RESEARCH REPORT

EVALUATION OF OPTIMAL BATH GRAB BAR PLACEMENT FOR SENIORS

EXTERNAL RESEARCH PROGRAM

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FINAL REPORT

Evaluation of Optimal Bath Grab Bar Placement for Seniors

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Evaluation of Optimal Bath Grab Bar Placement for Seniors

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Abbreviated Abstract

The purpose of the proposed study was to evaluate the patterns of use as well as the perceived usefulness and perceived safety of five different configurations of bathtub grab bars for community-living seniors. Current bathing activities, fall history, sociodemographic characteristics, balance measures as well as details about the home bathing environment were recorded for 103 participants. Participant also evaluated five different configurations of bathtub grab bars to get in/out and sit down/get up from a standard bathtub. The five configurations evaluated corresponded to the standards published by the Canadian Standards Association, the US Uniform Accessibility Standards, a modification of the Ontario Building code, a "common configuration" and a composite configuration. A series of recommendations and suggestions for future research are made based on the data from the study.

Évaluation de l’emplacement optimal des barres d’appui pour la baignoire destinées aux personnes âgées

H Sveistrup, D Lockett, N Edwards, F Aminzadeh

Abrégé

L’étude proposée avait pour but d’évaluer le mode d’utilisation ainsi que la perception de l’utilité et de la sécurité de cinq différentes configurations de barres d’appui pour la baignoire conçues pour les personnes âgées vivant dans la communauté. Dans le cadre de l’étude, des données ont été consignées auprès de 103 participants sur les activités habituelles entourant le bain, les antécédents de chutes, les caractéristiques sociodémographiques, les mesures de l’équilibre, et sur certains détails de l’environnement dans lequel se déroulent les activités du bain au domicile des personnes âgées. Les participants ont également évalué cinq différentes configurations de barres d’appui utilisées pour entrer dans la baignoire/en sortir, s’asseoir au fond / se relever. Les cinq configurations évaluées correspondaient respectivement aux normes publiées par l’Association canadienne de normalisation, aux normes américaines intitulées Uniform Federal Accessibility Standards, à une version modifiée de la configuration conforme aux exigences du Code du bâtiment de l’Ontario, à une « configuration courante » et à une configuration composite. Une série de recommandations et de suggestions fondées sur les données de l’étude ont été formulées en vue de recherches futures.

ABSTRACT

In a previous study, many seniors reported that the placement of the bath bar in the tub area of the bathroom of their homes was not optimal for their use. The purpose of this study was to evaluate the patterns of use as well as the perceived usefulness and safety of different configurations of bath bars. Five bathtub grab bar configurations were tested: the first was designed to fulfill the standards published by the Canadian Standards Association (CSA); the second to meet the US Uniform federal Accessibility Standards (UFAS); the third was a modified version of the Ontario Building Code configuration (OBC); the fourth was an Ottawa-Carleton common configuration (OCC Configuration, based on data from a 1998-1999 study); and the fifth was a composite of all the grab bars used in the previous four configurations (All Bars). The specific objectives of the study were to develop a profile of bathtub grab bars in seniors' homes; determine the perceived usefulness, safety and patterns of use of five different configurations of bathtub grab bars; and find out which of the five configurations tested was perceived as the safest and most useful.

Community-living seniors (n=103) completed a series of questions on health and activity levels, specifics about current bathing activities, fall history and sociodemographic characteristics as well as details about the physical configurations of the bathroom grab bars in their homes. Two clinical tests were used to obtain a measure of participant's ability to maintain their balance: the timed get-up-and-go test and the one-legged stance test. Finally, each participant was asked to use and then evaluated the five different configurations of grab bars designed to help them to get in/out and sit down/get up from a standard bathtub. All testing took place in a laboratory setting.

The majority of respondents did not have bathtub grab bars installed in their home. Of those with home bars (37%), most reported that they used the bars on a regular basis (~80%). Significant differences in mean ratings of safety, comfort, ease of use, helpfulness, likelihood of use, and total composite score were detected between configurations. Overall, respondents were fairly consistent in their ratings of grab bar configurations. Configurations rated as highly comfortable were also more likely to be rated as helpful, easy to use, safe, and most likely to be used. An exception was the modified OBC configuration where the rating for helpfulness in getting in and out of the bathtub was not highly correlated with ratings of such factors as comfort, safety or ease of use. The modified OBC configuration was consistently ranked least favourable: almost half of respondents felt it was least acceptable, least comfortable, most difficult to use, least helpful, least safe, and least preferred. The next lower ranked configuration was the CSA standard. The third least favourable was the UFAS configuration although it received a low rating by less than 20% of respondents. There were no relationships between the respondent's profiles and their preferred configurations. A series of recommendations and suggestions for future research are made.

RÉSUMÉ

Au cours d'une étude précédente, plusieurs personnes âgées avaient indiqué que l'emplacement des barres d'appui autour de la baignoire dans la salle de bains de leur maison n'en favorisait pas l'utilisation. La présente étude avait pour but d'évaluer le mode d'utilisation ainsi que la perception de l'utilité et de la sécurité de différentes configurations de barres d'appui pour la baignoire. Cinq configurations de barres d'appui ont fait l'objet d'essais : la première configuration était conçue en fonction des normes publiées par l'Association canadienne de normalisation (ACN); la deuxième correspondait aux normes américaines intitulées Uniform Federal Accessibility Standards (UFAS); la troisième était une version modifiée de la configuration du Code du bâtiment de l'Ontario (CBO); la quatrième représentait la configuration courante d'Ottawa-Carleton (CCOC fondée sur les données d'une étude menée en 1998-1999); et la cinquième était composée de toutes les bars d'appui utilisées dans les quatre autres configurations (Toutes les barres). Les objectifs spécifiques de l'étude consistaient à établir un profil des barres d'appui pour la baignoire installées au domicile des personnes âgées; de déterminer le mode d'utilisation ainsi que la perception de l'utilité et de la sécurité de cinq différentes configurations de barres d'appui pour la baignoire; et de trouver quelle configuration, parmi les cinq, était perçue comme la plus utile et la plus sûre.

Dans le cadre de l'étude, des personnes âgées vivant dans la communauté (n=103) ont répondu à une série de questions concernant les niveaux de santé et d'activité, les habitudes précises entourant le bain, les antécédents de chutes, les caractéristiques sociodémographiques, et ils ont fourni des renseignements détaillés sur les configurations de barres d'appui installées dans leur salle de bains. Deux tests cliniques ont été utilisés pour obtenir une mesure de la capacité des participants à garder leur équilibre : le test Get Up and Go et le test d'équilibre One-legged Stance Test. Pour terminer, chaque participant devait utiliser et évaluer les cinq différentes configurations de barres d'appui conçues pour aider la personne à entrer dans une baignoire ordinaire / à en sortir, à s'asseoir dans la baignoire / à se relever. Tous les essais ont eu lieu en laboratoire.

La majorité des participants ont indiqué qu'il n'y avait pas de barres d'appui pour la baignoire dans la salle de bains de leur maison. La plupart de ceux qui avaient des barres (37 %), ont indiqué qu'ils les utilisaient régulièrement (~80 %). Des différences significatives sont apparues entre les configurations pour ce qui est des cotes moyennes attribuées à la sécurité, au confort, à la facilité d'utilisation, à l'utilité, à la probabilité d'utilisation, et le score composite. Dans l'ensemble, les répondants ont été assez cohérents dans leur évaluation des différentes configurations. Les configurations cotées très confortables étaient également plus susceptibles d'être cotées efficaces, faciles d'utilisation, sûres, et ayant le plus de chances d'être utilisées. La configuration modifiée du CBO constitue une exception à cet égard car la cote accordée au facteur de l'aide que procure la configuration pour entrer dans la baignoire et en sortir n'était pas hautement corrélée aux cotes attribuées à des facteurs comme le confort, la sécurité ou la facilité d'utilisation. Cette configuration a été constamment classée moins favorablement : presque la moitié des participants ont déclaré qu'elle était la moins acceptable, la moins confortable, la plus difficile à utiliser, la moins efficace, la moins sûre, et celle qu'on aimait le moins. La deuxième moins bien cotée a été la configuration correspondant aux normes de l'ACN. La configuration UFAS était au troisième rang parmi les moins favorables

même si moins de 20 % seulement des répondants lui ont attribué une basse cote. Aucune relation n’a été établie entre les profils des participants et leurs configurations préférées. Une série de recommandations et de suggestions ont été formulées en vue de recherches futures.

EXECUTIVE SUMMARY

Background: Falls are common barriers to independent living among older adults and are among the leading causes of fatal and non-fatal injuries, hospitalisations and functional disabilities among seniors. About one-third of seniors living independently in the community report at least one fall each year. Between one- to two-thirds of these falls occur inside the home, with bathrooms being one of the most commonly cited locations for indoor falls. Encouraging the use of bathroom aids for safe and independent bathing and toileting has been an important component of some recent fall prevention programs. Yet studies have shown that grab bars are largely under-utilised, even by seniors who would presumably benefit from them.

Our research suggests that this under-utilization is largely due to their perceived awkwardness. A 1998-99 study examining patterns of bathing and bath bar use among 550 community-dwelling seniors in the Ottawa-Carleton/Hull-Outaouais region found that almost one-third of participating seniors were restricted in their bathing practices because they had difficulty with bath transfers, that is getting in or out of the tub or sitting into or getting up from the bottom of the tub.[1] The study also found that 55% of the falls that took place in the bathroom, occurred while bathing. Unsuccessful transfers in or out of the tub were implicated in as many as 70% of bath falls. When seniors reported the details of their falls, all but one said that despite having access to bath grab bars, these were not being used at the time of their fall. Many seniors reported that the placement of the bath bar in the tub area was not optimal for their use.

Study Purpose: The purpose of this study was to evaluate the patterns of use as well as the perceived usefulness and safety of different configurations of bath bars for community-dwelling seniors. The different configurations include those built to CSA standards as well as four alternative designs. The specific objectives of the study were to develop a profile of the current use of bathtub grab bars; determine the perceived usefulness, safety, and patterns of use of five different configurations of bathtub grab bars; and find our which of the standards tested is perceived as the safest and most useful.

Methodology: A convenience sample of 103 seniors living in their homes were recruited from community centres and seniors programs in the Ottawa area and participated in the study. Testing required approximately 60 minutes per participant and took place in a laboratory setting at the University of Ottawa. Participants were first interviewed using the Bath Grab Bar Placement Questionnaire which included a series of questions on health and activity levels, specifics about current bathing activities, fall history, sociodemographic characteristics as well as details about the availability and placement of grab bars in the tub area of the bathroom of the participants' homes. In addition, participants completed two clinical balance tests - the Timed Up-and-Go (TUG) and the One-Legged Stance (OLS). Participants using a walking aid for mobility were asked to complete the TUG test both with and without (if able and deemed safe by both the participant and the interviewers) using their aid.

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[1] Aminzadeh, F., Edwards, N., Lockett, D., Nair, R. Utilization of bathroom safety devices, patterns of bathing & toileting and bathroom falls in a sample of community living older adults. Technology and Disability, 13, 95-103, 2000

The second component of the testing session consisted in evaluating a series of bathtub grab bar configurations. A bathtub testing area with interchangeable grab bar configurations was designed and built to mimic, as closely as possible, a residential bathroom. The 3.78 by 2.3 metre room included a bathtub (1.52 x .76 x .41 metre), a wall-mounted sink with a mirror and two toilets (one residential and one institutional). The walls of the bathtub were reinforced with ¾ inch plywood covered with gyp rock on the head, faucet and back walls. The faucet, water control and showerhead were located at the right end of the tub (when facing the tub). On the opposite wall, an opening was cut out of the wall at the height of .55 metres above the rim of the tub. This opening was required for teaching and videotaping purposes.

Participants were asked to stand and enter the standard bathtub, sit on the bottom of the tub, stand up from the bottom of the tub, and exit the tub using each of five different bathtub grab bar configurations. This component of the test session was done with the participants in bare feet. The instructions to the participants were limited. They were asked to get into and out of the tub as naturally as possible. They were told to use any supports, including the bathtub grab bars, if they felt they were necessary or if they would help. They were told that they were not required to use any of the bars if they did not feel that the bar would be helpful.

Once participants exited the tub, they were asked to rate a 6-question evaluation scale for the configuration they had just tried using a 1-6 evaluation scale. Each participant got into and out of the tub once with each of the five configurations installed. Participants were videotaped by two video cameras as they completed the bathtub test.

Two different series of questions were used to allow participants to evaluate each of the bath grab bar configurations. Once participants tested each of the five configurations they were asked to complete the first series of questions. The objective was to allow participants to evaluate each configuration separately on multiple factors (safety, ease of use, helpfulness, and comfort) immediately after using the configuration to get in and out of the tub. Once participants tested all of the five configurations they were asked to complete the second series of questions. These asked participants to rank order all of the configurations relative to each other on several factors (safety, ease of use, preference, acceptability, comfort, and helpfulness). Finally, participants were asked to draw an “ideal” grab bar configuration for their needs.

Five bathtub grab bar configurations were tested: the first was designed to fulfill the standards published by the Canadian Standards Association (CSA); the second to meet the US Uniform Federal Accessibility Standards (UFAS); the third was a modified version of the Ontario Building Code configuration (OBC); the fourth was an Ottawa-Carleton common configuration (OCC configuration); and the fifth a composite of all the grab bars used in the previous four configurations (All Bars). The original OBC configuration was not used due to difficulties in acquiring the specified bar. The modified version that was used consisted of an "L"-shaped bar with legs 15-cm. shorter than that specified by the OBC (75 cm versus 90 cm). The OCC configuration was designed to resemble a configuration widely used by seniors participating in the Ottawa-Carleton/Hull-Outaouais region study (Aminzadeh et al, 2000) as well as by a number of occupational therapists practicing in the Ottawa and Montreal areas. It consisted of two bars, one angled bar mounted on the back wall and one vertical bar mounted on the faucet wall.

Results: The sample of seniors recruited for participation in this study was relatively healthy with the majority able to complete all components of the testing protocol. Nine participants did not sit in the bottom of the bathtub for at least one configuration. One participant did not complete the TUG test and five did not complete the one-legged stance test. The demographic profile of the study participants reflects that of the general population of seniors living independently in the Ottawa/Carleton region. Moreover, overall demographic and health profiles, including the prevalence of falls, were comparable to estimates provided in other community-based studies (Campbell et al., 1989; Graafmans et al., 1996; Hale et al., 1992; Lockett et al., 1999; Lord et al., 1993; Nevitt et al., 1989; Nevitt et al., 1991; O'Loughlin et al., 1993; Robbins et al., 1989; Sorock & Labiner, 1992; Tinetti et al., 1988). Despite being generally healthy, almost one-third of participants reported having had balance problems and falls in the previous year and over one-third reported difficulties with bathing. The study evaluations of balance and mobility matched participants' self-evaluation results, indicating that participants were able to appropriately evaluate their individual competency levels. Further, one quarter of the participants who reported not using mobility aids self-reported a balance problem.

Characteristics of the grab bars that seniors use in their homes: The majority of study participants (64.1%) did not have grab bars installed in their home bathrooms. However, most participants with grab bars installed in their homes indicated that they used them on a regular basis, Although findings from our previous research (Aminzadeh et al., 2000) suggest that a minimum of two bath grab bars are needed in seniors' homes, only 11 participants in the this study reported having two or more bath grab bars in their home. This study did not address the question of why grab bars were not installed. Home bathtub grab bar location and configurations were varied. The most commonly reported location for bath bars was the back wall. However, 20% of respondents with grab bars indicated that they had a bar on the bath rim. Preliminary consultation with occupational therapists suggests that the horseshoe bar mounted on the bathtub rim may be a safety hazard (predisposing people to falls from tripping). Given this possibility, follow-up studies of this type of bar are warranted.

Preferred grab bar configurations: The ratings for each of the factors evaluated were relatively consistent for all configurations. This suggests that a single composite score could be used to represent each configuration. A significant relationship between ratings for safety, acceptance and preference further suggests seniors may recognise the safety bath grab bars can provide. An exception to consistent ratings was the OBC modified configuration where ratings for comfort, ease of use and safety were not significantly associated with helpfulness in getting in and out of the tub. This is not surprising since the OBC modified configuration consists of an L-shaped bar on the back wall only and thus it would not be helpful for entering or exiting the tub. Moreover, the OBC modified configuration was the only configuration tested that did not have a bar on either the head or faucet wall.

In all factors evaluated (perceived helpfulness, safety, ease of use, comfort, etc.), the All Bar configuration was ranked highest, followed by the UFAS and OCCC

configurations. The lowest rankings were recorded for the CSA and OBC configurations. The rankings using Composite Scores resulted in two groups of configurations with the All Bars, UFAS and OCCC configurations ranking significantly higher than the CSA and OBC configurations.

It is possible that the OBC modified configuration was ranked significantly lower than the other configurations tested simply due to the lack of a bar on the faucet/head wall. The low ranking of the CSA configuration is more difficult to explain since it includes a vertical bar on the faucet wall. In one pattern of entry into the tub observed in this study, participants grabbed the faucet wall bar with one hand, stepped into the tub and then quickly grabbed the back wall bar with the other hand before stepping into the tub with the second foot. If this were the preferred entry pattern, it is possible that the horizontal bar on the back wall in the CSA configuration could be too low to serve this purpose. However, this hypothesis remains to be confirmed.

Use of grab bars and other supports by participants: Video data collected during the study showed that there was no relationship between the Configuration Composite Scores (highest score indicating best results across all factors as determined by survey data) and the number of activities (i.e., getting in, sitting down, getting up, getting out) a grab bar within a given configuration was used. This is surprising and suggests that the self-report or perceived ratings on the factors tested may not be reflective of actual grab bar use. Thus, although participants may have positively ranked a given configuration, they may not have used the bars within the configuration when they actually performed the bathtub test.

Results of video data suggest that all but one participant used at least one grab bar at some point during the testing. Overall, the OBC modified configuration was least likely to be used. There were no significant differences between configurations in the prevalence of use of grab bars to sit down or get up from the bottom of the tub. This is not surprising since all configurations had at least on bar mounted on the back wall of the bathtub. However, as noted before, for entering and exiting the tub, the OBC modified configuration was significantly less used than all of the other configurations tested.

Most participants used other supports, other than grab bars, during the testing. Use of other supports was highest when using the OBC modified configuration. In over 17% of the individual entries and exits from the bathtub, participants used the bathroom wall to support themselves during the transfer and they relied on a wall for support most often when using the OBC modified configuration. The majority of participants (99%) used the bathtub rim and back rims to support themselves when sitting into or getting up from the bottom of the tub, irrespective of configuration. The high prevalence of use of bath edges to sit down and get up from the bottom of the bathtub is alarming and highlights the need for additional safety features such as non-slip surfaces for bath edges.

Characteristics of seniors for whom bath grab bars may be most useful: Characteristics of the individuals ranking each configuration high versus low on the different domains were determined. There were no differences between groups of individuals identified. This suggests that the rank order obtained is representative of perceived preference regardless of health/demographic/fall history for seniors with similar profiles to our study participants. Similarly, no significant differences between

those who used and those who did not use grab bars for various activities were found. These findings suggest that grab bars should be installed in all bath tubs to be used by seniors.

Ideal bath grab bar configurations: When participants were asked to identify an ideal configuration, the most prevalent configuration consisted of two bars: one vertical bar located on the faucet wall; and one bar horizontal or on an angle located on the back wall. This is consistent with the patterns of grab bar use identified during the testing.

Recommendations:

1. Grab bars should be installed in all bathtubs to be used by seniors.
2. A minimum of two bars should be included in each bathtub to be used by seniors. One bar should be intended to help them enter/exit the bathtub, the other to assist them in sitting down into or getting up from the bottom of the tub.
3. The bar intended to help seniors enter/exit the bathtub should be located on the head or faucet wall. A vertical bar is useful for both activities. A horizontal bar can also be useful if it is extended past the rim of the tub into the "clear" space outside the tub.
4. The bar intended to assist seniors to sit/stand from the bottom of the tub should be located on the back wall of the tub. A horizontal or angled bar can be most useful. However, multiple configurations may be necessary to respond to specific needs of users.
5. Non-slip surfaces on edges (bathtub rim and back bathtub rim) should be incorporated as standard safety features on bathtubs to be used by seniors.
6. In new bathtub constructions intended for seniors, a "U-shaped" drywall reinforced area on the back wall as well as two "inverted-T shaped" drywall reinforced areas on the faucet and head wall should be included to permit safe installation of appropriate configuration(s) (see figure below).

Suggestions:

Additional research should be carried out to:

1. Address possible social/cultural/affective bias against the use of assistive devices. Specifically, perceptions of frailty and aging have been associated with assistive device use and may influence an individual's decision to install a bath grab bar.
2. Determine why seniors do not install grab bars in their bathrooms.
3. Determine the level of safety, ease of use, and helpfulness of rim-mounted bathtub grab bars.
4. Address the level of coherence between an individual's self-report of behaviour and the actual behaviour of the individual when performing the task.

