******AUTHOR UNCORRECTED PROOF******

Mediation analysis of the associations between neighbourhood walkability and greenness, accelerometer-measured physical activity, and health-related fitness in urban dwelling Canadians.

Levi Frehlich,[1*] Tanvir C. Turin, [1, 2] Patricia K. Doyle-Baker,[3,7] Justin J. Lang,[4,5,6] and Gavin R. McCormack[1,3,7,8]

[1]Department of Community Health Sciences, Cumming School of Medicine, University of Calgary
[2]Department of Family Medicine, Cumming School of Medicine, University of Calgary,
[3]Faculty of Kinesiology, University of Calgary
[4]Centre for Surveillance and Applied Research, Public Health Agency of Canada
[5]School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa
[6]Alliance for Research in Exercise, Nutrition and Activity (ARENA), University of South Australia, Adelaide, South Australia, Australia
[7]School of Architecture, Landscape and Planning, University of Calgary
[8]Faculty of Sports Science, Waseda University, Japan

Word count: 3494
Abstract:; 249
Tables and figures: 5 tables, 1 figure

Author Note
*Correspondence can be sent to Levi Frehlich: levi.frehlich@ucalgary.ca; +1 (403) 921-5223.

Abstract

Objective: To estimate sex-specific associations (*total, direct, and indirect effects*) between objectively measured neighbourhood walkability and greenness and objectively measured physical activity and health-related fitness including cardiorespiratory and muscular fitness in Canadian adults.

Methods: Neighbourhood walkability (Canadian Active Living Environment) and greenness (Normalized Difference Vegetation Index; NDVI) data were linked to cardiorespiratory (i.e., submaximal step test estimated $\dot{V}O_2$ max) and muscular fitness (i.e., handgrip strength) and accelerometer measured physical activity; Canadian Health Measures Survey). Covariate-adjusted sex-stratified path analyses was conducted to assess if physical activity (light: LPA; moderate: MPA, and; vigorous: VPA) mediated the associations between neighbourhood walkability, NDVI and health-related fitness. Model sample sizes ranged from 987 to 2796 for males and 989 to 2835 for females.

Results: Among males, we found *indirect effects* between neighbourhood walkability and cardiorespiratory fitness via LPA (negative) and VPA (positive). We also found a *total effect* (negative) between neighbourhood walkability and grip strength and *indirect effects* between neighbourhood walkability and handgrip strength via LPA (negative) and MPA (negative). Among females, we found a *total effect* (positive) and *direct effect* (positive) between neighbourhood walkability and cardiorespiratory fitness, and an *indirect effect* for neighbourhood walkability and cardiorespiratory fitness via LPA. We found no significant effects related to neighbourhood greenness.

Conclusions: Residing in a neighbourhood with higher walkability may positively affect cardiorespiratory fitness but negatively affect muscular strength. The negative associations between neighbourhood walkability and LPA may offset potential positive associations between neighbourhood walkability and MPA and VPA and their subsequent influence on health-related fitness.

Keywords

Built environment, walkability, greenness, fitness, cardiorespiratory, muscular strength, physical activity

Introduction

Physical activity (PA) is a modifiable risk factor for chronic disease and premature mortality.[1, 2] Habitual PA can also promote health-related fitness.[3, 4] Health-related fitness reflects components of physical fitness (i.e., cardiorespiratory, muscular, motor, and morphological fitness) that are associated with health and the ability to perform activities of daily living.[5] Health-related fitness is typically assessed via laboratory (e.g., maximal and submaximal ergometer tests, dynamometry, and force platforms) or field-based (e.g., push-up or sit-up tests, sit-and-reach, run, step or walking tests) objective measures.[5] Despite most components of health-related fitness remaining relatively stable in the Canadian adult population, cardiorespiratory fitness has declined in recent years.[6] Health-related fitness, independent of PA, protects against cardiovascular disease[7], and mortality.[8] Relative to PA, it has been postulated that health-related fitness, and in particular cardiorespiratory fitness, is a more proximate determinant of health.[8]

The built, natural, and social environment may influence health-related fitness.[9] These environments may act directly on health-related fitness or through intermediate pathways via health behaviour change.[9] Few studies have estimated associations between neighbourhood built environment (BE) and health-related fitness outcomes.[10] Findings suggest that PA promoting features of the neighbourhood BE may support higher levels of health-related fitness.[10] Specifically, street connectivity, topography, population density, and neighbourhood greenness have been associated with health-related fitness (e.g., cardiorespiratory[11, 12], muscular[13, 14] and morphological fitness[12, 15]). Furthermore, a combination of PA supportive BE variables (i.e., walkability) may also promote health-related fitness.[10] Among elderly females in France, Bailly et al.[16] found positive associations between multiple improvements in the neighbourhood BE and increased PA (i.e., upgraded sidewalks, cross-roads, and central square, with signs indicating a pedestrian walking circuit), cardiorespiratory fitness and flexibility. Adjusting for self-reported PA, Hoehner et al.[12] found that higher neighbourhood walkability was associated with improvements in cardiorespiratory fitness among men and women in the US. Two Canadian studies found positive associations between perceived neighbourhood walkability and perceived muscular strength and cardiorespiratory fitness[17], and positive associations between proximity to recreational facilities and objectively measured cardiorespiratory fitness among adults.[18] While

promising, the findings regarding associations between the neighbourhood BE and health-related fitness remain mixed.[10]

Studies have reported associations between the neighbourhood BE and health-related fitness after adjustment for PA yet most have relied on self-reported measures of PA.[10] Self-report PA measures are prone to reporting and recall bias.[19] Moreover, studies to date examining adjusting for PA in the relationship between the neighbourhood BE and health-related fitness have focused on moderate (MPA) and vigorous PA (VPA) either separately or combined, but not light PA (LPA).[10] LPA is found to be positively associated with health outcomes[20] and recently linked to the neighbourhood BE.[21] Further, there is a lack of studies that have formally tested PA as a mediator of the relationship between the neighbourhood BE and health-related fitness. Generating evidence about the *direct* and *indirect* pathways by which the neighbourhood BE might influence health-related fitness is important for informing health promotion interventions and urban design. Additionally, few studies have examined the potential differential associations between the neighbourhood BE and health-related fitness among adult males and females, despite evidence demonstrating sex differences in PA[22], health-related fitness[9] and for associations between the neighbourhood BE and PA.[23]

Therefore, the aim of this study was to estimate sex-specific associations (*total, direct, and indirect effects*) between objectively measured neighbourhood walkability and greenness and objectively measured health-related fitness including cardiorespiratory and muscular fitness in adults.

