OBJECTIVE EVALUATION OF ENVIRONMENTAL OBSTACLES ENCOUNTERED IN TWO CANADIAN URBAN SETTINGS BY MOBILITY DEVICE USERS

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Abstract: Individuals using ambulation or wheeled assistive technologies encounter obstacles when accessing built environments. Although there are many environmental evaluations allowing the identification of these obstacles, very few take into consideration both outdoor and indoor environments. Since we know little about the environments of individuals with mobility impairments regarding their mobility assistive technologies (MAT) and mobility in general, the aim of the project was to objectively describe environmental obstacles encountered by mobility device users in two Canadian urban settings. Locations to be evaluated were nominated by community dwelling MAT users during focus groups in Quebec City (n=25 participants) and community forums in the Vancouver region (n=30-45). The measure of environmental accessibility (MEA) was used to evaluate the outdoor and indoor identified barriers. Relevant MEA sections were completed based on problems that were noted by MAT users, and non-compliant items were recorded. Nineteen locations (buildings and exterior spaces) in Quebec City and 20 in the Vancouver region were evaluated. Fifteen MEA sections were used in Quebec City and 12 in the Vancouver region (out of 29): curb ramps; sidewalk; parking; outdoor signage; doors; accessible routes; walls; obstacles; access ramps; handrails and guardrails; elevators; equipment (automatic teller machine); locker rooms; toilet, changing and shower stalls; and washrooms. Non-compliant items were similar in Quebec City and the Vancouver region. The most frequently encountered ones were similar in both locations. The most problematic MEA sections (with more non-compliant items) were access ramps and washrooms. This study provides a better understanding of the objective characteristics of outdoor and indoor environments impeding access among mobility device users, and consequently, the elements which should be considered for improvement.

Keywords: mobility limitation, environmental barriers, social participation.

Introduction

According to the most recent Canadian Survey on Disability, in 2012, over 7% of Canadians over the age of 15 years (about 1,971,800 individuals) reported having a mobility-related disability (Bizier, Fawcett, & Gilbert.S., 2012). It has been estimated that approximately 1,125,000 community-dwelling individuals who were 15 years of age or older used walking aids, representing 4.1% of the Canadian population (of these individuals, 962,290 used canes/walking sticks/crutches, and 465,340 used a walker) (Charette, Best, Smith, Miller, & Routhier, 2018). One percent of Canadians

(288,800 individuals) use a scooter, a manual or power wheelchair for their daily activities and travels (Smith, Giesbrecht, Mortenson, & Miller, 2016).

Manual and power wheelchairs, as well as scooters, are used to facilitate mobility and improve quality of life (Brandt, Iwarsson, & Stahle, 2004; Fomiatti, Richmond, Moir, & Millsteed, 2013; Salminen, Brandt, Samuelsson, Toytari, & Malmivaara, 2009). How ambulation or mobility assistive technologies (MAT) facilitate mobility and improves the quality of life across several facets of an individual's life is depicted in Jutai, Coulson, and Russell-Minda (2009) conceptual framework linking technology to improvement in the quality of life and well-being. The increase in mobility and quality of life is reflected in outcomes such as increased independence (Brandt et al., 2004; Fomiatti et al., 2013; Lofqvist, Pettersson, Iwarsson, & Brandt, 2012) and social participation (Barker, Reid, & Cott, 2006; Hjelle & Vik, 2011; Lofqvist et al., 2012). Likewise, walkers and canes are provided to facilitate ambulation (Porter, Matsuda, & Benson, 2011) and prevent falls (Bateni & Maki, 2005).