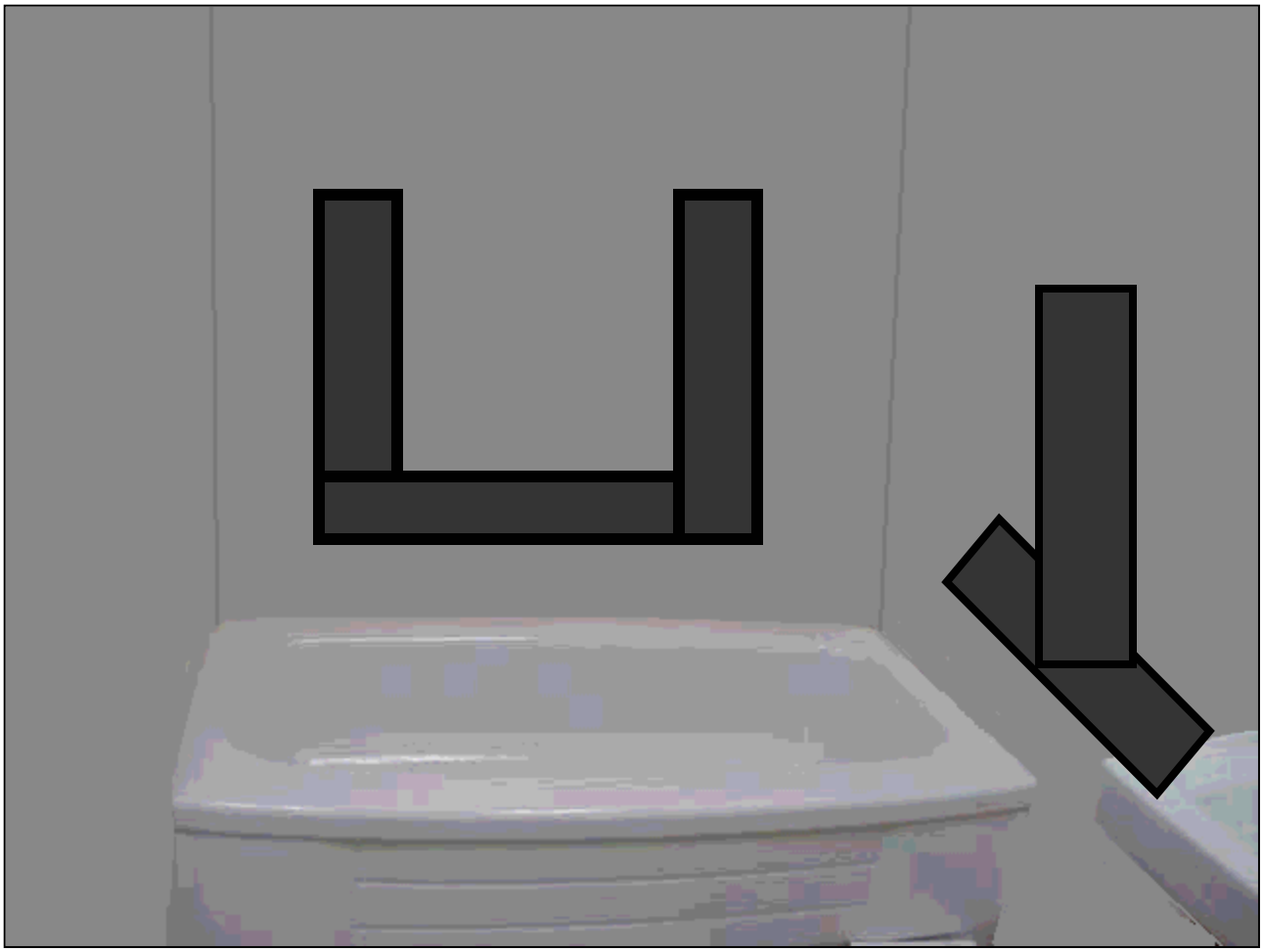

Figure: The dark blocks indicate the "U-shaped" and "Inverted t-shaped" wall areas requiring reinforcement for grab bar installation.

SOMMAIRE

Contexte : Les chutes constituent de fréquents obstacles au maintien de l'autonomie dans la vie quotidienne des adultes âgés, et comptent parmi les principales causes de blessures, mortelles et non mortelles, d'hospitalisations et d'invalidités fonctionnelles chez les aînés. Chaque année, un tiers environ des personnes âgées vivant de façon autonome dans la communauté déclarent avoir fait au moins une chute, et un à deux tiers de ces chutes surviennent à la maison, la salle de bains étant, à cet égard, l'endroit le plus souvent mentionné. Récemment, un volet important a été intégré à certains programmes de prévention des chutes visant à inciter les personnes âgées à utiliser des appuis de salle de bains pour prendre leur bain de façon autonome et faire leur toilette en toute sécurité. Cependant, les études ont démontré que les barres d'appui sont, dans une large mesure, sous-utilisées, même par les personnes âgées qui auraient vraisemblablement avantage à s'en servir.

Il ressort de notre recherche que le phénomène de sous-utilisation des barres d'appui est en grande partie dû au fait qu'elles sont perçues comme des objets encombrants. Au cours d'une étude menée en 1998-1999, les activités du bain et les habitudes d'utilisation des barres d'appui ont été examinées chez 550 personnes âgées de la région d'Ottawa-Carleton/Hull-Outaouais vivant dans la communauté. Il est apparu alors que près du tiers des participants était limité dans les activités entourant le bain en raison de problèmes de transfert, c'est-à-dire qu'ils avaient de la difficulté à entrer dans la baignoire ou à en sortir, à s'asseoir au fond ou à se relever[1]. L'étude a également révélé que 55 % des chutes survenues dans les salles de bains s'étaient produites pendant le bain, et dans 70 % des cas, au moment où la personne entrait dans la baignoire ou en sortait. Lorsque les personnes âgées ont décrit leur chute en détail, toutes, sauf une, ont affirmé que même si elles avaient accès à des barres d'appui pour la baignoire, elles ne s'en servaient pas au moment de leur chute. Plusieurs participants ont indiqué que l'endroit où avaient été fixées les barres d'appui n'était pas l'emplacement optimal pour leur utilisation.

But de l'étude : L'étude avait pour but d'évaluer le mode d'utilisation ainsi que la perception de l'utilité et de la sécurité de différentes configurations de barres d'appui pour la baignoire destinées aux personnes âgées vivant dans la communauté. Les différentes configurations utilisées dans le cadre de l'étude comprenaient une configuration conçue selon les normes de l'Association canadienne de normalisation (ACN), ainsi que quatre configurations alternatives. Les objectifs spécifiques de l'étude consistaient à établir un profil de l'utilisation actuelle des barres d'appui pour la baignoire; de déterminer le mode d'utilisation ainsi que la perception de l'utilité et de la sécurité de cinq différentes configurations de barres d'appui; et de trouver quelle configuration était perçue comme la plus sûre et la plus utile, parmi celles qui avaient fait l'objet d'essais.

Méthodologie :
Un échantillon de commodité composé de 103 personnes âgées, habitant dans leur maison, a été recruté dans les centres communautaires et au sein de programmes pour personnes âgées dans la région d'Ottawa. Les tests duraient environ 60 minutes par participant et étaient

[1] Aminzadeh, F., Edwards, N., Lockett, D., Nair, R. Utilization of bathroom safety devices, patterns of bathing & toileting and bathroom falls in a sample of community living older adults. Technology and Disability, 13, 95-103, 2000

effectués dans une pièce de laboratoire à l'Université d'Ottawa. Une entrevue avait d'abord lieu avec les participants à partir d'un questionnaire sur l'emplacement des barres d'appui pour la baignoire comprenant une série de questions sur les niveaux de santé et d'activité, les habitudes entourant le bain, les antécédents de chutes, les caractéristiques sociodémographiques, l'accessibilité et l'emplacement des barres d'appui installées autour de la baignoire dans leur propre maison. En outre, les participants effectuaient deux tests cliniques d'équilibre – le test chronométré Get Up and Go et le test d'équilibre sur une seule jambe One-legged Stance. Les participants qui se servaient d'une aide technique pour se déplacer devaient effectuer le test Get Up and Go avec et sans cette aide (selon leur capacité et si la personne conduisant l'entrevue et eux-mêmes n'y voyaient aucun danger).

La deuxième composante de la séance d'essais consistait à évaluer une série de configurations de barres d'appui pour la baignoire. Dans l'aire du laboratoire aménagée aux fins des essais, on avait installé une baignoire et des configurations de barres d'appui interchangeables, le tout conçu et construit de façon à imiter le mieux possible la salle de bains d'une maison privée. La pièce, qui mesurait 3,78 mètres sur 2,3 mètres, comprenait une baignoire (1,52 x 0,76 x 0,41 mètre), un évier fixé au mur, ainsi qu'un miroir, et deux toilettes, l'une de type résidentiel et l'autre de type institutionnel. Les murs entourant la baignoire avaient été renforcés au moyen de panneaux de contreplaqué de ¾ pouce, et le mur où se trouvait le robinet, le mur opposé et le mur du fond avaient été recouverts de placoplâtre. Le robinet, le régulateur de débit d'eau et la pomme de douche étaient placés au bout de la baignoire, du côté droit (lorsqu'on faisait face à la baignoire). Sur le mur opposé, une ouverture avait été pratiquée à hauteur de 0,55 mètre au-dessus du bord de la baignoire aux fins d'enseignement et d'enregistrement sur bande magnétoscopique.

Pendant les essais, on demandait aux participants de se lever, d'entrer dans la baignoire (de type standard), de s'asseoir au fond, de se relever et de sortir, en utilisant cinq différentes configurations de barres d'appui. Les participants effectuaient cette composante des essais pieds nus. Les directives données au sujet de l'essai étaient limitées. On demandait aux participants d'entrer dans la baignoire et d'en sortir le plus naturellement possible, d'utiliser n'importe quel type d'appui, y compris les barres d'appui pour la baignoire, s'ils croyaient que ces appuis étaient nécessaires ou pouvaient les aider. On leur disait par ailleurs qu'ils n'étaient pas obligés d'utiliser les barres d'appui s'ils avaient l'impression qu'elles ne leur seraient d'aucune utilité.

Lorsque les participants étaient sortis de la baignoire, on leur demandait de coter immédiatement, sur une échelle d'évaluation de 1 à 6, la configuration qu'ils venaient tout juste d'utiliser à partir d'une échelle de 6 questions. Chaque participant entrait dans la baignoire et en sortait en utilisant chaque configuration une fois. Les participants étaient filmés au moyen de deux caméras vidéo au moment d'effectuer les essais dans la baignoire.

Deux différentes séries de questions ont été utilisées pour permettre aux participants d'évaluer chaque configuration de barres d'appui pour la baignoire. Lorsque les participants avaient terminé l'essai d'une configuration, on leur demandait de répondre à la première série de questions immédiatement après avoir utilisé la configuration pour entrer dans la baignoire et en sortir, l'objectif étant de leur permettre d'évaluer chaque configuration séparément, en fonction de plusieurs facteurs (sécurité, facilité d'utilisation, degré d'aide, confort). Lorsqu'ils avaient fait l'essai des cinq configurations, on leur demandait de répondre à la deuxième série de questions. Il s'agissait alors pour les participants de classer par ordre de rang toutes les configurations l'une par rapport à l'autre en fonction de plusieurs facteurs (sécurité, facilité

d'utilisation, préférence, acceptabilité, confort, degré d'aide). En terminant, les participants devaient dessiner une configuration de barres d'appui « idéale », en fonction de leurs besoins.

Cinq configurations de barres d'appui pour la salle de bains ont été essayées : la première était conçue selon les normes publiées par l'Association canadienne de normalisation (ACN); la deuxième correspondait aux normes américaines intitulées Uniform Federal Accessibility Standards (UFAS); la troisième était une version modifiée de la configuration conçue en fonction du Code du bâtiment de l'Ontario (CBO); la quatrième représentait une configuration courante d'Ottawa-Carleton (CCOC); et la cinquième était composée de toutes les barres d'appui utilisées dans les quatre autres configurations (Toutes les barres). La configuration originale conforme au Code du bâtiment de l'Ontario n'a pas été utilisée en raison des difficultés à obtenir la barre propre à cette configuration. La version modifiée ayant servi à l'essai consistait en une barre en forme de L, dont les deux bras mesuraient 15 cm de moins que la barre originale (75 cm au lieu de 90 cm). La configuration courante d'Ottawa-Carleton a été conçue pour ressembler à une configuration très utilisée par les personnes âgées ayant participé à l'étude dans la région d'Ottawa-Carleton/Hull-Outaouais (Aminzadeh et al, 2000), et par un certain nombre d'ergothérapeutes pratiquant dans les régions d'Ottawa et de Montréal. Il s'agissait de deux barres, une barre à angle fixée sur le mur du fond, et une barre verticale installée sur le mur du robinet.

Résultats :

L'échantillon de personnes âgées recrutées dans le cadre de l'étude était relativement en bonne santé et la majorité a été en mesure de compléter toutes les parties du protocole d'essai. Neuf participants ne se sont pas assis au fond de la baignoire pour au moins une des configurations. Un participant n'a pas terminé le test Get Up and Go et cinq n'ont pas effectué le test d'équilibre sur une seule jambe. Le profil démographique des participants de l'étude reflétait celui de la population des personnes âgées en général vivant de façon autonome dans la région d'Ottawa/Carleton. En outre, les profils démographiques et de santé dans l'ensemble, y compris la fréquence des chutes, étaient comparables aux estimations fournies dans d'autres études communautaires (Campbell et al., 1989; Graafmans et al., 1996; Hale et al., 1992; Lockett et al., 1999; Lord et al., 1993; Nevitt et al., 1989; Nevitt et al., 1991; O'Loughlin et al., 1993; Robbins et al., 1989; Sorock & Labiner, 1992; Tinetti et al., 1988). En dépit de leur bon état de santé général, près du tiers des participants ont indiqué qu'ils avaient eu des problèmes d'équilibre et fait des chutes au cours de l'année précédente, et au-delà du tiers ont déclaré avoir des difficultés au moment du bain. Les évaluations de l'équilibre et de la mobilité effectuées dans le cadre de l'étude correspondaient aux résultats des autoévaluations des participants, ce qui indique que les participants ont été capables d'évaluer correctement leur niveau de capacité individuel. De plus, un quart des participants qui avaient affirmé ne pas utiliser d'appareils et accessoires fonctionnels ont indiqué qu'ils avaient des problèmes d'équilibre.

Caractéristiques des barres d'appui utilisées par les personnes âgées à la maison : La majorité des participants de l'étude (64,1 %) n'avaient aucune barre d'appui dans leurs salles de bains. Toutefois, la plupart de ceux qui en avaient ont indiqué qu'ils utilisaient ces barres régulièrement. Bien que les résultats de notre précédente étude (Aminzadeh et al., 2000) laissent entendre qu'il est nécessaire d'installer au minimum deux barres d'appui pour la baignoire au domicile des personnes âgées, 11 participants seulement ont indiqué qu'il y avait deux barres d'appui ou plus installées dans leur salle de bains. Dans le cadre de la présente

étude, on n'a pas cherché à savoir pourquoi des barres d'appui n'y avaient pas été installées. Selon les indications des participants, l'endroit où avaient été fixées les barres d'appui pour la baignoire variait, de même que les configurations, mais l'endroit le plus souvent mentionné était le mur situé derrière la baignoire. De plus, 20 % de ceux qui avaient des barres d'appui ont indiqué qu'il y en avait une sur le bord de leur baignoire. Lors de consultations préliminaires auprès d'ergothérapeutes il était ressorti que les barres en forme de fer à cheval installées sur le bord de la baignoire pouvaient présenter des dangers (exposant les personnes à chuter en trébuchant). En raison de cette possibilité, des études de suivi sur ce type de barre sont justifiées.

Préférences au niveau des configurations de barres d'appui: Les cotes attribuées à chacun des facteurs évalués étaient relativement cohérentes dans toutes les configurations. Ce qui permet de penser qu'un score composite pourrait être utilisé pour représenter chacune d'elles. De plus, la relation significative entre les cotes attribuées aux facteurs sécurité, acceptation et préférence semble indiquer que les personnes âgées sont en mesure d'apprécier la protection que procurent les barres d'appui. La version modifiée de la configuration du CBO faisait exception à cet égard car les cotes accordées aux facteurs confort, facilité d'utilisation et sécurité n'étaient pas associées de façon significative à l'aide qu'elle procurait pour entrer dans la baignoire et en sortir. Cela n'a rien d'étonnant car cette configuration modifiée était composée d'une seule barre, en forme de L, fixée sur le mur derrière la baignoire. Par conséquent, cette barre seule n'était d'aucun secours pour entrer dans la baignoire et en sortir. En outre, la configuration modifiée du CBO était la seule à ne pas comprendre de barre d'appui sur le mur du robinet ou le mur opposé.

Parmi tous les facteurs évalués, (perception de l'utilité, de la sécurité, de la facilité d'utilisation, du confort, etc.), la configuration Toutes les barres a été classée au niveau le plus élevé suivie de la configuration UFAS et de la configuration courante d'Ottawa-Carleton (CCOC). Les configurations classées le plus bas sont celles de l'Association canadienne de normalisation (ACN) et du Code du bâtiment de l'Ontario (CBO). Le classement fait à partir des scores composites a eu pour résultat de diviser les configurations en deux groupes, Toutes les barres, UFAS et CCOC récoltant des scores significativement plus élevés que les configurations ACN et CBO.

Il est possible que la configuration modifiée du CBO ait été classée de façon significativement plus basse que les autres configurations mises à l'essai simplement en raison de l'absence de barre d'appui sur le mur où se trouve le robinet / mur opposé. Cependant, il est plus difficile d'expliquer pourquoi la configuration de l'ACN a été classée à un rang aussi bas alors qu'elle comprend une barre verticale sur le mur du robinet. Au cours de l'étude, on a observé que l'une des façons d'entrer dans la baignoire consistait pour le participant à saisir d'une main la barre fixée sur le mur où se trouve le robinet, puis à mettre un pied dans la baignoire, à saisir rapidement la barre située sur le mur arrière avec la deuxième main, avant même de placer l'autre pied à l'intérieur. S'il s'agit là d'une préférence dans la façon d'entrer dans la baignoire, on peut penser que dans le cas de la configuration de l'ACN, la barre horizontale fixée sur le mur à l'arrière de la baignoire est placée trop bas pour servir à cette fin. Il faudrait toutefois confirmer cette hypothèse.

Utilisation des barres d'appui et autres appuis par les participants : Au cours de l'étude, les données recueillies sur vidéo ont montré qu'il n'existait aucune relation entre les cotes attribuées par les participants aux différentes configurations et l'utilisation qu'ils en

avaient fait. Ainsi, bien que les participants aient pu classer positivement une configuration donnée, il est possible qu'ils n'aient pas utilisé les barres de cette configuration au moment des essais dans la baignoire.

Les résultats fournis par les données de la vidéo montrent que tous les participants, sauf un, ont utilisé au moins une barre d'appui à un moment ou l'autre des essais. Dans l'ensemble, la version modifiée de la configuration du Code du bâtiment de l'Ontario était la moins susceptible d'être utilisée. Il n'y avait aucune différence significative entre les configurations pour ce qui est de la fréquence d'utilisation des barres pour s'asseoir au fond de la baignoire ou se relever. Cela n'a rien de surprenant car dans toutes les configurations au moins une barre d'appui avait été fixée sur le mur derrière la baignoire. Toutefois, comme il a été dit précédemment, pour entrer dans la baignoire et en sortir, la configuration modifiée du Code du bâtiment de l'Ontario était, de façon significative, beaucoup moins utilisée que toutes les autres configurations mises à l'essai.

La plupart des participants ont utilisé d'autres appuis, différents des barres d'appui, au moment d'effectuer les essais. L'utilisation d'autres types d'appui était la plus élevée quand les participants faisaient l'essai de la configuration modifiée du Code du bâtiment de l'Ontario. Dans plus de 17 % des cas, lorsqu'ils entraient dans la baignoire et en sortaient, les participants utilisaient le mur de la salle de bains comme soutien, durant ces transferts, et c'est lorsqu'ils utilisaient cette configuration qu'ils se servaient le plus souvent d'un mur en guise d'appui. La majorité des participants (99 %) se servaient du bord immédiat et arrière de la baignoire pour se soutenir lorsqu'ils s'asseyaient au fond de la baignoire ou se relevaient, indépendamment de la configuration de barres d'appui utilisée. À cet égard, la fréquence très élevée d'utilisation par les participants du bord de la baignoire pour s'asseoir et se relever est alarmante et montre la nécessité de prévoir des dispositifs de sécurité additionnels comme la mise en place de surfaces antidérapantes.

Caractéristiques des personnes âgées pour qui les barres d'appui pourraient être les plus utiles. Aucun mode particulier d'utilisation n'est ressorti permettant de croire que les participants ayant des caractéristiques particulières seraient plus susceptibles de coter positivement ou d'utiliser des configurations spécifiques. Par exemple, les participants plus âgés et plus jeunes étaient également susceptibles de préférer et d'utiliser indifféremment l'une ou l'autre configuration. Ces résultats permettent de croire que les barres d'appui sont perçues comme utiles et sont utilisées par les personnes âgées, indépendamment de leur profil démographique, du niveau de santé ou des antécédents de chute, et qu'elles devraient être universellement accessibles aux personnes âgées.

Configurations idéales de barres d'appui pour la baignoire : Lorsqu'on a demandé aux participants de déterminer quelle configuration de barres d'appui était idéale, la configuration la plus fréquemment citée était celle composée de deux barres : une barre verticale installée sur le mur du robinet et une barre horizontale, ou à angle, placée sur le mur à l'arrière de la baignoire. Ces résultats correspondent aux observations faites sur les modes d'utilisation des barres d'appui durant les essais.

Recommandations :

1. Toutes les baignoires utilisées par les personnes âgées devraient être munies de barres d'appui.

2. Ces baignoires devraient être munies de deux barres d'appui au minimum, soit une barre pour aider les personnes à entrer dans la baignoire et en sortir, et une autre pour les aider à s'asseoir au fond et à se relever.
3. La barre d'appui destinée à aider les personnes âgées à entrer dans la baignoire et en sortir devrait être fixée sur le mur où se trouve le robinet ou sur le mur opposé. Une barre verticale peut servir à ces fins. Pour ce qui est de la barre horizontale, elle peut également être utile si elle est installée de manière à dépasser le bord jusqu'à la partie « libre », à l'extérieur de la baignoire.
4. La barre d'appui destinée à aider les personnes âgées à s'asseoir au fond de la baignoire et à se relever devrait être placée sur le mur du fond. Une barre horizontale ou à angle peut être des plus utiles. Toutefois, il est possible qu'on doive installer plusieurs configurations de barres pour répondre aux besoins spécifiques des utilisateurs.
5. Il faudrait munir le bord des baignoires (bord immédiat et bord arrière) de surfaces antidérapantes et inclure cette caractéristique dans les normes de sécurité obligatoires pour ce qui est des baignoires utilisées par les personnes âgées.
6. Dans les salles de bains des nouvelles habitations destinées aux personnes âgées, une partie du mur situé derrière la baignoire devrait être renforcée à l'aide de placoplâtre en forme de U, et de placoplâtre en forme de deux T inversés sur le mur du robinet et le mur opposé, afin de permettre l'installation sécuritaire d'une ou de plusieurs configuration (s) appropriée (s) de barres d'appui (voir figure ci-dessous).