Methods

Data source

Canadian Health Measures Survey: This study included health-related fitness (cardiorespiratory and muscular fitness [along with jumping mechanography and flexibility: see Supplementary Material]), PA, and sociodemographic data from three cycles of the Canadian Health Measures Survey (CHMS) (Cycle 4: 2014–2015; Cycle 5: 2016–2017; Cycle 6: 2018–2019). A detailed description of the CHMS sample design and data collection procedures are presented

elsewhere.[24-28] The CHMS was approved by the Health Canada and the Public Health Agency of Canada Research Ethics Board.[24-28] The current secondary analysis obtained security clearance and was approved by Statistics Canada.

Health-related fitness measures

Cardiorespiratory fitness: Participants performed the modified Canadian Aerobic Fitness Test (mCAFT). The mCAFT was only administered during cycles 5 and 6 of the CHMS. The mCAFT is a multistage, submaximal step test performed to a pre-set audio cadence.[29] The mCAFT provides valid estimates of $\dot{V}O_2$ max for men and women when compared to a maximal treadmill test with directly measured respiratory gases.[30]

Muscular strength: Participants performed an isometric handgrip strength test using a Smedley III analog hand dynamometer (Takei Scientific Instruments, Tokyo, Japan). Handgrip strength was measured during all CHMS cycles. Participants performed two trials on each hand (alternating) for a total of four trials.) Absolute maximal handgrip strength (kg) was calculated from the sum of the maximal values from the right and left hand.[29] Handgrip dynamometry is a valid measure of overall upper body muscular strength and is shown to correlate with muscular endurance in men and women when compared to maximal and sustained repetition exercises.[31]

Accelerometer-measured physical activity

Participants were instructed to wear an Actical tri-axial accelerometer (Philips Respironics, Oregon, United States) on their right hip for seven consecutive days. A valid day was defined as a wear time of at least 10 hours, and a valid participant was defined as having at least four valid days.[32, 33] Validated accelerometer intensity cut-points for adults were used to estimate daily minutes of LPA (100-1534 counts per minute [cpm]), MPA (1535 to 3961cpm and VPA (≥3,962cpm).[34, 35]

Neighbourhood built environment

Walkability: The 2016 Canadian Active Living Environments (Can-ALE) dataset was used to assess neighbourhood walkability.[36, 37] Walkability variables included connectivity (count of ≥3-way intersections/km^2), residential density (number of dwellings/km^2), destinations (count of

points of interest), and transit density (number of public transit stops/stations) and were estimated for a 1km circular buffer around each dissemination area centroid. Data were standardized using raw values for each of the four walkability variables (z scores) and summed into a sample-specific index.

Greenness: The Normalized Difference Vegetation Index (NDVI) was estimated from Terra satellite imagery data.[38-40] NDVI is a dimensionless index that uses the difference between visible and near-infrared reflections caused by green vegetation cover and is a proxy for the density of green space. For comparability between neighbourhood variables, we used the 2016 annual mean NDVI estimated within 1km around residential postal codes.

Covariates

Sociodemographic and health characteristics: Our analysis included participant age (years), sex (male/female), university education (yes/no), self-rated health (very good or excellent vs. poor, fair, or good), self-rated mental health (very good or excellent vs. poor, fair, or good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children living in the household under 15 years of age (yes/no), waist circumference (cm), and weight (kg).

Particulate matter: Higher neighbourhood walkability may increase levels of air pollution through densification which can negatively affect health-related fitness.[41] Thus, we included annual average of ground-level fine particulate matter ($PM_{2.5}$; ug/m^3) concentration, estimated from satellite-captured data.[42, 43] Using 2016 data, measurements were obtained at a spatial resolution of 0.01° × 0.01° grid (~1 km) and linked to residential postal codes.

Statistical analysis

CHMS data were merged to the Can-ALE (99.7% matched), NDVI (100% matched), and the particulate matter (100% matched) datasets using the participant's 6-digit postal codes. Postal code was used to exclude participants residing in non-urban areas.[44] Descriptive statistical analysis was undertaken using Stata (version 16, StataCorp, College Station, TX, USA) and

included calculated means and standard deviation for continuous variables, and frequency for categorical variables.

All mediation analyses were conducted using the PROCESS SPSS macro (PROCESS version 3.5.3.; SPSS version 28 for Windows; SPSS, Chicago, IL, USA).[45] Sex-stratified covariate-adjusted analysis was undertaken, whereby associations between neighbourhood walkability and greenness, daily minutes of LPA, MPA, and VPA, and the health-related fitness outcomes (cardiorespiratory fitness and muscular strength) were estimated. Figure 1 highlights the pathways estimated to conduct the mediation analysis. Path *c* represents the estimated association between walkability/greenness and health-related fitness without controlling for PA (*total effect*) (Figure 1 [1]). Path *a* represents the estimated association between walkability/greenness and PA; Path *b* represents the estimated association between PA and health-related fitness; Path *c'* represents the estimated association between walkability/greenness and health-related fitness with the inclusion of PA as a mediating variable (*direct effect*). To estimate mediation of PA on the association between walkability/greenness and health-related fitness the product of path *a* and path *b* was estimated (*indirect effect*) (Figure 1 [2]). In the analysis, PA was included as a parallel mediator (simultaneous inclusion of LPA, MPA, and VPA). The PROCESS macro estimates *indirect effects* (path *ab*) using a bootstrapped 95% confidence interval (CI; 5000 replicates). All estimates reported are unstandardized beta coefficients (β). Estimates with confidence intervals that did not overlap zero were identified as statistically significant. All models were adjusted for sociodemographic and health characteristics and $PM_{2.5}$. All available participant data were included in each model and no weights were used for any analysis, thus the analytical sample size varied across models (males n = 987 to 2796; females n = 989 to 2835).

