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## Accessibility and Aging in Place in Subsidized Housing

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### ABSTRACT

This study investigated how accessible housing features related to aging in place by gathering information from those who live in subsidized, accessible housing. Data were collected from tenants of subsidized units with and without accessible features, using a survey exploring the ease of use in their unit's bathroom, kitchen, bedroom, and the unit overall. Tenants of both unit types were mildly to strongly satisfied with all aspects of their units. The occupants did not significantly differ in satisfaction, with the exception of kitchen design. The findings imply that accessible units afford tenants livability similar to that of non-accessible units, and that aging in place is likely to occur.

## INTRODUCTION

An aging population is compelling designers, researchers, and decision-makers to consider the entire lifespan in housing policy, as well as those with disabilities and mobility challenges. Residential environments strongly and meaningfully impact health and well-being (Oswald, Wahl, Mollenkopf, & Shilling, 2003). Moreover, for many elderly individuals, the home is a setting central to a positive lifestyle, autonomy, self-determination, and well-being (Evans, Wells, Chan, & Saltzman, 2000; Gitlin et al., 2006; Lawrence, 2002; Olaf & Johannes, 2007; Rioux & Werner, 2011; Percival, 2002; Stark, 2004). Studies investigating associations between health, wellness, and residential settings have conceptualized accessible design as a public health effort (Helle, Brandt, Slaug, & Iwarsson, 2011). Because access to, and participation in, one's community are determinants of health, as well as successful aging in place (Christiansen & Townsend, 2004; Chui, 2001), it follows that extended exclusion from public activity due to environmental barriers beyond an individual's control may lead to health risks (Whiteford, 2000). In addition, those with fewer choices concerning residential mobility report more illness-related symptoms than those who have greater choices (or greater perceptions of control) (Stokols & Shumaker, 1982).

To respond to the need for safe and adaptable options, numerous accessible fixtures and home designs have been developed; however, the next step in creating optimal housing models that are safe and adaptable for all ages and abilities is to understand how current accessible designs are used and perceived by residents. Accessible (or "universal") design models aim to accommodate everyone, including people with disabilities, by affording undemanding and convenient interior spaces that allow individuals with limited mobility to enter, exit, and maneuver inside a building (Canada Mortgage and Housing Corporation, 2010; The Centre for Universal Design, 1997). Applied to residences, the

principles of universal design are intended to ensure that people of all ages can live safely, independently, and satisfactorily in their homes. Thus, universal design aligns well with aging in place—a principle emphasizing that older individuals ought to be enabled by society to remain living in the locality with which they are familiar for as long as they prefer (Chui, 2001; Heuman & Boldy, 1993; Pastalan, 1990; Tilson, 1989). Indeed, as Danzinger and Chaudhury (2009) note, the home environment is relevant to the health and functioning of the elderly in particular because more of their time is spent in this setting than any other (Evans, Wells, Chan, & Saltzman, 2000).

Certainly, the strong attachments older people often have to homes and communities can make them reluctant to relocate to another neighborhood or residence because of the social routines and memories made in their current environment (Canada Mortgage and Housing Corporation, 1999). To this end, structural modifications to residences must be made (e.g., additional knee and leg space under sinks and counters, installation of light switches at sitting heights, building free space on the sides of toilets, tubs, and beds, height-adjustable cabinets, hallways that are at least five feet wide) so occupants can live comfortably, without relocating, as their needs change (The Centre for Universal Design, 1997). Additionally, financial advantages to accessible design and aging in place exist. Child care costs may be reduced if a livable, accessible space is available in the home for an aging grandparent. Reducing the frequency with which individuals relocate also can save real estate agent fees, legal fees, building inspector fees, and other moving costs that sum, on average, up to C\$20,000 (Canada Mortgage and Housing Corporation, 2011).