Suggestions :

Il serait nécessaire d'effectuer davantage de recherches pour :

1. Examiner les préjugés sociaux, culturels et affectifs à l'égard des appareils et accessoires fonctionnels. En particulier, les perceptions de fragilité et de vieillissement qui ont été associées à l'utilisation des appareils et accessoires fonctionnels peuvent influer sur la décision d'un individu d'installer des barres d'appui pour la baignoire.
2. Comprendre pourquoi les personnes âgées n'installent pas de barres d'appui dans leurs salles de bains.
3. Déterminer dans quelle mesure les barres d'appui installées sur le bord de la baignoire sont sûres, faciles d'utilisation et utiles.
4. Examiner le degré de cohérence entre la description que donne un individu de son comportement au sujet d'une tâche à accomplir et son véritable comportement dans la pratique.

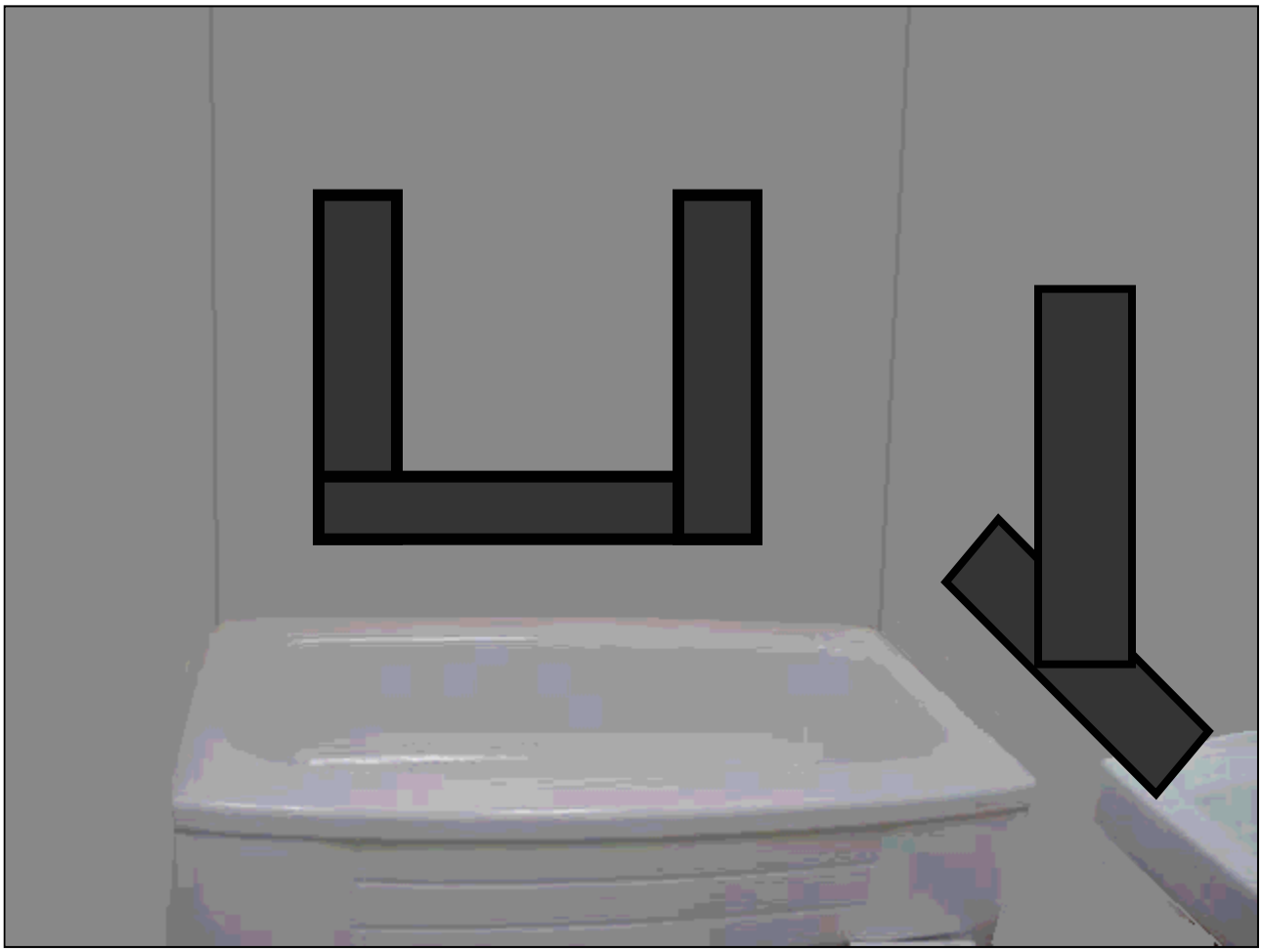

Figure : Les blocs de couleur foncée en forme de U et de T inversé indiquent les parties du mur nécessitant un renforcement pour l'installation des barres d'appui.

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TABLE OF CONTENTS

INTRODUCTION

Research Problem: A 1998-99 study examining patterns of bathing and bath bar use among 550 community-dwelling seniors in the Ottawa-Carleton, Hull-Outaouais region found that almost one-third of seniors are restricted in their bathing practices because they have difficulty with bath transfers (i.e., getting in or out of the tub or sitting into or getting up from the bottom of the tub) (Aminzadeh, F., Edwards, N., Lockett, D., Nair, R. Utilization of bathroom safety devices, patterns of bathing and toileting and bathroom falls in a sample of community living older adults. Technology and disability, 13, 95-103, 2000). In addition, 55% of the falls that took place in the bathroom, occurred while bathing. Unsuccessful transfers in or out of the tub could be implicated in as many as 70% of bath falls. When seniors reported the details of their falls, all but one related that despite having access to bath grab bars, these were not being used at the time of their fall. Many seniors reported that the placement of the bath bar in the tub area was not optimal for their use. **In this study, different configurations of bath bar placements were assessed to identify the perceived safest and perceived most useful configuration for community-dwelling seniors.**

Scope and Objectives: The purpose of the proposed study was to evaluate the patterns of use as well as the perceived usefulness and perceived safety of different configurations of bath bars for community-dwelling seniors. The different configurations include those built to CSA standards as well as four alternative designs. The specific objectives of the study were to:

i) develop a profile of the current use of bathtub grab bars;
ii) determine the perceived usefulness of five different configurations of bathtub grab bars;
iii) determine the perceived safety of five different configurations of bathtub grab bars;
iv) determine the pattern of use of five different configurations of bathtub grab bars;
v) determine which of the standards tested is perceived as the safest and most useful.

OVERVIEW OF PROGRESS

The University of Ottawa Health Sciences and Science Research Ethics Board Certification for the research project was obtained on September 25th 2000 (see Appendix 1). Final signatures for funding release were obtained around March 12 2001 (see Appendix 2). The CMHC Project Officer, Mr. Luis Rodriguez, met with Dr. Heidi Sveistrup on April 11th 2001. At this meeting, the testing area was visited and preliminary observations and possible implications of participant behaviours were discussed. The project Substantive Report was submitted in June 2001 and accepted with minor comments.

METHOD

Participant Recruitment and Eligibility

Recruitment: Recruitment of seniors took place in various seniors' community agencies and clubs. In total, 20 agencies were contacted and asked whether we could recruit seniors from their organisation. Of these, 14 permitted us to conduct presentations, put up posters, and/or set up a booth to facilitate recruitment of seniors in their organisation. Seniors were asked to sign up for the study on site, and were subsequently called to determine their eligibility and continued

willingness to participate in the study. Testing for those who were eligible and willing was arranged at a time that was convenient to the senior.

In total, 134 seniors signed up for the study. Of these, 28 indicated that they were no longer interested in participating when contacted by phone and three were deemed ineligible because they were unable to independently enter/exit their bathtub or did not meet our age criteria (i.e., were younger than 60). Thus, a total of 103 seniors were deemed eligible and agreed to come into the laboratory at the Health Sciences Building, University of Ottawa for testing.

Participant Screening: Measures were developed and used for participant screening. Screening took place in two stages. First, a telephone-screening tool was developed and used to confirm participant eligibility prior to clients attending a testing session (Appendix 4). Once initial eligibility was confirmed and participants consented to participate, an appointment was scheduled. Informed consent was obtained immediately on participant arrival in the testing laboratory. The second phase of eligibility, a cognitive screening (Mini-Mental Test, see Appendix 4) was completed upon arrival to the lab. A protocol was established for those who did not meet the cognitive screening eligibility criteria (they were to be administered the baseline survey only).

Testing

Pilot testing: Three pilot tests were conducted during the process of finalising the bathtub configuration. An initial pilot test of the bathtub configurations was completed with Drs. Lockett and Sveistrup in order to optimise the process of installing and changing the individual configurations for each participant. A second pilot test was completed with the Primary and Secondary #1 and #2 research assistants in order to establish a smooth and efficient testing session. Finally, pilot testing of all measures was conducted with three community-living seniors to determine the actual time required to complete the questionnaire, to "fine tune" data acquisition methods and to assess face validity of the survey items.

Final Procedure: Testing required approximately 60 minutes per participant. Participants were met by one of the research assistants at the front entrance of the Health Sciences Building, University of Ottawa. Upon arriving at the testing laboratory, participants were offered a chair and refreshments. Participants were then asked to read the Letter of Information and Consent. Prior to signing indicating that they consent to participate, participants were shown the bathroom area, testing of bathtub grab bar configurations was explained, balance testing was explained and the questionnaire content was outlined. Also included in the consent form was permission to use the video data for teaching purposes. Participants who refused this portion of the consent form were assured that their faces would not be displayed in any presentation for which the data was used. The participants' right to stop participation at any time was clearly stated. Participants were then asked to sign the Letter of Information and Consent indicating their consent to participate in the study.

Once consent was obtained, interviewers conducted the Mini-Mental State Test. The test was scored immediately to confirm inclusion eligibility. No participants were refused based on the cognitive screen.

Participants were then interviewed by the Primary Tester using the Bath Grab Bar Placement Questionnaire. The Questionnaire included the two balance tests - the Timed Up-

and-Go (TUG) and the One-Legged Stance (OLS). Participants using a walking aid for mobility were asked to complete the TUG both with and without (if able and deemed safe by both the participant and the interviewers) their aid.

A copy of the final version of the Bath Grab Bar Placement Survey with all measures used in the study is included in Appendix 5. The measures include a series of questions on health and activity levels, specifics about current bathing activities, fall history, sociodemographic characteristics as well as details about the respondent's home bathing environment. Two clinical tests were used to obtain a measure of participant's ability to maintain their balance: the timed get-up-and-go test and the one-legged stance test.

Video recording of bathtub grab bar configuration use: A bathtub testing area with interchangeable grab bar configurations was incorporated into a newly constructed multi-purpose Occupational Therapy teaching laboratory. The design of the teaching laboratory was such that all components of the testing session could be completed in the same area. Moreover, a small part of the laboratory was partitioned off and served as a waiting area for participants arriving early or participants who came in pairs (see Appendix 6 for floor plan).

The bathroom area was designed to mimic, as closely as possible, a residential bathroom. The 3.78 by 2.3 metre room included a bathtub (1.52 x .76 x .41 metre), a wall-mounted sink with a mirror and two toilets (one residential and one institutional). The walls of the bathtub were reinforced with ¾ inch plywood covered with gyp rock on the head, faucet and back walls. The faucet, water control and showerhead were located at the right end of the tub (when facing the tub). On the opposite wall, an opening was cut out of the wall at the height of .55 metre above the rim of the tub. This opening was required for teaching and videotaping purposes.

Five different bathtub grab bar configurations were tested (Appendix 7 and below). One change to the proposed configurations to be tested was the amalgamation of the two configurations, Ottawa/Carleton Common Configuration and Occupational Therapy Configuration, since the two formats were similar and thus deemed redundant. This permitted us to include a new configuration into the series of five configurations tested. We chose to add a modified version of the configuration outlined in the Ontario Building Code (OBC). The OBC configuration is distinct from the others tested and has significant relevance to the population tested. Due to difficulties in acquiring the appropriate bar, we tested an "L"-shaped bar with legs 15-cm. shorter than that specified by the OBC (75 cm versus 90 cm).

Two sets of mounting plates for four of the configurations were installed to permit installation for bathrooms with faucets on the left or right ends of the tub. The orientation of the configurations actually tested was set to match the faucet wall location of the participant's home bathing area. The UFAS configuration did not require bilateral flexibility since this did not alter the installation.

The standards for each of the configurations are specified below and a digital photograph of each configuration illustrates the left and right mounting configuration. The precise measurements and locations of the bars that were tested within each standard are also specified:

Canadian Standards Association (CSA) Configuration:

> <u>Configuration Standards:</u> The configuration consists of two grab bars. The first bar is located horizontally (or angled) on the back wall. The second bar is located vertically on the faucet end wall (footwall). The bath bars should be at least 120 cm long and located from 18 to 28 cm above the rim.

Configuration Tested: The configuration consisted of two grab bars. The first bar was located horizontally on the back wall. The bar was 120 cm long, centred on the back wall and located 18 cm above the rim. The second bar was located vertically on the faucet end wall. The bar was 120 cm long and was located 18 cm above the rim.

Figure 1. Illustration of Canadian Standards Association (CSA) Configuration

US Uniform Federal Accessibility Standards (UFAS) Configuration:

Configuration Standards: At the foot of the tub, the grab bar is 24 inches (61 cm) minimum in length measured from the outer edge of the tub. On the back wall, two grab bars are required. The grab bars mounted on the back wall (sidewall) shall be a minimum of 24 inches (61 cm) in length located 12 inches (30,5 cm) maximum from the foot of the tub and 24 inches (61 cm) maximum from the head of the tub. One grab bar shall be located 9 inches (23 cm) above the rim of the tub. The others shall be 33 to 36 inches (84 cm to 91 cm) above the bathroom floor. At the head of the tub, the grab bar shall be a minimum of 12 inches (30,5 cm) in length measured from the outer edge of the tub.

Configuration Tested: At the foot of the tub, the grab bar was 61 cm long and mounted adjacent to the outer edge of the tub. On the back wall, two grab bars were mounted.

The grab bars were 82 cm long and were located 29 cm from the head and faucet walls. The lower grab bar on the back wall was mounted 23 cm above the rim of the tub. The other grab bars (upper grab bar on back wall, grab bars on faucet wall and head wall) were mounted 48 cm above the rim (88 cm above the floor). At the head of the tub, the grab bar was 61 cm long and was mounted adjacent to the outer edge of the tub.

Figure 2. Illustration of US Uniform Accessibility Standards (UFAS) Configuration

Ontario Building Code (OBC) Configuration:

Configuration Standards: An "L"-shaped grab bar mounted on the back wall with each leg of the "L" being at least 900 mm (2 ft 11 in) long with the legs of the "L" being separated by 90 degrees. The horizontal leg of the "L" shall be located between 150 mm (5 7/8 in) and 200 mm (7 7/8 in) above and parallel to the rim of the bathtub. The vertical leg of the "L" shall be located between 300 mm (11 ¾ in) and 450 mm (17 ¾ in) from the control end (faucet end) of the bathtub.

Configuration Tested: An "L"-shaped grab bar was mounted on the back wall. Each leg of the "L" measured 75 cm and the legs of the "L" were separated by 90 degrees. The horizontal leg of the "L" was located 17 cm above and parallel to the rim of the bathtub. The vertical leg of the "L" was located 38 cm from the control end (faucet end) of the bathtub.

Figure 3. Illustration of Ontario Building Code (OBC) Configuration

Occupational Therapy (Ottawa/Carleton Common: OCCC) Configuration:

Configuration Standards: The two proposed configurations Ottawa/Carleton Common configuration and Occupational Therapy Configuration were relatively similar and therefore a combined configuration was tested.

Findings from our previous study indicated that the most common configuration of bath bars among 513 seniors residing in non-profit apartments across the Ottawa-Carleton and Hull-Outaouais regions who had grab bars were two bars. One angled bar on the back wall measuring 178 mm above the rim, with a horizontal base of 770 mm long and whose vertical side is 430 mm long. Most often accompanying this bar was a vertical bar on the faucet wall that was placed on average 50 mm above the rim and measuring 505 mm in length.

Practicing occupational therapists whose primary workload consists of home adaptation were surveyed to determine the most common configuration used in custom

design bathtub grab rail adaptations. The most commonly proposed configuration consisted of two bars, one angled bar mounted on the back wall and one vertical bar mounted on the faucet wall. Although standard mounting positions were not available, guidelines indicated that a 600 mm (24 in) angled bar be mounted at approximately 45 degrees. The top of the bar should be located approximately 300 mm (12 in) from the faucet wall and the bottom of the bar located approximately 150 mm (6 in) above the rim of the tub. A 460 mm – 600 mm (18 to 24 in) vertical bar should be mounted on the faucet wall approximately in line with the rim of the tub between 150 mm to 300 mm (6 to 12 in) above the rim.

Configuration Tested: The configuration consisted of two bars. The first bar was 60 cm long and was mounted at approximately 45 degrees on the back wall. The bottom end of the bar was located 23 cm above the rim of the tub. The top of the bar was located 30 cm from the faucet wall and the bottom of the bar approximately 74 cm from the faucet wall. The second bar was located vertically on the faucet end wall. The bar was 120 cm long and was located 18 cm above the rim.

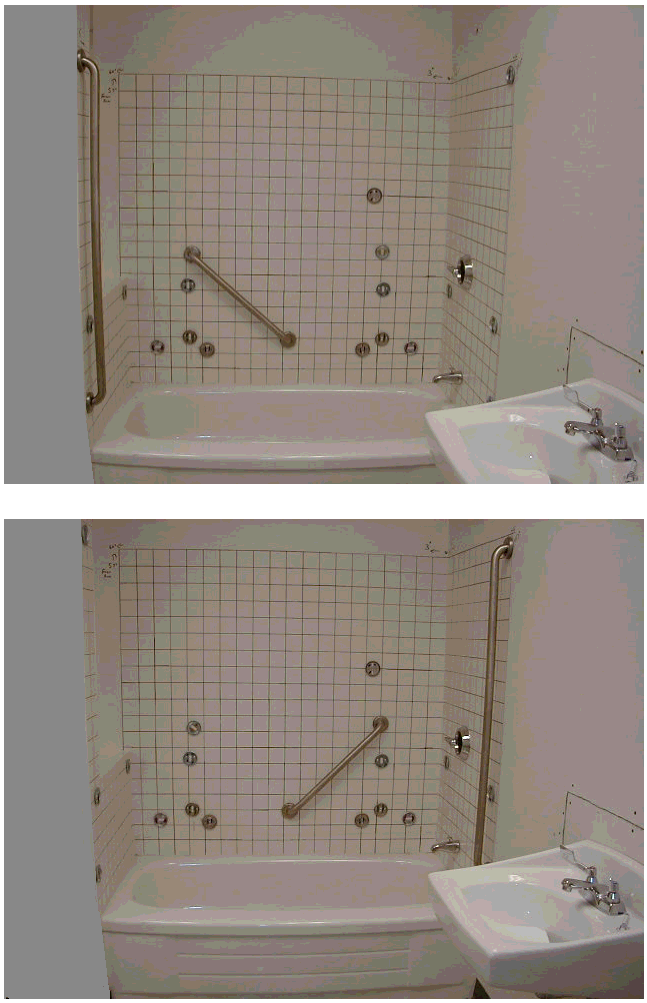


Figure 4. Illustration of Ottawa/Carleton Common Configuration (OCC)

All Bar (AB) Configuration:

Configuration Standards: The configuration consisted of a composite of the grab bars used in the previous four configurations.

Configuration Tested: The specific bars tested included two vertical bars (left and right mounting configurations from the CSA configuration); two horizontal bars (bars mounted on the head wall and faucet wall from the UFAS configuration); one horizontal bar (mounted on the back wall from the CSA configuration); and one angled bar mounted on the back wall (from the OCCC configuration – orientation depended on the faucet end as reported by the participant).

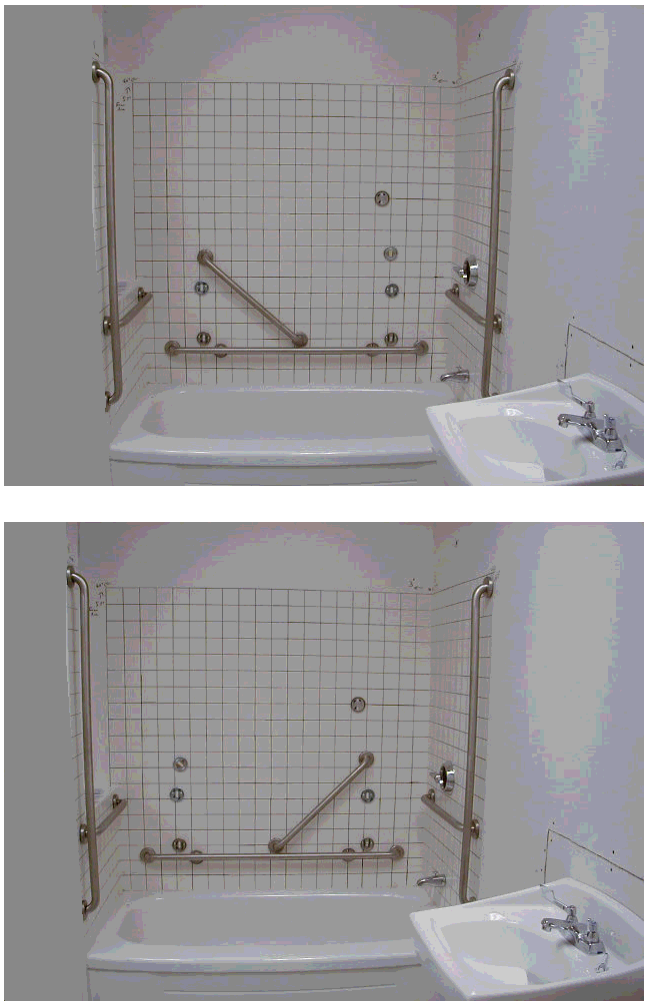


Figure 5. Illustration of All Bar Configuration

All participants were asked, prior to the bath grab bar configuration testing, whether they were able and willing to sit in the bottom of the bathtub. Three participants expressed discomfort in performing this task and thus were instructed to simply get into and exit the bathtub without sitting down. Six additional participants were not invited to sit into the bottom of

the bathtub for at least one configuration because the interviewers deemed that their level of mobility was insufficient to safely perform that task.