Results

Sample characteristics

Table 1 shows the sample characteristics for males (n = 2983) and females (n = 3085) included in our analysis. The average age of males and females were similar (47.6 and 47.7 years, respectively) as was level of education (73.0% and 74.1%, respectively). Approximately one-half of males (55.8%) and females (55.8%) self-rated their overall health as very good or excellent,

and most males (71.0%) and females (66.2%) self-rated their mental health as very good or excellent. Half (50.4%) of all males and 60.3% of females had never smoked. Among males, 74.2% were married compared to 61.9% among females. Males had a higher mean total grip strength of 89.2kg and estimated $\dot{V}O_2$ max of 27.5mL•kg^{-1}•min^{-1}, compared to females (54.4kg and 23.2mL•kg^{-1}•min^{-1}, respectively). Males and females resided in neighbourhoods with similar average walkability (1.09 and 1.08, respectively), greenness (0.39 and 0.39, respectively), and particulate matter (5.89ug/m^3 and 5.90ug/m^3, respectively).

[Table 1]

Neighbourhood built environment and physical activity

For males and females, walkability was negatively associated with daily minutes of LPA, and positively associated with daily MPA and VPA minutes (path *a*) (Table 2; Table 3). Greenness was negatively associated with daily minutes of LPA, MPA, and VPA (path *a*) (Table 3; Table 4).

Physical activity and health-related fitness

There were statistically significant positive associations (path *b*) between LPA minutes and $\dot{V}O_2$ max (Table 2; Table 3), and grip strength (Table 3). There were also statistically significant positive associations (path *b*) between MPA minutes and $\dot{V}O_2$ max (Table 3, females only) and grip strength (Table 4, males only), and between VPA minutes and $\dot{V}O_2$ max (Table 2; Table 3) and grip strength (Table 3, females only; Table 4, females only).

Mediation analysis

Walkability and cardiorespiratory fitness: For males, although LPA, MPA, and VPA together mediated 19.7% of the effect of walkability on cardiorespiratory fitness, there was no significant *total effect* (path *c*) or *direct effect* (path *c'*) (Table 2). However, there were *indirect effects* (path *ab*) between walkability and cardiorespiratory fitness via daily LPA (β = -0.008; 95%CI: -0.018 to -0.001) and VPA minutes (β = 0.014; 95%CI: 0.004 to 0.031) (Table 2).

For females, walkability had a positive *total effect* (path *c*) (β = 0.079; 95%CI: 0.023 to 0.134) and *direct effect* (path *c'*) (β = 0.086; 95%CI: 0.030 to 0.141) on cardiorespiratory fitness. We found a negative *indirect effect* (path *ab*) between walkability and cardiorespiratory fitness via daily LPA minutes (β = -0.008 95%CI: -0.016 to -0.002) however, the confidence intervals for the *total* (path *c*) and *direct effect* (path *c'*) had substantial overlap (β = 0.086; 95%CI: 0.030 to 0.141 and β = 0.079; 95%CI: 0.023 to 0.134, respectively) (Table 2).

[Table 2]

Walkability and muscular strength: LPA, MPA, and VPA together mediated 17.8% of the effect of walkability on grip strength. Moreover, there was a significant negative *total effect* (path *c*) (β = -0.185; 95%CI: -0.364 to -0.005), but not a *direct effect* (path *c'*) between walkability and grip strength (Table 3). There were negative *indirect effects* (path *ab*) between walkability and grip strength via daily LPA (β = -0.017; 95%CI: -0.037 to -0.003) and MPA minutes (β = -0.022; 95%CI: -0.050 to -0.000).

Among females, walkability had no significant *total effect* (path *c*) or *direct effect* (path *c'*) on grip strength (Table 3). However, there was evidence of a negative *indirect effect* (path *ab*) between walkability and grip strength via daily minutes of LPA (β = -0.011; 95%CI: -0.025 to -0.001). LPA, MPA, and VPA together mediated 14.5% of the effect of walkability on grip strength.

[Table 3]

Neighbourhood greenness and cardiorespiratory fitness: For males and females, we found no significant *total* (path *c*), *direct* (path *c'*), or *indirect effects* (path *ab*) between the NDVI and cardiorespiratory fitness (Table 4).

[Table 4]

Greenness and muscular strength: For males and females, we found no significant *total* (path *c*), *direct* (path *c'*), or *indirect effects* (path *ab*) between the NDVI and grip strength (Table 5).

[Table 5]

Discussion

To our knowledge, this is the first study to undertake a formal mediation analysis to estimate the *total, direct and indirect* pathways between objective measures of the neighbourhood walkability and greenness, PA, and health-related fitness (i.e., cardiorespiratory and muscular fitness). In addition, our analysis was novel in that we simultaneously included LPA, MPA, and VPA as mediators. Our findings add to the existing body of mixed evidence[10] regarding the neighbourhood BE's role in supporting health-related fitness and suggest that walkability may have only a weak positive effect on cardiorespiratory fitness and a potential negative effect on muscular strength. We found no meaningful associations (total, direct, or indirect effects) between greenness and cardiorespiratory or muscular fitness despite other studies finding positive associations between greenspace and health-related fitness[12].

