in conjunction with subjective perceptions, to provide a better understanding of the importance of proximity to physical

Financial disclosure: The authors have no conflicts of interest to declare. Research was supported by a Doctoral Scholarship from the Social Sciences and Humanities Research Council of Canada (K.P.A.) and an Operating Grant and New Investigator Award from the Canadian Institutes of Health Research (MOP 57778) (K.A.M.G.).

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activity—related facilities [13]. Therefore, these two types of proximity measures were used in the present study.

Studies of the relationship between perceived and actual proximity have found overall slight-to-fair levels of agreement between the two types of measures (κ = 0.00–0.30 [10,12]). However, poor measurement correspondence may be partly to blame for the low κ values. For example, in Sallis et al.'s [8] study, the subjective proximity measure (i.e., a composite measure of perceived accessibility [cost, social requirements], and perceived proximity) did not match the objective proximity measure (i.e., number of facilities within 5 km of participants' homes). Consequently, the authors were unable to show a significant relationship between the two proximity measures. In contrast, Jilcott et al. [10] found a moderate correlation between measures of perceived facility distance and objective GIS-determined distance, both of which were assessed using equivalent scale units (i.e., miles). Additionally, Jilcott et al. [10] found higher agreement for perceived existence of neighborhood fitness facilities and GIS-measured existence of facilities within a 1-mile (κ = 0.14) versus a 2-mile (κ = 0.09) walk from one's home, suggesting a better match between perceptions and GIS-determined proximity measures for shorter versus longer distances from one's home [11,12]. Consistent with this finding, a higher percentage of adolescent girls perceived access to recreational facilities that were located within ½ mile of their homes than facilities situated greater than 1 mile from their homes [14]. Together, these findings suggest that the strength of agreement between perceived and actual proximity measures may depend on the measurement correspondence and the distance between the facility and one's home.

An additional factor that may influence the strength of agreement is physical activity status. People who are active may be more aware of the physical activity opportunities within their neighborhood and, consequently, have more accurate perceptions of these environmental supports than their inactive counterparts [cf., 13]. However, studies that have examined the relationship between physical activity status and the two types of proximity have shown mixed results. While Kirtland et al. [12] found lower agreement among inactive (κ = 0.16) than among active respondents (κ = 0.35), Jilcott et al. [10] were unable to show consistently higher agreement levels among the more active women in their sample. However, Jilcott et al.'s sample were part of a larger physical activity intervention, and the agreement levels between the two proximity measures tended to be higher for the intervention group (ICC = 0.41) than for the controls (ICC = 0.10), suggesting that level of physical activity may indeed moderate the relationship between perceived and actual proximity. As such, physical activity status was examined as a moderator in the present study.

We also investigated the relationship between facility proximity (perceived and actual) and LTPA. A number of

studies have identified positive, albeit modest, associations between LTPA and both perceived [3,10,14,15], and actual [1,2,4–7,16] proximity to physical activity facilities. There is also indication that the association may be stronger when proximity is measured subjectively rather than objectively [5,8,10,14]. However, the strength of association tends to be small [e.g., 5,10,14]. Moreover, all of these studies were conducted among individuals without disabilities. To our knowledge, no study has examined whether perceived and actual proximity to an accessible physical activity facility is related to LTPA in persons living with SCI.

Thus, the purposes of the present study were to (1) examine the level of agreement between perceived and actual proximity to accessible neighborhood physical activity facilities among persons with SCI; (2) determine whether the agreement level between the two proximity measures varies as a function of physical activity status; and (3) determine the relationship between perceived and actual proximity to accessible physical activity facilities and LTPA among persons with SCI. In line with previous research in persons without disabilities [8,10,12], it was hypothesized that the perceived and actual proximity measures would exhibit a low level of agreement. Consistent with previous physical activity and proximity research [12], our second hypothesis was that active participants would exhibit higher agreement levels between perceived and actual proximity than inactive participants. Finally, given the small associations between perceived proximity and LTPA in persons without disabilities [5,10,14], in combination with the novelty of LTPA and proximity research in persons with disabilities, our final hypothesis was that both types of proximity measures would be positively related to LTPA, although the strength of associations would be small.

