

RESEARCH REPORT

External Research Program



How Effective are Bath Grab Bars for
Stopping a Fall When You Lose Your
Balance?



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**HOW EFFECTIVE ARE BATH GRAB BARS FOR STOPPING A FALL WHEN YOU
LOSE YOUR BALANCE?**

FINAL REPORT

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How Effective Are Bathtub Grab Bars for Stopping a Fall When You Lose Your Balance?

INTRODUCTION

Falls are among the leading causes of fatal and non-fatal injuries, hospitalizations and functional disabilities among seniors.¹ About one-third of seniors living independently report at least one fall each year. Seniors' self reports also indicate that bathrooms are one of the most common locations for indoor falls. A recent study found that 55% of all bathroom-related falls were associated with bathing and that unsuccessful transfers played a role in as many as 70% of bath falls.² In addition, 73% of all bath falls resulted in mild to severe bruising, pain, and fractures. Fear of falling while bathing was also found to be high and was associated, for 30% of the sample for this study, with restrictions in bathing practices. Fear of falling has also been reported in other studies.

Encouraging the use of bathroom aids, such as grab bars, for safe and independent bathing and toileting has been an important objective of some recent fall prevention programs. Bathroom aids are expected to minimize the effects of many age-related deficits such as impaired balance, co-ordination, range of motion, muscular strength, and endurance. Minimizing these effects can allow seniors to bathe safely and independently. Nevertheless, no study to date has actually examined the effectiveness of bath grab bars and their degree of usefulness in helping individuals regain stability or in preventing falls when balance is lost while getting in or out of the bathtub.

OBJECTIVES

The general objectives of this study were to:

- a) examine how individuals who had lost their balance used four different bathtub grab bar configurations;
- b) investigate the effectiveness of these grab bar configurations in preventing falls; and
- c) identify barriers to the acceptance and use of grab bars.

The four grab bar configurations were:

- (1) No bars, where no grab bars were provided. *See figure 1;*
- (2) CSA (Canadian Standards Association) configuration, consisting of a vertical bar on the side wall and a horizontal bar on the back wall. *See figure 2;*
- (3) OBC (Ontario Building Code) configuration, consisting of a right angled bar on the back wall. *See figure 3; and*
- (4) OCC (Ottawa-Carleton Common) configuration, consisting of a vertical bar on the side wall and an angled bar on the back wall. *See figure 4.*

1 Seniors are people 65 years old or more—The National Advisory Council on Aging (2006), Seniors in Canada 2006 Report Card.

2 Aminzadeh, F., Edwards, N., Lockett, D., Nair, R. (2000) 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.

Research Highlight

How Effective Are Bathtub Grab Bars for Stopping a Fall When You Lose Your Balance?

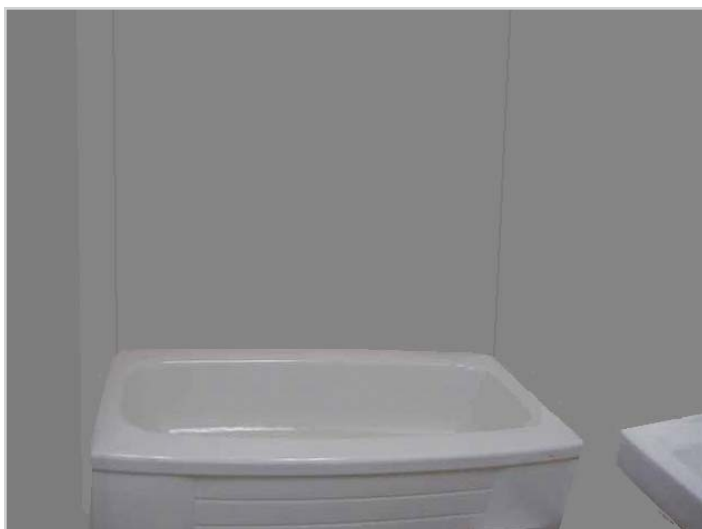


Figure 1 Grab bar configuration: No bars



Figure 2 Grab bar configuration: Canadian Standards Association (CSA)



Figure 3 Grab bar configuration: Ontario Building Code (OBC)



Figure 4 Grab bar configuration: Ottawa-Carleton Common (OCC)

The specific objectives of the study were to:

- determine whether, and how, study participants used grab bars following an experimentally-induced perturbation of balance;
- determine which grab bar configuration most prevented a fall following a perturbation of balance;
- determine whether the phase of the task performed (such as getting in/out of the bathtub) had an influence on which grab bars were used; and
- study the influence that a loss of balance experienced by participants had on their acceptance of grab bars.

METHODOLOGY

Eighty-one people, 21 younger adults and 60 older adults, participated in the study. Younger adults were students recruited from the University of Ottawa. Older adults were recruited from various community organizations. Testing took approximately 30 minutes for younger adults and 60 minutes for older adults. All participants were tested in a research laboratory at the University of Ottawa and completed the *Bath Grab Bar Effectiveness During Balance Perturbation* questionnaire.

The questionnaire requested information on sociodemographic characteristics (age, gender, marital status, living arrangements,

mother tongue, education, and income); health status; patterns of bathing, and patterns of use and acceptance of bathroom aids; and included the Falls Behavioural Scale (FaB) for the Older Person.³

Participants were asked to assess the bathtub grab bar configurations. A platform (*see* figure 5) that moved 20 cm forward and backward at an adjustable speed reaching up to 24 cm/sec was used to induce balance perturbation among both younger and older adults. The mock bathroom (*see* figure 6) consisted of a bathtub (1.52 x 0.76 x 0.41 m) surrounded by three walls at right angles, and designed to accommodate the grab bar configurations and built over the structural frame of the platform at a perpendicular angle. When activated, the platform moved back and forth under the bathtub. The bathtub was lightweight and made of acrylic. Its rims were padded with light foam. All grab bars had non-slip surfaces. Participants wore protective hip garments and were secured in a harness to prevent injury in the unlikely event of a fall.



Figure 5 Platform used to induce balance perturbation

Each group of participants were randomly divided into three subgroups (A, B and C), (n = 7 per subgroup for younger adults and n = 20 per subgroup for older adults). Each subgroup tested two of the four configurations of grab bars. Group A evaluated the *No Bar* and the *CSA* configurations. Group B evaluated the *No Bar* and the *OBC* configurations. Group C evaluated the *No Bar* and *OCC* configurations. The order in which the grab bar configurations were tested varied within each subgroup. Each participant was asked to complete a minimum of 16 trials (bathtub transfers) for each of the two configurations assigned to them (for a minimum of 32 trials). In a minimum of 25% of the trials for each configuration, the platform was activated to create an unexpected balance perturbation for participants.



Figure 6 Mock bathroom and safety harness.

Following the final trial for each configuration, participants were asked to comment on the usefulness and safety of the configurations tested. Participants rated the safety, ease or difficulty of use, and helpfulness of each grab bar configuration on a 5-point Likert scale (*Difficulty*: 1 = very difficult to 5 = very easy; *safety*: 1 = very unsafe to 5 = very safe; and *helpfulness*: 1 = not at all helpful to 5 = very helpful). Two cameras were used to videotape participants as they completed the trials. The objective was to record their behaviour as they experienced balance perturbation. Videotapes were coded to determine which grab bar configuration appeared most effective in helping participants regain stability when their balance was challenged.

³ Clemson, L., Cumming, R.G. & Heard, R. (2003). The development of an assessment to evaluate behavioral factors associated with falling. *The American Journal of Occupational Therapy*. 57 (4), 380-388

FINDINGS

All participants were able to complete the testing protocol without any discomfort. In total, 1,419 bathtub entries and exits with platform activation were recorded (1,040 with older adults and 379 with younger adults). Of total testing, 70% was completed in less than one hour (100% of the younger adults and 44.1% of the older adults).

In the younger adults group, all participants reported having general good health; only two participants (9.5%) reported having specific health problems (minor knee problems) that did not interfere with the completion of the experiment.

In the older adults group, 91.2% of the participants rated their overall health, compared to that of their peers, as good and 9.8% rated it as fair. Sixteen per cent of the older participants reported balance problems; 36.1% had hip, leg or knee problems; 41% reported back and/or neck problems; 52.5% had visual problems and 10.6% reported other minor ailments. Although only 16% of the older adults reported balance problems, 42.6% ($n = 26$) had experienced a fall within the previous year. Of these 26 older adults, 12 (46.2%) had one fall and 14 (53.8%) had more than one fall. Two of the falls (8%) occurred as the individuals were getting in or out of the bathtub (during a bath/shower) where there were no grab bars present. Women reported more falls than men.

Determining how people use bathtub grab bars when balance is lost or perturbed

Results were different for younger and older adults. In the younger adults, 53.8% (204/379) of the bathtub entry/exits with platform activation recorded resulted in a balance loss. In 75% (153/204) of these, participants were able to regain balance without coming in contact with any of the surrounding structures by pressing both feet firmly on the floor (40%), taking a step forward (38%), or taking a step forward and compensating with major bodily adjustments such as arm swaying (22%). In 25% ($\frac{51}{204}$) of the trials, younger adults needed to come in contact with a surrounding structure to regain their balance (see figure 7). In the absence of grab bars, younger adults favoured, in order, the back wall of the tub, the side wall and the bathtub rim. When grab bars were present, younger adults favoured the back wall and the vertical bar located on the side wall.

In the older adults, 80% ($\frac{831}{1,040}$) of the bathtub entry/exits with platform activation recorded resulted in a balance loss. In 79.3% ($\frac{659}{831}$) of these, participants required contact with the surrounding structure to regain their balance (see Figure 7). In the absence of grab bars, older adults favoured, in order, the side wall, the bathtub rim and the back wall.



Figure 7 Structure surrounding the bathtub

When grab bars were present, older adults favoured, in order, the vertical bar located on the side wall, the side wall, and the bathtub rim to regain their balance.

When grab bars were present, the older adults used them more than the younger adults did. Older adults used the grab bars in 49.7% ($\frac{212}{426}$) of instances, while younger adults used the bars in 14.4% ($\frac{17}{118}$) of instances.

Determining which grab bar configuration would be the most successful in preventing a fall following a perturbation of balance

Most participants did not have grab bars at home and since they were instructed to enter/exit the bathtub as they normally would, they did not always use the bars during the experiment. Nonetheless, the results observed provide valuable information.

Regardless of the configuration tested, the vertical bar was the most used in helping participants to regain their balance during bathtub transfer. The location of the vertical bar on the side wall may explain why it was favoured. During a loss of balance, a person would instinctively reach for the nearest object. During a bathtub transfer, this object would be the side wall or a bar on the side wall. The vertical bar was the only bar mounted on the side wall of the bathtub. The other bars tested (diagonal, L-shaped and horizontal) were all located on the back wall and were not frequently used by participants to help regain their balance during bathtub transfer. Results indicate that bathtub configurations that include a vertical bar on the side wall, such as CSA and OCC configurations, would be more effective in helping individuals regain their balance as they get in/out of the bathtub than ones that do not, such as the OBC configuration.

Determining the influence of the phase of the task performed on grab bars use

Ideally, all phases of the task (entering the tub, sitting in it, standing up in it and exiting it) would have been explored. Unfortunately, the platform used was mounted in such a manner that it would move under the tub and, therefore, could not induce a loss of balance during the phases of sitting and standing up in the bathtub. Nevertheless, the results do suggest that the phase of the task influences the use of grab bars. Both younger and older adults favoured the vertical bar as they entered and exited the bathtub. The vertical bar was the only bar mounted on the side wall of the bathtub. The other bars tested (diagonal, L-shaped and horizontal) were all located on the back wall. The results suggest that the vertical bar was the most useful for helping participants regain their balance as they entered/exited the bathtub.

Identifying barriers to the acceptance and use of bathtub grab bars

It was hypothesized that a loss of balance experienced by participants would influence the use and the acceptance of grab bars. During the experiments, the balance loss experienced in earlier trials influenced the behaviour of older women participants in subsequent trials more so than it did for men. Some participants tended to use the bars frequently; others were more hesitant. Results indicate that the presence of bathtub grab bars increases the sense of security for both younger and older adults, which may explain why the majority of the participants (78.3% of older adults and 57.1% of younger adults) preferred a grab bar configuration to the no grab bar configuration.

Studying the influence of the induced balance loss on grab bar acceptance

This was studied through follow-up telephone interviews. Three months following the experiment, older adult participants were contacted by telephone and asked if they had made modifications to their bathroom, and specifically, if they had installed or intended to install bath grab bars, and if not, why not. In total, 92% (92%) of the participants completed the telephone interview. Only 9% (9%) of respondents had purchased grab bars since the experiment. The main reasons for not purchasing bars, according to the respondents, were that the bars were not currently needed (60%), respondents were “too young” (13.5%) and respondents only took showers (13.5%). Interestingly, 41.8% (41.8%) of the participants reported having recommended bars to someone else: mainly to other family members (34.8%), to colleagues and seniors in organizations (34.8%), to friends (21.7%), or to both family and friends (8.7%). Four participants reported that others had purchased grab bars following their suggestion because of aging or difficulty getting in/out of the tub, or as a precautionary measure.