Several studies have found positive associations between the overall neighbourhood BE and cardiorespiratory fitness.[10] For example, Bailly et al.[16] found a measure of the neighbourhood BE, similar to our walkability measure, were positively associated with cardiorespiratory fitness in a sample of French women. In adults from the United States, Hoehner et al.[12] found higher walkable neighbourhoods associated with higher cardiorespiratory fitness, even after adjusting for self-reported PA. McCormack et al.[17] found that self-reported, but not objectively measured neighbourhood walkability, was positively associated with self-reported cardiorespiratory fitness among Canadian adults. Our results lend some support to these previous findings. We found a small positive *total effect* of walkability on cardiorespiratory fitness that was significant for females and approached significance for males. For females, this *total effect* primarily reflected a direct relationship between walkability and cardiorespiratory fitness (despite a small negative *indirect effect* via LPA). For males, however, PA and in particular LPA and MPA partially mediated the total effect of walkability on cardiorespiratory fitness. The small *total* and *direct*

effects of walkability on cardiorespiratory fitness reflected the magnitude and direction of the estimated path *a* and path *b* coefficients that were different for LPA, MPA, and VPA.

Despite cardiorespiratory fitness being positively associated with LPA, LPA was negatively associated with neighbourhood walkability, contributing an overall negative indirect effect on cardiorespiratory fitness. In other words, walkability may only have a small effect on cardiorespiratory fitness due to its negative association with LPA. Our results suggest that any positive effect of walkability on cardiorespiratory fitness is primarily via higher levels of VPA. While this study and those elsewhere show that walkability is positively associated with MPA such as active transportation[23], our results suggest that higher MPA alone may not be associated with higher levels cardiorespiratory fitness. In alignment with our findings, preliminary evidence also suggests modest negative association between objectively measured walkability and LPA.[21] One possible explanation for this counterintuitive association is that residents in higher walkable neighbourhoods may undertake less LPA and compensate by undertaking more MPA and VPA throughout the day compared to those residing in lower walkable neighbourhoods.[21] However, the evidence on compensatory change in PA is mixed and understudied.[46] Further, our study included an objective measure of PA that was not context specific and thus, we are unable to determine the extent to which PA of different intensities was undertaken inside the neighbourhood. Nevertheless, our findings suggest that health gains linked to higher walkability are most likely via the promotion of MPA and VPA, and not LPA. Specifically, LPA appears to suppress the positive effect of higher walkability on cardiorespiratory fitness and muscular fitness.

Compared to cardiorespiratory fitness, there are fewer studies assessing the relationship between the neighbourhood BE and muscular fitness.[10] Moreover, within the limited studies assessing muscular fitness and aggregate or composite measures of the neighbourhood most associations were null.[10] For instance, several studies found no associations between self-reported neighbourhood walkability and objectively measured muscular fitness.[13, 47, 48] Conversely, McCormack et al.[17] found that self-reported but not objectively measured neighbourhood walkability was positively associated with self-reported muscular fitness among Canadian adults. Further, although not a measure of neighbourhood walkability, Duchowny, et al.[49] found a

negative association between an aggregate score of neighbourhood disorder and muscular fitness. To our knowledge, previous research has not simultaneously incorporated objectively measured walkability, PA, and muscular fitness outcomes, as is the case in our study. Apart from a small negative *total effect* in males, earlier findings align with our results where we found mainly null *direct* and *total effects*. Although there were significant negative *indirect effects* via LPA for both males and females, and MPA for males, the magnitude was small. Similar to our results for cardiorespiratory fitness, despite muscular fitness being positively associated with LPA, LPA was negatively associated with walkability, contributing a negative *indirect effect* on muscular fitness. Overall, our results suggest that there may not be an association between walkability and muscular fitness in females, and perhaps a small negative or no association in males. Increases in walkability may lead to more to aerobic activity such as walking[23] but may offer fewer challenges to the muscular system (i.e., external loads and resistance).[4] When exploring the determinants of muscular fitness, neighbourhood built characteristics like the proximity to recreational facilities (e.g., indoor and outdoor gyms)[18] or exposure to challenging terrain, like steep hills[14] that offer opportunities to enhance muscular strength and endurance, may be of greater relevance.

Previous findings suggest that neighbourhood greenness is associated with PA and overall mortality[50], yet we found that the *total* and *direct* effect of greenness on cardiorespiratory and muscular fitness, while positive, was not statistically significant. Furthermore, we found a general pattern of negative associations between greenness and LPA, MPA, and VPA (i.e., path a). However, few studies estimating associations between NDVI and objectively measured health-related fitness exist with which we can compare our findings. One exception is a study by Feng et al.[51] where NDVI had minimal influence on urban Chinese adults' grip strength – a result that aligns with our finding. We used NDVI to estimate neighbourhood greenness however, this measure does not accurately reflect physical spaces that are accessible to people, nor the availability of amenities or equipment that may attract visitors to greenspaces and offer opportunities to improve muscular fitness (e.g., fitness parks[52]). Moreover, several studies have found that higher quality of greenspaces, such as parks, were associated with more visits and higher PA[23], and a Canadian study found that favourable perceptions towards neighbourhood parks was positively associated with self-reported cardiorespiratory fitness.[17] This may reflect

the negative association between neighbourhood walkability and greenness (Supplementary Material – Table S5) and the lack of greenspace found in more densely built (and walkable) urban areas.[53, 54]

Strengths and limitations

In response to addressing the limitations highlighted in previous studies[23], our study included objective measures of the BE, PA, and health-related fitness and a sex-stratified analysis. Another strength of our study was the simultaneous inclusion of LPA, MPA, and VPA in a formal mediation analysis. The inclusion of LPA in our analysis was novel, particularly given findings suggesting that accelerometer-measured LPA is associated with reductions in all-cause mortality.[55] However, our study also had limitations. While accelerometers can overcome the limitations of self-reported PA (i.e., recall and reporting bias[19]), alone these devices do not provide information about the context or purpose in which PA is undertaken.[56] Moreover, although the use of 1km buffer for estimating the BE is common in the literature, there is evidence that associations between the BE and PA vary by buffer size.[56, 57] In a sensitivity analysis, we found no relevant differences in associations when neighbourhood greenness was estimated using a 500m buffer – not shown). Another strength of our study included a widely used nationally representative measure of neighbourhood walkability that captured street connectivity, residential density, number destinations, and transit density.[36, 37, 58-61] However, this measure of walkability omitted potentially important fitness relevant built characteristics such as topography and neighbourhood disorder[10], distance to recreation facilities[18], and availability of fitness parks.[52]

Conclusion

Neighbourhood walkability has the potential to support cardiorespiratory fitness; however, it may not support muscular fitness. Notably, PA does not appear to be a mediator. Further, neighbourhood greenness was not associated with cardiorespiratory or muscular fitness. While the neighbourhood BE may support PA, our findings do not provide compelling evidence that this increased support necessarily translates into improved cardiovascular or muscular fitness.