Methods

Participants

This cross-sectional study utilized data from an 18-month, prospective investigation of the physical activity patterns and predictors in people with traumatic SCI (Study of Health and Physical Activity of People with Spinal Cord Injury [SHAPE-SCI]) [17]. SHAPE-SCI is currently the largest multicenter, epidemiological study of physical activity in the SCI population, involving a total of 695 individuals recruited from four regional SCI rehabilitation and research centers in Ontario, Canada. At each site, participants were recruited primarily from a database of patients with SCI who had given consent to be contacted for research purposes, as well as through advertisements in local newspapers and SCI-relevant publications, presentations at events for people with SCI, mailings to SCI community groups, clinics, and word-of-mouth. Baseline LTPA and perceived proximity data from 50 SHAPE-SCI

participants who lived within the Hamilton-Wentworth region of Ontario, Canada, were used for the current investigation.

Procedure

Addresses of 90 fitness-only (26 privately and publicly operated fitness/health centers, 5 yoga/pilates studios, 3 martial arts studios, 1 dragon boat racing, and 1 tennis complex) and multipurpose (23 arenas, 16 publicly operated recreational centers, 15 indoor/outdoor community pools) facilities within the Hamilton-Wentworth region were geocoded. These 90 facilities were identified through an exhaustive search on the Internet, in the *Yellow Pages*, and in the City of Hamilton Sports and Recreation directory using keywords *fitness*, *health clubs*, *recreational centers*, *yoga*, *pilates*, *martial arts*. The primary investigator called each of the 90 facilities to obtain verbal confirmation from the staff that the facility had programming and/or equipment for persons with disabilities (e.g., personal training, yoga, adapted aerobics classes, swimming, recumbent bikes, and accessible universal weight machines).

Participants' home addresses and the civic addresses of the physical activity facilities were geocoded using ArcGIS 9.1 (Environmental Systems Research Institute, Redlands, CA). All addresses were standardized so that they could be matched against a file containing both tabular and spatial data of all of the Ontario road networks and were subsequently cross-checked with Google Map (Google Inc., Mountain View, CA).

To determine the total number of neighborhood physical activity facilities surrounding each participant's residence, three network buffers were created using the Network Analyst extension of ArcGIS. In contrast to a straight-line buffer ("as the crow flies"), which does not consider the road networks, a network buffer establishes boundaries based on the existing street networks. Essentially, the network buffer is a more accurate representation of the area that people can access around their residence [18]. The three network buffers were labeled as follows: (1) a 15-minute drive, (2) a 30-minute manual wheel for persons with *tetraplegia*, and (3) a 30-minute manual wheel for persons with *paraplegia*. The 15-minute driving network buffer was determined by converting the city driving speed limit of 50 km/hr into an equivalent distance in meters per minute and then multiplying the value by 15. This distance was calculated as 12,495 m. Given that manual wheeling distance traveled varies as a function of injury level [19], one of two values was used to calculate the 30-minute manual wheeling network buffer. Based on the propulsion data from Beekman et al.'s [19] study, 46.26 m/min was used as the average manual wheeling distance traveled for persons with *tetraplegia*, while 72.86 m/min was used for persons with *paraplegia*. These two manual wheeling distances were then multiplied by 30 to create the 30-minute manual wheeling network buffer for participants with *tetraplegia* (1387.80 m) and

paraplegia (2185.80 m). Therefore, each participant had a total of two network buffers created around their residence—a 15-minute drive and a 30-minute wheel.

Measures

Perceived Proximity and Use of Accessible Neighborhood Physical Activity Facilities

Participants were asked, "Does your neighborhood (defined as either "places one could get to using one's wheelchair in 30 minutes OR places one could drive to in 15 minutes") include an accessible recreational facility?" Responses were recorded as either "Yes" or "No/Don't Know." If participants answered "Yes," they were then asked to indicate whether they used the facility on a regular basis ("Yes" or "No").