Despite many of the legislative changes that occurred in the past years, individuals using MAT still encounter accessibility problems (outdoors or indoors) (Avis, Card, & Cole, 2005; Fomiatti et al., 2013; Hjelle & Vik, 2011; Hoenig, Landerman, Shipp, & L., 2003; Kaye, Kang, & LaPlante, 2000; King, Dutta, Gorski, Holliday, & Fernie, 2011; McClain, Medrano, Marcum, & Schukar, 2000; Meyers, Anderson, Miller, Shipp, & Hoenig, 2002; Mortenson, Miller, Backman, & Oliffe, 2012). Although these important aspects regarding mobility have been documented, we know little about mobility device users' environments (locations they use) with regards to their ambulation or MAT and mobility in general. Many evaluations can be found in the literature to assess public environments; however, many are only concerned with outdoor (Bennett, Kirby, & Macdonald, 2009; Canadian Heritage Parks Canada, 1994; Don MacDowall of Bass International Consulting for People Outdoors, 2004) or indoor environments (Americans with disabilities act [ADA], 1995, 2001; Stark, Hollingsworth, Morgan, & Gray, 2007). Very few take into consideration both outdoor and indoor environments.

Given the current level of knowledge regarding mobility device users and obstacles encountered in the community presented above, our research team is conducting a larger mixed-methods study to describe the components of mobility for mobility device users' daily activities (Routhier et al., 2019). The project described in this paper aimed to objectively describe environmental obstacles that are encountered by mobility device users in two Canadian urban settings.

Methodology

This study is part of a larger mixed-methods multiphase study regarding mobility and social participation in Quebec City and the Vancouver region of mobility device users. Locations (buildings and exterior spaces) to be audited in each city/region were selected in two ways, based on data collected in a previous phase from this larger study (Routhier et al., 2019). Site identification will be presented in the following section. The evaluation used will then be presented (*Measure of environmental accessibility* (MEA)) as well as the procedure for its use. Finally, the procedure for data analysis will conclude this methodology section. The protocol for this study has been approved by the Research Ethics Boards at the *University of British Columbia* (H15-01340) and the *Institut de réadaptation en déficience physique de Québec* (Approval # 2015-424), as well as the regional health authorities of each site. All study participants provided informed consent.

Site identification

In Quebec City, the locations to be evaluated were selected with study participants of the larger study (Routhier et al., 2019) in which PhotoVoice data were collected and individual interviews and focus groups were conducted. During the focus groups, the participants were asked the following questions:

- What barriers to mobility and social participation do people who use different types of mobility ambulation or wheeled assistive technologies encounter?
- What facilitators to mobility and social participation do people who use different types of mobility ambulation or wheeled assistive technologies encounter?
- What changes would you like to see happen to improve your mobility and social participation?
- How would you like to see these changes facilitated?

From these focus groups, participants identified obstacles of the built environment (barriers) that should be evaluated for future improvements. We did not ask to identify the specifics regarding the problematic dimensions or comparisons with constructions codes. In the following section, the tool used to measure accessibility will be presented (allows respect of construction codes, but goes beyond to ensure access). In Quebec City, 25 participants took part in four focus groups.

In the Vancouver region, the identification of the locations to be evaluated was done during community forums in which preliminary results from the larger mixed-methods multiphase study were shared (Routhier et al., 2019). The attendees were asked about obstacles in the built environment (barriers) that needed to be addressed. The attendees included participants from the larger mixed-methods multiphase study and people from the community (city officials and stakeholders). Three community forums took place (one per Vancouver region city: New West, Vancouver, North Vancouver). A total of 10-15 people were in attendance at each of the three community forums. Locations were decided by consensus at each forum.