Acknowledgements

This work is supported by the Canadian Institutes of Health Research (FDN − 154331). The funders have no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. Levi Frehlich acknowledges support for this study from the Canadian Research Data Centre Network Emerging Scholars Grant. Can-ALE, NDVI, and $PM_{2.5}$ metrics, indexed to DMTI Spatial Inc. postal codes, were provided by Canadian Urban Environmental Health Research Consortium.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author contributions

Levi Frehlich: Conceptualization, Methodology, Formal analysis, Writing - Original draft preparation; **Tanvir C. Turin**: Conceptualization, Methodology, Writing - Review & Editing; **Patricia K. Doyle-Baker**: Conceptualization, Methodology, Writing - Review & Editing; **Justin J. Lang**: Methodology, Writing - Review & Editing; **Gavin R. McCormack**: Conceptualization, Methodology, Writing - Review & Editing, Supervision, Funding acquisition.

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Tables and figures

Figure 1. Proposed mediation by physical activity on the associations between the neighbourhood built environment (walkability and greenness) and health-related.

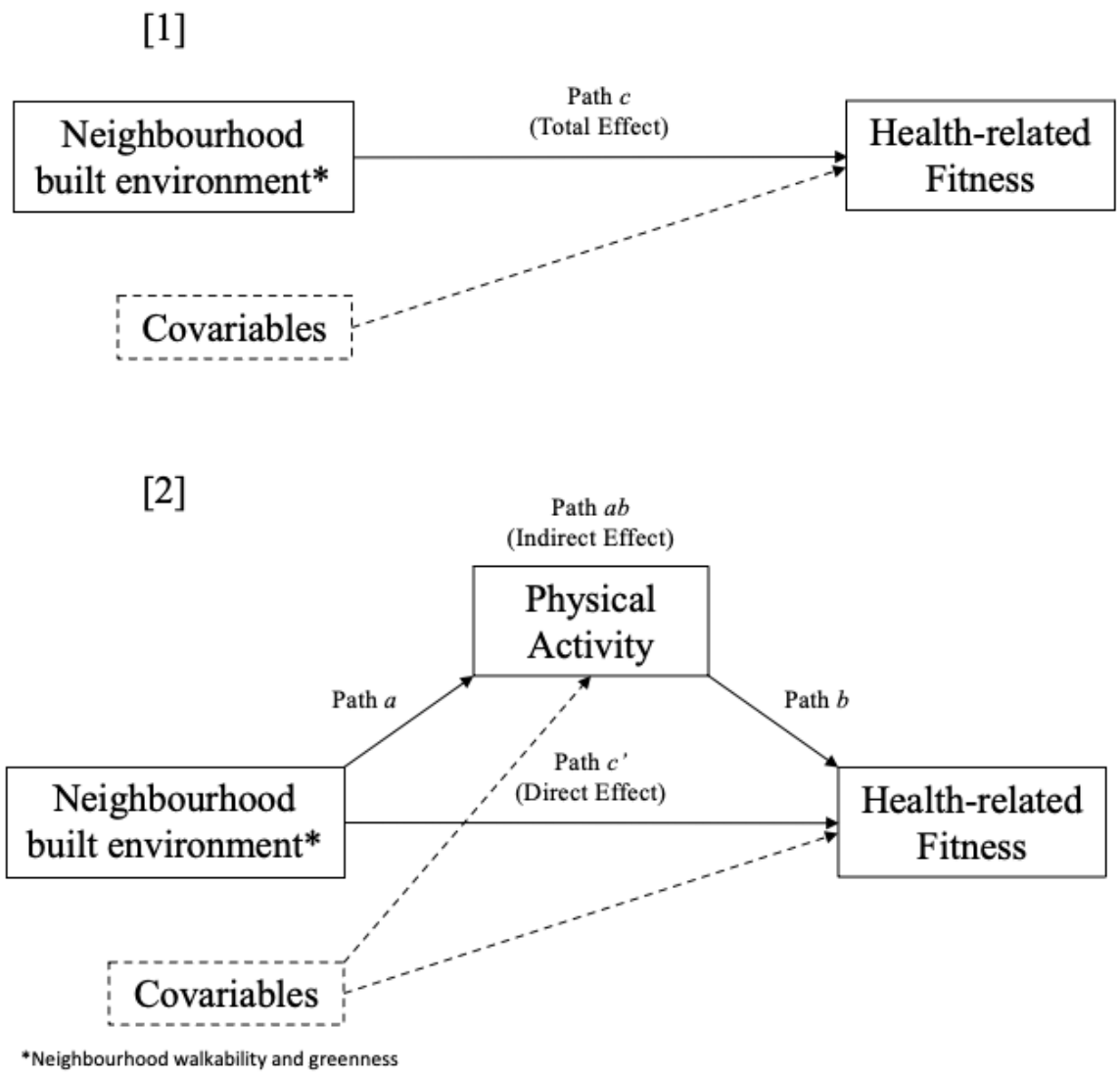

Table 1. Descriptive statistics for our sample of urban dwelling Canadian adults.