Actual Proximity to Accessible Neighborhood Physical Activity Facilities

Using ArcGIS, the total number of neighborhood facilities was counted within each of the two network buffers (15-minute drive and 30-minute wheel) surrounding participants' residences. The counts were then used to classify participants' neighborhoods as either having 0 (absent) or ≥ 1 (present) accessible physical activity facilities within the specified network buffer.

Leisure-Time Physical Activity

LTPA was assessed using the Physical Activity Recall Assessment for People with SCI [PARA-SCI; 20]. This instrument is an SCI-specific, 3-day activity recall measure that is administered over the telephone by a trained research assistant. Consistent with PARA-SCI administration guidelines, participants were mailed a printed chart before the interview, describing four physical activity intensity categories: (a) *nothing at all*, (b) *mild*, (c) *moderate*, and (d) *heavy* [20]. During the telephone interview, participants were asked to use the chart to self-designate the intensity of each physical activity they recalled performing over the preceding 3 days. Next, the researcher coded the type of physical activity performed as either LTPA (e.g., basketball, weight-training) or LA (lifestyle activity; e.g., household chores, computer work). This information was entered into a computer program to calculate the mean number of minutes spent in mild-, moderate-, and heavy-intensity LTPA over the previous 3 days. Total LTPA was calculated by summing the mean number of minutes participants spent in LTPA at all three intensity levels. The PARA-SCI has shown acceptable test-retest reliability (ICC = 0.65–0.80), construct validity, as well as concurrent validity with indirect calorimetry [20,21]. This instrument has been previously used to examine predictors of physical activity behavior among individuals with SCI [22,23] with no interpretational problems reported in the target group. Although both LTPA and LA were assessed, only a dichotomized LTPA variable (i.e., active: LTPA minutes >0 versus

inactive: LTPA minutes = 0) was used in the present study's analyses for all three intensity types, as well as for total LTPA. A dichotomized variable was used because of the lack of variability (i.e., 46% of the sample reported no LTPA over the previous 3 days), and therefore, the inability to conduct linear regression analyses.

Demographics

For descriptive purposes, information was gathered regarding participants' age, sex, years postinjury (YPI), ethnicity, primary mode of mobility outside of the home (e.g., manual wheelchair, electric wheelchair), injury level, and injury severity (i.e., complete/incomplete).

Statistical analyses

Kappa statistics (κ) were computed to examine the level of agreement between perceived and actual proximity to accessible physical activity facilities within a 30-minute wheel and whether the level of agreement between the two proximity measures varied across physical activity status (active versus inactive). Kappa coefficients were interpreted as moderate (0.41–0.60), fair (0.21–0.40), slight (0.01–0.20), or poor (0.00) [24]. z-statistics were then computed to conduct between-groups comparisons of the κ values. Given the lack of variability in the actual proximity measure using the 15-minute driving network buffer (i.e., all participants had ≥ 1 facility within a 15-minute drive from their residence), a κ -statistic could not be computed for this measure.

To examine the relationship between proximity to accessible physical activity facilities and the dichotomized LTPA variable (active versus inactive), logistic regression was used. Four separate logistic regression analyses were performed, whereby LTPA (mild, moderate, heavy, total) was regressed on perceived and actual proximity to accessible neighborhood physical activity facilities. Model fit was assessed using the Hosmer-Lemeshow statistic and the omnibus test of model coefficients. Models with nonsignificant Hosmer-Lemeshow statistics, and significant Omnibus χ^2 values were indicative of good fit [25].

A series of χ^2 tests were conducted for each categorical demographic variable (e.g., injury level, injury severity, mode of mobility, sex) to examine any differences between active versus inactive participants across the four LTPA categories (i.e., mild, moderate, heavy, total). Spearman rho (ρ) correlations were used to examine whether age or years YPI were associated with LTPA status (active versus inactive). No between-groups differences were found on any of the demographic categorical variables, nor were there any significant correlations between the continuous variables and LTPA status (all $ps > .05$); thus, no covariates were used in any of the regression analyses. For all analyses, no differences were found for injury level (i.e., tetraplegia versus paraplegia). Thus, the results are presented with the data collapsed across the two injury levels.