Because of the complexity in setting up two of the bathtub grab bar configurations, the All Bar (AB) and OBC configurations, all bath grab bar configuration testing began and ended with one of these two configurations. The order in which these two configurations were tested changed with every testing (i.e., if AB was the first configuration tested for one participant, it would be the last configuration tested for the following participant). The remaining three configurations (CSA, OCC, UFAS) were randomly ordered for all participants. Using each configuration, participants were asked to sit on a chair outside the tub and remove their footwear (disposable slippers were provided to participants to wear when not completing a bathtub configuration test). Participants were asked to stand and enter the tub, sit on the bottom of the tub, stand up from the bottom of the tub, exit the tub and sit back down on the chair. The instructions to the participants were limited. They were asked to get into and out of the tub as naturally as possible. They were told to use any supports, including the bathtub grab bars, if they felt they were necessary or if they would help. They were told that they were not required to use any of the bars if they did not feel that the bar would be helpful.

Once the participant exited the tub, they were asked to complete the 6-question evaluation scale for the configuration they had just tried. As the participant completed the questions, the Secondary Tester changed the grab bar configuration for the subsequent trial. Each participant got into and out of the tub once with each of the five configurations installed. The research assistant recorded any commentary regarding the bathtub grab bar configuration made by the participant during testing. Participants were videotaped by two video cameras as they completed the bathtub test.

Two series of questions were developed and used in the participant evaluation of each of the bath grab bars. Once the participant tested one of the five configurations they were asked to complete the first series of questions. This series required that the participant evaluate each configuration on multiple factors (safety, ease of use, helpfulness, and comfort) immediately after using the configuration to get in and out of the tub. Once the participant completed testing of all of the five configurations they were asked to complete the second series of questions. This series required that the participant rank order all of the configurations on several factors (safety, ease of use, preference, acceptability, comfort, and helpfulness). Finally, participants were asked to draw an “ideal” configuration for bathtub grab bars.

Data Reduction

The TUG was summarised according to whether participants took 20 seconds or longer to perform the test, as the level of independence for tub and shower transfers may be less among these individuals than among individuals taking less than 20 seconds to complete the test (Podsiadlo & Richardson, 1991). The one-legged stance scores of the left and right legs were not significantly different so the data were combined. A total one-legged stance score was computed by summing results of right and left scores

Three different sets of composite rating scores were computed: a) Configuration Composite Scores (CCS), ranging from 6-30, were computed based on the sum of all rating factors (safety, comfort, helpfulness getting in/out, sitting down/getting up, ease of use, likelihood of use) for each configuration. Thus, a Configuration Composite Score was computed

for the OBC configuration, UFAS configuration, etc. This score served as a global evaluation for each configuration; b) Factor Composite Scores (DCS), ranging from 5-25, were computed based on the sum of scores for each of the rating factors, across configurations. That is, a total safety score was computed, based on the sum of safety rating for each configuration. The DCS was used as an outcome measure in analyses designed to identify groupings of participants who tended to rate grab bars as safe, helpful, etc; c) a Grand Composite Score (GCS), ranging from a possible low of 30 to a high of 150, based on the sum of scores for each rating factor and configuration. The grand composite score provides an overall summary measure of desirability of grab bars.

Video data were summarised for each configuration by recording which bars were used to: a) get into the bathtub; b) sit in the bottom of the bathtub; c) get up from the bottom of the bathtub; and d) get out of the bathtub. A score for the number of activities for which a bar was used was computed based on these observations. For example, if a bar (any bar) within a configuration was used for each of the recorded activities (getting in, sitting in, getting up, getting out), the participant received a score of 4. If it was used for only three of the four activities, a score of 3 was assigned. Video coders also noted whether participants used the wall, rim, back rim, or other objects for balance or support in the execution of any of the activities. Because participants were asked to enter the bathtub as they would at home, the faucet and head wall were coded in consideration of the self-reported location of their faucet at home.

Data Analysis

Descriptive statistics were used to summarise: a) participant profiles; b) data on grab bars at home; c) self-reported ratings and rankings of the different grab bar configurations; d) data on reported ideal grab bar locations and shapes; and e) video data.

Bivariate statistics (chi-square, t-tests, Spearman correlations and Pearson correlations, as appropriate) were used to examine: a) relationships between different *ratings* within each configuration (e.g., within the All Bar configuration, the relationship between the rating of safety and ease of use); b) relationships between different *rankings* of configurations (e.g., consistency with which the All Bar configuration was ranked as safe and acceptable); c) the relationship between respondent characteristics and Factor Composite Scores for rating factors of comfort, safety, ease of use, likely to use, helpfulness getting in/out and getting up/down, and Grand Composite Score of all ratings (i.e. characteristics of those for whom grab bars might be most useful, safe, etc.); d) the relationship between the number of activities for which a configuration was used based on video data and Configuration Composite Scores for configurations based on survey data (i.e. the relationship between self-reported evaluations and objective measures of use); and e) differences in profiles of participants who used grab bars to get into and out of the bathtub and those who chose not to use grab bars.[*] Where Levene's test for equality of variances indicated significant group differences in the homogeneity of variance for tests of group differences, the t-test for unequal variances was used. Bonferroni corrections were used to adjust the criteria for significance to compensate for multiple tests, as required.

One-way analyses of variance (ANOVAS) and chi-square tests were used to assess differences in participant profiles based on individual rankings of different configurations (e.g.,

[*] The number of participants who did not use a bar to sit down or get up from the bottom of the bathtub was too small to allow for meaningful statistical analyses.

differences in characteristics of participants who ranked the All Bar configuration safest versus characteristics of those who ranked the OBC configuration as safest). Separate tests were performed for each factor evaluated (i.e., acceptance, ease of use, safety, helpfulness, and preference). Bonferroni corrections were used to compensate for multiple tests, setting the criteria for significance at .004 (.05/13).

Separate repeated measures ANOVAS, followed by paired t-tests, were used to compare, between the five configurations, rating scores for each: comfort, ease of use, helpfulness getting in/out of the bathtub, helpfulness sitting/getting up from the bottom of the bathtub, safety, likelihood of use and the Configuration Composite Score. Bonferroni corrections were used to compensate for multiple tests, setting the criteria alpha for each omnibus test at .007 (.05/7) and the criteria for significance for follow-up tests at .005 (.05/10).

Cochran Q tests, for multiple related dichotomous variables, were used to assess differences in prevalence of use of different configurations based on video data. Separate tests were performed to assess differences in use of configurations for any activity as well as for each of the activities: getting into the bathtub, sitting down, getting up, and getting out. Bonferroni corrections were used for each omnibus test setting the criteria alpha at .01 (.05/5). Follow-up tests were performed using McNemar tests for two related samples with Bonferroni corrections setting the significance criteria at .005 (.05/10).

Finally, the Cochran Q was used to assess differences in the prevalence of use of walls, rims, back rims, and total supports used in function of grab bar configuration to get into, sit, get up, exit, and for all activities together. As for other tests, Bonferroni corrections were used for each omnibus test setting the criteria alpha at .01 (.05/5). Follow-up tests were performed using McNemar tests for two related samples with Bonferroni corrections for these tests setting the criteria for significance at .005 (.05/10).

RESULTS

A total of 103 seniors participated in the study. Testing required, on average, 58.8 ($\pm$ 16.5) minutes to complete. Nine participants did not sit in the bottom of the bathtub for at least one configuration. Of these, three people did not sit for any of the five configurations; one person did not sit for four configurations; two did not sit for three configurations; one did not sit for two configurations; and two did not sit for one configuration. Three of these participants had self-selected not to sit in the bottom of the bathtub. Decisions not to sit for the remaining six were made by the testers who felt that these participants would be at risk for injury especially as fatigue set in. Analyses of demographic and health profile differences between those who sat in the tub for all configurations and those who missed at least one configuration revealed no significant differences (p's ns).

Results of survey data

Respondent profiles

Demographics**.** Participants ranged from 60 to 83 years (70.4 ±6.2) (see Figure 6). Most were females (62.1%), listed English as their mother tongue (75.7%), and lived with someone else (68.0%), most often a spouse (75.7%). The majority of participants (n=100, 97.1%) reported that their income adequately met their needs.

Figure 6. Demographic profile of participants

- **Mean age: 70.4 (±6.2)**
- **Gender**
  - **Female: 64 (62.1%)**
  - **Male: 39 (37.9%)**
- **Mother tongue**
  - **English: 78 (75.7%)**
  - **French: 17 (16.5%)**
  - **Other: 8 (7.8%)**
- **Marital status**
  - **Married/common-law: 72 (69.9%)**
  - **Widowed: 14 (13.6%)**
  - **Divorced/separated: 9 (8.7%)**
  - **Never married/single: 8 (7.8%)**
- **Living arrangements**
  - **Live with another: 70 (68.0%)**
  - **Live alone: 33 (32.0%)**

General health. Most participants (n=88, 86.3%) reported having some health problems (Figure 7). Yet, almost two-thirds (61.2%) reported to be in very good health relative to their peers and the majority of the participants (71.8%) reported that they were more active than their peers. Specific health problems identified included high blood pressure (n=11), cancer (n=2), arthritis n=1), and osteoporosis (n=2).

Figure 7. General health profile of participants

- **Self-rated health relative to peers**
  - **Very good: 63 (61.2%)**
  - **Good: 33 (32.0%)**
  - **Fair/Poor: 7 (6.8%)**
- **Self-rated level of activity relative to peers**
  - **More active: 74 (71.8%)**
  - **About the same: 25 (24.3%)**
  - **Less active: 4 (3.9%)**
- **Number of health problems: mean = 1.9 (±1.2)**
  - **None: 14 (13.7%)**
  - **One-two problems: 59 (57.8%)**
  - **Three or more problems: 29 (28.4%)**

Other health-related risk factors for falls. Figure 8 outlines some health-related risk factors for falls in this sample. Slightly over one quarter of all participants (n=27, 26.2%) reported having experienced a fall in the year preceding the study. Only a minority of participants (10.7%) reported using a mobility device (cane) yet almost one-third of participants self-reported balance problems (31.1%).

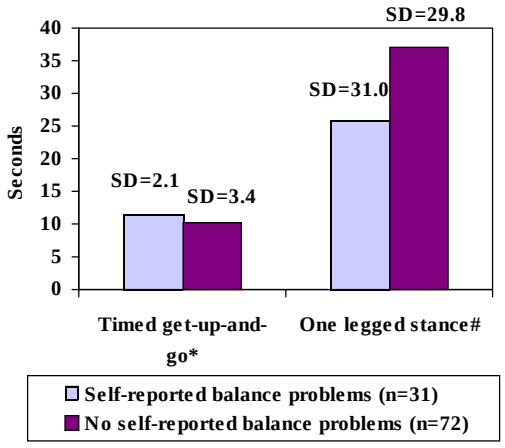
Figure 8. Participant profile of risk factors for falls

- **Fall in previous year**
  - **No: 76 (73.8%)**
  - **Yes: 27 (26.2%)**
- **Self-reported balance difficulties**
  - **No problems: 72 (69.9%)**
  - **Problem with balance: 31 (31.1%)**
- **Uses mobility aid:**
  - **No: 92 (89.3%)**
  - **Yes: 11 (10.7%)**
- **One-legged stance:**
  - **Left leg: mean = 16.8 (±17.7) seconds**
  - **Right leg: mean = 17.4 (±17.9)**
  - **Total of both legs: mean = 33.8 (±30.9)**
- **Timed get-up-and-go: mean = 10.8 (±2.6) seconds**
  - **Completed test in less than 20 seconds: 100 (98.0%)**
  - **Took 20 seconds or longer to complete: 2 (2.0%)**

All but one participant completed the timed get-up-and-go test (TUG). The mean time required for this test was 10.8 seconds**.** Only two participants took more than 20 seconds to perform the test. In all, 101 participants completed the one-legged stance on the right leg, while 100 completed it on the left leg. Those who did not complete the one-legged stance determined that they would not be stable enough to perform the test. A significant relationship was found between the one-legged stance score for the right and left leg ($r=.54$, $p \leq .001$). The average time for which participants were able to balance was 17.4 seconds on the right leg and 16.8 seconds on the left leg. The mean total balance score, based on the sum of the left and right leg, was 33.8 seconds.

Participants seemed to accurately judge their balance limitations. Specifically, participants with self-reported balance problems took significantly longer to perform the TUG and, though not significant, were not able to balance as long as those who reported no balance problems (Figure 9). Furthermore, participants who used a mobility aid on a regular basis (n=11) took longer than those who did not use mobility aids (n=92) to complete the TUG (without mobility aid) (Figure 10) although, based on the t-test for unequal samples, group differences were not significant (10.5 versus 12.7; t (9.3) = 1.30, ns). Of the 11 participants who used a cane, 9 completed the one-legged stance. The total time (left + right leg) that they were able to balance for was significantly less than that recorded for participants who did not use a mobility aid (16.9 seconds versus 35.4 seconds; t(14.5)=2.9, $p = .04$).

Figure 9. Relationship between self-reported balance problems timed get-up-and-go and one-legged stance



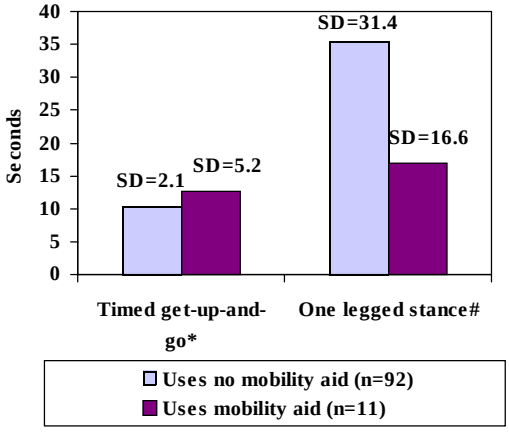
*More time to perform test denotes greater difficulty,

* t(100) = 2.09, p = .04.

Based on sum of both legs.

More time denotes greater ability, p = .09.

Figure 10. Relationship between mobility aid use and timed get-up-and-go and one-legged stance



*More time to perform test denotes greater difficulty, ns.

Based on sum of both legs.

More time denotes greater ability, t(14.5)=2.9, p = .01.

Also noteworthy, almost three-quarters of those who used a mobility aid (72.7%) self-reported that they had balance problems. However, 25% (n=23/92) of those who did NOT use a mobility aid also reported that they had balance problems. Group differences, in this respect, were nonetheless significant, (chi square(1)=10.6, $p \leq .001$).

Risk factors for bath-related falls. Only two participants reported bath-related falls in their homes within the last year (Figure 11). One fall was described as having occurred as the person was about to step out of the bathtub. The other fall occurred as a consequence of the participant's hand slipping on the bath rim as she was getting up from the bottom of the bathtub and using the rim for support. Neither participant was using, nor attempting to use, a grab bar at the time of the fall. Both participants were slightly injured in their fall (bruising).

Although the number of bath-related falls were minimal, over one-third (40.8%) of all participants reported at least some difficulties bathing - either getting into or out of the bathtub (n=16, 15.5%) or sitting in or getting up from the bottom of the bathtub (n=42, 40.8%). Moreover, two participants reported restricting their bathing routines due to these difficulties (i.e., took a shower rather than a bath).

Figure 11. Participant profile of risk factors for falls in bathtub

- **Bath-related falls**
  - **No: 101 (98..0%)**
  - **Yes: 2 (2.0%)**
- **Self-reported difficulties bathing**
  - **No: 61 (59.2%)**
  - **Yes: 42 (40.8%)**
- **Self-reported difficulties getting in or out of bathtub**
  - **No: 87 (84.5%)**
  - **Yes: 16 (15.5%)**
- **Self-reported difficulties sitting in or getting up from bottom of bathtub**
  - **No: 61 (59.2%)**
  - **Yes: 42 (40.8%)**

Availability and use of grab bars at home (Specific Research Objective #1)

Prevalence, location and shape of grab bars at home. Data on grab bars at home are shown in Figure 12. As can be seen therein, a total of 37 (35.9%) respondents reported having at least one grab bar in their bathtub at home. Of these, 26 (70.3%) reported having only one grab bar, 8 (21.6%) reported two bars, and 3 (8.1%) reported three bars. The majority (78.4%) who had bars at home reported using them on a regular basis.

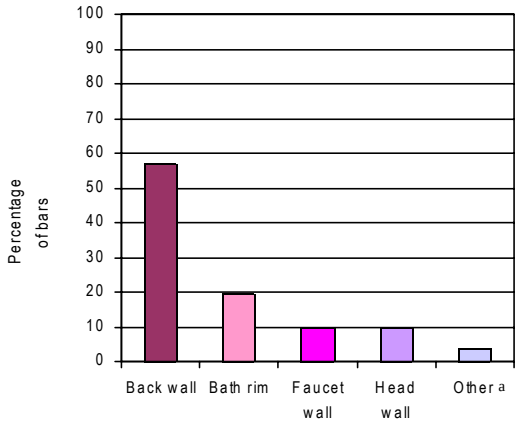
A total of 51 grab bars were reported and described. Grab bars in the home were most commonly located on the back wall of the bathtub (n=29, 56.9%), followed by a bar on the bath rim (n=10, 19.6%) and the faucet wall or head wall (n=5, 9.8% each). Two bathtub grab bars were described, as being attached inside the bathtub, on either side (owned by the same individual).

Back wall bars were most often horizontal in orientation (n=12, 41.4%), although angled (n=6, 20.7%), L-shaped (n=6, 20.7%) and vertical (n=5, 17.21%) bars were also reported. Bars on the rim were almost all (n=9, 90.0%) horseshoe in shape, though one was reported to be horizontal. Bars on the faucet wall were either horizontal (n=2, 40%) or vertical (n=2, 40%) in orientation with one bar oriented on an angle. Finally, bars on the head wall were reported to be either oriented horizontally (n=3, 60%) or vertically (n=2, 40%).

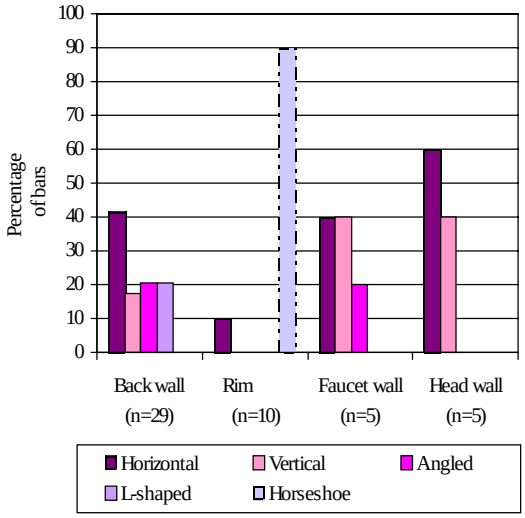
Figure 12. Prevalence, location and shape of grab bars at home

- **Prevalence of grab bar(s) at home**
  - **Has no grab bar: 66 (64.1%) participants**
  - **Has at least 1 grab bar: 37 (35.9%) participants**
    - **Has 1 grab bar: 26 participants**
    - **Has 2 grab bars: 8 participants**
    - **Has 3 grab bars: 3 participants**
  - **Total number of grab bars at home: 51 bars**
  - **Uses grab bar on regular basis: 29 (78.4% of bar owners)**

- **Location of grab bars at home (n=51 grab bars)**
- **Shape of grab bars at home**



[a]: 2 bars, owned by same person on either side of bathtub, inside bathtub



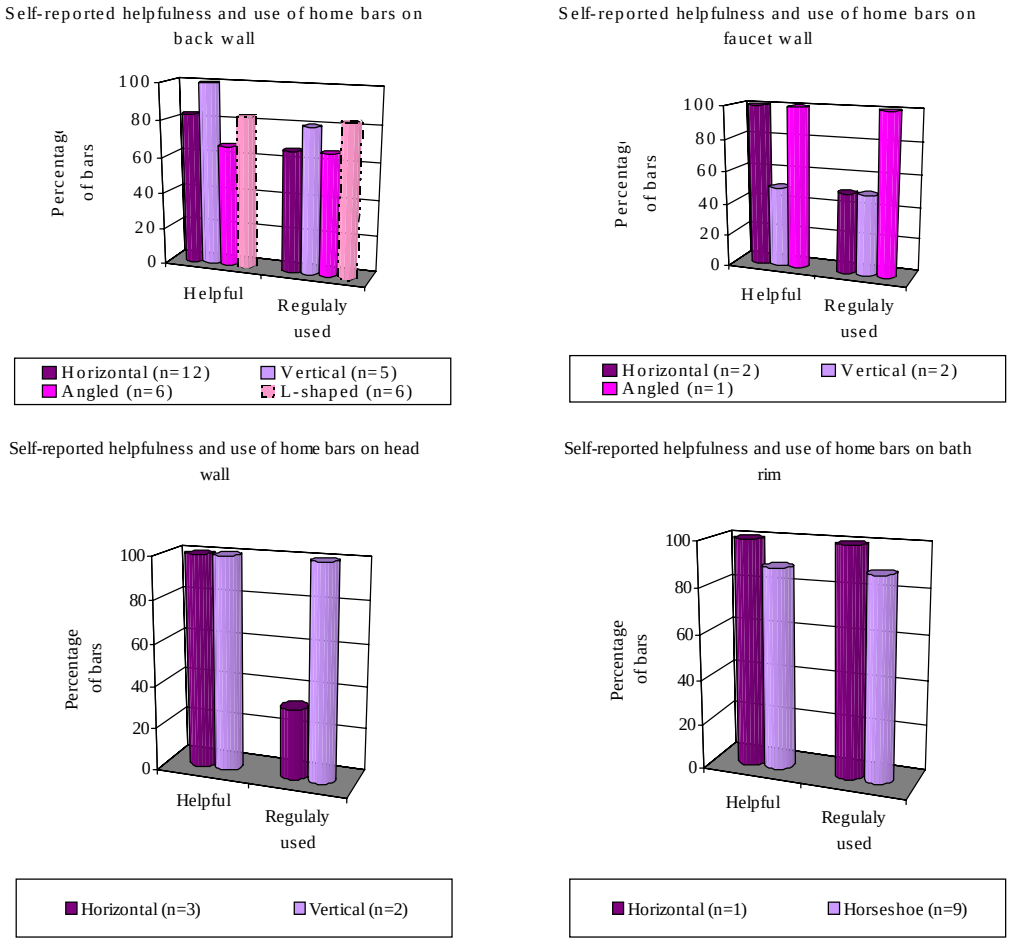
Helpfulness and prevalence of use of home grab bars.* Self-reported ratings of helpfulness and prevalence of use of grab bars at home are shown in Figure 13. Horizontal back wall bars were reported helpful and regularly used by 83.1% and 66.7% of owners, respectively. L-shaped bars, though less prevalent, were also found to be helpful and regularly used (83.5% each). The angled bars on the back wall were less likely to be used than the other bars, though reported usage was still high (66.7%).