		Male [a]		Female [b]	
Sample characteristic	**Units**	**n**	**Estimate**	**n**	**Estimate**
Neighbourhood built environment					
Walkability (Can-ALE)	Standardized score [c]	2121	1.09 (3.93)	2190	1.08 (3.67)
Greenness (NDVI)	Dimensionless [d]	2983	0.39 (0.10)	3085	0.39 (0.09)
$PM_{2.5}$	ug/m3	2983	5.89 (1.48)	3085	5.90 (1.46)
Fitness					
Grip strength	kg	2932	89.2 (18.0)	3030	54.4 (10.7)
$\dot{V}O_2$ max	$mL \cdot kg^{-1} \cdot min^{-1}$	1410	27.5 (5.20)	1382	23.2 (3.96)
Physical activity					
Light intensity	min/day	2983	219 (79.3)	3085	207 (71.1)
Moderate intensity	min/day	2983	23.7 (21.9)	3085	19.5 (20.0)
Vigorous intensity	min/day	2983	4.26 (9.80)	3085	3.75 (9.80)
Sociodemographic and health					
Age	years	2983	47.6 (15.4)	3085	47.7 (15.7)
Waist circumference	cm	2978	97.0 (13.5)	3049	89.8 (14.7)
Weight	kg	2979	84.8 (16.2)	3082	70.7 (16.4)
Education		2952		3063	
University			73.0%		74.1%
No university			27.0%		25.9%
Self-rated health		2983		3085	
Very good or excellent			55.8%		55.8%
Poor, fair, or good			44.2%		44.2%
Self-rated mental health		2971		3070	
Very good or excellent			71.0%		66.2%
Poor, fair, or good			29.0%		33.8%
Smoking status		2976		3076	
Daily			12.1%		9.2%
Occasional			4.3%		3.4%
Former			33.2%		27.2%
Never			50.4%		60.3%
Marital status		2981		3083	
Married			74.2%		61.9%
Widowed/separated/divorced			8.7%		19.5%
Single			17.2%		18.7%
Ethnicity		2898		2967	
White			76.0%		77.2%
Ethnic minority			24.1%		22.9%
Children under 15 in the house		2983		3085	
Yes			46.6%		45.7%
No			53.4%		54.3%

Continuous variables are reported with mean and standard deviation.
Neighbourhood built environment variables were measured in 2016. Fitness, physical activity, and sociodemographic and health variables were measured between 2014-2019.

[a] n = 2983

[b] n = 3085

[c] Standardized scores (z scores) for each neighbourhood built environment variable (intersection density, dwelling density, points of interest, and transit density) summed these to estimate an overall index. Higher scores reflect greater activity friendliness of the neighbourhood.

[d] NDVI ranges between -1 and 1 with higher values representing more greenness)

Table 2. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood walkability and cardiorespiratory fitness ($\dot{V}O_2$ max) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* **Coefficient (95% CI)**	**Path *b*** **Coefficient (95% CI)**	**Path *ab*** ***Indirect effect*** [b] **Coefficient (95% CI)**	**Path *c'*** ***Direct effect*** **Coefficient (95% CI)**	**Path *c*** ***Total effect*** **Coefficient (95% CI)**	**Percent mediation** [c]
Male: [d]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} \dot{V}O_2max$	**-1.799 (-3.106 to -0.492)**	**0.004 (0.001 to 0.008)**	**-0.008 (-0.018 to -0.001)**			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} \dot{V}O_2max$	**0.701 (0.333 to 1.070)**	0.008 (-0.005 to 0.022)	0.006 (-0.006 to 0.018)	0.049 (-0.018 to 0.115)	0.061 (-0.006 to 0.128)	19.7%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} \dot{V}O_2max$	**0.298 (0.101 to 0.496)**	**0.048 (0.024 to 0.072)**	**0.014 (0.004 to 0.031)**			
Female: [e]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} \dot{V}O_2max$	**-1.648 (-2.856 to -0.440)**	**0.005 (0.002 to 0.008)**	**-0.008 (-0.016 to -0.002)**			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} \dot{V}O_2max$	**0.841 (0.464 to 1.217)**	-0.010 (-0.021 to 0.002)	-0.008 (-0.020 to 0.001)	**0.086 (0.030 to 0.141)**	**0.079 (0.023 to 0.134)**	N/A[f]
$Walkability \xrightarrow{a} VPA \xrightarrow{b} \dot{V}O_2max$	0.167 (-0.058 to 0.391)	**0.057 (0.038 to 0.076)**	0.010 (-0.000 to 0.025)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity.
Neighbourhood walkability was measured in 2016. $\dot{V}O_2$ max was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), neighbourhood greenness (NDVI), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] n = 987

[e] n = 989

[f] Percent mediated was negative due to inconsistent mediation therefore it is illogical

Table 3. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood walkability and muscular fitness (grip strength) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Grip\ strength$	**-1.469 (-2.443 to -0.494)**	**0.012 (0.003 to 0.020)**	**-0.017 (-0.037 to -0.003)**			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Grip\ strength$	**0.652 (0.388 to 0.917)**	-0.034 (-0.069 to 0.000)	**-0.022 (-0.050 to -0.000)**	-0.152 (-0.333 to 0.029)	**-0.185 (-0.364 to -0.005)**	17.8%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Grip\ strength$	**0.227 (0.099 to 0.354)**	0.028 (-0.041 to 0.098)	0.006 (-0.013 to 0.024)			
Female: [e]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Grip\ strength$	**-1.150 (-2.062 to -0.239)**	**0.010 (0.003 to 0.016)**	**-0.011 (-0.025 to -0.001)**			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Grip\ strength$	**0.726 (0.462 to 0.990)**	-0.008 (-0.034 to 0.017)	-0.006 (-0.027 to 0.015)	-0.071 (-0.200 to 0.057)	-0.083 (-0.210 to 0.044)	14.5%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Grip\ strength$	0.108 (-0.028 to 0.245)	**0.049 (0.001 to 0.097)**	0.005 (-0.001 to 0.016)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity.
Neighbourhood walkability was measured in 2016. Grip strength was measured between 2014-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), neighbourhood greenness (NDVI), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] Grip strength n = 2002