Results

Participant descriptive characteristics

Participants (mean age, 43.52 ± 12.70 years; mean YPI, 13.80 ± 10.44 years) were predominantly male (70.0%), white (96.0%), and manual wheelchair users (72.0%). Approximately half of the sample (52.0%) had tetraplegia, and 70.0% had an incomplete injury. Overall, the sample was representative of the larger population of Ontarians living with SCI (male, 81%; white, 87%; tetraplegia, 47%; manual wheelchair users, 68% [26]).

Leisure-time physical activity

Overall, LTPA participation rates were modest, with 54.0% of the sample engaging in LTPA at any intensity level (i.e., total LTPA). Among the active sample, mean minutes of total LTPA was 20.54 ± 36.48 . Similar to total LTPA, participation rates for mild, moderate, and heavy LTPA were low (22.0%, 32.0%, and 28.0%, respectively).

Level of agreement between perceived and actual proximity

As shown in Table 1, almost half of the sample (46.0%) perceived their neighborhood to have an accessible physical activity facility. Of those 46%, 13% indicated using the facility on a regular basis. No significant differences were found for perceived access or reported use between those who were active versus inactive (all $ps > .05$). Based on the GIS analyses, 82% of the sample lived within a 30-minute manual wheel from at least one accessible facility, while 100% lived within a 15-minute drive. On average, participants lived within a 15-minute drive and 30-minute manual wheel of 56.6 and 3.0 physical activity facilities, respectively.

Kappa statistics are displayed overall and as a function of LTPA participation in Table 2. Overall, κ statistics were low, ranging from 0.13 to 0.29. Slight agreement was found between perceived and actual proximity for the 30-minute manual wheeling network buffer ($\kappa = 0.16$, $p > .10$). Highest agreement was found for active participants who performed mild ($\kappa = 0.29$) or heavy ($\kappa = 0.26$) LTPA. Pairwise comparisons using z-test statistics revealed significant between-groups differences for those who did some versus no mild or heavy LTPA (z-statistics > 1.95). As hypothesized, active participants reported higher agreement between the two proximity measures in comparison to their inactive counterparts. No between-groups differences were found for moderate and total LTPA.

Given the lack of variability in the actual proximity measure using the 15-minute driving network buffer (i.e., all participants had ≥ 1 facility within a 15-minute drive from their residence), a κ -statistic could not be computed for this measure. Rather, a χ^2 test was used, which tested the null hypothesis that all participants should perceive an accessible facility within a 15-minute drive. Results

Table 1

Perceived and Actual Proximity of Accessible Physical Activity (PA) Facilities for the Overall Sample and Across Total Leisure-Time Physical Activity (LTPA) Status

Variables	Overall (<i>N</i> = 50)	Active (<i>n</i> = 27)	Inactive (<i>n</i> = 23)	Effect size
Percent reporting accessible neighborhood PA facility (perceived)	46.0	48.1	43.5	.05
Percent using accessible neighborhood PA facility ^a	13.0	23.1	0	.34
No. of accessible PA facilities, mean (SD)				
15-Minute drive	56.6 (16.8)	51.9 (19.0)	62.0 (9.8)*	−0.66
30-Minute wheel	3.0 (2.5)	2.8 (2.3)	3.3 (2.8)	−0.20
Percent with accessible neighborhood PA facility (actual)				
15-Minute drive	100.0	100.0	100.0	0
30-Minute wheel	82.0	74.1	91.3	−.22

Note. Sample size for LTPA is based on total LTPA. *Cramer's V* statistic was used to determine effect size for proportions (0.1 = small effect, 0.3 = moderate effect [35]), while *Cohen's d* statistic was used for means (0.20 = small effect, 0.50 = medium effect, and 0.80 = large effect; [36]).

^a Sample size based on those participants who indicated having an accessible neighborhood physical activity facility (*N*_{overall} = 23; *n*_{active} = 13; *n*_{inactive} = 10).

* *p* < .05.

revealed the χ^2 statistic was significant for the overall sample and across the four LTPA intensities (all *ps* < .001). The significant χ^2 statistics indicate that, as hypothesized, there was low agreement between the perceived and actual existence of accessible physical activity facilities, with participants underreporting the presence of facilities within a 15-minute drive from their homes. As hypothesized, active participants had higher agreement levels than their inactive counterparts across all LTPA intensities.