The two horizontal bars on the faucet wall were reported to be helpful, but used regularly by only one of their owners. Vertically oriented bars on the faucet wall were as equally likely to be helpful and used as not. The only angled bar reported was reported to be helpful and consistently used by its owner.

All five bars on the head wall were reported to be helpful. However, only one of the three horizontal bar owners used this bar on a regular basis. In contrast, both vertical bars were used on a regular basis.

Eight of the nine participants who reported having a horseshoe bar on their bathtub rim reported it to be helpful and regularly used (88.8%). The one bath rim bar that was horizontal in shape was reported to be helpful and regularly used.

Figure 13. Self-reported helpfulness and use of grab bars at home



* The number of bars per location and shape were too small in number to perform meaningful statistical tests.

Ratings: Overall, respondents were fairly consistent in their ratings of grab bar configurations with Spearman correlation coefficients between rating factors being consistently high and positive within each configuration (see Table 1). That is, configurations that participants rated as highly comfortable were also more likely to be rated as helpful, easy to use, safe, and most likely to be used. An exception was the OBC configuration where the rating for helpfulness in getting in and out of the bathtub was, in particular, not highly correlated with ratings of comfort, safety or ease of use.

Table 1. Spearman correlation coefficients between factor ratings within each configuration (n=103)

a. All bars

Acceptability	Comfort	Ease of use	Helpfulness getting in/out	Helpfulness getting up/down	Safety
Comfort	-	.61***	.40***	.40***	.73***
Ease of use	.61***	-	.25*	.26**	.46***
Helpfulness getting in/out	.40***	.25*	-	.73***	.29**
Helpfulness getting up/down	.40***	.26**	.73***	-	.30**
Safety	.73***	.46***	.29**	.30**	-
Likely to use	.55***	.30**	.34***	.42***	.44***

b. CSA

Comfort	-	.75***	.58***	.58***	.77***
Ease of use	.75***	-	.60***	.59***	.68***
Helpfulness getting in/out	.58***	.60***	-	.64***	.50***
Helpfulness getting up/down	.58***	.59***	.64***	-	.63***
Safety	.77***	.68***	.50***	.63***	-
Likely to use	.69***	.57***	.53***	.53***	.52

c. UFAS

Comfort	-	.71***	.58***	.65***	.77***
Ease of use	.71***	-	.60***	.66***	.78***
Helpfulness getting in/out	.58***	.60***	-	.70***	.62***
Helpfulness getting up/down	.65***	.66***	.70***	-	.71***
Safety	.77***	.78***	.62***	.71***	-
Likely to use	.63***	.48***	.51***	.53***	.45***

d. OCCC

Comfort	-	.73***	.55***	.59***	.78***
Ease of use	.73***	-	.58***	.52***	.68***
Helpfulness getting in/out	.55***	.58***	-	.70***	.55***
Helpfulness getting up/down	.59***	.52***	.70***	-	.56***
Safety	.78***	.68***	.55***	.56***	-
Likely to use	.82***	.70***	.65***	.71***	.62***

e. OBC

Comfort	-	.78***	.18	.57***	.73***
Ease of use	.78***	-	.13	.65***	.83***
Helpfulness getting in/out	.18	.13	-	.28*	.09
Helpfulness getting up/down	.57***	.65***	.28*	-	.66***
Safety	.73***	.83***	.09	.66***	-
Likely to use	.60***	.41***	.25*	.41***	.35***

* p < .05 ** p < .01 *** p < .001

Rankings: Spearman correlation coefficients between rankings of different configurations were similarly consistent (see Table 2). That is, the configuration that was ranked as most acceptable was more likely to be ranked as most easy to use, helpful, preferred, and safe. Similarly, the configuration that was ranked as safest was most likely to be ranked high in terms of comfort, ease of use, helpfulness, and preference. However, rankings of comfort were not consistently related to overall acceptability, helpfulness or preference.

Table 2. Spearman correlation coefficients between factor rankings for different configurations - all configurations (n=103)

	Comfort	Ease of use	Helpfulness	Preference	Safety	Acceptability
Comfort	-	.21*	.17	.15	.25*	.11
Ease of use	.21*	-	.76***	.60***	.77***	.60***
Helpful	.17	.76***	-	.69***	.65***	.56***
Preference	.15	.60***	.69***	-	.62***	.76***
Safety	.25*	.77***	.65***	.62***	-	.54***

* p < .05 ** p < .01 *** p < .001

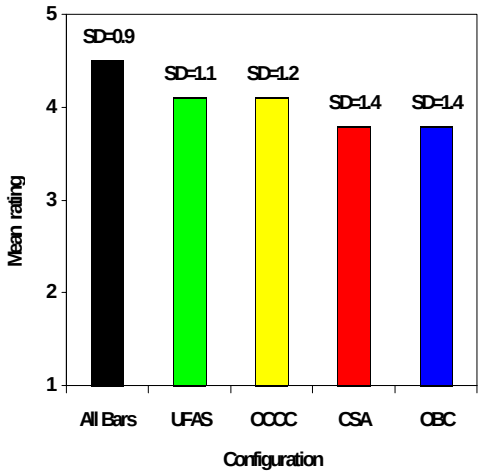
Ratings of grab bar configurations (Specific Research Objectives # 2, 3 and 5)

Significant differences in mean ratings of safety, comfort, ease of use, helpfulness likelihood of use, and total composite score were detected between configurations. These significant omnibus tests were attributed, in most cases, to several significant paired differences in ratings.

Comfort. A significant omnibus test ($F(4,89) = 7.6$, $p \leq .007$) between configurations in ratings of comfort is attributed to significantly higher ratings for the All Bars configuration, as compared to each the OBC, UFAS, and CSA configurations. Other trends in configuration differences emerged that approached, but did not reach, significance (Figure 14).

Ease of use. A significant omnibus test ($F(4,93) = 6.2$, $p \leq .007$) between configurations in ratings of ease of use is attributed to significantly higher ratings for the All Bars configuration, as compared to each the OBC and CSA configurations. Further, the OCCC configuration was rated as significantly higher in terms of use as compared to the OBC or CSA configurations. A trend emerged indicating that the UFAS configuration was rated as (non-significantly) easier to use than the OBC configuration (Figure 15).

Figure 14. Comfort

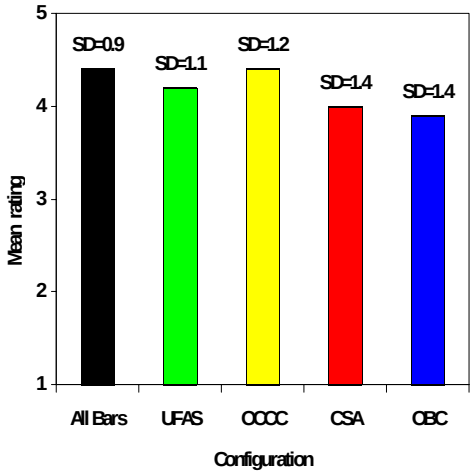


Result of repeated ANOVA: ***F(4,89)=7.6, p≤ .007***

Results of follow-up paired t-tests:

All bars versus OBC: p ≤ .005; All bars versus UFAS: p ≤ .005; All bars versus CSA: p ≤ .005; All bars versus OCCC: p = .02; OCCC versus OBC: p = .05; OCCC versus CSA: p = .02; UFAS versus CSA: p = .04.

Figure 15. Ease of use



Result of repeated ANOVA: ***F(4,93)=6.2, p≤ .007***

Results of follow-up paired t-tests:

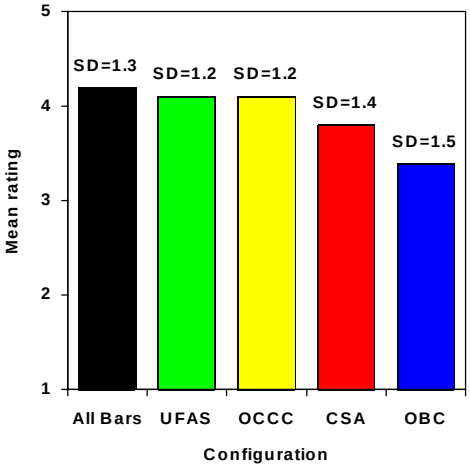
All bars versus OBC: p ≤ .005; All bars versus CSA: p ≤ .005; OCCC versus OBC: p≤ .005; OCCC versus CSA: p ≤ .005; UFAS versus OBC: p = .02

Help getting in/out of the bathtub. A significant omnibus test ($F(4,92) = 5.5$, $p \leq .007$) between configurations in ratings of helpfulness in getting in and out of the bathtub is attributed to significantly higher ratings for the All Bars configuration, as compared to the OBC and CSA configurations. Further, the OCCC and UFAS configurations were each rated as more helpful to

getting in and out of the bathtub than the OBC configuration. Other trends in configuration differences emerged that approached, but did not reach, significance (Figure 16).

Help sitting in/getting up from the bottom of the bathtub. A significant omnibus test ($F(4,84) = 4.4$, $p \leq .007$) between configurations in ratings of helpfulness in sitting in/getting up from the bottom of the bathtub is attributed to significantly higher ratings for the All Bars configuration, as compared to the OBC and CSA configurations. Further, the UFAS configuration was rated as more helpful to sitting in and getting up from the bottom of the bathtub than the OBC configuration. Other trends in configuration differences emerged that approached, but did not reach, significance (Figure 17).

Figure 16. Help with getting in/out of bathtub



Result of repeated ANOVA: ***F(4,92)=5.5, p≤ .007***

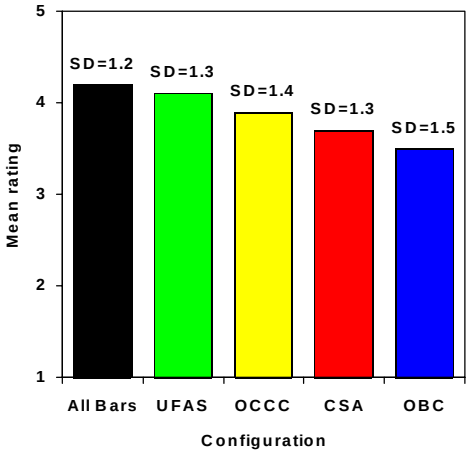
Results of follow-up paired t-tests:

All bars versus OBC: p ≤ .005; All bars versus CSA: p ≤ .005;

OCCC versus OBC: p ≤ .005; OCCC versus CSA: p = .01;

UFAS versus OBC: p ≤ .005 ; UFAS versus CSA: p = .05.

Figure 17. Help with sitting in/getting up from bottom of bathtub



Result of repeated ANOVA: ***F(4,84)=4.4, p≤ .007***

Results of follow-up paired t-tests:

All bars versus OBC: p ≤ .005; UFAS versus CSA: p = .01;

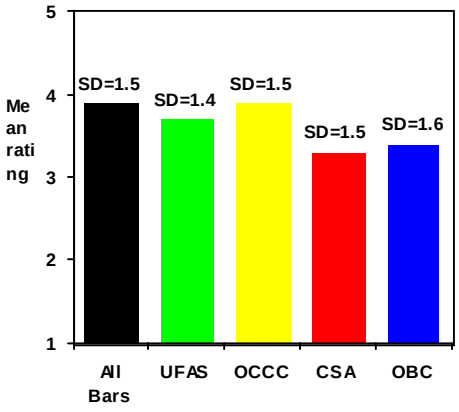
All bars versus CSA: p ≤ .005; OCCC versus OBC: p=.05;

UFAS versus OBC: p ≤ .005.

Likelihood of use. A significant omnibus test ($F(4,93) = 4.2$, $p \leq .007$) between configurations in ratings of likelihood of use of the configuration is attributed to significantly higher ratings for the OCCC configuration, as compared to the CSA configuration. Several other trends in configuration difference emerged that approached, but did not reach, significance (Figure 18).

Safety. A significant omnibus test ($F(4,91) = 7.4$, $p \leq .007$) between configurations in ratings of safety is attributed to significantly higher ratings for the All Bars configuration, as compared to each the OBC and CSA configurations. Further, the UFAS configuration was rated significantly higher for safety, as compared to the OBC configuration. Other trends in configuration differences emerged that approached, but did not reach, significance (Figure 19).

Figure 18. Likely to use



Result of repeated ANOVA: ***F(4,93)=4.2, p≤ .007***

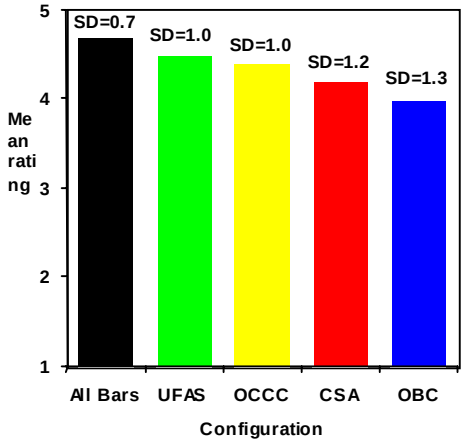
Results of follow-up paired t-tests:

All bars versus OBC: p =.01; All bars versus CSA: p =.00;

OCCC versus OBC: p =.02; OCCC ***versus CSA: p ≤ .005;***

UFAS versus CSA: p = .05

Figure 19. Safety



Result of repeated ANOVA: *F(4,84)=4.4, p≤ .007*

Results of follow-up paired t-tests:

All bars versus OBC: p ≤ .005; All bars versus UFAS: p =.01;

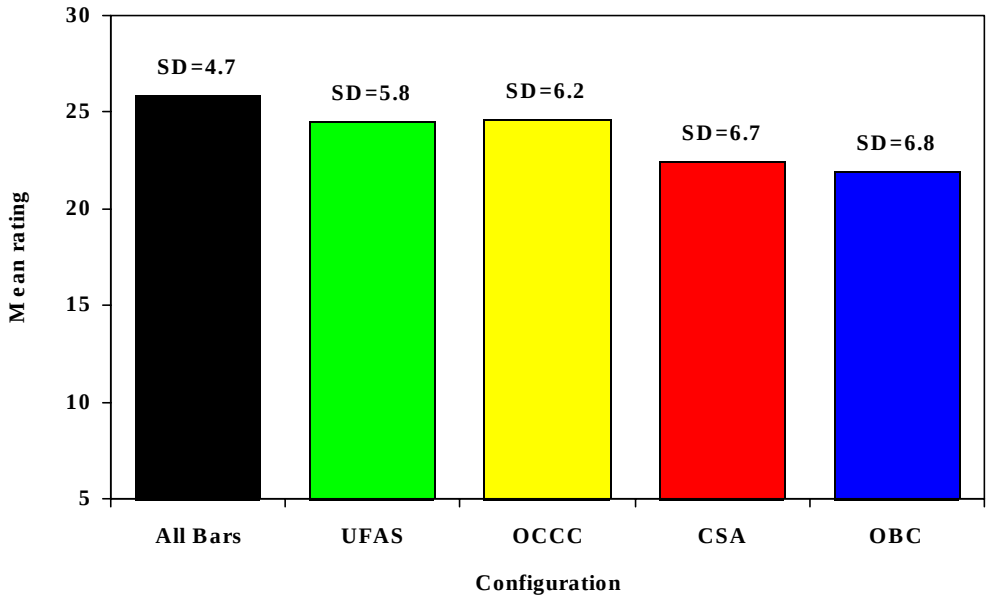
All bars versus CSA: p ≤ .005; All bars versus OCCC: p=.03;

OCCC versus OBC: p=.006; UFAS ***versus OBC: p ≤ .005;***

UFAS versus CSA: p = .05

Configuration Composite Score. A significant omnibus test ($F(4,80) = 9.4$, $p \leq .007$) between configurations in overall composite rating scores is attributed to significantly higher ratings for the All Bars configuration, as compared to the OBC, CSA, UFAS, and OCCC configurations. Further, the composite scores for the OCCC and UFAS configurations were each significantly higher than that for the OBC configuration. Other trends in configuration differences emerged that approached, but did not reach, significance (Figure 20).

Figure 20. Configuration Composite Score



Result of repeated ANOVA: ***F(4,80)=9.4, p≤ .007***

Results of follow-up paired t-tests:

***All bars versus OBC*: $p \leq .005$**

***All bars versus UFAS*: $p \leq .005$**

***All bars versus CSA*: $p \leq .005$**

OCCC versus CSA: p=.01

***OCCC versus OBC*: $p \leq .005$**

UFAS ***versus OBC*: $p \leq .005$**

UFAS versus CSA: p = .02

Rankings of configurations

Figures 21-26 present the highest and lowest ranked configuration for each factor evaluated. As can be seen in each of these figures, the All Bars configuration was consistently ranked the highest in terms of acceptance, comfort, ease of use, overall helpfulness, safety, and overall preference. The OCCC configuration was also ranked highest by many in terms of acceptance (32.4%), comfort (21.6%), ease of use (24.5%), helpfulness (25.5%), and preferred grouping (31.4%). However, it was ranked highest in terms of safety by only 14.9% of respondents.

The OBC configuration was consistently ranked least favourable on each factor. Almost half of respondents felt it was least acceptable, least comfortable, most difficult to use, least helpful, least safe, and least preferred. Also not widely endorsed, in terms of each of the ranked factors, was the CSA configuration. The UFAS configuration was ranked as the third least favourable configuration in all factors although by usually less than 20% of respondents.

Figure 21. Perceived easiest and most difficult to use configurations

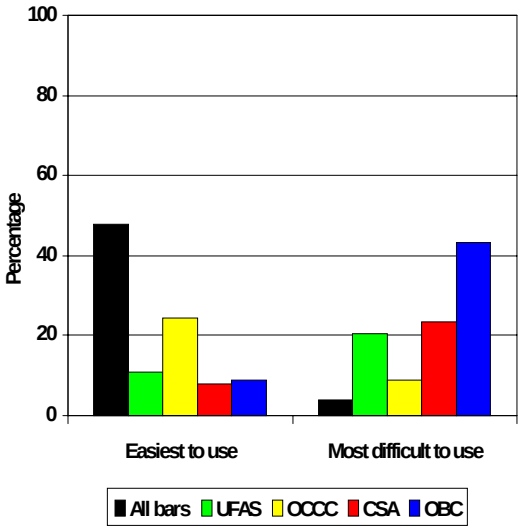


Figure 22. Perceived most and least comfortable configurations

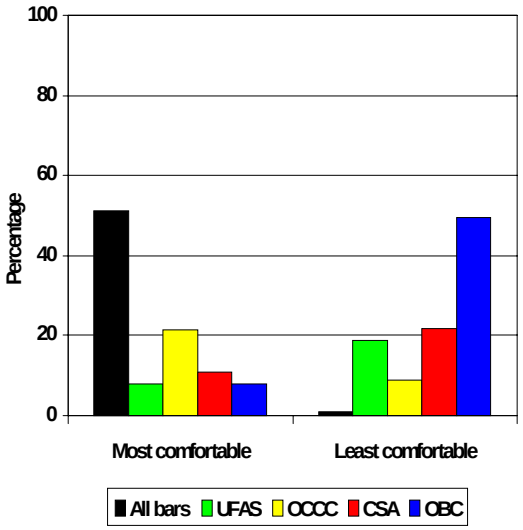


Figure 23. Perceived most and least helpful configurations

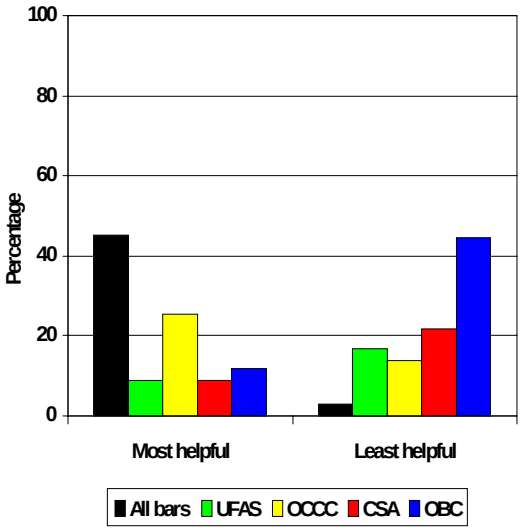


Figure 24. Perceived most and least safe configurations

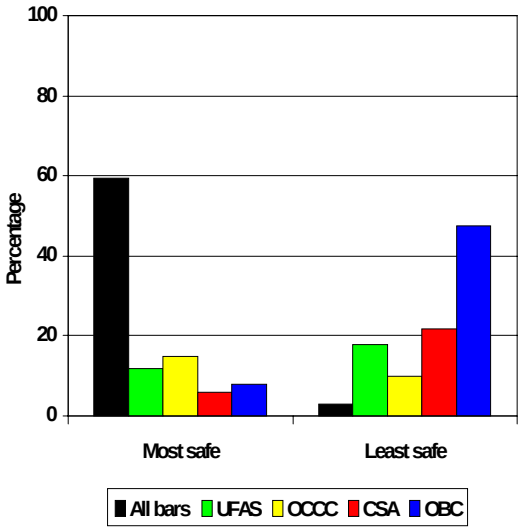


Figure 25. Perceived most and least acceptable configurations

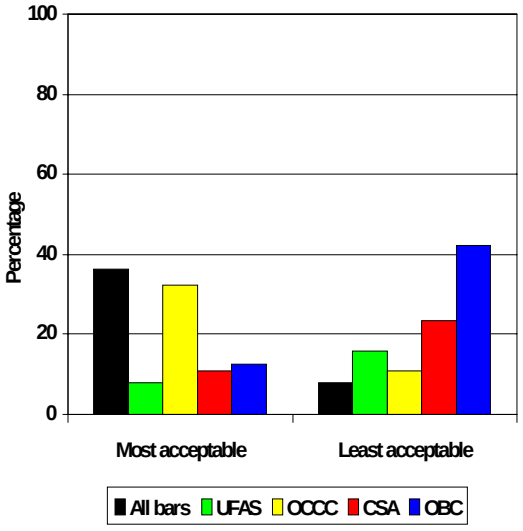
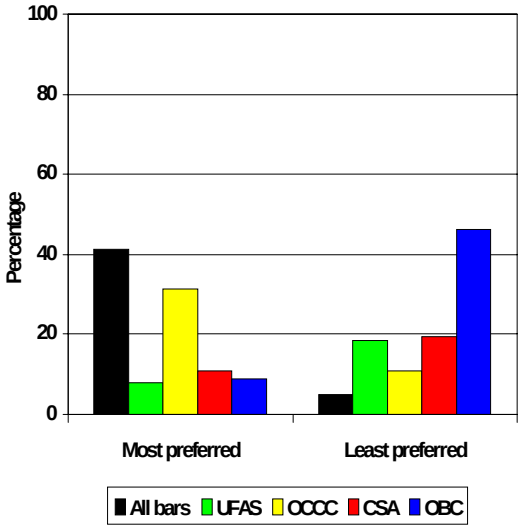


Figure 26. Perceived most and least preferred configurations



Relationship between respondent profiles and composite ratings

After correcting the criteria alpha for multiple tests, none of the respondent characteristics were significantly associated with factor composite rating scores for comfort, ease of use, helpfulness, safety, likelihood of use, and Grand Composite Score (Table 3). However, trends emerged indicating: a) participants with balance problems tended to rate bars as more difficult to use (p=.04) and less safe (p=.02) than those with no balance problems; b) participants with no difficulty sitting in their bathtub rated grab bars, in general, as more comfortable (p=.05), easy to use (p=.02), and safe (p=.04) than those with difficulty; c) age was positively correlated with composite scores for helpfulness of bars in getting in and out of the bathtub (r=.22, p = .04); d) number of health problems was positively correlated to composite scores for ease of use (r=.22, p = .03) and safety (r=.26, p = .01); e) the one-legged stand score (summed for both legs) was positively correlated to composite safety scores (r=.21, p = .05); and f) the timed get-up-and-go was inversely correlated to composite scores for ease of use (r= - .21, p = .04) and safety (r= - .22, p = .04).