[e] Grip strength n = 2038

Table 4. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood greenness and cardiorespiratory fitness ($\dot{V}O_2$ max) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} \dot{V}O_2max$	-10.099 (-58.685 to 38.49)	**0.003 (0.001 to 0.006)**	-0.034 (-0.215 to 0.139)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} \dot{V}O_2max$	-7.130 (-21.132 to 6.873)	0.005 (-0.006 to 0.016)	-0.035 (-0.305 to 0.057)	0.770 (-1.603 to 3.143)	0.523 (-1.884 to 2.930)	N/A[f]
$Greenness \xrightarrow{a} VPA \xrightarrow{b} \dot{V}O_2max$	-3.600 (-10.503 to 3.304)	**0.050 (0.028 to 0.071)**	-0.179 (-0.578 to 0.166)			
Female: [e]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} \dot{V}O_2max$	-14.264 (-59.691 to 31.163)	**0.005 (0.003 to 0.007)**	-0.070 (-0.309 to 0.147)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} \dot{V}O_2max$	**-13.906 (-27.744 to -0.067)**	**-0.011 (-0.021 to -0.001)**	0.154 (-0.014 to 0.421)	1.393 (-0.551 to 3.337)	1.235 (-0.753 to 3.222)	N/A[f]
$Greenness \xrightarrow{a} VPA \xrightarrow{b} \dot{V}O_2max$	-4.3800 (-12.4407 to 3.6807)	**0.055 (0.039 to 0.072)**	-0.242 (-0.757 to 0.206)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity.
Neighbourhood greenness was measured in 2016. $\dot{V}O_2$ max was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] n = 1348

[e] n = 1323

[f] Percent mediated was negative due to inconsistent mediation therefore it is illogical

Table 5. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood greenness and muscular fitness (grip strength) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Grip\ strength$	-21.902 (-56.494 to 12.691)	**0.015** **(0.008 to 0.022)**	-0.319 (-0.889 to 0.165)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Grip\ strength$	-7.105 (-16.710 to 2.50)	**-0.044** **(-0.073 to -0.016)**	0.315 (-0.104 to 0.944)	4.409 (-1.984 to 10.803)	4.267 (-2.143 to 10.676)	0.0%
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Grip\ strength$	-3.467 (-7.886 to 0.952)	0.040 (-0.021 to 0.100)	-0.138 (-0.536 to 0.107)			
Female: [e]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Grip\ strength$	-5.218 (-36.534 to 26.097)	**0.010** **(0.005 to 0.015)**	-0.053 (-0.387 to 0.273)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Grip\ strength$	-2.198 (-11.159 to 6.762)	-0.014 (-0.035 to 0.008)	0.030 (-0.122 to 0.233)	2.498 (-1.741 to 6.736)	2.418 (-1.836 to 6.671)	0.0%
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Grip\ strength$	-0.986 (-5.487 to 3.516)	**0.058** **(0.016 to 0.099)**	-0.057 (-0.373 to 0.219)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity.
Neighbourhood greenness was measured in 2016. Grip strength was measured between 2014-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] Grip strength n = 2796

[e] Grip strength n = 2835

Supplementary Material

Muscular fitness. Jumping mechanography (Leonardo Mechanography® Ground Reaction Force Plate; Novotec Medical GmbH, Pforzheim, Germany) was measured during cycles 5 and 6 of the CHMS. To assess muscular power, participants completed a two-leg jump test involving a countermovement squat jump with swinging arms up to a maximum of 5 times.[1] Maximal jumping height (m) was recorded.

Morphological fitness. The sit-and-reach test assessed flexibility.[2] This test was only administered during CHMS cycles 5 and 6. Prior to completing the sit-and-reach test participants performed a modified hurdler stretch for 20 seconds, twice on each leg, alternating legs. During the sit-and-reach test, a participant sits on a mat with the legs fully extended with the soles of their feet flat against the flexometer (Fit Systems Inc., Calgary, Canada). In a steady motion leaning forward at the torso, the participant moves a needle on the flexometer along a measurement scale as far as they can. The maximum value from two trials is recorded (cm).[3]

Males had a mean maximum jump height of 0.39 m, and a mean sit-and-reach score of 22.9 cm.

Females had a mean maximum jump height of 0.28 m, and a mean sit-and-reach score of 30.3 cm.

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Table S1. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood walkability and muscular fitness (jump height) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Jump\ height$	**-1.847** **(-3.485 to -0.208)**	0.000 (-0.000 to 0.000)	0.000 (-0.000 to 0.000)			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Jump\ height$	**0.866** **(0.431 to 1.301)**	0.000 (-0.000 to 0.000)	0.000 (-0.000 to 0.000)	-0.000 (-0.002 to 0.001)	-0.000 (-0.002 to 0.001)	0.0%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Jump\ height$	**0.467** **(0.270 to 0.664)**	0.000 (-0.000 to 0.000)	0.000 (-0.000 to 0.000)			
Female: [e]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Jump\ height$	-1.372 (-2.843 to 0.098)	0.000 (0.000 to 0.000)	0.000 (-0.000 to 0.000)			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Jump\ height$	**0.769** **(0.324 to 1.215)**	0.000 (-0.000 to 0.000)	0.000 (-0.000 to 0.000)	-0.001 (-0.002 to 0.000)	-0.001 (-0.002 to 0.000)	0.0%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Jump\ height$	0.130 (-0.121 to 0.380)	0.000 (-0.000 to 0.001)	0.000 (0.000 to 0.000)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity. Neighbourhood walkability was measured in 2016. Jump height was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), neighbourhood greenness (NDVI), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] Jump height n = 983