A post-hoc univariate analysis of variance (ANOVA) was conducted to determine whether people who perceived their neighborhood to include an accessible physical activity facility actually had more neighborhood facilities. Results indicated no significant differences between the number of accessible physical activity facilities within a 30-minute manual wheel [*F*(1,48) = 2.59, η^2 = 0.05,

p < .12] or a 15-minute drive [*F*(1,48) = 2.05, η^2 = 0.05, *p* < .13] for those who perceived (mean = 3.6 and 60.1, respectively; *n* = 23) versus those who did not perceive (mean = 2.5 and 53.6, respectively; *n* = 27) an accessible facility in their neighborhood. Therefore, perceptions were not related to the actual number of facilities in one's neighborhood.¹

Relationship with LTPA: Contribution of perceived and actual proximity

Results from the logistic regression analyses are displayed in Table 3. Nonsignificant Hosmer and Lemeshow goodness-of-fit statistics were found for all four regression models (χ^2 (1) < .25, *ps* > .62), indicating good model fit. For the heavy LTPA model, the Omnibus test was significant (χ^2 (2) = 6.28, *p* < .05), indicating that the variables, as a set, reliably distinguished between active and inactive participants in comparison to the constant-only model [25]. Strength of association was greatest for the heavy LTPA model (R^2 = 0.17), with smaller associations found for mild, moderate, and total LTPA (R^2 < 0.10). The overall percent of cases correctly identified by the models ranged from 58.0% to 81.6%, with the majority of cases overclassified into the inactive (47.8% to 100.0%) versus the active (0% to 66.7%) group.

Table 3 shows regression coefficients, Wald statistics, and odds ratios for the two correlates. Overall, heavy LTPA was significantly related to the actual 30-minute wheeling

Table 2

Kappa Statistics (κ) Indicating the Level of Agreement Between the Perceived and Actual Proximity Measures of Accessible Neighborhood Physical Activity Facilities as a Function of Leisure-Time Physical Activity (LTPA) Participation.

Variable	κ	SE	<i>t</i>	<i>n</i>	<i>p</i>	<i>z</i>
30-Minute wheeling network buffer						
Overall	0.16	0.10	1.58	50	.11	2.17*
Mild LTPA						
Some LTPA	0.29	0.27	1.03	11	.30	
No LTPA	0.13	0.10	1.26	39	.21	1.62
Moderate LTPA						
Some LTPA	0.13	0.23	0.54	16	.59	
No LTPA	0.19	0.09	1.89	34	<.06	2.25*
Heavy LTPA						
Some LTPA	0.26	0.26	0.97	14	.33	
No LTPA	0.16	0.08	1.79	36	<.08	1.73
Total LTPA						
Some LTPA	0.20	0.16	1.20	27	.23	
No LTPA	0.14	0.10	1.30	23	.19	

Note. Kappa statistics ranging from 0.21 to 0.40, 0.01 to 0.20, and 0.00 correspond with fair, slight, and poor levels of agreement, respectively [24].

z-statistic = $\kappa_{(\text{mean})}/SE_{(\text{pooled})}$.

* *p* < .05.

¹ Participants who used another assistive device than a manual wheelchair, such as a power chair or braces, were also included in the sample. Between-group differences were examined for mode of mobility (manual wheelchair users [*n* = 36] versus other mobility users [*n* = 14]). No significant group differences were found for the agreement level between the perceived and actual proximity (κ = .17). For the regression analyses, actual facility proximity (30-minute wheel) was significantly associated with mild (odds ratio = 0.12, *p* < .04) and heavy (odds ratio = 0.13, *p* < .05) LTPA, but only for the manual wheelchair users. No significant relationship was found between perceived proximity and LTPA for either of the two mobility groups.