CONCLUSION

This study showed that the very presence of bathtub grab bars does not ensure that they will be used when adults get in or out of the bathtub. Younger adults used the bars to regain their balance in only 14.4% of trials where bars were present. Older adults used bars to regain their balance in 49.7% of trials where bars were present and their behaviour also changed once they experienced balance loss (increased use of grab bars, hesitancy). Nonetheless, most of the participants (57.1% of younger adults and 78.3% of older adults) preferred a grab bar configuration to the No Bar configuration. Participants used the vertical bar on the side wall most frequently to regain their balance during bathtub transfer. The study also showed that bathtub grab bar configurations that include a vertical bar on the side wall, such as CSA and OCC configurations, are more effective in helping individuals to regain their balance as they are getting in/out of the bathtub than those that do not include a bar on the side wall, such as the OBC configuration.

Furthermore, the study showed that grab bars may help prevent falls only if they are already being held when balance is lost. If the bar is not already being held when a loss of balance occurs, people may not be able to grab the bar or grab it properly and may still fall. In such a case, the presence of the bar may limit the consequences of the fall (limit injury), but may not prevent it.

There is a justifiable concern as to whether, as people grow older and their reaction time decreases, they will be able to reach a grab bar in time to prevent a fall. To improve and ensure safe bathtub transfers among seniors, education regarding the usefulness of bath grab bars and training on how to use them are highly needed. Initiatives must also be taken to reduce the stigma associated with grab bars and to promote safety in the home.

Finally, the study concludes that a minimum of two bars, a bar on the side wall and another bar on the back wall, are needed to ensure safety in all phases of bathtub transfers.

RECOMMENDATIONS

Priority action

- Seniors should install bathtub grab bars to reduce their risk of falling.
- A minimum of two bars should be installed to ensure safety in all phases of bathtub transfer:
 - one on the side wall to facilitate entry/exit; and
 - one on the back wall to help during sitting and standing in the tub.

Research Highlight

How Effective Are Bathtub Grab Bars for Stopping a Fall When You Lose Your Balance?

- The grab bar configuration requirements in the 1997 version of the Ontario Building Code (OBC) should be revised to include a bar on the side wall. This will facilitate bathtub entry/exit and ensure safety in all phases of bathing.

Future research

This study provided valuable information on the use of bathtub grab bars and their usefulness in helping people regain their balance; however, several questions remain unanswered. The following could prove to be highly useful:

- replicating the current study to assess the use of bars when balance loss occurs when individuals are sitting down in or getting up from the bottom of the bathtub;
- determining which grab bar (horizontal, angled, vertical or L-shaped) on the back wall is the most useful when individuals are sitting down in or standing up from the tub;
- examining the usefulness of various grab bars (horizontal, L-shaped) on side walls compared to that of a vertical bar;
- examining the usefulness of a grab bar on the rim of the tub compared to that of one on the side wall for individuals entering/exiting the bathtub; and
- examining the effects of a wet and slippery surface (real life situation) on the use and usefulness of grab bars.

CMHC Project Manager: Luis Rodriguez, Policy and Research

Research Report: How Effective Are Bath Grab Bars for Stopping a Fall When You Lose Your Balance?

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Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

INTRODUCTION

Les chutes figurent parmi les principales causes de décès accidentels ou de blessures corporelles, d'hospitalisations et de déficiences fonctionnelles chez les aînés¹. Environ le tiers des personnes âgées qui vivent de façon autonome rapportent avoir fait au moins une chute chaque année. Les aînés signalent également que la salle de bains est un des endroits où les chutes se produisent le plus souvent à l'intérieur du domicile. Selon une étude récente, 55 % de toutes les chutes dans la salle de bains avaient lieu lorsque les personnes prenaient leur bain et jusqu'à 70 % des chutes survenues au moment du bain se produisaient lors des transferts². De plus, 73 % de toutes ces chutes ont causé des contusions, de la douleur et des fractures dont l'intensité et la gravité allaient de légères à graves. On a aussi constaté que beaucoup de personnes avaient peur de tomber en prenant un bain et que cette crainte avait amené 30 % des participants à cette étude à limiter les bains. D'autres études ont également mentionné la crainte de tomber.

Un objectif important de certains programmes récents de prévention des chutes est d'encourager l'utilisation de dispositifs d'aide dans la salle de bains, comme les barres d'appui, pour assurer la sécurité des personnes âgées vivant de façon indépendante. On s'attend à ce que ces dispositifs atténuent les effets de nombreuses déficiences reliées au vieillissement, comme une diminution de l'équilibre, de la coordination, de l'amplitude articulaire, de la force musculaire et de l'endurance, et permettent aux aînés de prendre leur bain de façon autonome et en toute sécurité. Pourtant, aucune étude jusqu'à présent n'a examiné l'efficacité des barres d'appui et dans quelle mesure elles sont utiles pour aider les individus à retrouver leur équilibre ou à

éviter une chute lorsqu'ils perdent l'équilibre au moment d'entrer dans la baignoire ou d'en sortir.

BUTS

Cette étude avait les objectifs généraux suivants :

- a) examiner comment les personnes qui avaient perdu l'équilibre utilisaient quatre configurations différentes de barres d'appui;
- b) examiner l'efficacité avec laquelle ces configurations de barres d'appui préviennent les chutes, et
- c) déterminer les facteurs qui empêchent les personnes âgées d'accepter et d'utiliser les barres d'appui.

Les quatre configurations de barres d'appui étaient les suivantes :

- (1) sans barres (il n'y avait aucune barre d'appui sur les murs autour de la baignoire). Voir la figure 1;
- (2) configuration préconisée par l'Association canadienne de normalisation (CSA), qui comprend une barre verticale sur le mur latéral et une barre horizontale sur le mur arrière. Voir la figure 2;
- (3) configuration préconisée par le Code du bâtiment de l'Ontario (CBO), qui comprend une barre à angle droit ou en L sur le mur arrière. Voir la figure 3, et
- (4) configuration couramment utilisée dans la région d'Ottawa-Carleton (CCOC), qui comprend une barre verticale sur le mur latéral et une barre en diagonale sur le mur arrière. Voir la figure 4.

1 Les personnes âgées, ou aînés, sont les personnes âgées de 65 ans et plus – Conseil consultatif national sur le troisième âge (CCNTA), *Les aînés au Canada* : Bulletin 2006.

2 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.

Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

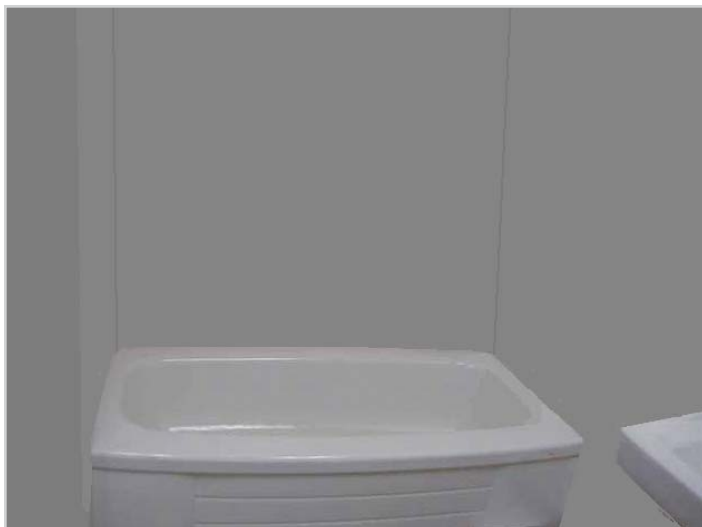


Figure 1 Sans barres d'appui.



Figure 2 Configuration préconisée par l'Association canadienne de normalisation (CSA)



Figure 3 Configuration préconisée par le Code du bâtiment de l'Ontario (CBO)



Figure 4 Configuration couramment utilisée dans Ottawa-Carleton (CCOC)

De façon précise, l'étude avait les objectifs suivants :

- déterminer si les participants à l'étude utilisaient les barres d'appui lorsqu'une perte d'équilibre était provoquée dans le cadre de l'expérience, et si oui, comment ils les utilisaient;
- déterminer quelle configuration des barres d'appui prévenait le mieux les chutes après une perte d'équilibre provoquée;
- déterminer si la phase de la tâche à accomplir (comme entrer dans la baignoire ou en sortir) influençait les barres d'appui qui étaient utilisées, et
- étudier l'influence qu'une perte d'équilibre vécue par les participants avait sur leur acceptation des barres d'appui.

MÉTHODOLOGIE

Quatre-vingt-une personnes, soit 21 jeunes adultes et 60 adultes plus âgés, ont participé à l'étude. Les jeunes adultes étaient des étudiants recrutés à l'Université d'Ottawa. Les adultes plus âgés ont été recrutés au sein de diverses organisations communautaires. Les essais ont pris environ 30 minutes dans le cas des jeunes adultes et 60 minutes dans celui des adultes plus âgés. Tous les participants ont fait les essais dans un laboratoire de recherche à l'Université d'Ottawa et ont rempli le questionnaire sur l'efficacité des barres d'appui lors d'une perte d'équilibre.

Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

Ce questionnaire demandait de l'information sur les caractéristiques sociodémographiques des participants (âge, sexe, état familial, conditions de logement, langue maternelle, niveau de scolarité et revenu); leur état de santé; leurs habitudes de bain et leur utilisation et leur acceptation des barres d'appui dans la salle de bains. Le questionnaire comprenait aussi l'outil d'évaluation *Falls Behavioural Scale (FaB) for the Older Person* (échelle de comportements pour personnes âgées lors de chutes)³.

Les participants devaient évaluer les configurations de barres d'appui. Une plate-forme (voir la figure 5), qui se déplaçait de 20 cm vers l'avant et vers l'arrière à une vitesse réglable pouvant atteindre jusqu'à 24 cm par seconde, a été utilisée pour simuler une perturbation de l'équilibre tant chez les jeunes adultes que chez les adultes plus âgés. La salle de bains d'essai (voir la figure 6) comprenait une baignoire (1,52 x 0,76 x 0,41 m) entourée de trois murs à angle droit conçus de manière à permettre l'installation des barres d'appui selon les configurations décrites. Lorsqu'elle était mise en marche, la plate-forme faisait un mouvement de va-et-vient sous la baignoire. La baignoire en acrylique était légère et les bords étaient revêtus d'une mousse légère. Toutes les barres d'appui avaient des surfaces antidérapantes. Les participants portaient des protecteurs de hanches et étaient maintenus par un harnais pour prévenir toute blessure dans l'éventualité improbable d'une chute.



Figure 6 Salle de bains d'essai et harnais de sécurité



Figure 5 Plate-forme utilisée pour provoquer une perte d'équilibre

Chaque groupe de participants a été divisé au hasard en trois sous-groupes (A, B et C) ($n = 7$ par sous-groupe dans le cas des jeunes adultes et $n = 20$ par sous-groupe dans le cas des adultes plus âgés). Chaque sous-groupe a fait l'essai de deux des quatre configurations de barres d'appui. Le groupe A a évalué la configuration *Sans barres* et celle de la CSA. Le groupe B a évalué la configuration *Sans barres* et celle du CBO. Le groupe C a évalué la configuration *Sans barres* et la CCOC. L'ordre dans lequel les configurations de barres d'appui ont été testées variait à l'intérieur de chaque sous-groupe. Chaque participant devait effectuer un minimum de 16 essais (entrées et sorties de baignoire) pour chacune des deux configurations qui leur avaient été assignées (ce qui représente un minimum de 32 essais). Dans au moins 25 % des essais pour chaque configuration, la plate-forme a été mise en marche pour provoquer une perte d'équilibre inattendue chez les participants.

3 Clemson, L., Cumming, R.G. et Heard, R. « The development of an assessment to evaluate behavioral factors associated with falling », *The American Journal of Occupational Therapy*, 2003, 57 (4), p. 380-388.

Après le dernier essai de chaque configuration, les participants devaient donner leur avis sur l'utilité et la sécurité des configurations testées. Les participants ont évalué la sécurité, la facilité ou difficulté d'utilisation et l'utilité de chaque configuration de barres d'appui sur une échelle de Likert en cinq points (difficulté : 1 = très difficile à 5 = très facile; sécurité : 1 = très peu sûre à 5 = très sûre; et utilité : 1 = pas utile du tout à 5 = très utile). Deux caméras ont filmé les participants sur bande vidéo pendant les essais. L'objectif était d'observer leur comportement lorsqu'ils perdaient l'équilibre. Les bandes vidéo ont été codifiées pour déterminer quelles configurations de barres d'appui semblaient être les plus efficaces pour aider les participants à retrouver leur équilibre.

CONSTATATIONS

Tous les participants ont réussi à terminer le protocole d'essai sans aucun inconfort. En tout, 1 419 entrées et sorties de baignoire avec mise en marche de la plate-forme ont été enregistrées (1 040 avec les adultes plus âgés et 379 avec les jeunes adultes). Soixante-dix pour cent (70 %) des essais ont été terminés en moins d'une heure (100 % dans le cas des jeunes adultes et 44,1 % dans celui des adultes plus âgés).

Dans le groupe des jeunes adultes, tous les participants ont rapporté un bon état de santé général; seulement deux participants (9,5 %) ont mentionné des problèmes de santé particuliers (problèmes mineurs au genou) qui n'ont pas nui à l'expérience.