Relationship between respondent profiles and preferred configurations

After correcting for multiple tests, none of the participant characteristics were predictive of those who ranked different configurations as easiest to use (Table 4), most helpful (Table 5), safest (Table 6), most acceptable (Table 7), or most preferred (Table 8).

Table 3. Bivariate predictors of factor composite scores (n=103)

Predictors	Comfort [a]	Ease of use [a]	Help getting in/out [a]	Help getting up/down [a]	Likely to use [a]	Safety [a]	Composite score [b]
Gender - mean (SD)							
Female	20.7 (3.9)	21.2 (3.3)	19.7 (4.5)	19.1 (4.7)	18.4 (4.6)	21.9 (3.2)	120.2 (19.0)
Male	19.5 (3.5)	20.7 (3.3)	19.7 (3.4)	20.0 (3.0)	18.1 (5.1)	21.3 (2.9)	117.9 (19.4)
Live with anyone - mean (SD)							
No	20.4 (4.1)	20.8 (3.3)	19.3 (4.8)	18.9 (5.0)	17.9 (5.7)	21.4 (3.1)	117.8 (21.9)
Yes	20.3 (3.7)	21.1 (3.4)	19.8 (3.7)	19.7 (3.7)	18.5 (4.3)	21.9 (3.1)	120.3 (17.5)
Balance problems							
No	20.6 (3.9)	21.5 (3.2)	19.6 (4.4)	19.7 (4.2)	18.1 (4.9)	22.2 (2.9)	121.1 (19.1)
Yes	19.6 (3.5)	20.0 (3.4)	19.8 (3.5)	19.0 (4.6)	18.7 (4.5)	20.6 (3.2)	115.4 (18.6)
		t(95) = 2.1,p=.04				**t(93)=2.5, p=.02**	
Difficulty getting in/out of tub - mean (SD)	20.1 (3.7)	20.9 (3.4)	19.5 (4.2)	19.4 (4.2)	17.9 (4.5)	21.8 (3.0)	119.1 (19.1)
No	21.1 (4.1)	21.7 (2.9)	20.6 (3.2)	19.6 (4.0)	20.3 (5.4)	21.2 (3.3)	121.2 (19.7)
Yes							
Difficulty sitting in tub - mean (SD)							
No	21.0 (3.4)	21.7 (3.1)	19.6 (4.5)	19.8 (4.4)	18.0 (4.8)	22.3 (2.9)	122.2 (18.2)
Yes	19.4 (4.2)	20.1 (3.5)	19.7 (3.5)	18.9 (3.7)	18.8 (4.8)	21.0 (3.2)	114.4 (19.9)
	t(90)=2.0, p=.05	**t(94)=2.3, p=.02**				**t(92)=2.5, p=.04**	
Falls in past year - mean (SD)							
No	20.2 (3.9)	21.1 (3.3)	19.4 (4.5)	19.0 (4.4)	17.8 (4.8)	21.7 (3.1)	118.3 (19.4)
Yes	20.7 (3.6)	21.0 (3.4)	20.4 (2.8)	20.6 (3.2)	19.5 (4.7)	21.8 (2.9)	122.6 (18.1)
Grab bars at home - mean (SD)							
No	20.8 (3.8)	21.4 (3.6)	19.3 (4.5)	19.1 (4.8)	18.8 (4.9)	22.0 (3.1)	120.2 (20.6)
Yes	19.4 (3.6)	20.4 (2.8)	20.3 (3.2)	20.1 (2.8)	17.4 (4.5)	21.1 (2.9)	118.2 (16.6)
Use mobility aid(s) - mean (SD)							
No	20.5 (3.7)	21.2 (3.2)	19.6 (4.1)	19.5 (4.1)	18.4 (4.8)	21.8 (3.0)	120.1 (18.7)
Yes	18.9 (4.2)	20.1 (4.4)	19.9 (4.0)	18.5 (4.7)	17.5 (4.4)	21.3 (3.7)	113.2 (22.7)
Age – r	.02	.06	**.22, p=.04**	.05	.02	.00	.11
Number of health problems –r	.12	**.22, p=.03**	.04	.11	.06	**.26, p=.01**	-.18
MMSE score - r	.11	.01	.03	.03	.08	.01	-.05
One-legged stance total score – r	.14	.17	.02	.10	.01	**.21, p=.05**	.16
TUG score (without aid) – r	-.07	**-.21, p=.04**	-.01	-.10	-.16	**-.22, p=.04**	-.05

Note: Bonferroni correction set criteria alpha at .004 for each rating factor.

[a] Range from 5-25.

[b] Composite ratings based on sum of ratings of comfort, ease of use, safety, helpfulness getting in/out and up/down from bathtub, likelihood of use across all configurations. Scale ranges from 5 (low score) to 25, with higher scores denoting more favorable rating

Table 4. Characteristics of participants who ranked configurations as easiest to use

Predictors	All bars ranked as easiest (n=49)	UFAS ranked as easiest (n=11)	OCCC ranked as easiest (n=25)	CSA ranked as easiest (n=8)	OBC ranked as easiest (n=9)	Significance of group difference[a]
Age - mean (SD)	70.6 (6.1)	70.4 (8.1)	69.9 (6.0)	68.8 (4.0)	70.3 (7.5)	ns
Number of health problems - mean (SD)	2.0 (1.3)	1.6 (1.1)	1.9 (1.2)	1.0 (1.4)	2.2 (0.8)	ns
MMSE score - mean (SD)	29.3 (08)	28.5 (2.2)	29.8 (0.4)	28.7 (1.4)	28.9 (1.6)	ns
One-legged stance total score - mean (SD)	29.1 (28.5)	26.9 (26.1)	41.9 (35.9)	43.9 (42.4)	33.8 (17.8)	
TUG score (without aid) - mean (SD)	11.2 (2.9)	10.7 (2.5)	10.2 (2.1)	9.7 (2.1)	10.4 (2.5)	ns
Gender						ns
Female	30 (61.2)	6 (54.5)	17 (68.0)	6 (75.0)	4 (44.4)	
Male	19 (38.8)	5 (45.5)	8 (32.0)	2 (25.0)	5 (55.6)	
Live with someone else						ns
No	13 (26.5)	3 (27.3)	11 (44.0)	3 (37.5)	3 (33.3)	
Yes	36 (73.5)	8 (72.7)	14 (56.0)	5 (62.5)	6 (66.7)	
Balance problems						
No	31 (63.3)	8 (72.7)	19 (76.0)	6 (75.0)	7 (77.8)	ns
Yes	18 (36.7)	3 (27.3)	6 (24.0)	2 (25.0)	2 (22.2)	
Fall(s) in previous year						
No	33 (67.3)	9 (81.8)	20 (80.0)	4 (50.0)	9 (100.0)	ns
Yes	16 (32.7)	2 (18.2)	5 (20.0)	4 (50.0)	0	
Difficulty getting in/out of tub						ns
No	43 (87.8)	8 (72.7)	20 (80.0)	8 (100.0)	7 (77.8)	
Yes	6 (12.2)	3 (27.3)	5 (20.0)	0	2 (22.2)	
Difficulty sitting in/getting up from bottom of tub						
No	27 (56.3)	7 (63.6)	14 (56.0)	7 (87.5)	6 (66.7)	ns
Yes	21 (43.8)	4 (36.4)	11 (44.0)	1 (12.5)	3 (33.3)	
Have bars at home						ns
No	28 (57.1)	9 (81.8)	17 (68.0)	5 (62.5)	6 (66.7)	
Yes	21 (42.9)	2 (18.2)	8 (32.0)	3 (37.5)	3 (33.3)	
Use mobility aid						ns
No	42 (85.7)	10 (90.9)	23 (92.0)	8 (100.0)	8 (88.9)	
Yes	7 (14.3)	1 (9.1)	2 (8.0)	0	1 (11.1)	

Note. Bonferroni correction for multiple tests set alpha at .004.

[a] Based on chi square test and one-way ANOVA, as appropriate.

Table 5. Characteristics of participants who ranked configurations as most helpful

Predictors	All bars ranked as most helpful (n=46)	UFAS ranked as most helpful (n=9)	OCCC ranked as most helpful (n=26)	CSA ranked as most helpful (n=9)	OBC ranked as most helpful (n=12)	Significance of group difference[a]
Age - mean (SD)	70.8 (6.0)	71.2 (8.7)	69.3 (5.8)	69.1 (4.5)	70.2 (7.1)	ns
Number of health problems - mean (SD)	2.1 (1.4)	1.4 (0.9)	1.7 (1.1)	1.1 (1.4)	2.2 (0.8)	ns
MMSE score - mean (SD)	29.3 (0.9)	28.3 (2.4)	29.8 (0.4)	28.7 (1.2)	29.2 (1.5)	ns
One-legged stance total score - mean (SD)	30.4 (28.6)	23.8 (21.5)	39.9 (37.2)	41.4 (40.2)	38.3 (19.9)	
TUG score (without aid) - mean (SD)	11.2 (3.0)	11.1 (2.5)	9.9 (1.6)	9.1 (1.6)	11.6 (2.7)	ns
Gender						ns
Female	25 (54.3)	6 (66.7)	17 (65.4)	8 (88.9)	7 (58.3)	
Male	21 (45.7)	3 (33.3)	7 (34.6)	1 (11.1)	5 (41.7)	
Live with someone else						ns
No	13 (28.3)	2 (22.2)	10 (38.5)	4 (44.4)	4 (33.3)	
Yes	33 (71.7)	7 (77.8)	16 (61.5)	5 (55.6)	8 (66.7)	
Balance problems						
No	29 (63.0)	6 (73.1)	19 (73.1)	6 (66.7)	11 (91.7)	ns
Yes	17 (37.0)	3 (33.3)	7 (26.9)	3 (33.3)	1 (8.3)	
Fall(s) in previous year						
No	30 (65.2)	7 (77.8)	21 (80.8)	6 (66.7)	11 (91.7)	ns
Yes	16 (34.8)	2 (22.2)	5 (19.2)	3 (33.3)	1 (8.3)	
Difficulty getting in/out of tub						ns
No	39 (84.8)	6 (66.7)	21 (80.8)	9 (100.0)	11 (91.7)	
Yes	7 (15.2)	3 (33.3)	5 (19.2)	0	1 (8.3)	
Difficulty sitting in/getting up from bottom of tub						
No	22 (48.9)	6 (66.7)	15 (57.7)	8 (88.9)	10 (83.3)	ns
Yes	23 (51.1)	3 (33.3)	11 (42.3)	1 (11.1)	2 (16.7)	
Have bars at home						ns
No	30 (65.2)	7 (77.8)	16 (61.5)	5 (55.6)	7 (58.3)	
Yes	16 (34.8)	2 (22.2)	10 (38.5)	4 (44.4)	5 (41.7)	
Use mobility aid						ns
No	38 (82.6)	8 (88.9)	24 (92.3)	9 (100.0)	12 (100.0)	
Yes	8 (17.4)	1 (11.1)	2 (7.7)	0	0	

Note. Bonferroni correction for multiple tests set alpha at .004.
[a] Based on chi square test and one-way ANOVA, as appropriate.

Table 6. Characteristics of participants who ranked configurations as safest

Predictors	All bars ranked as most safest (n=60)	UFAS ranked as safest (n=12)	OCCC ranked as safest (n=15)	CSA ranked as safest (n=6)	OBC ranked as safest (n=8)	Significance of group difference[a]
Age - mean (SD)	70.9 (6.3)	69.3 (6.7)	69.4 (5.6)	67.2 (3.4)	69.3 (7.2)	ns
Number of health problems - mean (SD)	1.8 (1.3)	1.6 (1.1)	2.1 (1.2)	1.3 (1.5)	2.1 (0.8)	ns
MMSE score - mean (SD)	29.4 (0.9)	28.7 (2.1)	29.7(0.5)	28.8 (1.0)	28.9 (1.7)	ns
One-legged stance total score - mean (SD)	31.7 (28.8)	28.0 (28.0)	38.4 (39.4)	58.2 (43.9)	35.6 (18.1)	ns
TUG score (without aid) - mean (SD)	11.1 (2.9)	10.8 (2.2)	9.8 (1.8)	9.1 (2.1)	10.5 (2.6)	ns
Gender						ns
Female	37 (61.7)	7 (58.3)	11 (73.3)	4 (66.7)	4 (50.0)	
Male	23 (38.3)	5 (41.7)	4 (26.7)	2 (33.3)	4 (50.0)	
Live with someone else						ns
No	17 (28.3)	3 (25.0)	8 (53.3)	1 (16.7)	3 (37.5)	
Yes	43 (71.7)	9 (75.0)	7 (46.7)	5 (83.3)	5 (62.5)	
Balance problems						
No	42 (70.0)	8 (66.7)	10 (66.7)	4 (66.7)	7 (87.5)	ns
Yes	18 (30.0)	4 (33.3)	5 (33.3)	2 (33.3)	1 (12.5)	
Fall(s) in previous year						
No	42 (70.0)	9 (75.0)	11 (73.3)	4 (66.7)	8 (100.0)	ns
Yes	18 (30.0)	3 (25.0)	4 (26.7)	2 (33.3)	0	
Difficulty getting in/out of tub						ns
No	51 (85.0)	9 (75.0)	12 (80.0)	6 (100.0)	7 (87.5)	
Yes	9 (15.0)	3 (25.0)	3 (20.0)	0	1 (12.5)	
Difficulty sitting in/getting up from bottom of tub						ns
No	32 (53.3)	8 (66.7)	9 (60.0)	6 (100.0)	6 (75.0)	
Yes	28 (46.7)	4 (33.3)	6 (40.0)	0	2 (25.0)	
Have bars at home						ns
No	38 (63.3)	10(83.3)	7 (46.7)	5 (83.3)	5 (62.5)	
Yes	22 (36.7)	2 (16.7)	8 (53.3)	1 (16.7)	3 (37.5)	
Use mobility aid						ns
No	53 (88.3)	11 (91.7)	13 (86.7)	6 (100.0	8 (100.0)	
Yes	7 (11.7)	1 (8.3)	2 (13.3)	0	0	

Note. Bonferroni correction for multiple tests set alpha at . 004.

[a] Based on chi square test and one-way ANOVA, as appropriate.

Table 7. Characteristics of participants who ranked configurations as most acceptable

Predictors	All bars ranked as most acceptable (n=37)	UFAS ranked as most acceptable (n=8)	OCCC ranked as most acceptable (n=33)	CSA ranked as most acceptable (n=11)	OBC ranked as most acceptable (n=13)	Significance of group difference[a]
Age - mean (SD)	70.6 (6.0)	71.9 (7.7)	69.5 (5.6)	67.2 (3.7)	72.2 (7.4)	ns
Number of health problems - mean (SD)	1.7 (1.4)	1.5 (0.9)	1.9 (1.0)	1.5 (1.3)	2.3 (0.9)	ns
MMSE score - mean (SD)	29.2 (1.0)	28.1 (2.4)	29.6 (0.7)	29.6 (1.1)	29.2 (1.4)	ns
One-legged stance total score - mean (SD)	35.2 (32.9)	24.4 (18.5)	35.6 (33.8)	36.7 (38.6)	38.2 (21.2)	
TUG score (without aid) - mean (SD)	10.9 (2.6)	11.9 (2.1)	9.9 (1.8)	9.8 (2.1)	10.9 (2.8)	ns
Gender						ns
Female	23 (52.2)	4 (50.0)	23 (69.7)	7 (63.6)	6 (46.2)	
Male	14 (37.8)	4 (50.0)	10 (20.3)	4 (36.4)	7 (53.8)	
Live with someone else						ns
No	12 (32.4)	2 (25.0)	13 (39.4)	3 (27.3)	3 (23.1)	
Yes	25 (67.6)	6 (75.0)	20 (60.6)	8 (72.7)	10 (76.9)	
Balance problems						
No	29 (78.4)	5 (62.5)	20 (60.6)	7 (63.6)	10 (76.9)	ns
Yes	8 (21.6)	3 (37.5)	13(39.4)	4 (36.4)	3 (23.1)	
Fall(s) in previous year						
No	27 (73.0)	6 (75.0)	22 (66.7)	7 (63.6)	13 (100.0)	ns
Yes	10 (27.0)	2 (25.0)	11(33.3)	4 (36.4)	0	
Difficulty getting in/out of tub						ns
No	31 (83.8)	6 (75.0)	29 (87.9)	9 (81.8)	11 (84.6)	
Yes	6 (16.2)	2 (25.0)	4 (12.1)	2 (18.2)	2 (15.4)	
Difficulty sitting in/getting up from bottom of tub						ns
No	20 (54.1)	5 (71.4)	21 (63.6)	6 (54.5)	9 (69.2)	
Yes	17 (45.9)	2 (28.6)	12 (36.4)	5 (45.5)	4 (30.8)	
Have bars at home						ns
No	24 (64.9)	5 (62.5)	18 (54.5)	9 (81.8)	9 (69.2)	
Yes	13 (35.1)	3 (37.5)	15 (45.5)	2 (18.2)	4 (30.8)	
Use mobility aid						ns
No	34 (91.9)	6 (75.0)	29 (87.9)	10 (90.9)	12 (92.3)	
Yes	3 (8.1)	2 (25.0)	4 (12.1)	1 (9.1)	1 (7.7)	

Note. Bonferroni correction for multiple tests set alpha at . 004.

[a] Based on chi square test and one-way ANOVA, as appropriate.

Table 8. Characteristics of participants who ranked configurations as most preferred

Predictors	All bars ranked as most preferred (n=42)	UFAS ranked as most preferred (n=8)	OCCC ranked as most preferred (n=32)	CSA ranked as most preferred (n=11)	OBC ranked as most preferred (n=9)	Significance of group difference[a]
Age - mean (SD)	70.9 (6.2)	69.8 (8.1)	69.9 (5.6)	67.7 (4.6)	71.4 (7.1)	ns
Number of health problems - mean (SD)	1.7 (1.3)	1.5 (0.9)	1.9 (1.2)	1.5 (1.3)	2.4 (0.7)	ns
MMSE score - mean (SD)	29.2 (1.0)	28.4 (2.4)	29.7 (0.7)	29.1 (1.1)	29.0 (1.7)	ns
One-legged stance total score - mean (SD)	36.5 (32.0)	24.1 (18.6)	35.2 (33.9)	33.6 (38.5)	39.4 (19.6)	ns
TUG score (without aid) - mean (SD)	10.7 (2.5)	11.5 (2.3)	10.0 (1.7)	9.9 (2.4)	11.8 (2.9)	ns
Gender						ns
Female	24 (57.1)	5 (62.5)	22 (68.8)	7 (63.6)	5 (55.6)	
Male	18 (42.9)	3 (37.5)	10 (31.3)	4 (36.4)	4 (44.4)	
Live with someone else						ns
No	15 (35.7)	1 (12.5)	10 (31.3)	4 (36.4)	3 (33.3)	
Yes	27 (64.3)	7 (87.5)	22 (68.8)	7 (63.6)	6 (66.7)	
Balance problems						
No	33 (78.6)	5 (62.5)	19 (59.4)	6 (54.5)	8 (88.9)	ns
Yes	9 (21.4)	3 (37.5)	13 (40.6)	5 (45.5)	1 (1.1)	
Fall(s) in previous year						
No	31 (73.8)	6 (75.0)	22 (68.8)	7 (63.5)	9 (100.0)	ns
Yes	11 (26.2)	2 (25.0)	10 (31.3)	4 (36.4)	0	
Difficulty getting in/out of tub						ns
No	36 (85.7)	5 (62.5)	27 (84.4)	10 (90.9)	8 (88.9)	
Yes	6 (14.3)	3 (37.5)	5 (15.6)	1 (9.1)	1 (11.1)	
Difficulty sitting in/getting up from bottom of tub						
No	19 (46.3)	6 (75.0)	20 (62.5)	9 (81.8)	7 (77.8)	ns
Yes	22 (53.7)	2 (25.0)	12 (37.5)	2 (18.2)	2 (22.2)	
Have bars at home						ns
No	28 (66.7)	5 (62.5)	18 (56.3)	8 (72.7)	6 (66.7)	
Yes	146 (33.3)	3 (37.5)	14 (43.8)	3 (27.3)	3 (33.3)	
Use mobility aid						ns
No	35 (83.3)	7 (87.5)	29 (90.6)	11 (100.0	9 (100.0)	
Yes	7 (16.7)	1 (12.5)	3 (7.6)	0	0	

Note. Bonferroni correction for multiple tests set alpha at . 004.

[a] Based on chi square test and one-way ANOVA, as appropria

Ideal bars

A total of 93 people[*] were asked to identify what they considered to be their ideal grab bar configuration. Of these, 13 (14.0%) reported that they did not need bath tub grab bars, or could not envision, their ideal bars. Overall, 19 (20.4%) indicated that they would ideally include one bar; 37 (39.8%) identified two bars; 21(22.6%) identified three bars; and 3 (3.2%) identified four bars.