Table 3

Logistic Regression Analyses Predicting Leisure-Time Physical Activity (LTPA) With Perceived and Actual Presence of Accessible Neighborhood Physical Activity Facilities

	R^2	OR (95% CI)	β (SE)	Wald (z-test)	P
DV: Mild LTPA	0.09				
Perceptions					
Yes		1.3 (0.3-5.7)	0.29 (0.74)	0.15	.70
No		1.0			
Facility available (wheeling network buffer)					
Yes		0.2 (0.5-1.2)	−1.45 (0.83)	3.05	.08
No		1.0			
DV: Moderate LTPA	0.09				
Perceptions					
Yes		1.7 (0.5-6.2)	0.53 (0.66)	0.65	.42
No		1.0			
Facility available (wheeling network buffer)					
Yes		0.2 (0.1-1.2)	−1.40 (0.80)	3.07	.08
No		1.0			
DV: Heavy LTPA	0.17				
Perceptions					
Yes		3.1 (0.7-13.5)	1.14 (0.75)	2.30	.13
No		1.0			
Facility available (wheeling network buffer)					
Yes		0.2 (0-0.8)	−1.93 (0.87)	4.92	.03
No		1.0			
DV: Total LTPA	0.08				
Perceptions					
Yes		1.5 (0.5-5.0)	0.43 (0.60)	0.51	.48
No		1.0			
Facility available (wheeling network buffer)					
Yes		0.2 (0-1.4)	−1.44 (0.89)	2.62	.11
No		1.0			

CI, confidence interval; DV, dependent variable; OR, odds ratio.

LTPA coded as 0 (no LTPA—referent) or 1 (some LTPA).

proximity measure; however, the direction of the relationship was contrary to expectation. People living within a 30-minute manual wheel were *less* likely to engage in heavy LTPA ($p < .03$) than people who did not live within 30- minutes of a facility. This unexpected, negative relationship was also shown for mild, moderate, and total LTPA ($ps > .05$). Also contrary to hypothesis, the perceived proximity measure did not significantly contribute to the explanation of any of the four intensity levels of LTPA ($ps > .10$). Of note, though, the results for perceived proximity were in the expected direction, with greater LTPA reported by participants who perceived an accessible physical activity facility in their neighborhood than by those who did not.

Discussion

The present study examined the relationships between perceived and actual proximity to accessible neighborhood physical activity facilities and LTPA among persons with SCI. As hypothesized, low agreement was exhibited between the two proximity measures, using both the 30-minute wheeling and 15-minute driving network buffers. In partial support of our hypothesis, agreement levels were

significantly higher for participants who reported engaging in mild or heavy LTPA versus their inactive counterparts but only for the 30-minute wheeling network buffer. For the 15-minute drive network buffer, agreement levels were higher for participants who reported engaging in all four LTPA intensities. Contrary to hypothesis, people living within a 30-minute manual wheel from an accessible facility were less likely to engage in heavy LTPA than were people who did not have an accessible facility located within the specified network buffer. No significant associations were found between LTPA and perceived proximity. Each of these findings will be discussed in turn.

First, as hypothesized, low agreement was shown between perceived and actual proximity. This finding is similar to previous research in persons without disabilities [10,12], which indicates difficulties of subjectively estimating distances and the actual presence of physical activity facilities. Our findings add to this literature by demonstrating that estimation difficulties also exist for persons with SCI. Consequently, we recommend that future studies include both objective and subjective proximity measures to fully understand the relationship between proximity and LTPA participation in persons with and without disabilities.

Second, consistent with previous research in persons without disabilities [12], agreement levels for the two

proximity measures were shown to be higher for those who engaged in LTPA using both the 30-minute wheel and 15-minute drive network buffers. An exception to this finding was the analyses for moderate-intensity LTPA. Agreement did not differ as a function of moderate-intensity LTPA when using the 30-minute wheeling buffer. Given the uneven split of participation rates for the three LTPA intensity types (i.e., 22% to 32%) and, therefore, the potential attenuation of the correlations, these findings must be cautiously interpreted. Further research is warranted into the relation between LTPA intensity and facility proximity in persons with disabilities.