Dans le groupe des adultes plus âgés, 91,2 % des participants ont indiqué que, comparativement à celui de leurs pairs, leur état de santé général était bon, et 9,8 % l'ont évalué comme étant assez bon. Seize pour cent (16 %) des participants plus âgés ont indiqué qu'ils avaient des problèmes d'équilibre; 36,1 % des problèmes de hanche, de jambe ou de genou; 41 % des problèmes de dos et/ou de cou; 52,5 % des troubles visuels et 10,6 %, d'autres malaises mineurs. Bien que 16 % seulement des adultes plus âgés aient rapporté avoir des problèmes d'équilibre, 42,6 % (n = 26) avaient fait une chute pendant l'année précédente. Parmi ces 26 adultes plus âgés, 12 (46,2 %) avaient fait une chute et 14 (53,8 %) en avaient fait plus d'une. Deux des chutes (8 %) s'étaient produites au moment d'entrer ou de sortir de la baignoire (pendant un bain ou une douche) dans une salle de bains qui n'était pas munie de barres d'appui. Les femmes ont signalé plus de chutes que les hommes.

Déterminer comment les gens utilisent les barres d'appui lorsqu'ils perdent l'équilibre

Les résultats ont été différents pour les jeunes adultes et les adultes plus âgés. Parmi le premier groupe, 53,8 % ($\frac{204}{379}$) des entrées/sorties accompagnées d'une mise en marche de la plate-forme qui ont été filmées ont provoqué une perte d'équilibre. Dans 75 % ($\frac{153}{204}$) de ces cas, les participants ont pu rétablir leur équilibre sans entrer en contact avec l'un ou l'autre des éléments du pourtour du bain en plantant fermement les deux pieds sur le plancher (40 %), en prenant un pas vers l'avant (38 %) ou en prenant un pas vers l'avant et en compensant par d'importants ajustements du corps, par exemple, en balançant les bras (22 %). Dans 25 % des essais ($\frac{51}{204}$), les jeunes adultes ont dû entrer en contact avec un élément du pourtour du bain pour retrouver leur équilibre (voir la figure 7). En l'absence de barres d'appui, les jeunes adultes ont utilisé, par ordre de préférence, le mur arrière de la baignoire, le mur latéral et le bord de la baignoire pour retrouver leur équilibre. Lorsqu'il y avait des barres d'appui, ils ont utilisé, toujours par ordre de préférence, le mur arrière et la barre verticale située sur le mur latéral.



Figure 7 Éléments du pourtour du bain

Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

Chez les adultes plus âgés, 80 % ($^{831}_{040}$) des entrées/sorties avec mise en marche de la plate-forme ont occasionné une perte d'équilibre. Dans 79,3 % de ces cas ($^{659}_{31}$), les participants ont dû entrer en contact avec un élément du pourtour du bain pour retrouver leur équilibre (voir la figure 7). Ainsi, en l'absence de barres d'appui, les adultes plus âgés ont le plus souvent utilisé, par ordre de préférence, le mur latéral, le bord de la baignoire et le mur arrière. Lorsqu'il y avait des barres d'appui, les adultes plus âgés se sont servis, toujours par ordre de préférence, de la barre verticale située sur le mur latéral, du mur latéral et du bord de la baignoire pour retrouver leur équilibre.

Lorsqu'il y avait des barres d'appui, les adultes plus âgés les ont utilisées plus que les jeunes adultes. Les adultes plus âgés se sont servis des barres d'appui dans 49,7 % des cas ($^{212}_{26}$), alors que les jeunes adultes les ont utilisées dans 14,4 % des cas ($^{17}_{18}$).

Déterminer quelle configuration de barres d'appui réussirait le mieux à prévenir une chute après une perturbation de l'équilibre

La plupart des participants n'avaient pas de barres d'appui à la maison, et puisqu'on leur a demandé d'entrer dans la baignoire et d'en sortir comme ils le feraient normalement, ils n'ont pas toujours utilisé les barres pendant l'expérience. Néanmoins, les résultats observés fournissent des renseignements utiles.

Quelle que soit la configuration testée, les participants ont le plus souvent utilisé la barre verticale pour retrouver leur équilibre pendant un transfert au bain. L'emplacement de la barre verticale sur le mur latéral explique peut-être pourquoi elle fut préférée. En cas de perte d'équilibre, une personne cherche instinctivement à saisir l'objet le plus proche. Pendant un transfert au bain, cet objet serait le mur latéral ou une barre sur le mur latéral. La barre verticale est la seule sur le mur latéral de la baignoire. Les autres barres testées (en diagonale, en L et à l'horizontale) étaient toutes situées sur le mur arrière et elles n'ont pas été souvent utilisées par les participants pour retrouver leur équilibre pendant le transfert au bain. Les résultats indiquent que les configurations qui comprennent une barre verticale sur le mur latéral, comme celles préconisées par la CSA et la CCOC, seraient plus efficaces pour aider les personnes à retrouver leur équilibre en entrant/sortant de la baignoire que celles qui n'en ont pas, comme la configuration préconisée par le CBO.

Déterminer l'influence de la phase de la tâche effectuée sur l'utilisation des barres d'appui

L'idéal aurait été d'explorer toutes les étapes de la tâche (entrer dans la baignoire, s'asseoir dedans, se relever et en sortir). Malheureusement, la plate-forme utilisée était montée de manière à bouger sous la baignoire et, par conséquent, ne pouvait pas provoquer une perte d'équilibre pendant qu'une personne était assise ou debout dans la baignoire. Les résultats suggèrent néanmoins que la phase de la tâche influence l'utilisation des barres d'appui. Les jeunes adultes et les adultes plus âgés ont tous privilégié la barre verticale en entrant et en sortant de la baignoire. La barre verticale était la seule qui était montée sur le mur latéral de la baignoire. Les autres barres testées (en diagonale, en L et à l'horizontale) étaient toutes situées sur le mur arrière. Les résultats suggèrent que la barre verticale est la plus utile pour aider les participants à retrouver leur équilibre en entrant et en sortant de la baignoire.

Déterminer les obstacles à l'acceptation et à l'utilisation des barres d'appui

Selon l'hypothèse de départ, une perte d'équilibre chez les participants influencerait sur l'utilisation et l'acceptation des barres d'appui. Pendant les expériences, la perte d'équilibre provoquée lors d'essais antérieurs a influencé le comportement des participantes plus âgées dans les essais ultérieurs plus que cela n'a été le cas pour les hommes. Certains participants avaient tendance à utiliser les barres fréquemment, alors que d'autres étaient plus hésitants à compléter le transfert. Les résultats indiquent que les jeunes adultes aussi bien que les adultes plus âgés se sentent plus en sécurité lorsqu'il y a des barres d'appui, ce qui pourrait expliquer pourquoi la majorité des participants (78,3 % des adultes âgés et 57,1 % des jeunes adultes) préféraient une configuration avec barres d'appui à une configuration sans barres d'appui.

Étudier l'influence de la perte d'équilibre provoquée sur l'acceptation des barres d'appui

Cet aspect a été étudié au moyen d'entrevues téléphoniques. Trois mois après l'expérience, les participants âgés ont été joints par téléphone afin de vérifier s'ils avaient apporté des modifications à leur salle de bains et, de façon précise, s'ils avaient installé ou s'ils avaient l'intention d'installer des barres d'appui et, sinon, les raisons pour lesquelles ils ne l'avaient pas fait ou n'avaient pas l'intention de le faire. En tout, 92 % des participants (5%) ont été interrogés. Seulement 9 % (5%) des répondants avaient acheté des barres d'appui depuis l'expérience. Les principales raisons rapportées par les participants pour ne pas acheter de barres d'appui, étaient qu'ils n'en avaient pas besoin actuellement (60 %), qu'ils étaient « trop jeunes » (13,5 %) et qu'ils ne prenaient que des douches (13,5 %). Fait intéressant, 41,8 % des participants (23%) ont dit avoir recommandé l'installation de barres d'appui à quelqu'un d'autre : principalement à d'autres membres de la famille (34,8 %), à des collègues et personnes âgées de leur entourage (34,8 %), à des amis (21,7 %) ou à des membres de la famille et à des amis (8,7 %). Quatre participants ont indiqué que ces personnes avaient acheté des barres d'appui suite à leur recommandation parce qu'elles vieillissaient ou avaient de la difficulté à entrer/sortir de la baignoire ou par mesure de précaution.

CONCLUSION

Cette étude a démontré que la présence de barres d'appui n'assure pas leur utilisation pour entrer ou sortir du bain par les adultes. Les jeunes adultes se sont servis des barres d'appui pour retrouver leur équilibre dans seulement 14,4 % des essais où les barres d'appui étaient présentes. Les adultes plus âgés ont utilisé les barres pour rétablir leur équilibre dans 49,7 % des essais où elles étaient présentes et leur comportement a aussi changé après une perte d'équilibre (usage accru des barres d'appui, hésitation). Néanmoins, la plupart des participants (57,1 % des jeunes adultes et 78,3 % des adultes plus âgés) préféraient une configuration avec barres d'appui à la configuration sans barres. Les participants ont utilisé la barre verticale sur le mur latéral le plus souvent pour retrouver leur équilibre pendant le transfert au bain. L'étude a aussi révélé que les configurations de barres d'appui comprenant une barre verticale sur le mur latéral, comme celle de la CSA et la CCOC, sont plus efficaces pour aider les individus à retrouver leur équilibre au moment d'entrer dans la baignoire ou d'en sortir que celles qui ne comprennent pas de barre sur le mur latéral, comme la configuration préconisée par le CBO.

De plus, l'étude a montré que les barres d'appui peuvent aider à prévenir les chutes seulement si les gens les tiennent déjà au moment où ils perdent l'équilibre. S'ils ne tiennent pas déjà la barre lorsqu'ils perdent l'équilibre, les gens peuvent ne pas être capables de saisir la barre ou de la saisir convenablement et risqueraient quand même de tomber. Dans ce cas, la présence de la barre peut limiter les conséquences de la chute (limiter les blessures), mais sans nécessairement la prévenir.

On se demande, à juste titre, si les gens seront en mesure de saisir une barre d'appui à temps pour éviter une chute à mesure qu'ils vieillissent et que leur temps de réaction diminue. Afin d'améliorer l'efficacité des barres d'appui et d'assurer les transferts au bain sans danger chez les personnes âgées, on a grandement besoin de les renseigner sur l'utilité des barres d'appui et la façon de les utiliser. Il faudra aussi prendre des initiatives pour améliorer l'acceptation des barres d'appui et promouvoir la sécurité à la maison.

Enfin, l'étude conclut qu'au moins deux barres, une sur le mur latéral et l'autre sur le mur arrière, sont nécessaires pour assurer la sécurité à toutes les étapes du transfert au bain.

Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

RECOMMANDATIONS

Mesures prioritaires

- Les personnes âgées devraient installer des barres d'appui autour de la baignoire pour réduire le risque de tomber.
- Au moins deux barres devraient être installées pour assurer la sécurité à toutes les étapes du transfert au bain :
 - une sur le mur latéral pour faciliter l'entrée dans la baignoire et la sortie; et
 - une sur le mur arrière pour aider les gens à s'asseoir et à se relever de la baignoire.
- Il y aurait lieu de réviser les exigences relatives à la configuration des barres d'appui dans la version de 1997 du Code du bâtiment de l'Ontario (CBO) afin d'inclure une barre sur le mur latéral. Cela facilitera les mouvements, à l'entrée et à la sortie, et assurera la sécurité à toutes les étapes du transfert au bain.

Recherche future

Cette étude a permis de recueillir de l'information précieuse sur l'utilisation des barres d'appui et leur utilité pour aider les gens à retrouver leur équilibre lors de transfert au bain. Toutefois, plusieurs questions demeurent sans réponse. Les initiatives suivantes pourraient s'avérer extrêmement utiles :

- reproduire la présente étude pour évaluer l'utilisation des barres lorsque la perte d'équilibre se produit pendant que les individus s'assoient dans le fond de la baignoire ou s'y relèvent;
- déterminer quel type de barre d'appui (à l'horizontale, en diagonale, à la verticale ou en L) sur le mur arrière est la plus utile lorsque les individus s'assoient dans le fond de la baignoire ou s'y relèvent;
- examiner l'utilité de divers types de barres d'appui (à l'horizontale, en L) sur les murs latéraux comparativement à celle d'une barre verticale;
- examiner l'utilité d'une barre d'appui sur le bord de la baignoire comparativement à celle d'une barre sur le mur latéral pour entrer dans la baignoire et/ou en sortir;
- examiner les effets d'une surface mouillée et glissante (situation réelle) sur l'utilisation et l'utilité des barres d'appui.

Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

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Politiques et recherche

Rapport de recherche : Dans quelle mesure les barres d'appui pour les baignoires sont-elles efficaces pour prévenir une chute lors d'une perte d'équilibre?