Evaluation

The *Measure of environmental accessibility* (MEA) was used to objectively describe obstacles for mobility device users. This measure of the accessibility of public environments for individuals with motor, visual, hearing, cognitive and intellectual disabilities is the updated version of the *Measure of accessibility to urban infrastructures for adults with physical disabilities* (MAUAP) (Gamache et al., 2016), in a Canadian context. The MAUAP was originally developed following a literature review on the accessibility of outdoor and indoor environments for individuals with motor, visual and hearing disabilities as well as the consultation of individuals with disabilities, health clinicians, researchers and municipal representatives.(Gamache et al., 2016) It is not based on compliance standards, therefore not dependant on jurisdiction. It has been evaluated for inter-rater reliability and showed mainly good inter-rater reliability indicators in the province of Quebec's context. The revised version (i.e. the MEA) was updated through a new literature review (addition: inclusion of individuals with cognitive and intellectual disabilities which could likely include more mobility device users given co-morbidity) (Gamache, Morales, Noreau, Dumont, & Leblond, 2018). As stated in the paper presenting the development of the MEA, the *Canadian Standards Association*'s recommendations (CSA Group, 2012) were selected as the principal source of information since they are most representative of the possible progress in accessibility and of Canadian practices which can be applied in Nordic countries. (Gamache et al., 2018) Moreover, ISO recommendations (International Organization for Standardization [ISO], 2011) were also used, because of their influence and the fact that they are produced by an issuer of controlled norms developed by a group of experts from different fields. Even so, all data gathered from other sources were considered in the development of the MEA and were added if relevant. (Gamache et al., 2018) The measure is available here: https://www.ciusss-capitalenationale.gouv.qc.ca/mea-mesure-environnementale-de-laccessibilite. The MEA has good inter-rater reliability indicators [most items (71%, 626/882) had AC1 values ranging from good to excellent] (Gamache et al., 2018). The MEA contains 29 independent sections:

Exterior environment:

1. Curb ramps/Curb cuts

2. Pedestrian crossing
3. Pedestrian signals
4. Sidewalk and pedestrian path
5. Designated parking
6. Parking meter, Ticket machine or Toll station

Interior environment:

1. Signage and outdoor access
2. Doors
3. Security
4. Signage
5. Desks
6. Tables and chairs
7. Accessible routes
8. Walls
9. Obstacles
10. Staircase
11. Access ramp
12. Handrails and guardrails
13. Elevator
14. Platform lift
15. Manoeuvring devices

16. Equipment: drinking fountain, ATM, telephone, Trashcans/bins/ashtrays
17. Locker rooms
18. Toilet, changing and shower stalls
19. Washrooms
20. Room and auditorium
21. Library and resource centre
22. Cafeteria
23. Accessible seats

Each item of each section is evaluated on three scales: 1) the actual measure (actual dimensions of environmental factors), 2) the compliance of the actual measure with the item (whether the dimensions comply with the proposed dimensions in the MEA) as well as 3) observations and the proposed modifications. For example, when evaluating the clear width of an exterior door (section 8, item 7: ≥920mm), the evaluator measures a clear width of 900mm. The evaluator indicates 900mm as the actual measure. Since the proposed criterion is ≥920mm, the actual measure is not compliant with the item. For the observations and the proposed modifications, the evaluator can indicate, according to his or her knowledge, whether an obstacle is reducing the clear width or if 180°-hinges could be installed to provide more clear space.

Procedure

According to the site identification procedures, each section of the MEA (Gamache et al., 2018) necessary to objectively describe the problematic environmental elements proposed by the participants were identified. Here is an example of the process undertaken. Based on information from a participant that an access ramp was hard to use because of limited space, this location would be targeted with the MEA. Sections 17 (access ramp) and 18 (handrails) would be used to objectively describe the problematic access ramp. The other sections were not evaluated. If a building was identified without specific environmental elements being provided by the participants, the main building features allowing access were evaluated: signage, door, access ramp, elevator, and washrooms. Evaluations were performed by research assistants.

Analysis

A descriptive portrait of the obstacles encountered in Quebec City and the Vancouver region was made and were compared by identifying non-compliant MEA' items. The non-compliant MEA' items in both contexts were identified, and the frequency at which they appeared in the locations nominated by the participants was calculated. Only items which have been identified as non-compliant in ≥50% of the locations will be presented. Otherwise, almost all items were non-compliant in at least one in the evaluated sample. By identifying those items that are non-compliant in ≥50% of the evaluations, a trend can be observed regarding the more problematic ones, compared to those that are only evaluated as non-compliant once. For MEA sections that have been used only once, the items identified as non-compliant in ≥50% of the locations will not be provided for the same reason, no trend can be identified with only one evaluation.