Despite the psychosocial and economic benefits, more needs to be learned about accessible housing designs and how specific features can further encourage aging in place (Helle et al., 2011). Research confirms that elderly people perceive adaptations to their home as useful in assisting daily activities

(Clemson & Martin, 1996; Gitlin, Mann, Tomit, & Marcus, 2001; Johansson, Lilja, Petersson, & Borell, 2007); however, drawing clear conclusions about which features do this better than others from the small number of studies on this topic is challenging, in part, because of the cultural and demographic differences in the populations researched to date (e.g., Chui, 2001; Rioux & Werner, 2011; Helle et al., 2011). Although some qualitative evaluations have begun to emerge in the literature, such as Danzinger and Chaudhury's (2009) study on use and satisfaction of North Vancouver's adaptable design features in housing units by older adults, few have focused on the low-income housing sector.

A gap in knowledge exists concerning how residents of subsidized housing units experience accessible features and how successful aging in place for low-income earners may be predicted. One study found that people living in accessible homes perceived their dwellings as meaningful and useful in relation to carrying out daily activities (Oswald et al., 2007). This supports the expectation that accessible features should maximize residential satisfaction and, in turn, increase the probability that occupants will remain in their home longer. Successful aging in place arguably has much to do with feelings of comfort in an environment and ease of use of the residence's features. If individuals do not feel positive about their home, they may not choose to age in place, even when accessible attributes are present.

Our study serves as an initial step in understanding how occupants living in subsidized housing units equipped with accessible features experience their residence, compared to those living in unmodified units. Indeed, offering users the opportunity to review and critique the design of a space is an important step in a holistic design cycle. Additionally, investigating specific issues like this is important if accessible housing development models are to be adapted for the safety, mobility, and satisfaction of aging populations, and for a broader understanding of aging in place. Agencies and organizations that provide subsidized housing can benefit from

feedback on the practical adequacy of the accessible design model and from knowing which features do or do not contribute to occupant satisfaction. Design elements found to be working well can be maintained and included more often, and those that pose a challenge to occupants can be studied and improved upon in current and future housing projects.

## METHOD

### Participants

A total of 100 individuals living in subsidized housing units in British Columbia, Canada, took part in the study (26 males, 72 females; two participants did not report their gender). Of the 100 participants, 47 lived in accessible units, and 53 lived in non-accessible units. Their mean age was 75, and the average length of time participants had lived in their unit was three years. On average, residents lived alone and planned to stay in their unit for longer than five years. Out of the 24 housing complexes that were sent the survey, responses from 19 were received; the response rate from tenants was 14%.

No statistically significant differences were found in demographic information between occupants of accessible and non-accessible units (e.g., age, gender, years spent living in their unit, length of time tenants planned to remain living in their unit, or the number of other occupants living in the unit with the primary tenant) (all  $ps > .05$ ). Participants who lived in units that had been modified to be accessible met physical eligibility requirements for tenancy; however, those who lived in non-accessible units may or may not have required accessible design features in their home.

### Materials

Most challenges related to autonomy in the home happen in the bathroom, kitchen, and bedroom (Gitlin et al., 2001). Thus, to capture residents' satisfaction with their unit's design attributes, participants were asked in a questionnaire to agree or

disagree about the ease of use in their unit’s bathroom, kitchen, bedroom, and the unit in general (e.g., “My bathtub and shower are accessible and safe”; “I am satisfied with the counter height in my kitchen”) on 5-point Likert scales. Some broad attitudinal questions (e.g., “My unit ‘fits’ with my lifestyle”) also were asked (see **Exhibit 1**), and participants were given the opportunity to include open-ended, handwritten explanations related to scoring after each question. This qualitative ele-

ment is expected to complement quantitative data in providing a thorough understanding of tenant satisfaction.

Although the questionnaire had been created specifically for this study (and, therefore, was not a previously validated tool), the items focused on aspects previously reported to be challenging for occupants of accessible homes in the Centre for Inclusive Design and Environmental Access Problematic Activities Study (2009).