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ABSTRACT

The objectives of this study were the following: (1) to determine how individuals use bathtub grab bars following a loss of balance; (2) to examine the effectiveness of four bathtub grab bar configurations in preventing individuals from falling; and (3) to identify barriers seniors have to accepting and using bathtub grab bars. Healthy adults ($n = 21$) between 19 and 28 years of age and older adults ($n = 60$) between 50 and 60 years of age participated in this study. The four bathtub grab bar configurations examined were the following: (1) no bars; (2) vertical/horizontal combination; (3) L-shaped bar; and (4) vertical/angled combination. Participants in both groups (younger and older adults) were randomly assigned to one of three groups and were then divided into subgroups. Groups A evaluated configurations 1 and 2, Groups B evaluated configurations 1 and 3, and Groups C evaluated configurations 1 and 4. Participants were asked to complete a minimal of 16 trials of entering and exiting the bathtub (bathtub transfer) for the two configurations assigned to them. During a subset of trials (minimum 25%), a loss of balance was induced during each phase of the task for each assigned configuration. The participants were videotaped as they completed the task. Following the final trial, participants were asked to comment on the usefulness and safety of the configurations tested. Three months after the experiment, the older adults were contacted by telephone to determine the impact the loss of balance they experienced had on their acceptance and use of bathtub grab bars. Results show that the presence of bathtub grab bars does not ensure their use during bathtub transfer. Both younger and older adults strongly preferred a grab bar configuration to no grab bar configuration because the former increased their sense of security. Younger adults rarely used the bars to regain their balance ($^{17}_{118}$ or 14.4% of trials) compared to older adults ($^{212}_{426}$ or 49.7% of trials). Results suggest that a minimum of two bars, a vertical bar on the sidewall and a horizontal or diagonal bar on the back wall, is required to ensure safety in all phases of bathtub transfer. Finally, the initial loss of balance did influence the behaviour of older participants in subsequent trials during the experiment, but the experiment had little effect on whether the participants then accepted and used bathtub grab bars in the home.

HOW EFFECTIVE ARE BATH GRAB BARS FOR STOPPING A FALL WHEN YOU LOSE YOUR BALANCE?

INTRODUCTION

Research problem: Falls are among the leading causes of fatal and non-fatal injuries, hospitalizations and functional disabilities among seniors.¹ About one-third of seniors living independently report at least one fall each year, between one- to two-thirds of these falls occur inside the home, and bathrooms are one of the most commonly reported locations of indoor falls.

A study examining patterns of bathing and usage of bath bars among 550 community-dwelling seniors found that 55% of the falls that took place in the bathroom occurred while seniors were bathing and that unsuccessful transfers in or out of the tub played a role in as many as 70% of bath falls.² When seniors described their falls, all but one indicated that while bath grab bars were present, they were not used at the time of the fall. Many seniors reported that the location of grab bars in the tub area was not optimal for their use and that they were awkward to use.² A study was therefore undertaken to determine the optimal placement of bath grab bars for community-dwelling seniors.³ The results show that the configurations identified most often as ideal have one vertical bar on the faucet wall and one horizontal or diagonal bar on the back wall.³

Encouraging the use of bathroom aids, such as grab bars, for safe and independent bathing and toileting has been an important component of some recent fall prevention programs. However, no study has actually examined the effectiveness of these devices and their degree of usefulness in helping individuals regain stability or in preventing a fall when balance is lost during bathtub entry/exit. This study focussed on the effectiveness of the bath grab bar configurations identified as ideal, compared to the No Bar configuration and one other configuration, during balance perturbation. This study also focussed on how individuals who lost their balance would or would not use bath grab bars set in four configurations and the effectiveness of these configurations in helping individuals regain their balance.

LITERATURE REVIEW

Research indicates that about one-third of community-living seniors report at least one fall each year.^{4, 5, 6, 7, 8, 9, 10, 11, 12, 13} Of these falls, 20%–70% result in injuries, with serious injuries occurring in about 5%–12% of falls and fatal injuries occurring in 6% of falls.^{8, 9, 10, 13, 14, 15, 16} Falls are a major cause of hospitalization for older adults^{17, 18, 19, 20} and a contributing factor in many nursing home admissions.^{21, 22} In Canada, the cost of falls among seniors for 1994 was estimated at \$2.8 billion.²³ These estimates do not include the costs in loss of mobility and independence suffered by older adults. Moreover, the psychological trauma of a fall has been associated with loss of confidence, self-imposed activity restriction and social withdrawal,^{24, 25, 26, 27} all of which may be associated with loss of independence and increased health care costs. Seniors' self reports indicate that 25%–77% of falls occur inside the home^{7, 13, 28, 29, 30, 31} and that bathrooms are one of the most common locations for indoor falls.^{30, 31} A previous study found that 55% of all bathroom-related falls were associated with bathing and that unsuccessful bathtub transfers played a role in as many as 70% of falls.² In addition, 73% of all bath falls resulted in mild to severe bruising, pain, and fractures. Fear of falling while bathing was also high and was associated, for 30% of this sample, with restrictions in bathing practices. Fear of falling has been reported in other studies^{32, 33, 34}.

Bathroom aids, including bath grab bars, can minimize the effects of many age-related deficits such as impaired balance, coordination, range of motion, muscular strength, and endurance. Minimizing these effects allows seniors to bathe safely and independently.^{35, 36} Bathroom aids are among the assistive devices most commonly owned by community-living seniors.^{33, 37, 38, 39, 40, 41, 42} In a randomized, controlled trial of over 1500 older adults, safety changes made to the bathroom (e.g., installation of grab bars and use of raised toilet seats) were the most frequently reported home safety modifications made by the participants within the year preceding the study.⁴³ Another recent study reported similar findings and went further by reporting that when safety modifications were made, the average home where seniors resided received two grab bars.⁴⁴

Even seniors who do not own bathroom aids identify the need for these devices.^{45, 46} In an American consumer assessment survey of 86 non-institutionalized older adults with mixed impairments, grab bars were the devices for which the greatest need was expressed by the participants.⁴⁶ In a study conducted by the Canada Mortgage and Housing Corporation (CMHC),⁴⁷ participants identified grab bars in the bathrooms as a high priority, basic safety feature for all dwellings. Similar beliefs were expressed in a qualitative study of 30 community-dwelling seniors.⁴⁵ Another study found that 69% of seniors who did not have bath grab bars indicated that they would use them if they had access to them.² Findings from another study indicated that 87% of seniors who had access to bath grab bars used them on a regular basis.² Grab bar use was greatest among those with access to two or more grab bars that were easily graspable.

In qualitative descriptions of falls, all seniors but one reported they had not been using their grab bar to facilitate the transfer at the time the fall occurred². The most common reasons identified by seniors for not using bath grab bars included feeling that bars were awkward to use or that they were unsafe (cited by 25% and 15.6% of non-users, respectively). Moreover, seniors reported relying on potentially hazardous objects to facilitate transfers while bathing (e.g., soap dishes, bath rims, shower curtain rods) in the absence of appropriate bath grab bars. The descriptive data provided by respondents also indicated that seniors sometimes engaged in hazardous practices in their attempts to use bath grab bars. For example, many reached across the bathtub to grab a bar on the backwall of the tub, leaving them vulnerable to losing their balance, slipping, or worse, falling.

The perceived safest and most useful bath grab bar configuration consists of two bars: one vertical bar on the sidewall and one horizontal or diagonal bar located on the back wall.³ The ideal placement of grab bars should increase their use among seniors and decrease the incidence of falls. In fact, one report suggests that men without access to bath grab bars were 3.7 times more likely to fall than men with access to grab bars.⁴⁸ However, no studies have examined the effectiveness of grab bars when the balance of individuals is perturbed. Although grab bars are

frequently prescribed and installed, there is no evidence that they are effective once balance is lost during bathtub entry/exit or when individuals are sitting down or standing up in the tub.

In a related field, studies of stairway handrails have focussed primarily on static experiments. A recent dynamic task experiment used perturbations of balance and initial hand position to determine their influence on handrail grasping responses. The stabilizing responses elicited when handrails were present were clearly of functional significance and resulted in a marked reduction in the incidence of falls compared to situations where handrails were absent.⁴⁹

Scope and objectives: The general objectives purpose of this study were to examine how individuals who lost their balance would use bath grab bars when the grab bars were set in various configurations, to examine the effectiveness of four bath grab bar configurations in preventing a fall in individuals after a loss of balance, and to identify barriers to the acceptance and use of bath grab bars. The four grab bar configurations were the following: (1) no bars, (2) vertical/horizontal combination (CSA), (3) right angle combination (OBC) and (4) vertical/angled combination (OCC) (see Figures 4, 5, 6, 7 on pages 21-24) .

The specific objectives for the project were the following:

1. To determine if, and how, people actually used grab bars following an experimentally-induced perturbation of balance;
2. To determine which grab bar configuration was the most successful in preventing a fall following a perturbation of balance;
3. To determine if the phase of the task performed (i.e., getting in/out of the tub) had an influence on which grab bars were used;
4. To identify barriers to the acceptance and use of grab bars; and
5. To study the influence that a loss of balance experienced by participants had on the acceptance of grab bars.

The following was hypothesized:

1. Grab bars would be effective in helping participants re-establish balance.
2. The type of activity performed by participants would influence the effectiveness of the grab bar configurations.
3. Participants experiencing a balance perturbation would increase their use and acceptance of bath grab bars.

METHODOLOGY

Participant recruitment

Two sample groups were recruited for this study: a primary group* of older adults between 50 and 60 years of age; and a pilot comparison group of younger adults between 19 and 28 years of age.

The older adult group

The older adults were recruited from community organizations such as walking groups, community centres, Ottawa Athletic Club and YMCA, local gyms catering to the 50–60 population, pre-retirement workshops, the University of Ottawa, and by word of mouth. A letter and poster were sent to over 30 community-based organizations asking them to post the posters in their organization's common area and to share the information with their members. The project team also volunteered to visit the various organizations to present the project, if so desired. The letter (Appendix C) was also posted on various billboards within the University and the community.

The younger adult group

Prior to testing older adults, it was important to assess whether the platform used for balance perturbation could induce a loss of balance without putting older adults at great risk of injury. For this assessment, a group of younger adults was recruited from the University of Ottawa student body with a letter posted on various student billboards and distributed electronically through the students associations' mailing list. This group of participants would also serve as a comparative group in the data analysis.

In all cases, organizations were asked to post the information and participants were encouraged to communicate directly with the research team. An initial telephone contact served to address any questions and to arrange a time for the experiment that was convenient for the participant.

* Adults between 50 and 60 years of age were recruited for this project even though the primary population of interest was seniors (people 65 years of age or older). The experiments proposed had an associated risk of falls and although protective clothing was provided and all necessary precautions were taken, the risk of fall-induced injury would have been greater for seniors.

Eligibility

To be eligible, all subjects (younger and older adults) had to be capable of completing 32 independent transfers in and out of bathtubs, without the use of a mobility aid; to be cognitively intact, to ensure comprehension of tasks and reliability of post-trial interview data; and to be able to understand and communicate in English or French. All attempts were made to recruit a representative number of males and females.

Testing

Pilot testing and survey questionnaires: The research procedure was first pilot tested with research assistants and then with the younger adult group. These trials were important not only to validate the research protocol, but also, to determine whether the platform used could induce a loss of balance in older adults without putting them at great risk of injury.

The survey questionnaire used for this project which was developed in 2000² and then modified for another study with an older adult clientele in 2002³, can be found in Appendix E

Procedure: Testing required approximately 30 minutes for younger adults and 60 minutes for older adults. All participants were tested at the University of Ottawa in a research laboratory located in Guindon Hall. Participants were met by one of the research assistants at the front entrance of the Health Sciences Building. Upon arriving at the testing laboratory, participants were offered a chair. They were then asked to read the Letter of Information and Consent (Appendix D). Participants were shown the mock bathroom area and informed about the testing process and the survey questionnaire contents. The right of participants to stop participation at any time was clearly stated. Participants were then asked to sign the Letter of Information and Consent to participate in the study.

Once consent was obtained, participants were interviewed by the Primary Research Assistant (older adults) or by a 4th year student (younger adults) using the *Bath Grab Bar Effectiveness During Balance Perturbation* questionnaire (Appendix E). The questionnaire requested information on sociodemographic characteristics (age, gender, marital status, living

arrangements, mother tongue, education, and income), health status, patterns of bathing, and patterns of use and acceptance of bathroom aids, and it included the Falls Behavioural Scale (FaB) for the Older Person.⁵¹

The mock bathtub area consisted of three walls at right angles designed to accommodate the grab bar configurations and to allow the configurations to be changed quickly. The walls surrounded a regular bathtub (1.52 x 0.76 x .041 m). The bathtub and walls were secured over the structural frame of the platform at a perpendicular angle (Figure 1). When activated, the platform moved 20 cm forward and backward under the bathtub. The platform speed was adjustable to 24 cm/sec, an adequate speed for causing balance perturbation among younger and older healthy adults. The bathtub and walls were fixed and did not move, only the platform was capable of moving. The bathtub was lightweight and made of acrylic. The bathtub rims were padded with light foam. All grab bars had non-slip surfaces. Participants wore protective hip garments and were secured in a harness to prevent injury in the unlikely event of a fall (Figure 2).



Figure 1. Platform used to induce balance perturbation



Figure 2. Mock bathroom area and safety harness

Bath tub grab bar configurations

Four bathtub grab bar configurations were tested: (1) no grab bar configuration (Figure 4), (2) Canadian Standards Association (CSA) configuration (Figure 5), (3) Ontario Building Code (OBC) configuration (Figure 5), and (4) Occupational Therapy Ottawa–Carleton Common (OCC) configuration (Figure 6). Mounting plates were installed according to standards to allow modelling of bathrooms with faucets at either end of the tub. The mock bathroom did not include faucets. Participants were asked to describe their own setting at home and the configurations tested were oriented to match the faucet location in the participant's home. The standards for each of the four configurations are specified below. The precise measurements and locations of the bars that were tested within each standard are also specified.

No grab bar



Figure 3. No grab bar configuration

Canadian Standards Association (CSA) configuration (1995)

Standards: The configuration consists of two grab bars. The first bar is located horizontally (or angled) on the backwall. The second bar is located vertically on the faucet end wall (sidewall). The bath bars should be at least 120 cm long and located from 18 to 28 cm above the rim. Furthermore, the grab bar should have a slip resistant surface, a 30-40 mm diameter and a 35 mm clearing from wall.