[e] Jump height n = 926

Table S2. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood walkability and morphological fitness (flexibility) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Flexibility$	**-1.652** **(-2.850 to -0.454)**	0.007 (-0.001 to 0.014)	-0.011 (-0.028 to 0.001)			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Flexibility$	**0.650** **(0.326 to 0.975)**	0.008 (-0.025 to 0.040)	0.005 (-0.022 to 0.029)	0.100 (-0.055 to 0.255)	0.093 (-0.060 to 0.245)	N/A[f]
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Flexibility$	**0.266** **(0.098 to 0.434)**	-0.005 (-0.065 to 0.055)	-0.001 (-0.020 to 0.015)			
Female: [e]						
$Walkability \xrightarrow{a} LPA \xrightarrow{b} Flexibility$	**-1.400** **(-2.537 to -0.263)**	0.002 (-0.007 to 0.010)	-0.002 (-0.017 to 0.011)			
$Walkability \xrightarrow{a} MPA \xrightarrow{b} Flexibility$	**0.858** **(0.500 to 1.217)**	-0.008 (-0.040 to 0.025)	-0.006 (-0.034 to 0.020)	.0146 (-0.022 to 0.314)	0.140 (-0.02 to 0.305)	0.9%
$Walkability \xrightarrow{a} VPA \xrightarrow{b} Flexibility$	0.107 (-0.095 to 0.309)	0.020 (-0.037 to 0.077)	0.002 (-0.003 to 0.016)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity. Neighbourhood walkability was measured in 2016. Flexibility was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), neighbourhood greenness (NDVI), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] n = 1191

[e] n = 1212

[f] Percent mediated was negative due to inconsistent mediation therefore it is illogical

Table S3. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood greenness and muscular fitness (jump height) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Jump\ height$	13.135 (-41.536 to 67.805)	0.000 (-0.000 to 0.000)	-0.000 (-0.002 to 0.001)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Jump\ height$	-10.605 (-26.020 to 4.810)	0.000 (-0.000 to 0.000)	0.001 (-0.002 to 0.004)	0.0287 (-0.016 to 0.073)	0.029 (-0.015 to 0.073)	0.0%
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Jump\ height$	-2.901 (-9.534 to 3.732)	0.000 (-0.000 to 0.001)	-0.000 (-0.002 to 0.002)			
Female: [e]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Jump\ height$	-1.674 (-54.987 to 51.639)	0.000 (0.000 to 0.000)	0.000 (-0.002 to 0.002)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Jump\ height$	**-18.289** **(-34.163 to -2.414)**	0.000 (-0.000 to 0.000)	-0.001 (-0.005 to 0.003)	0.017 (-0.020 to 0.053)	0.015 (-0.022 to 0.051)	N/A[f]
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Jump\ height$	-3.984 (-12.704 to 4.735)	0.000 (0.000 to 0.001)	-0.001 (-0.004 to 0.001)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity. Neighbourhood greenness was measured in 2016. Jump height was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] Jump height n = 1315

[e] Jump height n = 1264

[f] Percent mediated was negative due to inconsistent mediation therefore it is illogical

Table S4. Unstandardized beta coefficients estimates of sex-specific associations between neighbourhood greenness and morphological fitness (flexibility) with accelerometer measured daily minutes of physical activity at different intensities as a mediator[a] in urban dwelling Canadian adults.

	Path *a* Coefficient (95% CI)	Path *b* Coefficient (95% CI)	Path *ab* *Indirect effect* [b] Coefficient (95% CI)	Path *c'* *Direct effect* Coefficient (95% CI)	Path *c* *Total effect* Coefficient (95% CI)	Percent mediation [c]
Male: [d]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Flexibility$	-14.193 (-58.831 to 30.445)	**0.009** **(0.003 to 0.016)**	-0.129 (-0.586 to 0.291)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Flexibility$	-8.766 (-21.475 to 3.943)	0.008 (-0.018 to 0.034)	-0.071 (-0.476 to 0.206)	0.819 (-4.858 to 6.497)	0.646 (-5.040 to 6.331)	N/A[f]
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Flexibility$	-2.710 (-8.723 to 3.305)	-0.010 (-0.063 to 0.044)	0.027 (-0.188 to .309)			
Female: [e]						
$Greenness \xrightarrow{a} LPA \xrightarrow{b} Flexibility$	-15.654 (-56.160 to 24.851)	0.004 (-0.003 to 0.011)	-0.063 (-0.353 to 0.153)			
$Greenness \xrightarrow{a} MPA \xrightarrow{b} Flexibility$	**-13.377** **(-25.790 to -0.964)**	-0.004 (-0.031 to 0.024)	0.050 (-0.354 to 0.481)	**-7.180** **(-12.775 to -1.586)**	**-7.314** **(-12.899 to -1.728)**	0.0%
$Greenness \xrightarrow{a} VPA \xrightarrow{b} Flexibility$	-5.385 (-12.303 to 1.533)	0.022 (-0.026 to 0.071)	-0.120 (-0.536 to 0.153)			

CI: Confidence Interval; LPA: Light-intensity Physical Activity; MPA: Moderate-intensity Physical Activity; VPA: Vigorous-intensity Physical Activity.
Neighbourhood greenness was measured in 2016. Flexibility was measured between 2016-2019.

[a] Adjusted for participant age (years), university education (yes/no), self-rated health (very good and excellent vs. poor, fair, and good), self-rated mental health (very good and excellent vs. poor, fair, and good), smoking status (daily, occasional, former, never), marital status (married, [widowed, separated, or divorced], single), ethnicity (white vs. ethnic minority), children under the age of 15 years living in the home (yes/no), waist circumference (cm), weight (kg), and neighbourhood particulate matter (PM2.5).

[b] Bootstrapped 95% CI (5,000 repetitions with replacement)

[c] 1 – (direct effect/total effect)

[d] n = 1622

[e] n = 1630

[f] Percent mediated was negative due to inconsistent mediation therefore it is illogical

Table S5. Pearson correlations between neighbourhood built environment variables in urban dwelling Canadian adults in 2016.

Male: [a]	
$Walkability \leftrightarrow Greenness$	-0.43*
Female: [b]	
$Walkability \leftrightarrow Greenness$	-0.44*

[a] n = 2121
[b] n = 2190
*p<0.001