Results

A total of 19 locations where environmental obstacles were identified by the participants in Quebec City were evaluated. These locations were: pedestrian zone (n=5), municipal building (n=4), mall (n=3), commercial building (n=2), health institution (n=2), restaurant (n=1), theater (n=1) and tourist attraction (n=1). Other locations (n=8) were identified by the participants in Quebec City; however, they could not be evaluated since they were owned by private companies and permission could not be obtained. A

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total of 15 MEA sections were used to objectively describe these environmental obstacles.

A total of 20 locations where environmental obstacles have been identified by the participants in the Vancouver region were evaluated. These locations were: pedestrian zone (n=1), municipal building (n=4), business (n=5), commercial building (n=2), health institution (n=2), grocery store (n=1), tourist attraction (n=2), restaurant (n=1), senior center (n=1) and swimming pool (n=1). Other locations (n=5) were nominated by the participants in the Vancouver region; however, they could not be evaluated because permission was not granted for the evaluation to take place. A total of 12 MEA sections were used to objectively describe these environmental obstacles.

The information related to the MEA evaluations is provided in table 1, with the non-compliant items in ≥50% of the evaluations. For example, in the curb ramp section of the MEA, the item *1.7-Running slope (66.7%)* was evaluated as non-compliant 66.7% of the time. The detailed results can be found in extra data, including a complete description of the items (complete labels).

Comparison Quebec City vs Vancouver region

For MEA sections that have been used more than once in each location (Quebec City and the Vancouver region), many of the non-compliant items are the same (see table 1). For **section 5**, regarding designated parking, five non-compliant items (out of 10 in Quebec City and out of nine in the Vancouver region) are the same in both locations (in bold in Table 1). These items are not related to the designated accessible parking space per se but to other elements enhancing its access (parking for vans, the separation between vehicles and pedestrian, call bell or assistance, drop-off area). For **section 8**, regarding doors, five non-compliant items (out of 11 in both locations) are the same in Quebec City and the Vancouver region. These items consider the clear width of the door as well as the glass panel, if present (lower and upper edge, width, contrast). For **section 17**, regarding access ramps, eight non-compliant items (out of eight in Quebec City and out

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of 13 in the Vancouver region) are the same in both locations. These items consider landings (intermediate landing: location, surface, dimensions, and the dimensions of the top landing), the clear width, the ground surface and the manoeuvring area when the ramp leads to a door. For **section 25**, regarding restrooms, 14 non-compliant items (out of 22 in Quebec City and out of 27 in the Vancouver region) are the same in both locations. These items are related to hooks (location and height), the dimensions of accessible stalls, the location of the toilet, the seat length and colour, toilet paper (height, operability and sanitary bin), the clearance underneath the sink, the size of the sink and the location of the soap dispenser.

Table 1. MEA sections used to evaluate environmental obstacles

MEA sections	Quebec City		Vancouver region	
	# times the section was used	**Most problematic items (not compliant)**	**# times the section was used**	**Most problematic items**
1-Curb ramps/Curb cuts	9	1.7-Running slope (66.7%) 1.8-Running slope-flared sides (77.8%) 1.12-Edge (lip)-slope (77.8%) 1.13-Edge (lip)-width (55.6%)		
4-Sidewalk and pedestrian	10	4.21-Lighting (50.0%)		
5-Designated parking	9	5.4-Reserved parking sign-clearance (77.8%) 5.7-Drop-off marking (55.6%-absent) 5.8-Walkway to entrance (55.6%-absent) 5.9-Lighting (55.6%) 5.10-Number of reserved spaces (55.6%) ***5.11-Parking for vans (66.7%)*** ***5.14-Separation vehicles vs pedestrians (55.6%)*** ***5.18-Call bell or assistance (66.7%-absent)*** ***5.22+23-Drop-off area (88.9%-absent)***	3	
7-Signage and outdoor access	1		14	7.01- Height (64.3%) 7.03-Colour contrast (50.0%) 7.05-Accessibility sign (78.6%) 7.06-Height of accessibility sign (57.1%)