**Exhibit 1. Means and Standard Deviations Per Room Type, Item, and Unit Type.**

Room Type	Item	Unit Type	Mean	Standard Deviation
Bathroom	“I find it easy to move around in my bathroom.”	Accessible	4.60	1.01
		Non-Accessible	4.60	0.98
	“I can easily reach the sink in my bathroom.”	Accessible	4.60	1.01
		Non-Accessible	4.77	0.80
	“I am satisfied with the counter height in my bathroom.”	Accessible	4.43	1.25
		Non-Accessible	4.53	1.20
	“I am satisfied with the grab bars in my bathroom.”	Accessible	4.43	1.31
		Non-Accessible	4.67	0.89
	“My bathtub and shower are accessible and safe.”	Accessible	4.43	1.16
		Non-Accessible	4.59	1.08
	“I can easily move through the door to enter and exit my bathroom.”	Accessible	4.74	0.77
		Non-Accessible	4.77	0.82
Kitchen	“There is enough room to open the fridge and stove easily in my kitchen.”	Accessible	4.23	1.39

**Exhibit 1, Cont. Means and Standard Deviations Per Room Type, Item, and Unit Type.**

Room Type	Item	Unit Type	Mean	Standard Deviation
		Non-Accessible	4.85	0.36
	"I can easily reach the kitchen cabinet handles in my unit."	Accessible	3.94	1.61
		Non-Accessible	4.23	1.34
	"I am satisfied with the counter height in my kitchen."	Accessible	4.04	1.43
		Non-Accessible	4.66	0.85
	"I can easily use the sink and taps in my kitchen."	Accessible	4.23	1.32
		Non-Accessible	4.81	0.62
Bedroom	"There is enough space next to my bed for me to get in and out."	Accessible	4.68	0.78
		Non-Accessible	4.70	0.89
	"I can easily see out my window from my bed."	Accessible	3.98	1.65
		Non-Accessible	4.36	1.39
	"I can easily use the light fixtures in my bedroom."	Accessible	4.30	1.28
		Non-Accessible	4.58	1.05
Unit in General	"It is easy for me to enter and exit my unit (for example, I don't trip or stumble when I enter or exit my unit)."	Accessible	4.81	0.58
		Non-Accessible	4.74	0.74
	"It is easy for me to reach the door handles in my unit."	Accessible	4.81	0.77
		Non-Accessible	4.89	0.32
	"It is easy for me to use the alarm system in my unit."	Accessible	2.78	2.04
		Non-Accessible	2.91	2.22

**Exhibit 1, Cont. Means and Standard Deviations Per Room Type, Item, and Unit Type.**

Room Type	Item	Unit Type	Mean	Standard Deviation
	"I can easily access my mailbox and other common areas like the laundry room."	Accessible	4.04	1.64
		Non-Accessible	4.53	0.91
	"The medical equipment I use fits well in my unit."	Accessible	2.77	2.25
		Non-Accessible	2.53	2.38
	"I think my unit has enough room to accommodate my medical needs in the future."	Accessible	4.00	1.32
		Non-Accessible	4.13	1.54
	"I am satisfied/content in my unit."	Accessible	4.66	0.73
		Non-Accessible	4.77	0.64
	"My unit 'fits' with my current lifestyle."	Accessible	4.60	0.74
		Non-Accessible	4.64	0.92
	"I think my unit will meet my future needs so that I can live in it for a lengthy period of time."	Accessible	4.34	1.09
		Non-Accessible	4.47	1.10

*Note: Means based on Likert scale codes as follows: 1 = Strongly disagree; 2 = Mildly disagree; 3 = I don't know; 4 = Mildly agree; 5 = Strongly agree.*

## Procedure

A provincial housing agency compiled a list of subsidized housing complexes in the province in which at least 80% of units were defined as "modified" (those with accessible design features). No sites with fewer than 10 units were included. Based on these criteria, 30 buildings were approached for inclusion in the study (one was directly managed by a govern-

ment agency, and 29 were operated by nonprofit organizations); a total of 24 agreed to participate. A package of materials, including several copies of the questionnaire, advertising posters to alert residents about the study, and a frequently asked questions (FAQ) document for building managers to learn about the study's purpose and process, was mailed to each building. Each participant whose responses were analyzed signed an informed consent form. A

stamped, blank envelope also was provided with each questionnaire so that participants could seal their completed survey inside to ensure confidentiality. In addition, gift cards to a restaurant chain (worth \$5 each) were offered to participants as an incentive to take part.