Tested: The configuration consisted of two grab bars. The first bar was located horizontally on the backwall. The bar was 120 cm long, centred on the backwall and located 18 cm above the rim. The second bar was located vertically on the sidewall (faucet end wall). This bar was 120 cm long and was located 18 cm above the rim. The grab bars were slip resistant and had a 32mm diameter. Both bars were mounted 38 mm from the wall.



Figure 4. Canadian Standard Association (CSA) configuration

Ontario Building Code (OBC) configuration (1997)

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 ($5 \frac{7}{8}$ in) and 200 mm ($7 \frac{7}{8}$ in) above and parallel to the rim of the bathtub. The vertical leg of the L shall be located between 300 mm (11 in) and

450 mm (17 _ in) from the control end (sidewall) of the bathtub. Furthermore, the grab bar should have a slip resistant surface, a 30-40 mm diameter and a 35 mm clearing from wall.

Tested: An L-shaped grab bar was mounted on the back wall. Each leg of the L measured 900 mm 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 380 mm from the control end (sidewall) of the bathtub. The grab bar was slip resistant and had a 32mm diameter. It was mounted 38 mm from the wall.



Figure 5. Ontario Building Code (OBC) configuration

Occupational Therapy Ottawa–Carleton Common (OCC) configuration

Standards: Findings from a previous study indicated that the most common configuration of bath bars among 550 seniors residing in non-profit apartments across the Ottawa–Carleton and Hull–Outaouais regions were two bars. Although standard mounting positions were not available, guidelines indicated that a 600 mm (24 in) angled bar be mounted on the back wall at approximately 45 degrees with the top of the bar located approximately 300 mm (12 in) from the faucet wall (sidewall) and the bottom of the bar located approximately 150 mm (6 in) above the rim of the tub. A 460 mm to 600 mm (18 to 24 in) vertical bar should be mounted on the sidewall (faucet wall) approximately in line with the rim of the tub between 150 mm to 300 mm (6 to 12 in) above the rim.

Tested: The configuration consisted of two bars. The first bar was 600 mm long and was mounted on the back wall at approximately 45 degrees from the rim of the tub. 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 sidewall. The bar was 1200 mm long and was located 180 mm above the rim (used the same bar as for the CSA standard). Both grab bars were slip resistant and had a 32mm diameter. Both bars were mounted 38 mm from the wall.



Figure 6. Ottawa Carlton Common (OCC) configuration

Testing protocol: Both groups of participants were randomly divided into three subgroups ($n = 7$ per subgroup for younger adults and $n = 20$ for older adults). Each group tested two of the four configurations of grab bars. Groups A evaluated the No Bar and the CSA configurations. Groups B evaluated the No Bar and the OBC configuration. Groups C evaluated the No Bar and OCC configuration. The order of grab bar configurations was randomized. Each participant was asked to complete a minimum of 16 trials (bathtub transfer) for each of the two configurations assigned to them (for a minimum of 32 trials). In a minimum of 25% of the trials for each configuration, the platform was activated to create an unexpected balance perturbation for the participant.

Participants wore protective padding (hip protectors) over their clothing to protect their hips and buttocks from impact in the event of a fall. A harness system was used to prevent participants from hitting the bottom of the tub and to limit lateral movements. Participants were asked to remove their footwear and complete the grab bar testing session barefoot. Participants were asked to approach and climb into the bathtub, stand quietly for a few seconds, and climb out of the tub. Instructions were to get in and out of the tub in any manner that they wished, using the grab bars or other structures around the tub, if necessary. Figure 7 illustrates the structure components surrounding the bathtub that are referred to in this report.



Figure 7. Structure surrounding the bathtub

Following the final trial for each configuration, participants were asked to comment on the usefulness and safety of the configuration they had just tested. Participants rated the safety, ease or difficulty of use, and helpfulness of each grab bar configuration on a 5-point Likert scale (Difficulty: 1 = very difficult to 5 = very easy; safety: 1 = very unsafe to 5 = very safe; helpfulness: 1 = not at all helpful to 5 = very helpful).

Two cameras were used to videotape the participants as they completed the bathtub trials and to record behaviour when balance perturbations were experienced. Each camera was set to record from one side of the bathtub. Videotapes were coded to determine which configuration of grab bars appeared most effective in helping individuals regain stability when balance was challenged.

Follow-up on the acceptance of bathtub grab bars: Three months after the experiment, older adult participants were contacted by telephone and asked if they had made modifications to their home bathing environment and, specifically, if they had installed or intended to install bath grab bars. Specific questions were asked to determine why grab bars were or were not added to the home environment, whether the participant had recommended grab bars to others (if so, for whom and for what reasons), and, where applicable, how other individuals reacted to the installation of bars.

Data analysis

Two cameras at different angles were used to videotape the participants as they completed the bathtub trials and to record behaviour when balance perturbations were experienced. Videotapes were reviewed and coded to determine which configuration of grab bars appeared most effective in helping participants regain stability when balance was challenged. How participants naturally entered/exited the tub (what they touched, with which part of the body) was noted, as was how they reacted when balance was perturbed during the experiment. Any change in behaviour after the first induced loss of balance was noted. Descriptive statistics were used to summarize (a) participant profiles, (b) health status, and (c) rating and ranking of the grab bar configurations. One-way repeated measures analyses of variance (ANOVAs) were used to analyze mean differences between configurations of grab bars on primary outcome measures. Chi-square tests were used to test for differences in the frequency of grab bar use and location. Results were compared between both groups of participants (younger and older adults) to identify similarities or differences in the effectiveness of grab bars.

RESULTS

Completion of the experiment

A total of 82 participants took part in the study, however, only 81 (21 younger adults and 60 older adults) completed it. One older adult who agreed to participate did not complete the study due to a mechanical breakdown that interrupted the testing session. The participant was unable to return to complete the experiment. All participants were able to complete the testing protocol without any discomfort. In total, 1419 bathtub entries and exists with platform activation were recorded (1040 with older adults and 379 with younger adults). Seventy percent (70%) of the testing was completed in less than one hour (100% of younger adults and 44.1% of the older adults).

Sample profiles

The younger adult group

The younger group comprised of 10 males and 11 females. The age of the participants ranged between 19 and 28 years with an average age of 23 years. One participant reported living alone;

the remainder reported living with a spouse/partner (19.0%) or with roommates (76.2%). Seventy-six percent of the participants were Anglophones and 24% were Francophones. Most of the participants felt that their current income satisfied their needs.

All participants reported having general good health (43% very good and 57% good). Only two participants reported having specific health problems (minor knee problems) that did not interfere with the completion of the experiment. Twenty-nine percent (29%) reported being more active than their peers, 57% considered themselves as active as their peers and 14% reported being less active.

As expected, no younger adult reported a fall during the year preceding the experiment. None of the younger adults reported any problems getting in/out of, sitting in, or getting up from the tub. One participant did report having bath grab bars at home (OBC configuration).

The older adults

A total of 61 older adults were interviewed but only 60 were tested. The age of the older participants varied from 50 to 59 years, with an average of 55 years. The older adult group consisted of 16 males and 45 females. Thirteen percent of the participants were single, 74% were married, 10% were divorced, and 3% were widowed. Most of the participants (90.2%) were living with someone (spouse, children or siblings); only 9.8 % were living alone. Fifty-seven percent (57%) of the participants were Anglophone, 34.4% were Francophone and 8.2% reported another mother tongue. More than half the participants felt that their current income totally met their needs (54.1%), 16.4% felt that their income somewhat met their needs, 23% stated that their income met most of their needs, and 4.9% felt that their needs were not being met. One participant (1.6%) refused to answer the question.

Among this group, 47.5% of the participants rated their overall health compared to that of their peers as very good, 42.6% as good and 9.8% as fair. No participant reported poor overall health; however, participants did report specific problems. Sixteen percent of the participants reported balance problems; 36.1% had hip, leg or knee joint problems; 41.0% reported back and/or neck problems; 52.5% had visual problems and 10.6% reported other minor ailments. Compared to the

activity level of other people their own age, participants rated their present overall activity level as more active (47.5%), about the same (42.6), or as less active (14.8%).

As previously indicated in the literature review, a fall significantly increases the risk of a second fall in older adults. Although only 16% of the older adults reported balance problems, 42.6% ($n = 26$) had experienced a fall within the year preceding the experiment. Of these 26 participants, 46.2% ($^{12}/_{26}$) had one fall and 53.8% ($^{14}/_{26}$) had more than one fall. Eight percent of these individuals ($^2/_{26}$) reported that the falls occurred as they were getting in or out of the bathtub (during a bath/shower) and that there were no bars present at the time. Table 1 provides the description of the people having reported a fall (or falls) within the year preceding the experiment compared to the people who had not fallen. Women reported more falls than men. More people who had fallen lived alone and reported visual problems.

As per the inclusion/exclusion criteria, no participant was incapable of entering/exiting a bathtub. Seventy percent of the participants reported no difficulty in entering/exiting a bathtub, but 21% did report a slight difficulty. No participant reported being helped to enter/exit a bathtub. Eight percent of the participants ($^5/_{61}$) reported having grab bars in their homes. Although the experiment did not involve sitting in and getting up from the bathtub, it did represent a challenge for a number of participants. Sixty-nine percent of the participants reported being able to sit in and get up from the bathtub without difficulty, 27.0% acknowledged some difficulty, and 3.3% reported a lot of difficult with the task. Twenty-two percent of the participants reported always taking a bath, sitting in the tub; 54.2% reported always taking a standing shower; and 23.7% reported alternating between showers and baths. No participant reported taking a bath or a shower sitting on a bath bench or bath seat.

All the older adults completed, as part of the survey, the 30-item Fall Behavioural Scale (FaB) for Older Adults.⁵¹ The FaB is an assessment tool designed to identify the older person's awareness and practice of behaviours that could potentially protect against falling. The FaB is intended to provide a way of focussing on everyday situations, identifying the behaviour patterns, actions and habits that protect against falling. During the development of the FaB, a factor analysis highlighted 10 elements that contribute to understanding the nature of behavioural

TABLE 1. Description of older adults who had fallen versus those who had not fallen in the previous year

Characteristics of participants		Fallers		Non-fallers	
		N	%	N	%
Gender (interviewer noted)	Female	23	88.5%	22	62.9%
	Male	3	11.5%	13	37.1%
Living arrangement	With someone	22	84.6%	33	94.3%
	Alone	4	15.4%	2	5.7%
Age*	50–55 years	13	52.0%	20	57.1%
	56 + years	12	48.0%	15	42.9%
Mother tongue	English	19	73.1%	16	45.7%
	French	7	26.9%	14	40.0%
	Other			5	14.3%
Income satisfies needs	Totally	15	57.7%	18	52.9%
	Somewhat	2	7.7%	8	23.5%
	Mostly	7	26.9%	7	20.6%
	Not at all	2	7.7%	1	2.9%
Problems with balance	Yes	6	23.1%	4	11.4%
	No	20	76.9%	31	88.6%
Problems with hip, leg or knee joints	Yes	9	34.6%	13	37.1%
	No	17	65.4%	22	62.9%
Problems with back and/or neck	Yes	10	38.5%	15	42.9%
	No	16	61.5%	20	57.1%
Problems with vision	Yes	17	65.4%	15	42.9%
	No	9	34.6%	20	57.1%
Other problems	Yes	4	15.4%	2	6.1%
	No	22	84.6%	31	93.9%
Overall health rating in comparison to peers	Very good	12	46.2%	17	48.6%
	Good	11	42.3%	15	42.9%
	Fair	3	11.5%	3	8.6%
Overall activity level in comparison to peers	More active	11	42.3%	13	37.1%
	About the same	11	42.3%	17	48.6%
	Less active	4	15.4%	5	14.3%
Use of a mobility aid such as a cane or a walker	No	26	100.0%	35	100.0%
	Yes	0	0%	0	0%

*One participant refused to answer.

factors and falls. These elements are Cognitive Adaptations, Protective Mobility, Avoidance, Pace, Awareness, Practical Strategies, Displacing Abilities, Being Observant, Changes in Level and Getting to the Phone.⁵¹

The FaB scale was developed to fill a gap in current fall assessment tools and provide a way of measuring behaviours that can contribute to falling.⁵¹ Response options refer to things people do in their everyday lives and are presented along a 4-point Likert scale, ranging from never (0) to always (4). In comparing total FaB scores, the mean scores for items rather than a total summed score were used. The FaB scale has demonstrated good internal reliability (Cronbach's alpha = 0.85). In this study, the total mean score for the group was 2.28 (sd = 0.40). Table 2 shows the total average score in relation to participants' age, gender, income, reported health problems as well as having experienced a fall. There were no significant differences in total score in the group (no variable had a p-value of less than 0.05); however, it seems that the higher score was found for people who were widowed (mean = 2.95) as well as for people who rated their health as not good (mean = 2.51).

Determining if, and how, people actually use grab bars following an experimentally induced balance perturbation. The first specific objective of the study was to determine if, and how, people actually used grab bars following an experimentally induced balance perturbation. To address this objective, a comparison was made between how participants responded to: a) configuration 1 (No Bar); and b) the second configuration assigned to them (CSA or OBC or OCCC).