As can be seen in Table 9, of the 80 respondents who reported that they desired *at least* one grab bar at home, the majority expressed a desire for at least one bar on the back wall of the bathtub (n = 69, 86.2%). The most commonly requested orientation (as identified on the ideally drawn configuration) for back wall bars were angled and horizontal bars, requested by 43.7% and 37.5% of respondents, respectively. A few (11.3%) of the respondents requested an L-shaped bar on the back wall while vertical bars were requested by only 7.5% of respondents.

Faucet wall bars were then next most commonly identified location for ideal bars (n = 41, 51.2% of respondents). The most commonly requested orientation for faucet wall bars were for vertical bars, identified as ideal by 46.2% of respondents. Other orientations of bars on the faucet wall were identified by fewer than 10% of respondents.

Bars on the head wall were requested by slightly more than a quarter of respondents (27.5%). The most commonly requested orientation for these bars were for vertical bars, requested by 18.8% of respondents. Horizontal bars on the head wall were requested by 10% of respondents. No other bars on the head wall were identified.

Finally, rim bars were requested by one-fifth of respondents (20.0%). The most common request was for a horseshoe bar on the rim, identified as ideal by 15.0% of respondents. Horizontally orientated bars on the rim were requested by 5% of respondents.

Two participants reported a desire for a bar located other than on the bath wall or bath rim. One identified a desire for a bar located at the height of the curtain rod, but did not identify whether this bar should be inside or outside of the bathtub. The other identified a need for something on the right hand side, outside of the bathtub.

[*] We added the questionnaire item asking participants to identify an ideal grab bar configuration after having tested an initial 10 people.

Table 9. Location and shape of ideal bars (n=80 respondents)

	Back wall	Head wall	Faucet wall	Bath rim	Other[b]
Number (%) desiring bar					
No bars	11 (13.8)	58 (72.5)	39 (48.8)	64 (80.0)	78 (97.5)
1 bar	57 (71.2)	21 (26.2)	37 (46.2)	16 (20.0)	2 (2.5)
2 bars	12 (15.0)	1 (1.3)	4 (5.0)	0	0
	69 (86.2)	*22 (27.5)*	*41 (51.2)*	*16 (20.0)*	*2 (2.5)*
TOTAL NUMBER OF PARTICIPANTS REQUESTING BAR:					
Most common shape requested overall: n(%) [a]					
Horizontal	30 (37.5)	8 (10.0)	6 (7.5)	4 (5.0)	0
Vertical	6 (7.5)	*15 (18.8)*	*37 (46.2)*	0	0
Angled	*35 (43.7)*	0	0	0	0
L-shaped	9 (11.3)	0	1 (1.2)	0	0
Horseshoe	0	0	0	*12 (15.9)*	0
Other	1 (1.2)	0	1 (1.2)	0	2 (2.5)
Total number bars requested:	*71*	*23*	*44*	*16*	*1*

[a] Some participants requested multiple bars on the same wall.

[b] Other: one bar at level of shower curtain rod – wall not identified; one bar on right hand side of bathtub outside the bath tub.

Note: only 93 were asked to identify their ideal bar

Table 10. Prevalence of use of any configurations n(%)

	No	Yes
Use to get in	13 (12.7)	89 (83.7)
Use to sit in	6 (5.9)	96 (94.1)
Used to get up	8 (7.8)	94 (92.2)
Used to get out	16 (15.7)	86 (84.3)
Used for any activity	1 (1.0)	101 (99.0)

Results of video coding

Three data coders viewed video data. Interrater reliability was assessed by having the three data coders review a sample of the same five videotapes each. Concordance for whether bars were used (range: 84% to 96%) and which bars were used (range: 80% to 100%) were very good to excellent.

Relationship between self-reported and coded data

Correlation between the number of activities (range from 1 to 4) for which different configurations were used and self-reported composite configuration scores were non-significant for each configuration: OBC($r = .14$), UFAS ($r = .16$), CSA ($r = .01$), OCCC ($r = .12$), all bars ($r = .28$).

Prevalence of grab bar use

Patterns of grab bar use, in general, are presented in Table 10. As reported, all but one participant used at least one grab bar during some part of the testing. The individual who chose not to use any grab bars for any activities did not use any supports, including walls, the bath rim, or bath rim, to facilitate getting in, sitting down, getting up, or getting out of the bathtub.

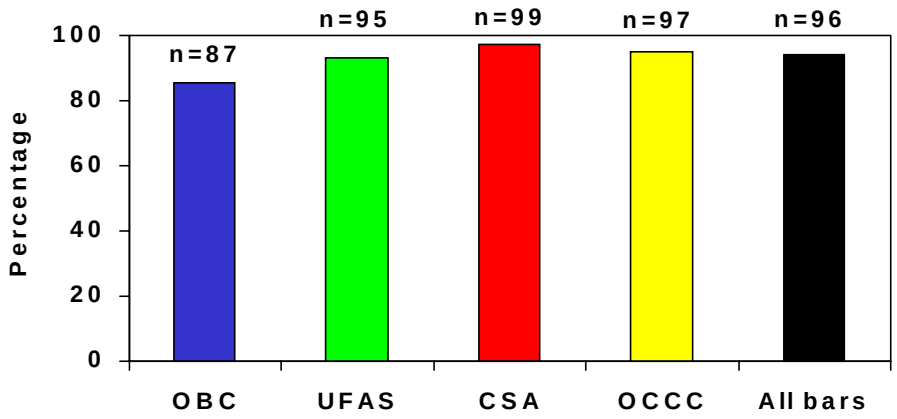
Over 10% of respondents did NOT use any bars at all to get in (12.7%) or out (15.7%) of the bathtub. Of the 13 participants who did not use a bar to get in, one participant was observed to use a wall to facilitate with the transfer. Of the 16 participants who did not use a bar to get out of the bathtub, four used a wall during the transfer.

Fewer than 10% of respondents chose NOT to use a bar to facilitate sitting down in (5.9%) or getting up from (7.8%) the bottom of the bathtub. Of the six who used no bars to sit down, five used the bath rim or back rim to help in getting down. Similarly, of the eight who used no bars to get up, six used the bath rim or back rim to get up.

Pattern of use of different configurations of bathtub grab bars (Specific Research Objective #4)

Patterns of use of different grab bar configurations and specific bars used are detailed in Figures 27-31 and Table 11. Beginning with Figure 27, significant differences were noted in the prevalence with which grab bars in different configurations were used overall ($Q(4)=16.6$, $p \leq .0$). This significant omnibus test is attributed to a significant difference in prevalence of use of grab bars when using the CSA as compared to the OBC configuration ($p \leq .005$). Indeed, the configuration most commonly used for any activity was the CSA configuration, used to get in, sit, get up, or out of the bathtub by 99 (97.1%) participants. Although not statistically significant, the next most commonly used configuration was the OCCC configuration, used by 97 (95.1%) participants. The UFAS and OBC configurations were used with the lowest prevalence (93.1% and 85.3%, respectively).

Figure 27. Video recorded use of different configurations during any part of the testing



Significance of results of differences based on repeated measurements Cochrane Q test:

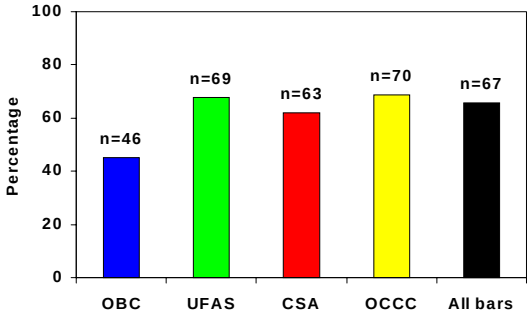
Q (4) = 16.6, p ≤ .01

Results of follow up tests based on McNemar test for two related samples:

All bars versus OBC: p = .04 OBC versus UFAS: p = .05

OBC versus CSA: p ≤ .005 OBC versus yellowOCCC: p = .01

Figure 28. Use of different configurations to get into bathtub



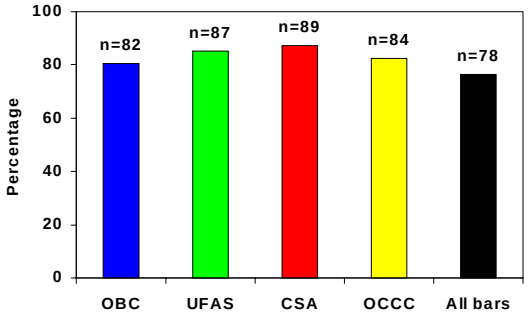
Significance of difference based on repeated measurements Cochrane Q test:

Q (4) = 27.5, p ≤ .01

Results of follow up tests based on McNemar test for paired samples:

- ***All bars versus OBC: p ≤ .005***
- ***OBC versus UFAS: p ≤ .005***
- ***OBC versus CSA: p < .005***
- ***OBC versus OCCC: p ≤ .005***

Figure 29. Use of different configurations to sit in bathtub



Significance of difference based on repeated measurements Cochrane Q test:

p = .08

Table 11. Number (%) of participants who used grab bars in function of configuration- (n=102)

Configuration	Getting into the bathtub	Sitting down in the bathtub	Getting up from the bottom of the bathtub	Getting out of the bathtub
OBC configuration				
None	56 (54.9)	20 (19.6)	23 (22.5)	71 (69.6)
Vertical on back wall	39 (38.2)	20 (19.6)	21 (20.6)	28 (27.5)
Horizontal on back wall	8 (7.8)	64 (62.7)	62 (60.8)	3 (2.9)
UFAS configuration				
None	33 (32.4)	15 (14.7)	14 (13.7)	47 (46.1)
Horizontal on wall opposite faucet	18 (17.6)	0	3 (2.9)	13 (12.7)
Top horizontal on back wall	29 (28.4)	28 (27.4)	22 (21.6)	18 (17.6)
Bottom horizontal on back wall	5 (4.9)	63 (61.7)	64 (62.7)	0
Horizontal on faucet wall	37 (36.3)	6 (5.9)	8 (7.8)	17 (16.0)
CSA configuration				
None	39 (38.2)	13 (12.7)	87 (20.6)	48 (47.1)
Vertical on faucet wall	58 (56.9)	4 (3.9)	4 (3.9)	51 (50.0)
Horizontal on back wall	8 (7.8)	87 (85.3)	79 (77.5)	3 (2.9)
OCCC configuration				
None	32 (31.4)	18 (17.6)	20 (19.6)	38 (37.3)
Vertical on faucet wall	58 (56.9)	2 (2.0)	3 (2.9)	48 (47.1)
Angled on back wall	12 (11.8)	84 (82.3)	81 (79.4)	23 (22.5)
All bars configuration				
None	35 (34.3)	24 (23.5)	24 (23.5)	40 (39.2)
Vertical on wall opposite faucet	14 (13.7)	0	0	13 (12.7)
Horizontal on wall opposite faucet	9 (8.8)	0	2 (2.0)	4 (3.9)
Angled on back wall	21 (20.6)	44 (43.1)	56 (54.9)	17 (16.7)
Horizontal on back wall	1 (1.0)	32 (31.4)	22 (21.6)	0
Horizontal on faucet wall	8 (7.8)	2 (2.0)	0	3 (2.9)
Vertical on faucet wall	33 (32.3)	2 (2.0)	0	33 (32.3)

Note. Sum of cells are greater than 102 (100%) because some participants used more than one bar per configuration.

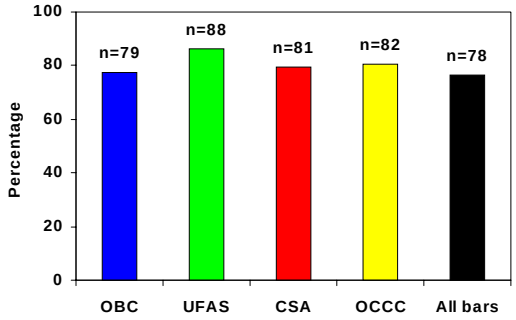
Significant differences were noted in the prevalence with which grab bars in different configurations were used to enter the bathtub ($Q(4)=27.5$, $p \leq .0$) (Figure 28). This is attributed to a significantly lower prevalence of use when using the OBC, as compared to the All Bars, UFAS, CSA, and OCCC configurations ($p's \leq .005$). The configuration most commonly used to get into the bathtub was the OCCC configuration, used by 68.6% of participants. The configuration least likely to be used to get into the bathtub was the OBC configuration, used by 45.1% of participants. As is detailed in Table 11, when given the option of All Bars, the bars most likely to be used to get into the bathtub were the vertical bars on the faucet wall, followed by angled back wall bars (used by 32.3% and 20.6% of respondents, respectively). The bars least likely to be used were the horizontal back wall bars, horizontal faucet wall bars, and all bars on the head wall.

Differences in the prevalence of use of different configurations to sit in the bottom of the bathtub were not significant (Figure 29). Nonetheless, the configuration most commonly used to sit in the bottom of the bathtub was the CSA configuration, used by 87.3% of participants. The configuration that was least likely to be used to sit in the bathtub was the All Bars configuration, used by 76.5% of participants. Given All Bar options (Table 11), participants were most likely to use angled or horizontal bars on the back wall to sit into the bottom of the bathtub (43.1 and 31.4%, respectively). The bars least likely to be used to sit in the bottom of the bathtub were the faucet wall bars and the bars on the head wall.

Differences in the prevalence of use of different configurations to get up from the bottom of the bathtub were not significant (Figure 30). Nonetheless, the UFAS configuration was most often used to facilitate getting up from the bottom of the bathtub (used by 86.3% of participants). The configuration that was least likely to be used to get up from the bottom of the bathtub was the All bars configuration, used by 77.5% of participants. As can be seen in Table 11, when given options of all bars, the bar that was most often used to get up from the bottom of the bathtub was the angled bar on the back wall, used by 54.9% of participants. The horizontal bar on the back wall was also commonly used, observed as having been used by 21.6% of participants. The bars least likely to be used to get up from the bottom of the bathtub were faucet wall bars and bars on the head wall.

Significant differences were noted in the prevalence with which grab bars in different configurations were used to exit the bathtub ($Q(4)=39.0$, $p \leq .01$) (Figure 31). This difference is attributed to significantly lower prevalence of use when using the OBC as compared to the all bars, UFAS, CSA, and OCCC configurations. The configuration most commonly used to get out of the bathtub was the OCCC configuration, used by 62.7% of respondents. The configuration least likely to be used to get out of the bathtub was the OBC configuration, used by 30.4% of participants. When given all options (Table 11), the bar that was most often used to exit the bathtub was the vertical bar on the faucet wall (used by 32.3% of respondents) and the angled bar on the back wall (used by 16.7% of respondents). Vertical bars on the head wall were used by 12.7% of participants. Horizontal bars on the back wall, the head wall, and the faucet wall were used by fewer than 5% of participants each to exit the bathtub.

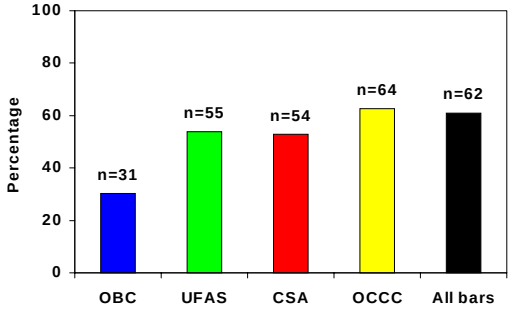
Figure 30. Use of different configurations to get up from the bottom of bathtub



Significance of difference based on repeated measurements Cochrane Q test:

P = .09

Figure 31. Use of different configurations to get out of bathtub



Significance of difference based on repeated measurements Cochrane Q test:

Q (4) = 39.0, p ≤ .01

Results of follow up tests based on McNemar test for paired samples:

All bars versus OBC: p ≤ .005; OBC versus UFAS: p ≤ .005; OBC versus CSA: p ≤ .005; OBC versus OCCC: p < .005; CSA versus OCCC: p = .03

Relationship between participant characteristics and use of grab bars

The number of people who chose to NOT use grab bars to sit into (n=6), or get up from (n=8) from the bathtub was too small for meaningful comparisons of those who use and do not use grab bars for these activities. The number of participants who chose not to use grab bars to get in (n=13) or out of the bathtub (n=16) were, while also small, sufficient to perform statistical analyses.

Profiles of participants who used, versus those who did not use, a grab bar to enter the bathtub are presented in Table 12. After correcting the criteria alpha for multiple tests, none of the respondent characteristics were significantly associated with use of grab bar upon entry. However, trends emerged indicating that compared to participants who used NO grab bars to get into the bathtub, those who used grab bars: a) were older (p= .07); b) took longer to perform the TUG (p=.12); and, c) were more likely to self-report difficulties getting in/out of the bathtub (p=.09) and sitting into/getting up from the bottom of the bathtub (p=.01).

After correcting the criteria alpha for multiple tests, none of the respondent characteristics were significantly associated with use of grab bar for exiting the bathtub. However, trends emerged indicating that, compared to participants who chose not to use a grab bar to exit the bathtub, those who used grab bars were more likely to: a) self-report balance problems (p= .07); b) take longer to perform the TUG (p=.12); c) balance for less time when performing the one-legged stance (p=.12); d) report more health problems (p=.15); e) self-report difficulties getting in/out of the bathtub (p=.05) and sitting into/getting up from the bottom of the bathtub (p=.05); and, f) report that they used a mobility aid (p=.14).

Table 12. Characteristics of participants who used versus those who chose not to use grab bars to enter and exit the bathtub

Predictors	Used bar to enter (n=89)	Did not use bar to enter (n=13)	Significance of group difference		Used bar to exit (n=86)	Did not use bar to exit (n=16)	Significance of group difference
Age - mean (SD)	**70.8 (6.3)**	**67.5 (4.1)**	**P=.07**		70.7 (6.3)	68.6 (5.0)	ns
Number of health problems - mean (SD)	1.8 (1.3)	1.9 (1.2)	ns		**1.9 (1.2)**	**1.4 (1.3)**	**P=.15**
Mini-mental score - mean (SD)	29.3 (1.2)	29.2 (1.2)	ns		29.3 (1.2)	29.1 (1.2)	ns
One-legged stance total score - mean (SD)	33.4 (29.4)	37.9(41.1)	ns		**31.8 (30.1)**	**45.1 (33.9)**	**P=.12**
TUG score (without aid) - mean (SD)	**10.9 (2.7)**	**9.7(1.4)**	**P=.12**		**10.9 (2.7)**	**9.8 (1.3)**	**P=.12**
Gender			ns				ns
Female	57 (64.0)	6 (46.2)			55 (64.0)	8 (50.0)	
Male	32 (36.0)	7 (53.8)			31 (36.0)	8 (50.0)	
Live with someone else			ns				ns
No	28 (31.5)	4 (30.8)			28 (32.6)	4 (25.0)	
Yes	61 (68.5)	9 (69.2)			58 (67.4)	12 (75.0)	
Balance problems			ns				**P=.07**
No	63 (70.8)	8 (61.5)			**57 (66.3)**	**14 (87.5)**	
Yes	26 (29.2)	5 (38.5)			**29 (33.7)**	**2 (12.5)**	
Difficulty getting in/out of tub			**P=.09**				**P=.05**
No	**73 (82.0)**	**13 (100.0)**			**70 (81.4)**	**16 (100.0)**	
Yes	**16 (18.0)**	**0**			**16 (18.6)**		
Difficulty sitting in/getting up from bottom of tub			**P=.01**				**P=.05**
No	**48 (54.5)**	**12 (92.3)**			**47 (55.3)**	**13 (81.3)**	
Yes	**40 (45.5)**	**1 (7.7)**			**38 (44.7)**	**3 (18.7)**	
Use mobility aid			ns				**P=.14**
No	79 (88.8)	12 (92.3)			**75 (87.2)**	**16 (100.0)**	
Yes	10 (11.2)	1 (7.7)			**11 (12.8)**		

Note. Bonferroni correction for multiple tests set alpha at .005

Table 13. Number (%) of participants using wall, bath rim, and bath brim to get in, down, up, and out of the bathtub (n=102)

	Getting into the bathtub	Sitting down in the bathtub	Getting up from the bottom of the bathtub	Getting out of the bathtub	Total for any activity
Total who used a wall [a]	28 (27.5)	0	2 (21.0)	28 (27.5)	43 (42.2)
Faucet wall	*17 (16.7)*	*0*	*0*	*17 (16.7)*	*26 (25.5)*
Wall opposite faucet	*6 (5.9)*	*0*	*2 (2.0)*	*9 (8.8)*	*15 (14.7)*
Back wall	*10 (9.8)*	*0*	*0*	*5 (4.9)*	*12 (11.8)*
Total who used bath rim	12 (11.8)	101 (99.0)	100 (98.0)	3 (2.9)	101 (99.0)
Total who used bath brim	0	22 (21.6)	22 (21.6)	0	30 (29.1)
Total using any supports other than grab bars	36 (35.3)	101 (99.0)	100 (98.0)	29 (28.4)	101 (99.0)

[a] Some participants used more than one wall.

Use of wall, rim, and back rim

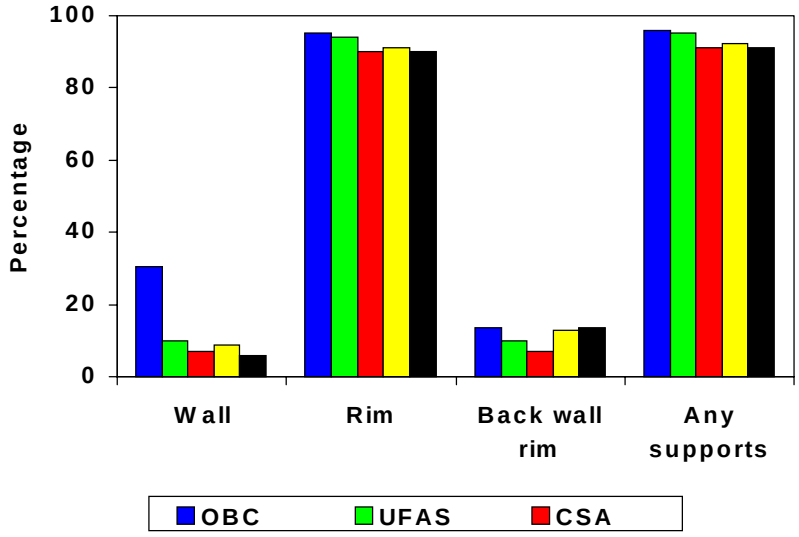
Prevalence of use of supports. As detailed in Table 13, 101 the 102 participants (99.0) for whom video data were available, relied on supports other than the grab bars to either enter, sit in, get up from, or exit the bathtub.