MEA sections	Quebec City		Vancouver region	
	# times the section was used	Most problematic items (not compliant)	# times the section was used	Most problematic items
8-Doors	8	***8.7-Clear width (62.5%)*** 8.9-Contrast-door and door frame (87.5%) 8.10-Contrast-door frame and wall (50.0%) 8.11-Contrast-door and handle (50.0%) ***8.13+14+15+16-Glass panel-lower edge, upper edge, width and contrast (87.5%, 62.5%, 100% and 62.5%))*** 8.20-Space between door and handle (62.5%) 8.39-Detection device (66.7%)	11	8.6-Protective strip (63.6%) ***8.7-Clear width (63.6%)*** ***8.13 + 14+ 15+ 16-Glass panel-lower edge, upper edge, width and contrast (72.7%, 63.6%, 72.7%, 63.6%)*** 8.36-Lighting (54.5%) 8.38+39-Detection device (54.5%) 8.42+43-Manoeuvring area (63.6%)
13-Accessible routes	4	13.15 to 13.17-Orientation guides (50%-absent) 13.18 to 13.42-Tactile tiles (100%-absent)	1	
14-Walls	4	14.4-Contrast-wall and ceiling (75.0%) 14.6-Contrast-walls and doors (50.0%) 14.8-Colouring (50.0%)	1	
15-Obstacles	4	15.1-Signage (100%) 15.2-Clearance and detectability (75.0%) 15.3-Warning feature (75.0%)	1	

MEA sections	Quebec City		Vancouver region	
	# times the section was used	Most problematic items (not compliant)	# times the section was used	Most problematic items
17-Access ramp	6	***17.5-Location intermediate landing (50.0%-absent)*** ***17.6-Surface intermediate landing (83.3%-absent)*** ***17.7-Dimensions intermediate landing (83.3%-absent)*** ***17.8-Clear width (50.0%)*** ***17.11-Dimensions top landing (66.7%)*** ***17.12+13-Ground surface (100%)*** ***17.16-Manoeuvring area (door) (83.3%)***	9	
18-Handrails and guardrails	5	18.10-Guardrails-height (60.0%) 18.11+12-Guardrails (80.0%)		

MEA sections	Quebec City		Vancouver region	
	# times the section was used	Most problematic items (not compliant)	# times the section was used	Most problematic items
	1		11	19.3-Door width (54.5%) 19.4-Door opening time (81.8%) 19.5-Activation time of the door mechanism (81.8%) 19.7-Cab floor (63.3%) 19.8-Surfaces (81.8%) 19.10+11-Handrails' location and shape (90.9% and 63.6%) 19.13-Space between handrail and panel (63.6%) 19.15-Handrails' texture (63.6%) 19.24-Signage height (63.6%) 19.27-Braille signage (54.5%) 19.30-Height of light indicator (54.5%) 19.36+41-Type of and force required for buttons at landings (54.5% and 72.2%) 19.46+49+52-Signage, light when activated and force required for cab controls (54.5%, 90.9% and 63.6%) 19.56+60-Signage and force required for emergency button (63.6%, 54.5%) 19.62+63-Emergency device bidirectional communication and feedback (54.5% and 72.7%)
22-Equipment (ATM)	1			