The younger adults

In the younger adults, a total of 379 bathtub entry/exits with platform activation were recorded and 53.8% ($^{204}/_{379}$) resulted in a loss of balance. Fifty-two percent ($^{118}/_{204}$) of the balance losses recorded occurred in the presence of grab bars and 42% ($^{86}/_{204}$) in the absence of grab bars. The balance losses varied in intensity, but in 75% ($^{153}/_{204}$) of the cases where balance perturbation was induced, participants were able to regain their balance **without** contacting the surrounding structure. Balance was regained by postural adjustment such as anchoring both feet firmly on the floor (40%), taking a step forward (38%), and taking a step forward and compensating with

TABLE 2. The FaB total score in relation to participants' characteristics.

		(n)	Average FaB Total Score*	Standard Deviation (+ or-)
Gender	Female	45	2.31	(.37)
	Male	16	2.22	(.49)
Age**	50–55 years	33	2.26	(.42)
	56 + years	27	2.32	(.38)
Current marital status	Never married	8	2.35	(.37)
	Married	45	2.24	(.38)
	Divorced	6	2.29	(.47)
	Widowed	2	2.95	(.27)
Mother tongue	English	35	2.26	(.39)
	French	21	2.28	(.40)
	Other	5	2.48	(.49)
Income satisfies needs	Totally	33	2.23	(.39)
	Somewhat	10	2.27	(.48)
	Mostly	14	2.47	(.30)
	Not at all	3	2.24	(.55)
Problems with balance	Yes	10	2.41	(.33)
	No	51	2.26	(.41)
Problems with hip, leg or knee joints	Yes	22	2.28	(.40)
	No	39	2.28	(.41)
Problems with back and/or neck	Yes	25	2.25	(.39)
	No	36	2.31	(.41)
Problems with vision	Yes	32	2.24	(.40)
	No	29	2.33	(.40)
Overall health rating in comparison to peers	Not so good	6	2.51	(.22)
	Good	55	2.26	(.41)
Have had a fall	Yes	26	2.26	(.36)
	No	35	2.30	(.43)

*A higher FaB indicates individuals who present a higher risk of falls

** One respondent did not provide age

major bodily adjustments such as arm swaying (22%). More balance losses were noted as the participants exited the tub (62%) than when they entered it (38%). In 25% ($^{51}/_{204}$) of the trials resulting in a loss of balance, younger adults needed to come in contact with the surrounding structure to regain their balance. In the absence of grab bars, younger adults favoured using the back wall, the sidewall and the bathtub rim to help regain their balance (Figure 8).

Number of time used

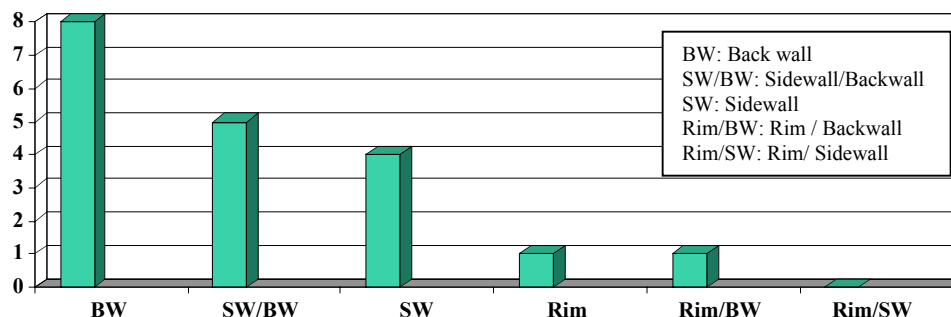


Figure 8. Objects used by younger adults to regain balance in the absence of grab bars

When grab bars were present, younger adults still favoured the back wall (Figure 9). They also favoured the vertical bar (located on the sidewall). Grab bars were present in 118 of the 204 trials where a loss of balance occurred. Younger adults used the bars to regain their balance (alone or in combination with a surrounding structure) in only 14.4% ($^{17}/_{118}$) of the occasions where grab bars were present.

Number of time used

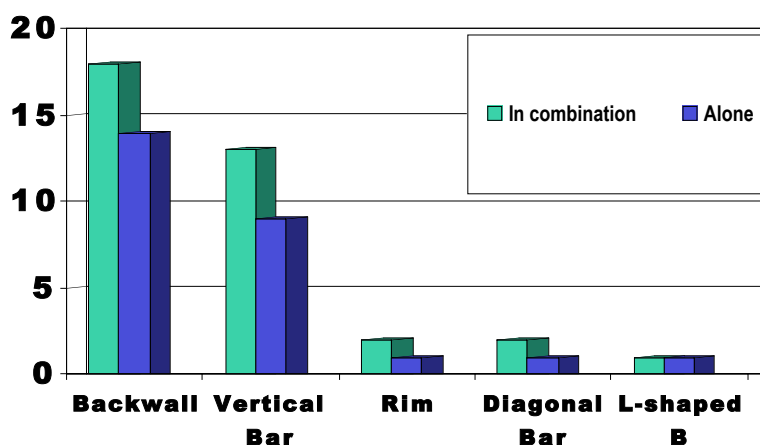


Figure 9. Objects used by younger adults to regain balance in the presence of grab bars

Balance loss appeared greater among women; they regained their balance by using a structure in 24% of the cases while men used structures in only 11% of the cases.

Older adults:

Among the older adults, 1040 perturbations (platform activation) were recorded and 80% ($^{831}/_{1040}$) resulted in a balance loss. Fifty-one percent ($^{425}/_{831}$) of the balance losses recorded occurred in the presence of grab bars and 49% ($^{406}/_{831}$) in the absence of grab bars. The balance losses varied in intensity, but in 79.3% ($^{659}/_{831}$) of the cases were balance perturbation was induced, participants required contact with surrounding structures to regain their balance. Participants were able to regain their balance without any contact to the surrounding structure in only 21% ($^{172}/_{831}$) of the trials. Once again, more balance losses were noted as the participants exited the tub than when they entered it. In the absence of grab bars, older adults favoured, in order, the sidewall, the bathtub rim and the back wall to help them regain their balance (Figure 10).

Number of time used

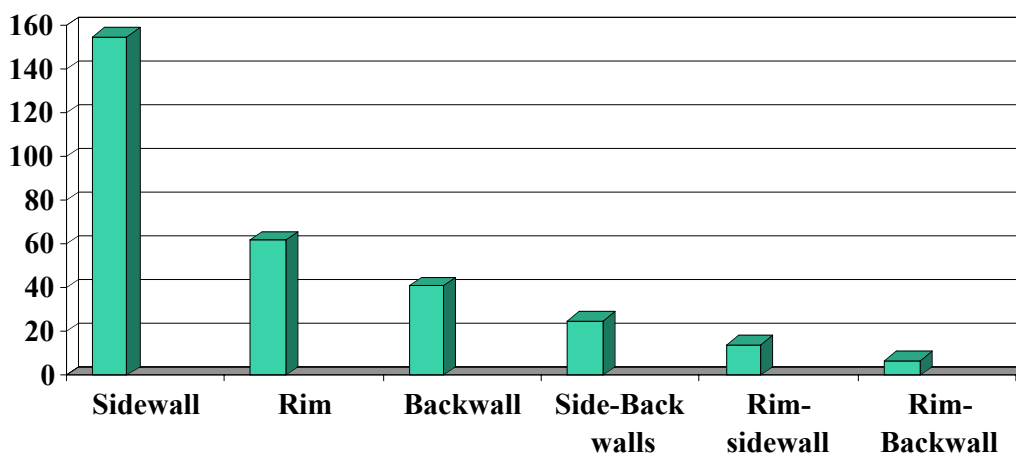


Figure 10. Object touched by older adults to regain balance in the absence of grab bars

When grab bars were present, older adults favoured, in order, the vertical bar (located on the sidewall), the sidewall and the bathtub rim (Figure 11).

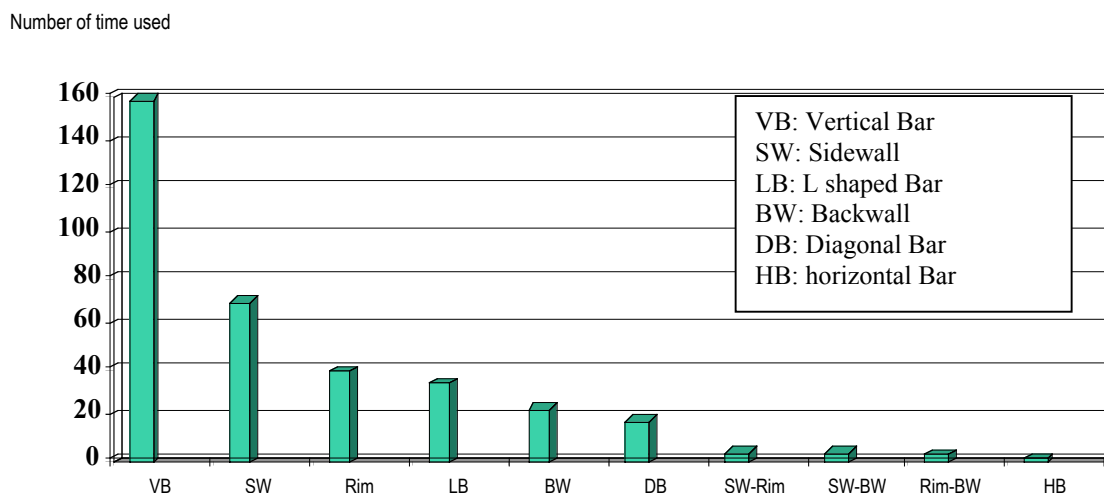


Figure 11. Objects touched by older adults to regain balance in presence of grab bars

The preference for the vertical bar is more apparent when the results of Figure 11 are separated according to specific bar use (alone or in combination with another structure). In Figure 12, the first column (green) indicates the total number of times the bar was used. This number includes all combination possible. The second column (blue) indicates the number of time the structure was used alone (no combination, strictly the structure).

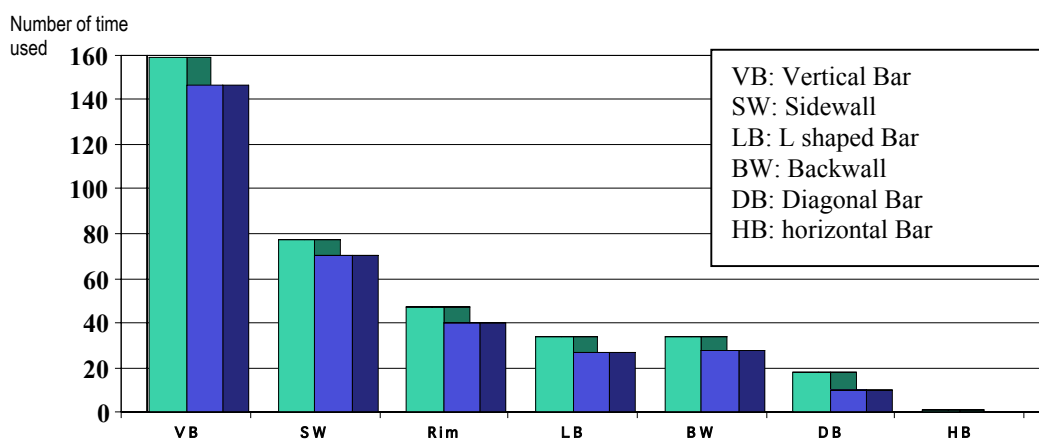



Figure 12. Comparison of the objects touched by older adults to regain balance in presence of grab bars

The following table shows the use of various objects to regain balance according to the various grab bar configurations.

TABLE 3. Object touched by older adults to regain balance according to grab bar configuration

Object	Grab Bar Configuration			Total	
	CSA	OBC	OCC		
	N	N	N	N	%
Vertical bar	66		80	146	41.1
Horizontal bar	1			1	0.3
Diagonal bar			8	8	2.3
L-shaped bar		27		27	7.6
Sidewall	4	59	7	70	19.7
Back wall	14	2	7	23	6.5
Rim	6	21	13	40	11.3
Sidewall-back wall	1	2	0	3	0.8
Sidewall-rim	0	4	0	4	1.1
Vertical bar + rim	3	1	1	5	1.4
Rim back wall	0	1	2	3	0.8
Diagonal bar back wall			10	10	2.8
Vertical bar+ side wall	3		0	3	0.8
Vertical bar + back wall	3		2	5	1.4
L-shaped bar + sidewall		7		7	2.0
Total	101	124	130	355	100

 Non-applicable in the configuration

Older adults used the grab bars to regain their balance (alone or in combination with the surrounding structure) in 49.7% ($^{212}/_{425}$) of the instances where grab bars were present.

Results indicate that 73% of the older women and 27% of the older men lost their balance. Slightly more participants between 50 and 55 years of age (54%) lost their balance than participants between 56 and 60 years of age (46%). Most of the people who lost their balance during the experiment had not reported falling in the preceding year (58%). Results also indicate that 93% ($^{40}/_{43}$) of the women (93%) used an object to regain their balance and 81% ($^{13}/_{16}$) of the

men did the same. As expected, participants mostly made contact to regain balance by using their hands, as shown in Figure 13.