Overall, 43 (42.2%) used a wall, at some point, during the testing. The most commonly used wall for any activity was the faucet wall, used by 25.5% of participants. Twenty-eight (27.5%) respondents used walls to each get into and out of the bathtub. The most commonly used wall, to get in and out, was the faucet wall, which was used by 13.7% of participants for each activity. Only two participants used a wall to get up from the bottom of the bathtub (head wall) and none of the participants used a wall as support when sitting into the bathtub.

Relatively few participants used the bath rim or back rim to get in or out of the bathtub. However, the bath rim was used by all but one participant at some point during the testing, most notably to sit in (n=101, 99%) and get up from (n=100, 98%) the bottom of the bathtub. However, more than 10% (n=12, 11.8%) also used the rim to get into the bathtub.

Finally, 29.1% of participants used the back rim during the testing. In all cases, the back rim was used to either sit into or get up from the bottom of the bathtub.

Figure 32. Use of support for any activity by configuration



Significant differences in prevalence of use of walls for any activity bathtub in function of grab bar configuration: $Q(4) = 42.9$, $p < .01$. This differences is attributed to significantly greater use of walls for the OBC, as compared to the UFAS, CSA, OCCC and All bars configurations (all p's < .005).

Use of supports in function of configuration.[*] As detailed in Table 14, the prevalence of use of supports other than grab bars for any activity did not differ significantly between the configurations. However, in general, the use of supports was greater when using the OBC configuration. In total, 98 (96.1%) participants required some support other than a grab bar when performing the testing using the OBC configuration. In contrast, supports other than grab bars were slightly less commonly used in each of the UFAS, CSA, OCCC, and all bars configurations (used by 95.1%, 91.2%, 92.2%, and 91.2% of participants, respectively, ns).

Significant differences in the use of any supports in function of configuration was found for entering the bathtub, $Q(4) = 60.7$, $p < .01$. As can be in Table 14, 31.4% of participants relied on supports other than grab bars to get into the bathtub when using the OBC configuration, a significantly higher prevalence than was observed when using other configurations (p's < .005). Similarly, significant differences were found in the prevalence with which supports were required to exit the bathtub, $Q(4) = 20.3$, $p < .01$. Follow-up tests indicated that, as with entering the bathtub, supports were used with significantly greater prevalence when using the OBC (17.6%), as compared to the other, configurations (p's < .005). No significant differences between configurations were found in the prevalence of use of supports to sit down or get up from the bottom of the bathtub.

Use of walls in function of configuration. Significant differences in the prevalence of use of walls for any activity in function of configuration were found, $Q(4) = 42.9$, $p < .01$. As seen in Table 14, 30.4% of participants used a wall for support for either getting in, down, up, or out of the bathtub when using the OBC configuration, a significantly higher prevalence than was observed when using other configurations (p's < .005). The wall most commonly used to help get into and out of the bathtub when using the OBC configuration was the faucet wall, used by 17.6% of participants, followed by the head wall (9.8%) and the back wall (5.9%). In contrast, the prevalence of use of any of the walls for any activity in other configurations was typically lower than 5%. One exception is the UFAS configuration, where 6.8% of participants used a faucet wall to help with at least one of the activities.

Significant differences were found in the prevalence with which a wall was used for support to enter the bathtub, $Q(4) = 52.5$, $p < .01$. Follow-up tests indicated that a wall was used to help get into the bathtub with significantly greater prevalence when using the OBC (23.5%%), as compared to the other configurations (p's < .005). The most commonly used wall to help get into the bathtub, when using the OBC configuration, was the faucet wall, used by 15.7% of participants. Few used walls for support when getting in with any other configuration.

Although the use of the wall for support to exit the bathtub was higher when using the OBC configuration (16.7%) than any other configuration, differences were not significant. The wall most often used to help participants get out of the bathtub when using the OBC configuration was the faucet wall. Fewer than 5 participants in each configuration relied on a wall to get out of the bathtub.

[*] The number of participants using different walls for supports for each activity was too small to allow for meaningful statistical analyses (i.e. many cells with n less than 5).

None of the participants used a wall to sit into the bathtub, although two participants relied on the support of the head wall to get up from the bottom of the bathtub.

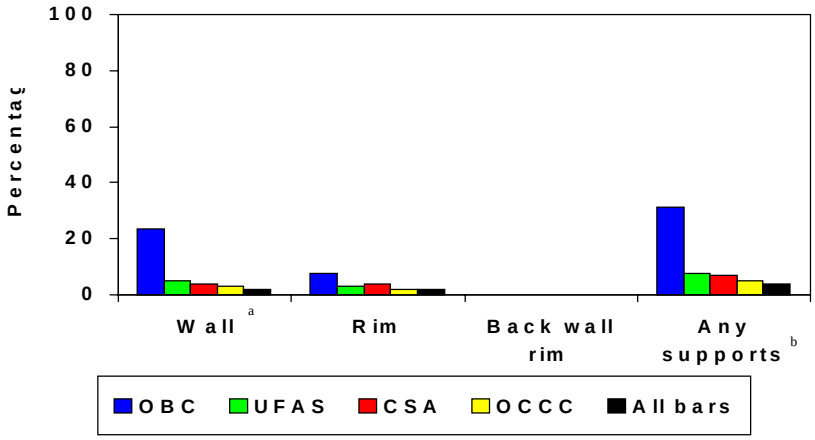
Use of bath back rim and rim in function of configuration. The prevalence with which the bath rim and back rim were each used for any activity was highest among the OBC configuration and lowest when using the CSA, OCCC, and All Bars configurations. However, group differences were not significant. Similarly, although few participants relied on the rim or back rim to enter or exit the bathtub, the distribution of use was not significantly difference when using the different configurations. Finally, group differences in the prevalence of use of the rim or back rim for sitting in or getting up from the bathtub were not significant. However, consistently, the OBC configuration was associated with a higher prevalence of use of the rim and/or back rim.

Table 14. Number (%) of participants using different walls, bath rim, and bath brim to get in, down, up, and out of the bathtub and in function of configuration (n=102)

Configuration	Any activity	Getting into the bathtub	Sitting down in the bathtub	Getting up from the bottom of the bathtub	Getting out of the bathtub
OBC configuration					
Faucet wall	*18 (17.6)*	*16 (15.7)*	*0*	*0*	*12 (11.8)*
Wall opposite faucet	*10 (9.8)*	*6 (5.9)*	*0*	*1 (1.0)*	*6 (5.9)*
Back wall	*6 (5.9)*	*4(3.9)*	*0*	*0*	*2(2.0)*
UFAS configuration					
Faucet wall	*7 (6.8)*	*4 (3.9)*	*0*	*0*	*3 (2.9)*
Wall opposite faucet	*3 (2.9)*	*1 (1.0)*	*0*	*0*	*2 (2.0)*
Back wall	*2(2.0)*	*1(1.0)*	*0*	*0*	*1(1.0)*
CSA configuration					
Faucet wall	*1 (1.0)*	*1 (1.0)*	*0*	*0*	*1(1.0)*
Wall opposite faucet	*2 (2.0)*	*1 (1.0)*	*0*	*0*	*1(1.0)*
Back wall	*4 (3.9)*	*3(2.9)*	*0*	*0*	*1(1.0)*
OCCC configuration					
Faucet wall	*4 (3.9)*	*2(2.0)*	*0*	*0*	*3 (2.9)*
Wall opposite faucet	*4 (3.9)*	*1(1.0)*	*0*	*0*	*3 (2.9)*
Back wall	*1(1.0)*	*3(2.9)*	*0*	*0*	*0*
All bars configuration					
Faucet wall	*3 (2.9)*	1 (1.0)	*0*	*0*	*2 (2.0)*
Wall opposite faucet	*2 (2.0)*	*0*	*0*	*1 (1.0)*	*1 (1.0)*
Back wall	*2 (2.0)*	*2(2.0)*	*0*	*0*	*1(1.0)*

Note: Bonferroni corrections were used to compensate for multiple tests, setting the criteria for significance in determining differences in use of supports (walls, rims, brims, total supports) for each activity at .01. Similar corrections for follow-up tests set the criteria for significance for each set of follow-up tests at .005.

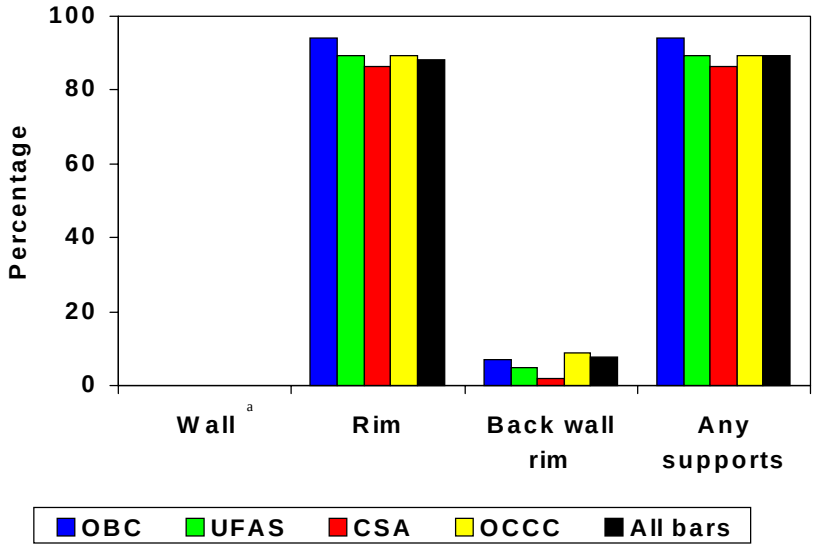
Figure 33. Use of supports to get into bathtub by configuration



a: Significant differences in prevalence of use of walls to get into the bathtub in function of grab bar configuration: $Q(4) = 52.5$, $p < .01$. This differences is attributed to significantly greater use of walls for the OBC, as compared to the UFAS, CSA, OCCC and All bars configurations (all p's < .005).

b: Significant differences in prevalence of use of any supports to get into the bathtub in function of grab bar configuration: $Q(4) = 60.7$, $p < .01$. This differences is attributed to significantly greater use of supports for the OBC, as compared to the UFAS, CSA, OCCC and All bars configurations (all p's < .005).

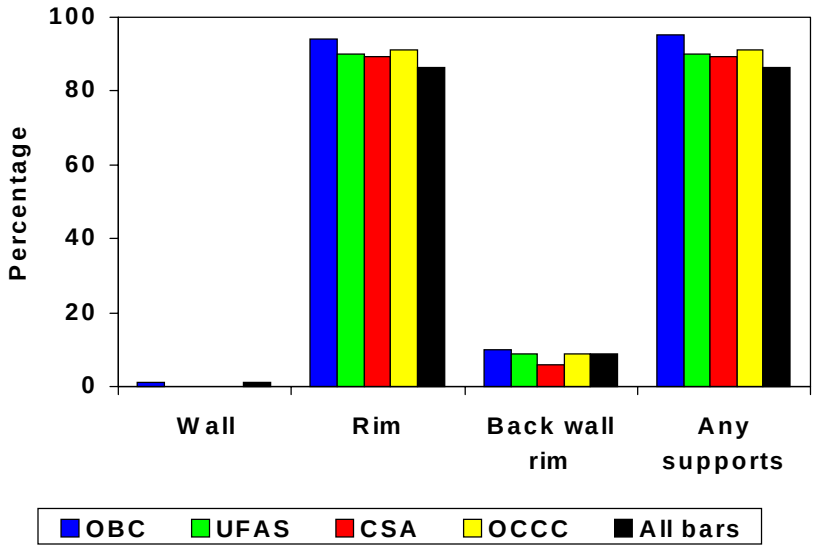
Figure 34. Use supports to sit down in bathtub by configuration



No significant differences in use of any supports across configurations.

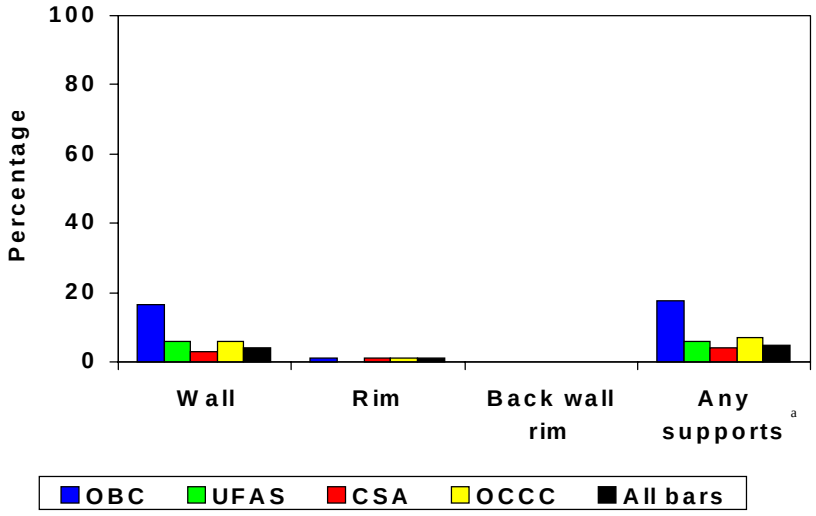
a: no one used a wall for support to sit down.

Figure 35. Use of supports to get up from the bottom of bathtub by configuration



No significant differences in use of any supports across configurations.

Figure 36. Use of supports to get out of bathtub



a: Significant differences in prevalence of use of any supports to exit the bathtub in function of grab bar configuration: $Q(4) = 20.3$, $p < .01$. This differences is attributed to significantly greater use of supports for the OBC, as compared to each the CSA, UFAS, OCCC, and All bars configurations (p's < .005).

DISCUSSION and SUMMARY

The purpose of this research study was to assess different locations and configurations of bathtub grab bars and to identify the safest and most useful options to help independent seniors living in the home to maintain their independence and avoid falls. Findings of this study are expected to provide information that would be useful to seniors, policy makers, and public health professionals whose objectives include reducing the incidence of falls and promoting independent living for seniors. The specific objectives of the study were to:

vi) develop a profile of the current use of bathtub grab bars;
vii) determine the perceived usefulness of five different configurations of bathtub grab bars;
viii) determine the perceived safety of five different configurations of bathtub grab bars;
ix) determine the pattern of use of five different configurations of bathtub grab bars;
x) determine which of the standards tested is perceived as the safest and most useful.

The sample of seniors recruited for participation in this study was relatively healthy with the majority able to complete all components of the testing protocol. The demographic profiles of the 103 participants tested adequately reflect the general community-dwelling population of seniors living in the Ottawa/Carleton region. Moreover, overall demographic and health profiles, including the prevalence of falls, were comparable to estimates provided in other community-based studies (Campbell et al., 1989; Graafmans et al., 1996; Hale et al., 1992; Lockett et al., 1999; Lord et al., 1993; Nevitt et al., 1989; Nevitt et al., 1991; O'Loughlin et al., 1993; Robbins et al., 1989; Sorock & Labiner, 1992; Tinetti et al., 1988). Despite being generally healthy, almost one-third of our participants reported balance problems and falls in the previous year and over one-third reported difficulties with bath transfers. Of interest, objective evaluations of balance and mobility matched the self-rated scores indicating that individuals were able to appropriately evaluate their individual competency levels. Further, although not an objective of the current study, we did identify that one quarter of the community-dwelling participants tested in the study that did not use mobility aids self-reported a balance problem. This suggests that a possible bias exists not only against the use of assistive devices but to assistive/mobility devices in general.

Characteristics of bars and bar use at home:

Although participants with grab bars installed in their homes generally indicated that they were used on a regular basis, the majority of study participants (64.1%) had no grab bars installed in their home bathrooms. Moreover, although findings from our previous research (Aminzadeh et al., 2000) suggests that a minimum of two bath grab bars are needed in seniors' homes, only 11 participants in the present study reported having two or more bath grab bars in their home. For this study, the survey the questionnaire used to determine individual participant profiles did not address the question of why grab bars were not installed.

Although the placements and orientations of the home bathtub grab bar configurations were varied, the most commonly reported were bath bars on the back wall. However, 20% of

respondents with grab bars indicated that they had a bar on the bath rim. Personal communication with occupational therapists working in community practice suggests that the horseshoe bar mounted on the bathtub rim may be a safety hazard predisposing people to falls from tripping. We were unable to add the horseshoe rim-mounted configuration to the series evaluated in the current study. However, given the possibility of safety risk associated, followup studies of this bar are warranted.

Preferred configurations:

The ratings on each of the factors for evaluation of the individual bathtub grab bar configurations were relatively consistent within each configuration. This suggests that a single composite score could be used to represent each configuration. A significant relationship between ratings for safety, acceptance and preference further demonstrates that seniors recognise the safety of bath grab bars. An exception to consistent ratings was the OBC configuration where ratings of comfort, ease of use and safety were not significantly associated with helpfulness in getting in and out of the tub. This is not surprising since the OBC configuration consists of an L-shaped bar on the back wall only and thus the bar configuration would not be helpful for entering and exiting the tub. Moreover, the OBC configuration was the only configuration tested that did not have a bar on either the head or faucet wall.

In all factors evaluated (perceived helpfulness, safety, ease of use, comfort, etc.), the All Bar configuration was ranked highest followed by the UFAS and OCCC configurations. The lowest rankings on all factors of perceived helpfulness, safety, ease of use, etc., were recorded for the CSA and OBC configurations. The rankings of the Configuration Composite Scores resulted in two groups of configurations with the All Bars, UFAS and OCCC configurations ranking significantly higher than the CSA and OBC configurations.

It is possible that the OBC configuration was ranked significantly lower than the other configurations tested simply due to the lack of a bar on the faucet/head wall resulting in no additional assistance for entering/exiting the bathtub. The low ranking of the CSA configuration is more difficult to explain since it includes a vertical bar on the faucet wall. One pattern of entry into the tub is for a participant to grab the faucet wall bar, step into the tub and then quickly grab the back wall bar before stepping into the tub with the second foot. If this is the preferred entry pattern, it is possible that the horizontally oriented bar on the back wall in the CSA configuration is too low to serve this purpose. This interpretation remains to be confirmed.

Video data

There was no relationship between the Configuration Composite Scores (highest score indicating best results across all factors as determined by survey data) and the number of activities for which a configuration was used (as determined by video data). This is surprising and suggests that the self-report or perceived ratings on the factors tested may not be reflective of actual grab bar use. Thus, although participants may have positively ranked a given configuration, they may not have used the bars within the configuration when they actually performed the bathtub test.

Results of video data suggest that all but one participant used at least one grab bar at some point during the testing. Overall, the All Bar, CSA, OCC, and UFAS configurations were the most commonly used for all activities. The OBC configuration was least likely to be used. There were no significant differences between configurations in the prevalence of use of grab bars to sit down or get up from the bottom of the tub. This is not surprising since all configurations had at least on bar mounted on the back wall of the bathtub. However, there was a significant difference between configurations for entering and exiting the tub with the OBC configuration significantly less used than all of the other configurations tested. This too is not surprising since the OBC configuration does not include a bar on either the faucet or head wall of the tub.

Most participants used supports, other than grab bars, during the testing. Use of supports was highest when using the OBC configuration. In over 17% of the individual entries and exits from the bathtub, participants were videotaped using the wall for support during the transfer. Participants relied on a wall for support most often with using the OBC configuration. The majority of participants (99%) used the bathtub rim and back rims when sitting into or getting up from the bottom of the tub, irrespective of configuration. A high prevalence of use of bath edges to sit down and get up from the bottom of the bathtub is alarming and highlights the need for additional safety features such as non-slip surfaces for bath edges.

Characteristics of seniors for whom bath grab bars may be most useful

Characteristics of the individuals ranking each configuration high versus low on the different factors were determined. There were no differences between groups of individuals identified. This suggests that the rank order obtained is representative of perceived preference regardless of health/demographic/fall history for seniors with similar profiles to our study participants. Similarly, no significant differences between those who used and those who did not use grab bars for various activities were found. These findings highlight the need for universal access to grab bars.

Ideal bath grab bar configurations

When asked to identify an ideal configuration, the most prevalent configuration consisted of two bars. In the ideal configuration, one vertically oriented bar was located on the faucet wall while a second bar, oriented either horizontally or on an angle was located on the back wall. This is consistent with patterns of grab bar use observed from video data and with supports required to get in/out of the bathtub (faucet wall) and up/down from the bottom of the bathtub (bath edges).

RECOMMENDATIONS FROM THIS STUDY and SUGGESTIONS FOR FUTURE RESEARCH

The following recommendations and suggestions can be made based on the data from this study.

RECOMMENDATIONS from this study:

1. A minimum of two bars should be included in each installation of bathtub grab bars for this population with one bar used for entering/exiting the bathtub and the second bar used to assist in sitting down into or getting up from the bottom of the tub.
2. One bar, to assist in entering/exiting the bathtub, should be located on the head or faucet wall. A vertically oriented bar is useful for both entering and exiting the tub. A horizontally oriented bar is useful for entering the tub however is less helpful when a person is exiting the tub unless the bar extends past the rim of the tub into the "clear" space.
3. One bar, to assist in sitting/standing from the bottom of the tub, should be located on the back wall of the tub. An ideal orientation was not identified indicating the need for multiple configurations in order to address population variability. However, the two most useful orientations were horizontal or angled on the back wall.
4. Grab bars should be universally available.
5. Non-slip surfaces on bath edges (bath rim and back rim) should be incorporated as standard safety features for bathing among seniors.
6. New construction should include a "U-shaped" reinforced area on the back wall as well as two "L/T-shaped" areas on the faucet and head wall to permit installation of appropriate configuration. Figure 37 shows the location of the circular mounting plates used to hold the different bars during this study. Notice the consistent grouping of the mounting plates within a reasonably well-defined area.

Figure 37. Digital image of location of circular plates used to mount grab bars.

SUGGESTIONS for future research:

1. Research addressing the possible social/cultural/affective bias against the use of both assistive devices as well as mobility devices should be undertaken.
2. Determine why individuals do not install grab bars.
3. Determine safety, ease of use, helpfulness etc for a rim-mounted bathtub grab bar.
4. Future studies of individual behaviour should not rely solely on self-report but should include an aspect of evaluation of the participant performing the task in question.

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