## ANALYSIS & RESULTS

### Bathrooms

In general, tenants of accessible and non-accessible units were mildly to strongly satisfied with their bathroom (means were between 4 and 5 on the questionnaire's Likert scales where 4 = "Mildly agree" and 5 = "Strongly agree"; refer to Exhibit 1 for all means and standard deviations). Between-groups analysis of variance (ANOVA) tests were conducted using Bonferroni-adjusted alpha levels of .008 per test (.05/6). These tests did not reveal statistically significant differences in tenant satisfaction with bathroom design between accessible and non-accessible units.

Tenants of both accessible and non-accessible unit types agreed most with the statement "I can easily move through the door to enter and exit my bathroom" ( $M_{acc} = 4.74$ ;  $M_{non-acc} = 4.77$ ). Those who lived in non-accessible units also strongly agreed with the statement "I can easily reach the sink in my bathroom" ( $M_{non-acc} = 4.77$ ). Occupants of non-accessible units agreed least that bathroom counter height was satisfactory ( $M_{non-acc} = 4.53$ ). Occupants of accessible units felt equally satisfied with bathroom counter heights, grab bars, and the safety of the bathtub or shower ( $M_{acc} = 4.43$ , respectively).

### Kitchens

Both accessible and non-accessible unit tenants were mildly to strongly satisfied with the design of their kitchen. On average, tenants of accessible units agreed most with the statements "There is enough room to open the fridge and stove easily in my kitchen," and "I can easily use the sink and taps

in my kitchen" ( $M_{acc} = 4.23$ ;  $M_{acc} = 4.23$ ). Those living in non-accessible units also agreed most with the statement "There is enough room to open the fridge and stove easily in my kitchen" ( $M_{non-acc} = 4.85$ ). Occupants of accessible and non-accessible units agreed least with the item concerning how easy it was to reach their kitchen cabinet handles ( $M_{acc} = 3.94$ ;  $M_{non-acc} = 4.23$ ).

ANOVA tests using Bonferroni-adjusted alpha levels of .0125 per test (.05/4) revealed statistically significant differences in tenant satisfaction between accessible and non-accessible kitchen design. Tenants who lived in non-accessible units were more satisfied with the amount of room they had to open the fridge and stove than those living in accessible units,  $M_{non-acc} = 4.85$ ,  $F(1, 98) = 9.70$ ,  $p < .01$ . Tenants of non-accessible units also were more satisfied with the counter height in their kitchen than those living in accessible units,  $M_{non-acc} = 4.66$ ,  $F(1, 98) = 9.70$ ,  $p < .01$ . Further, those who lived in non-accessible units were more satisfied with how easily they could use the sink in their kitchen than those living in accessible units,  $M_{non-acc} = 4.81$ ,  $F(1, 98) = 8.10$ ,  $p < .01$ .

### Bedrooms

As with their bathrooms and kitchens, tenants living in both accessible and non-accessible units were mildly to strongly satisfied with their bedroom. ANOVA tests conducted using Bonferroni-adjusted alpha levels of .016 per test (.05/3) did not reveal statistically significant differences in tenant satisfaction with bedroom design between accessible and non-accessible units.

Tenants in both accessible and non-accessible unit types agreed most with the statement "There is enough space next to my bed for me to get in and out" ( $M_{acc} = 4.68$ ;  $M_{non-acc} = 4.70$ ). Also, those in both unit types reported that not easily seeing out of their bedroom window was the most unsatisfactory feature ( $M_{acc} = 3.98$ ;  $M_{non-acc} = 4.36$ ).



## Units in General

Tenants in accessible and non-accessible units were mildly to strongly satisfied with their unit in general. ANOVA tests using Bonferroni-adjusted alpha levels of .005 per test (.05/9) did not reveal statistically significant differences in tenant satisfaction with the unit in general between accessible and non-accessible units (all  $p$ s > .05).

Those in both unit types agreed most with the statement “It is easy for me to reach the door handles in my unit” ( $M_{acc} = 4.81$ ;  $M_{non-acc} = 4.89$ ). Those in accessible units also strongly agreed with the statement “It is easy for me to enter and exit my unit (for example, I don’t trip or stumble when I enter or exit my unit)” ( $M_{acc} = 4.81$ ). The two items tenants of accessible and non-accessible unit types agreed with least were: “It is easy for me to use the alarm system in my unit” ( $M_{acc} = 2.78$ ;  $M_{non-acc} = 2.91$ ), and “The medical equipment I use fits well in my unit” ( $M_{acc} = 2.77$ ;  $M_{non-acc} = 2.53$ ).