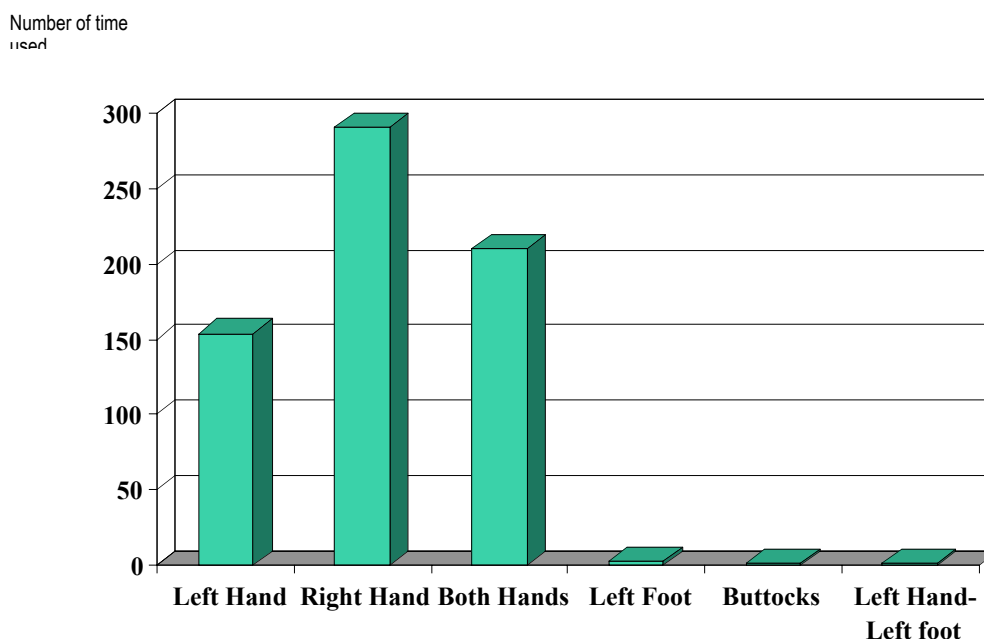


Figure 13. Body part that came in contact with surroundings when balance was lost

Results were also analyzed to examine whether participants who had reported a fall (fallers) in the previous year behaved any differently than the ones who reported no fall (non-fallers). Specifically, we were interested in determining whether fallers tended to use the bars more frequently or whether they relied on the surrounding structure to ensure safe transfers. There was no difference between fallers and non-fallers in the use of objects to regain their balance and grab bars were used equally between fallers and non-fallers.

Determining which grab bar configuration would be most successful in preventing a fall following a perturbation of balance (specific objective #2). This assessment was not fully possible since participants were secured in a harness that prevented any fall (ethics board requirement). Two participants would likely have fallen if not for the harness. Both were not using the grab bar at the time of the incident. Furthermore, the participants were asked to enter/exit the bathtub as they normally would. Since most of them did not use a bar at home, they did not consistently use a grab bar during the experiment. Nonetheless, the results observed

provide valuable information. Overall, the vertical bar was most useful in helping participants to regain their balance as they entered/exited the bathtub. The location of the bar can explain why it was favoured: when losing their balance, people instinctively reach for the nearest object. As people get in/out of a bathtub, the nearest object is likely to be the sidewall or a bar on the sidewall. The vertical bar was the only bar mounted on the sidewall of the bathtub. The other bars tested (diagonal, L-shaped and horizontal) were all located on the back wall and were not used frequently by participants to regain their balance when they got in/out of the bathtub. Reaching for a bar across the tub actually shifts a person's centre of gravity forward and may increase the risk of fall. Therefore, bathtub configurations that include a bar on the sidewall would be more effective than ones that do not. In this study, two configurations tested (CSA and OCC) had a bar on the sidewall, which in both cases was a vertical bar. Overall, a configuration that has no bars on the sidewall, such as the OBC configuration tested, would not be as effective in helping individuals regain balance as they get in/out of the tub. Logically, a vertical bar should be more helpful than a horizontal bar on the sidewall as it provides a greater range of support (length of bar), but further research is needed to examine this point.

Determining if the phase of the task performed had an influence on the grab bars (specific objective #3). Ideally, all phases of the task (entering the tub, sitting in it, standing up in it and exiting it) would have been explored. Unfortunately, the platform used was mounted such that it moved under the tub and could not induce a loss of balance during the phases of sitting and standing up in the bathtub. Nevertheless, the results do suggest that the phase of the task influences the use of grab bars. As shown in the following figures, both younger (Figure 14) and older adults (Figure 15) favoured the vertical bar as they entered and exited the bathtub.

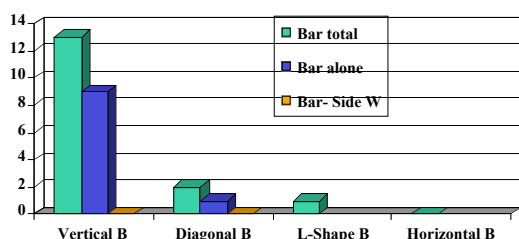


Figure 14. Younger adults grab bar use

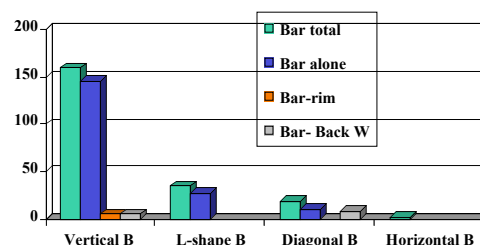


Figure 15. Older adults grab bar use

The vertical bar was the only bar mounted on the sidewall of the bathtub. The other bars tested (diagonal, L-shaped and horizontal) were all located on the back wall. The results suggest that the vertical bar was the most useful for helping participants regain their balance as they entered/exited the bathtub. These tables also illustrate that older adults tended to use the grab bars when they were present much more than younger adults did (50% and 14% of the time, respectively).

Identifying barriers to the acceptance and use of grab bars (specific objective #4). As indicated in Table 4, older adults found the grab bars easy to use. Results suggest that participants felt that the bars were either very helpful or were minimally helpful. Results also suggest that the presence of grab bars appeared to provide a sense of security. Furthermore, the majority of the participants felt that they would use grab bars in the future although the results are not as conclusive for the group testing the OBC configuration. The vast majority of participants felt comfortable using the bars tested. Results for younger adults are shown in Table 5.

All participants indicated that the presence of the bars provided a sense of security although the younger adults used the bars less often (14.4% of the time). Overall, the younger and the older adults preferred the configurations with bars to the No Bar configuration, as illustrated in Table 6.

TABLE 4. Older adults' appreciation of the grab bar configurations tested

		OBC		CSA		OCC	
		N	%	N	%	N	%
Ease of use	Difficult	1	5	0	0	1	4.8
	Somewhat	3	15	2	10.5	1	4.8
	Easy	8	40	5	26.3	2	9.5
	Very easy	8	40	12	63.2	17	80.9
		20	100	19	100	21	100
Helpfulness	A little	3	15	4	21.1	7	33.3%
	Some	2	10	0	0	2	9.5%
	Somewhat	6	30	2	10.5	2	9.5%
	Lot	7	35	2	10.5	1	4.8%
	A lot	2	10	11	57.9	9	42.9%
		20	100	19	100.0%	21	100.0%
Sense of security	A little	3	15	2	10.5	4	19.1
	Some	1	5	0	0	0	0
	Somewhat	1	5	1	5.2	2	9.5
	Lot	7	35	3	15.8	5	23.8
	A lot	8	40	13	68.5	10	47.6
Group Total		20	100.0%	19	100.0%	21	100
Anticipated use	Certainly not	0	0	0	0	1	4.8
	No	1	5	1	5.2	2	9.5
	Maybe	5	25	4	21.1	8	38.1
	Yes	4	20	1	5.2	2	9.5
	Certainly yes	10	50	13	68.5	8	38.1
Group Total		20	100.0%	19	100.0%	21	100.0%
Level of comfort	Not at all	0	0	0	0	1	4.8
	Uncomfortable	2	10	0	0	1	4.8
	Somewhat	2	10	0	0	1	4.8
	Comfortable	6	30	5	26.3	7	33.3
	Very comfortable	10	50	14	73.7	11	52.3
Group Total		20	100.0%	19	100.0%	21	100.0%

TABLE 5. Younger adults' appreciation of the grab bar configurations tested

		OBC		CSA		OCC	
		N	%	N	%	N	%
Ease of use	Difficult	1	14.3	0	0	0	0
	Somewhat	0	0	0	0	0	0
	Easy	0	0	1	14.3	3	42.9
	Very easy	3	42.9	5	71.4	4	57.1
	N/A	3	42.9	1	14.3	0	0
		7	100	7	100	7	100
Helpfulness	Not at all	2	28.6	3	42.9	4	57.1
	Little	1	14.3	0	0	0	0
	Somewhat	0	0	2	28.6	2	28.6
	Some	0	0	1	14.3	0	0
	A lot	1	14.3	0	0	1	14.3
	N/A	3	42.9	1	14.3	0	0
		7	100	7	100	7	100
Sense of security	Not at all	2	28.6	3	42.9	1	14.3
	Somewhat	1	14.3	1	14.3	4	57.1
	Some	1	14.3	1	14.3	1	14.3
	A lot	1	14.3	2	28.6	1	14.3
	N/A	2	28.6	0	0	0	0
		7	100	7	100	7	100
Group Total		7	100	7	100	7	100
Level of comfort	Not at all	2	28.6	0	0	0	0
	Somewhat	0	0	1	14.3	3	42.9
	Some	1	14.3	0	0	2	28.6
	Very comfortable	2	28.6	5	71.4	2	28.6
	N/A	2	28.6	1	14.3	0	0
		7	100	7	100	7	100
Group Total		7	100	7	100	7	100
Anticipated use in future	Yes	2	28.6	3	42.9	5	71.4
	No	1	14.3	1	14.3	1	14.3
	Maybe	4	57.1	3	42.9	1	14.3
Group Total		7	100	7	100	7	100

TABLE 6. Comparison of the two grab bar configurations tested

		Older Adults		Younger Adults	
		Total		Total	
		N	%	N	%
Configuration most useful	<i>With bar</i>	45	75	12	57.1
	<i>Without bar</i>	6	10	1	4.8
	<i>No difference/same</i>	9	15	8	38.1
	Group Total	60	100.0	21	100.0
Configuration easier to use	<i>With bar</i>	41	68.3	12	57.1
	<i>Without bar</i>	7	11.7		
	<i>No difference/same</i>	12	20	9	42.9
	Group Total	60	100.0	21	100.0
Configuration providing sense of security	<i>With bar</i>	52	86.6	20	95.2
	<i>Without bar</i>	4	6.7		
	<i>No difference/same</i>	4	6.7	1	4.8
	Group Total	60	100.0	21	100.0
Configuration most comfortable	<i>With bar</i>	44	73.3	12	57.1
	<i>Without bar</i>	8	13.3	2	9.5
	<i>No difference/same</i>	8	13.3	7	33.3
	Group Total	60	100.0	21	100.0
Configuration preferred	<i>With bar</i>	47	78.3	12	57.1
	<i>Without bar</i>	8	13.3	7	33.3
	<i>No difference/same</i>	5	8.3	2	9.5
	Group Total	58	100.0	21	100.0

There was no significant difference in the appreciation of bars (usefulness, ease of use, sense of security, comfort) between older men and older women, as seen in Table 7. However, there seems to be a significant difference between male and females in the younger group. Women tend to find the *with bar* configuration most useful and easier to use than men as seen in Table 7..

TABLE 7. Comparison of both grab bar configurations by men and women

		Older Adults				Younger Adults			
		Female		Male		Female		Male	
		N	%	N	%	N	%	N	%
Configuration most useful	<i>With bar</i>	33	76.7	12	75.0	8	72.7	4	40.0
	<i>Without bar</i>	4	9.3	2	12.5	1	9.1	0	0
	<i>No difference/same</i>	6	14.0	2	12.5	2	18.2	6	60.0
Group Total		43	100.0	16	100.0	11	100.0	10	100.0
Configuration easier to use	<i>With bar</i>	31	73.8	10	62.5	8	72.7	4	40.0
	<i>Without bar</i>	5	11.9	2	12.5	0	0	0	0
	<i>No difference/same</i>	6	14.3	4	25.0	3	27.3	6	60.0
Group Total		42	100.0	16	100.0	11	100.0	10	100.0
Configuration providing a greater sense of security	<i>With bar</i>	39	90.7	13	81.3	10	90.9	10	100.0
	<i>Without bar</i>	3	7.0	1	6.3	0	0	0	0
	<i>No difference/same</i>	1	2.3	2	12.5	1	9.1	0	0
Group Total		43	100.0	16	100.0	11	100.0	10	100.0
Configuration most comfortable	<i>With bar</i>	33	76.7	11	68.8	5	45.5	7	70.0
	<i>Without bar</i>	7	16.3	1	6.3	2	18.2	0	0
	<i>No difference/same</i>	3	7.0	4	25.0	4	36.4	3	30.0
Group Total		43	100.0	16	100.0	11	100.0	10	100.0
Configuration preferred	<i>With bar</i>	34	81.0	13	81.3	6	54.5	6	60.0
	<i>Without bar</i>	6	14.3	2	12.5	4	36.4	3	30.0
	<i>No difference/same</i>	2	4.8	1	6.3	1	9.1	1	10.0
Group Total		42	100.0	16	100.0	11	100.0	10	100.0

Furthermore, there is no significant difference in the appreciation of grab bars between older adults who have fallen and those who have not (Table 8).