Third, contrary to hypothesis, actual, but not perceived, proximity was correlated with LTPA. Furthermore, the direction of association was opposite to our prediction—people living within a 30-minute wheel of an accessible facility were *less* likely to engage in heavy LTPA. For the present study, LTPA data were drawn from a larger epidemiological study [17]. This larger study constrained our ability to extract more information from participants, such as the location of their activities. Consequently, participants may have been active in a location outside of the defined network buffers, or engaged in activities such as neighborhood wheeling or home-based exercise, which do not require a facility. Had the location of activity been considered in this study, a different pattern of relationships between proximity and LTPA may have emerged.

While the present study is one of the first to examine facility proximity and LTPA in persons living with a disability, there are some study limitations that must be addressed. First, given the small number of participants who engaged in the three LTPA intensities (mild: $n = 11$, moderate: $n = 16$, and heavy: $n = 14$, respectively), the findings must be cautiously interpreted. The small sample size is particularly problematic when examining nonparametric data, which rely on the distribution of cases relative to the independent variable [25] and, therefore, may have inflated the κ statistics and the χ^2 tests. This is also the case with the 30-minute wheeling network buffer, where 82% of the sample lived within a 30-minute manual wheel from at least one accessible facility. Second, the accessibility of the facility was determined by the facility owner, not the participant. Consequently, some participants may not have perceived these facilities to meet their own accessibility standards. Findings from previous descriptive studies have shown that the accessibility of the built environment for fitness and recreational centers tends to be quite low [27,28]. Thus, our count of accessible facilities may have included facilities that participants did not consider accessible.

Likewise, the neighborhood definitions used for the perceived proximity measure may not have corresponded with participants' perceptions of their neighborhood boundaries [cf., 10]. The "30-minute manual wheel" neighborhood definition used in the present study was specific to persons with SCI. To accommodate participants who would

be more likely to travel by car or bus, neighborhood was also defined as "places one could drive to within 15 minutes." Future research should examine the validity of these neighborhood definitions in people living with SCI, as well as other types of disabilities.

One future research direction is to examine why people with SCI are not using the accessible facilities in their neighborhoods. Overall, 46% of the sample reported an accessible physical activity facility in their neighborhood, while only 13% indicated that they used the facility on a regular basis. Unfortunately, *regular* was not defined for the participant. To better understand facility use in persons with SCI, more precise definitions must be included in future studies. Despite this limitation, the low reporting of facility use is similar to research in persons without disabilities, where 61% of participants perceived having access to fitness facilities, yet only 21% reported using the facility 10 or more times in the past year [29]. Contrary to Kruger et al.'s [29] findings, our results do not support the claim that facility use is higher among active versus inactive participants. For persons with disabilities, other factors may be related to the use of physical activity facilities, such as lack of transport, cost of programming, and perceived negative attitudes of patrons and staff at the facility [30,31]. Future studies should examine other barriers or facilitators that contribute to the use of physical activity facilities.

In terms of contribution to knowledge, the present investigation is the first to examine the relationship between LTPA and perceived and actual proximity to accessible physical activity facilities in persons with SCI. Furthermore, the findings are based on a GIS technique which included a network buffer that accounted for useable space [10,18]. Overall, these preliminary findings indicate that proximity to an accessible facility does not seem to be related to LTPA in persons with SCI. In addition, the results suggest educational opportunities for increasing persons with disabilities' awareness and knowledge of the existence of potentially accessible facilities within their neighborhood. The finding that all respondents lived within a 15-minute drive from an accessible facility, and that most were within a 30-minute wheel, suggests there may be a greater focus within the community over the last few decades on increasing the number of accessible facilities for people with disabilities.

Increasingly, the vital links between physical activity and health for people with disabilities are being recognized. For example, exercise has been shown to increase physical fitness, mental well-being, and social integration for persons with disabilities [32–34]. Given the limited resources available for community programming and the many challenges to achieve accessible, and accessed, community-based physical activity opportunities for people with disabilities, it is crucial to improve our understanding of factors that influence physical activity in populations with disabilities. Despite its limitations, the current study offers useful insight into the complexity of measurement

issues that will have to be addressed to achieve these goals. Further research is warranted to establish subjective and objective proximity measures with clearly defined neighborhood boundaries for persons with disabilities.

Acknowledgments

The authors acknowledge the help of Ivy Dam, a graduate student in the Department of Geography, for her assistance with the GIS data analyses.

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