## Common Open-Ended Responses

Some responses to the open-ended questions included in the questionnaire were commonly given. When asked whether they thought their unit would match their lifestyle in the future, seven tenants of non-accessible units responded that there would not be enough space in their bedroom for a wheelchair. Two participants in non-accessible units noted that their home’s smoke alarm was too high on the wall to disengage if they were confined to a wheelchair. Additionally, four tenants reported that they missed having a bathtub and that the windows did not open wide enough.

Tenants living in units that had been modified with accessible features commented about different things than people living in non-accessible units. Three participants in accessible units wrote about their unit being too hot in the summer, as well as their increasing difficulty in reaching blinds and stove knobs. Four wanted more grab bars in the bathroom. Ten

tenants of accessible units stated that they appreciated and liked their unit, and they were grateful to live somewhere accessible. In addition, seven participants living in accessible units stated that “they wouldn’t change a thing.”

## DISCUSSION

The general aging of populations in Western societies is driving a need for specialized housing strategies, especially in the subsidized sector. Examination into the role of adaptable design in supporting aging in place also is needed (Danzinger & Chaudhury, 2009). Although some research exists regarding the costs and benefits of aging in place, as well as regarding accessible design features that influence experiences of safety and independence in residential settings, more knowledge of tenant satisfaction with accessible and non-accessible designs would enrich understanding. To that end, the present study asked residents of subsidized housing units to assess their satisfaction with features in their kitchen, bathroom, bedroom, and unit in general.

Very few differences in tenant satisfaction were found between accessible and non-accessible units. Such similarity suggests that, overall, accessible subsidized housing units are affording tenants comfort and livability similar to that of non-accessible units, and that aging in place is likely to occur given the degree of satisfaction. This result may seem surprising because accessible design features can sometimes have an institutional appearance, making users feel less at ease. For example, metal grab bars in a bathroom, a ramp at an entrance, or an atypical kitchen counter arrangement can impact experiences of comfort, especially in a residential environment. One Canadian city’s accessibility design guidelines specifically outline that accessible designs must be made to feel “non-institutional” (City of Toronto, 2003, p. II). Furthermore, older adults may resist modifications to their homes because of a negative stigma linking home environment changes to having a dis-

ability (Bakker, 1999). Although our study's results do not reveal significantly greater satisfaction with accessible unit design compared to non-accessible unit design, tenants do report overall satisfaction with accessible design in a variety of rooms, as opposed to the dissatisfaction one may expect if designs were felt to be too sterile or uncomfortable. Our results also suggest that bathroom design in both accessible and non-accessible units adequately accommodate tenants in terms of access and door width, and that sinks in units that have not been modified to be accessible are at an adequate height for occupants who may or may not require accessible design at home; however, participants living in accessible units did not perceive tubs or showers as very safe, despite modifications to accommodate those with physical disabilities. Furthermore, tenants were not highly satisfied with the placement height of bathroom counters and grab bars in accessible housing models. Ease of use in bathrooms is important for maintaining older persons' independence, self-esteem, and sense of control (Naik & Gill, 2005; Sanford & Megrew, 1995; Stark, 2004). Further review of the adaptability and usability of bathroom designs used in accessible subsidized housing may promote psychological well-being as well as aging in place.

As for kitchens, tenants of both unit types reported enough room to open the fridge and stove easily, and that the sink and taps could be reached with ease. Those living in non-accessible units also agreed that there was enough room to open the fridge and stove. This parallel finding suggests that the square footage allotted for kitchens in subsidized housing units is functional and sufficient; however, occupants of both unit types experienced difficulty reaching their kitchen cabinet handles. Thus, despite accessible design guidelines, tenants are still challenged to use their kitchen with ease. This finding is similar to that of a study done by Danzinger and Chaudhury (2009) in which several participants reported challenges with the height of kitchen cupboards.