MEA sections	Quebec City		Vancouver region	
	# times the section was used	Most problematic items (not compliant)	# times the section was used	Most problematic items
24-Toilet, changing and shower stalls	4	24.11-Exterior handle shape (75.0%) 24.13-Exterior handle centre (75.0%) 24.13+14-Exterior handle operability and contrast (50.0%) 24.17+18+20-Interior handle height, centre, contrast (50.0%) 24.21-Locking mechanism type (50.0%)	1	

Discussion

The aim of this project was to objectively describe environmental obstacles (barriers) that are encountered by mobility device users in two Canadian urban settings. Unsurprisingly, it was found that the evaluation of all of the proposed locations where obstacles have been identified included non-compliant items; therefore, most subjective issues that were identified could be verified through an objective evaluation. MEA sections used more than once in both locations provided similar non-compliant items. This suggests that the most frequently encountered environmental obstacles are similar across locations. Two MEA sections generated a greater number of non-compliant items: access ramps and washrooms.

The non-compliant items identified in this research are also similar to those identified in other research projects, whether outdoor (Clarke, Ailshire, Nieuwenhuijsen, & Vrankrijker, 2011; Giesbrecht, Ripat, Cooper, & Quanbury, 2011; Jenkins, Yuen, & Vogtle, 2015; Kerr & Rosenberg, 2009; Millington et al., 2009; Rosenberg, Huang, Simonovich, & Belza, 2013) or indoor barriers (Dos Santos & de Carvalho, 2012; Hammel et al., 2008; Martins & Gaudiot, 2012; Mcintyre & Hanson, 2014; Thapar et al., 2004). Many other studies regarding environmental obstacles for mobility device users only provide qualitative data (e.g., from interviews) (Giesbrecht et al., 2011; Hanson, 2004; Jones & Catlin, 1978; McClain, Cram, Wood, & Taylor, 1998; McClain et al., 2000; Wennberg, Hyden, & Stahl, 2010), not considering the objective threshold (compliance) allowing access to the built environment. As for the objective evaluations used in other studies, most are highly dependent on the construction norms and codes in place, and therefore very context-specific. What construction codes and norms propose might not always the best accessible solutions. The MEA, however, was based on the recommendations found in the literature which best fit the needs of most users (including individuals with motor, visual, hearing, cognitive and intellectual disabilities) as well as the work initially performed in the development of the previous version (MAUAP) with experts. The use of the MEA goes beyond only considering MAT users and could be beneficial for the evaluation of accessibility for other groups of individuals with disabilities. This evaluation targets a larger population and it allowed the identification of environmental obstacles for the studied population (through the identification of non-compliant items), but also allowed the consideration of other groups of individuals with disabilities (visual, hearing, cognitive and intellectual disabilities) for the identification of the compromise allowing access for most (e.g., curb cut height low enough to favour access with a wheelchair, but high enough to be detectable for individuals with a visual impairment using a white cane).

The obtained results indicating that the most frequently encountered non-compliant MEA' items are similar across locations suggest that construction practices might be similar across Canada and could generate similar accessibility issues. All non-compliant items identified in this research should be reconsidered in construction norms and recommendations for improved access for all, especially for the two above mentioned environmental elements for which more non-compliant items have been identified, access ramps and washrooms. The presence of many non-compliant items could be because some of the evaluated locations' design was based on older building codes that were less demanding when it comes to accessibility. Moreover, the influence of the application of existing norms and craftsmanship could be the cause of the observed environmental obstacles. This could also be explored. However, this aspect has not been studied during this project, the information could not be gathered on the year of design of the evaluated infrastructure, and thus the construction code in place could not be identified, determining if the problem stems from the legislation per se or its application.

Since the MEA goes beyond current building codes in the proposed accessibility criteria, and although some of the evaluated locations were quite recent, the proposed criteria might not be met even if their design was fully compliant with the latest building code. The MEA could, therefore, be used to assess the accessibility of public locations (outdoor or indoor) for individuals with disabilities in general to improve specific environmental elements presented in its items.