Generally, although individuals living in non-accessible units felt a higher degree of satisfaction with some design aspects of their kitchen (perhaps because these tenants were not in immediate need of accessible design aspects), those living in accessible units were not dissatisfied with their kitchen space. Future research should consider supplemental survey methods, such as follow-up interviews, to clarify these findings.

Tenants of both unit types perceived there to be enough space next to their bed to comfortably get in and out. Occupants of both unit types also reported that not easily seeing out of their bedroom window was the most unsatisfactory design aspect of their bedroom. Going forward, design professionals should account for the possibility that occupants of accessible units may not be able to rise from their beds often (and individuals living in non-accessible units may not move from their bed as often as they may like). Thus, window size and placement in bedrooms should be considered from this perspective.

As for the unit in general, tenants of both unit types agreed most with the statement "It is easy for me to reach the door handles in my unit." Those living in accessible units also agreed most with the statement "It is easy for me to enter and exit my unit." Accessible design has apparently succeeded in making it simple for occupants to reach door handles and move in and out of a residence with ease. Given that making changes to the physical environment can increase autonomy and functional independence for older people, and that this can lead to positive physical and mental health outcomes (Bakker, 1999), this finding is important; however, the two general items participants agreed with least were: "It is easy for me to use the alarm system in my unit" and "The medical equipment I use fits well in my unit." These responses may have occurred because not every unit was equipped with an alarm system, or if one was installed, it may not have been noticeable. Also, perhaps not every tenant understood what the question meant by "medical equipment"; however,

if this were the case, participants had the option to offer this explanation in the open-ended section following the questionnaire item. Future research should clarify how different forms of medical equipment fit with accessible design models in subsidized housing.

Our findings focus on one specific type of housing; however, they may be extrapolated to other forms and locales to initiate further discussion and research about why people experience accessible and non-accessible home environments in similar ways. We hope that these findings will inform the provincial and national housing agencies for which this study was undertaken, as well as local governments interested in how satisfied older adults living in subsidized housing units are with accessible design features.

## Limitations

The number of accessible and non-accessible units in each participating building was known at the time of data collection. Nevertheless, responses were difficult to interpret because of a lack of information about square footage, fixed and movable features, and specific accessible design elements. Although each accessible unit had been modified according to guidelines in the British Columbia provincial building code (see Ministry of Public Safety and Solicitor General, 2011), future research should gather detailed information about how subsidized residences have been altered for accessibility and general design attributes included in non-accessible units.

Because the study was done in collaboration with a provincial housing agency, restrictions were placed on how much information could be asked of participants about their physical and mental competencies. These restrictions also made it necessary to create a questionnaire specific to the study's aim. Further research using previously validated tools to compare attitudinal and behavioral results with the physical and mental needs and abilities of residents would help substantiate the present study's findings.

Future research should also aim to understand how the health and functional status of older adults may associate with design effectiveness, as well as determine how representative respondents are of the larger populations from which they came.

## CONCLUSION

Increased sense of control in a residential environment has been positively associated with resident health, morale, self-esteem, and level of functioning (Danziger & Chaudhury, 2009; Olaf & Johannes, 2007). As aging in place becomes increasingly popular, the demand to alter housing stock for accessibility and maneuverability will rise. As the population ages, research on the strengths and weaknesses of accessible housing design models will also gain value. The goal of the present study was to begin to augment the body of knowledge about how individuals living in subsidized housing perceive and behave in both accessible and non-accessible units.

Current provincial accessibility design guidelines appear to be adequate, in that occupants of accessible and non-accessible subsidized housing are generally satisfied with the design of their unit. Levels of satisfaction do not significantly differ for the design of bathrooms, bedrooms, or the unit in general; however, the height of kitchen cabinet handles should be further investigated for functionality and comfort in accessible kitchen design models. Although individuals living in non-accessible units experience a higher degree of satisfaction with some design aspects of their kitchen, those living in accessible units are not significantly statistically dissatisfied with their kitchen space.

Overall, high satisfaction levels imply that accessible subsidized housing units are affording tenants comfort and livability similar to that of non-accessible units, and that aging in place is likely to occur given the degree of satisfaction. These findings may guide designers and researchers in understanding accessible residential environments and how people feel and function within them.

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