Limits of the study

Certain limitations of this study should be noted. The sample size (locations) was limited both in Quebec City (n=25) and in the Vancouver region (n=20). Other environmental obstacles or trends could have been observed if a larger sample of locations would have been assessed. For example, those items that have been identified as non-compliant only once or those sections that have been evaluated only once might represent important and common obstacles, but the samples identified by the participants might not have been large enough to ensure recurrence. Even so, a variety of types of locations were evaluated (vocation, date of construction, locations). To allow for the comparison of sites, it was impossible to attain an equivalent match between the number of MEA evaluations for each section in Quebec City and the Vancouver region (e.g., one elevator evaluation in Quebec City and 11 in the Vancouver region) since the choices made in both contexts were different [might have been influenced by local politics, the weather - timing of the year when the focus groups took place and the preciseness of the choices made by the participants (e.g., a greater number of elevators were assessed in Vancouver since more buildings were identified but in general terms, without targeting specific problematic environmental elements, and elevators was one of the MEA sections that was evaluated when the identification of the building was not specific to an environmental element)]. Therefore, the observed trends between locations are not generalizable. Moreover, many of the MEA sections have not been used, meaning that obstacles related to the elements evaluated in these sections were not identified. The MEA sections used in this study were dependant on the participants' choices to nominate locations and obstacles found within them; therefore, some non-compliant issues may be missed. The geographical sectors in which the evaluations took place were also limited since the study took place in two specific regions/cities (Quebec City and the Vancouver region). Other obstacles might have been more frequently observed in other locations/provinces. In both locations, no evaluations took place when snow or ice was present, which could have changed the findings. Finally, the evaluators in Quebec City and the Vancouver region were not the same, which could have generated difference in the interpretation of the MEA labels.

Future research

This project was focused on the identification of obstacles for MAT users, but other disabilities should be considered. This research could, therefore, be replicated with individuals with other types of disabilities (visual, hearing, cognitive, intellectual). The identification of the compromise that allows access for the greater number of individuals should be studied for different environmental features. Other locations in Canada could also be targeted to explore provincial variation. Further studies could also examine how policies and regulations, as well as their application, influence the presence of obstacles for individuals with disabilities in different contexts. Evaluations should be performed in different weather conditions, since they can greatly impact mobility. Moreover, the entire MEA could be administered in equivalent numbers of locations in different contexts to allow for better quantitative comparisons for its entire content. Measures of accessibility, such as the MEA, should be updated as more accessible practices proposed in the literature are tested with users to provide accurate tools to measure access, for the improvement of the level of accessibility of outdoor and indoor environments based on evidence-based practices. A complementary approach, combining subjective feedback and the objective evaluation of the environment for individuals with disabilities, could be used to identify how modifications to the environment should be prioritized and how construction practices could be improved. Environmental improvements to the encountered obstacles could be identified collaboratively with individuals presenting different types of disabilities, and examples of best practices should be shared. Finally, intervention studies could be performed to look at the impact of changes based on recommendations identified through the use of accessibility evaluations such as the MEA (potential versus costs of those changes and impacts on people with disabilities).

Conclusion

This paper identified environmental barriers hindering mobility and social participation for mobility device users in two Canadian urban settings. The use of the MEA could provide a good basis on which to modify the environment for it to be more accessible. Using it, based on the population's needs, focuses on what is truly important to users. The corresponding objective evaluation allows the formulation of recommendations for adaptations to be made that would best fit most individuals (with different types of disabilities). The complementary approach used, combining subjective feedback from participants and the objective evaluation of the environment for individuals with disabilities, could be an interesting approach to apply in different contexts for the improvement of the built environment and equitable access. This study, therefore, provided highlights the objective characteristics of exterior and interior locations impeding access for individuals with mobility limitations using an MAT (non-compliant items), and consequently, the elements which should be considered for improvement, especially access ramps and washrooms.

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