TABLE 8. Comparison of both grab bar configurations by fallers and non-fallers (older adults)

		Fallers		Non-Fallers		Total	
		N	%	N	%	N	%
Configuration most useful	With bar	19	79.2%	26	74.3%	45	76.3%
	Without bar	2	8.3%	4	11.4%	6	10.2%
	No difference/same	3	12.5%	5	14.3%	8	13.6%
Group Total		24	100.0%	35	100.0%	59	100.0%
Configuration easier to use	With bar	18	75.0%	23	67.6%	41	70.7%
	Without bar	2	8.3%	5	14.7%	7	12.1%
	No difference/same	4	16.7%	6	17.6%	10	17.2%
Group Total		24	100.0%	34	100.0%	58	100.0%
Configuration providing a greater sense of security	With bar	22	91.7%	30	85.7%	52	88.1%
	Without bar	2	8.3%	2	5.7%	4	6.8%
	No difference/same			3	8.6%	3	5.1%
Group Total		24	100.0%	35	100.0%	59	100.0%
Configuration most comfortable	With bar	18	75.0%	26	74.3%	44	74.6%
	Without bar	4	16.7%	4	11.4%	8	13.6%
	No difference/same	2	8.3%	5	14.3%	7	11.9%
Group Total		24	100.0%	35	100.0%	59	100.0%
Configuration preferred	With bar	19	82.6%	28	80.0%	47	81.0%
	Without bar	3	13.0%	5	14.3%	8	13.8%
	No difference/same	1	4.3%	2	5.7%	3	5.2%
Group Total		23	100.0%	35	100.0%	58	100.0%

Identifying the influence that an experienced loss of balance had on the acceptance of grab bars (specific objective #5). It was hypothesized that experiencing a loss of balance would have an influence on individuals' use and acceptance of grab bars. During the experiments, it was noted that the initial loss of balance did influence the behaviour of older participants in subsequent trials. The changes of behaviour noted were: always using the bar; always holding the wall; being more hesitant; always holding the rim; always using a combination of structure; being ready to use the bar. This influence was more apparent in women than in men (Figure 16). Older adults who had reported a fall did not seem to change their behaviour more than the ones

who had not reported a fall (Figure 17). Indeed, the results suggest the opposite: the people who had not reported a fall appeared to modify their behaviour slightly more so than those who had.

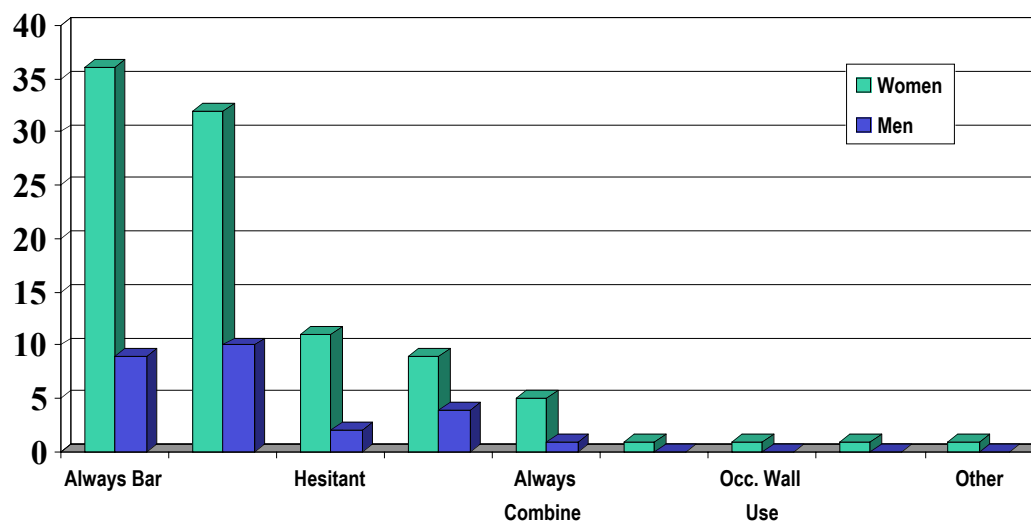


Figure 16. Change of behaviour observed after loss of balance in older men and women

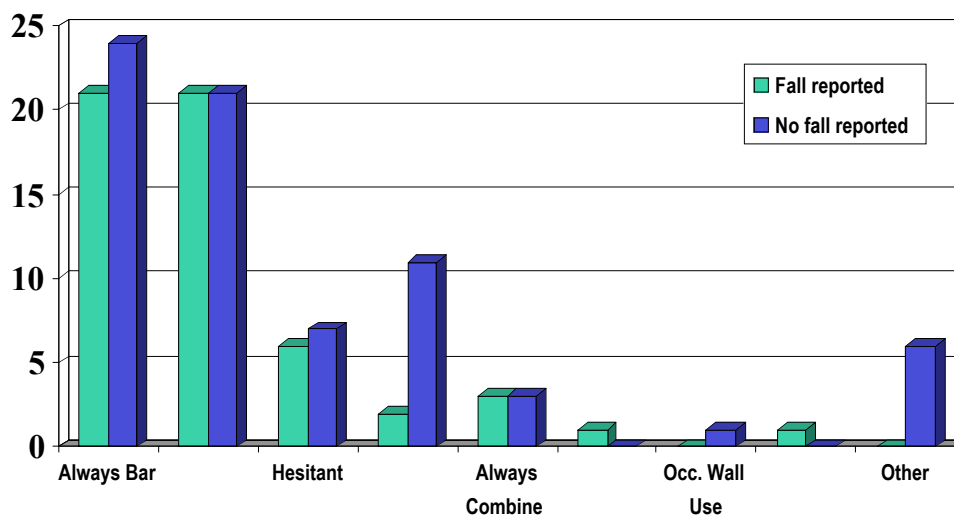


Figure 17. Change of behaviour observed after loss of balance in fallers and non-fallers

This change of behaviour was not observed in younger adults. This may be explained by the fact that this group could easily compensate for the balance loss induced and tended to use the surrounding structures much less than older adults.

The influence of the induced loss of balance on the acceptance of grab bars by older adults was further assessed during the follow-up telephone interviews. These interviews were conducted with 55 of the 60 participants who completed the study. The 5 remaining participants did not return the numerous messages left to invite them to complete the telephone interview. In total, 43 women ($^{43}/_{55}$ or 78.2%) and 12 men ($^{12}/_{55}$ or 21.8%) completed the telephone interview. Fifty six percent ($^{31}/_{55}$) of the participants were between 50 and 55 years of age. Most people (78.2%) completing the follow up interview were married and 94% lived with someone else. Fifty-five percent were Anglophones and 61% felt that their income totally satisfied their needs.

Most participants' (85%) health status had not changed since their participation in the lab experiment. The others reported increased pain, surgery, weight loss, and atrial fibrillation. One participant refused to answer the question. No participants reported a fall since their last contact with the research team. Only 47% of participants were able to recall the grab bar configuration they tested although when asked to discuss configuration preference, 73% remembered that they preferred the presence of bars to the absence; 5.7% preferred the No Bar configuration; 9.3% had no preference, and 12% could not recall. Only 9.1% ($^5/_{55}$) of the participants had purchased grab bars since the experiment. The reasons provided for not purchasing grab bars are presented below.

TABLE 9. Reasons provided for not purchasing bathtub grab bars

	N	%
<i>Don't need them now</i>	27	60.0
<i>Too young</i>	7	13.5
<i>Take showers</i>	7	13.5
<i>Already have them installed</i>	5	9.6
<i>Thinking about it</i>	2	3.8
<i>Not specified</i>	2	3.8
<i>Makes no difference</i>	1	1.9
<i>Live in a group</i>	1	1.9
<i>TOTAL</i>	52	100

Note: some participants provided more than one answer

When asked if they planned to purchase grab bars in the future, 47.3% ($^{26}/_{55}$) of the participants replied yes, “when I will need them” (21.1%); “when I get older” (19.2%); “this winter” (5.8%); “when I renovate the bathroom” (3.8%). The reasons provided for **not** planning to buy grab bars were, “don’t need them yet” (27.6%); “already have them” (20.7%); “difficult to fit” (6.9%); “hold on to shower door” (6.9%); “only shower” (6.9%); “very healthy” (3.4%); “when I slip” (3.4%); “don’t own bathroom” (3.4%); or there were no reasons specified (10.3%).

The telephone interviews yielded other interesting data. Forty two percent ($^{23}/_{55}$) of the participants reported having recommended bars to someone else. These recommendations were made mainly to other family members (34.8%), colleagues and seniors in organizations (34.8%), friends (21.7%) or to both family and friends (8.7%). Thirty percent of these participants reported that the people to whom they recommended grab bars thought their installation was a good idea, an additional 34.8% said they had reacted favourably, 6.9% would think about it, and 4.3% already had them. Five participants could not recall how people reacted. Interestingly, 4 participants reported that people had purchased grab bars as the participants had suggested for the following reasons: getting old, difficulty getting in/out of tub, and just in case. Six participants reported that the suggestion was not put into effect for the following reasons: “don’t need now,” “thinking about it,” “too young,” and “doesn’t own home.”

DISCUSSION

As hypothesized, results indicate that although the movement produced by the platform does induce a slight to moderate balance loss, young adults rarely use the grab bars even when balance is perturbed. They are able to compensate for the loss of balance by shifting their body weight. Although the speed of the platform was the same for both groups or slightly lower for older adults, its movement brought about stronger reactions in older adults, who could not easily compensate for the sudden shift in balance. Older adults used the bars and surrounding surfaces more often than younger adults to regain or maintain balance, a tendency that reflects the natural decrease in balance and balance compensation that is associated with normal aging.

Surprisingly, younger adults favoured touching the back wall of the tub for stabilization, as they were entering/exiting the tub when no bars were available. This movement actually projects the

body weight forward and may further contribute to balance loss. Yet when the bars were present, the vertical bar on the sidewall was most used. On the contrary, older adults favoured the sidewall that is readily at hand when entering/exiting tub. They also favoured the vertical bars on the sidewall to the other bars.

The phase of the bathtub transfer (i.e. entering versus exiting the bathtub) influenced the use of grab bars. The vertical bar on the sidewall (as in the CSA and OCC configurations) was used most often when participants entered/exited the tub (although once the participant stepped out of tub, the vertical bar on the sidewall was no longer useful). Conversely, the bar on the back wall (as in the CSA, OBC and OCC configurations) was rarely used when participants entered/exited the tub. This rarity of use is understandable since the bar is on the back wall, which is furthest away from an individual entering/exiting a tub, and grabbing a bar on that wall actually may provoke a fall by shifting the individual's centre of gravity forward. It appears that a bar on the back wall would be more useful while individuals sit down or stand up in the tub, which could explain why older adults did not appreciate the OBC configuration as much as the other two configurations. The OBC configuration was rated slightly lower than the CSA and OCC configurations for comfort and ease of use. The OBC configuration was found somewhat helpful and did provide a sense of security, but less so than the other configurations did.

These data concur with earlier reports of perceived grab bar helpfulness and safety as well as grab bar use in non-perturbed trials reported in a previous study.⁵⁰ These results also suggest the use of two grab bars to ensure safety during all phases of bathing, as suggested in previous studies.^{2, 3, 50} Therefore, the OBC configuration with the single bar is not recommended because it does not ensure safety in all phases of bathtub transfer. As noted in other studies,^{2, 3, 50} although the participants ranked a given configuration positively, they did not readily use it during bathtub transfer.

When considering both groups together, women lost their balance 3 times more often than men during the experiments. These results are consistent with findings of a study that reported that women represent 70.5% of cases treated in emergency departments for injuries related to falls.⁵² Women seem to fall more frequently than men; in the current study, they lost their balance more

frequently than men. Some of the difference in results with the men and those with the women may be attributable to difference in lower body strength.⁵² The fact that women lost their balance more frequently may explain why they changed their behaviour more than men did. It is possible that the behavioural changes reflected an increase in precautionary measures following the first induced loss of balance. Furthermore, both younger and older women tended to use bars slightly more than men did. Women appear more willing to use bars and find it more socially acceptable to use them; they may not identify the use of bars with negative connotations.

Surprisingly, more people between 50 and 55 years of age (54%) lost their balance than participants between 56 and 60 years of age (46%). It is possible that the youngest group of older adults may not have perceived a risk in participating in the experiment, thus were not prepared for a loss of balance nor to use the grab bars. Furthermore, most of the people who lost their balance (58%) during the experiment had reported not falling in the preceding year. The participants may therefore not have been fully aware of their own abilities or limitations. It is also possible that the people who had reported a previous fall were more prepared for an anticipated loss of balance or that they had already incorporated newer baseline behaviours in their everyday life because of their fall. More people who had fallen in the preceding year lived alone and reported visual problems, suggesting that the falls may have occurred because these people may not have had appropriate assistance.

As anticipated and consistent with previous reports,^{2, 3, 50} most participants had no grab bars in their home even though 42.6% had reported a fall. Given that only 2 of the falls occurred during bathing, people did not seem to realize the risk of a fall with bathing. Some changes in behaviour were noted in most participants during the experiments but the effect did not appear to last. By the three-month follow-up interview, most participants had not purchased grab bars. It is possible that they attributed their loss of balance during the experiment to the artificial set up and felt that a similar loss of balance would not happen at home.

Participants seemed to associate the use of grab bars with “old age.” As observed in the follow-up interviews, older adults did not feel that they were “old enough” to need bath grab bars. Although most of the older adult participants had experienced a loss of balance during the

experiment and some had reported falling prior to the study, most participants still felt they did not need bars. The stigma attached to grab bars seemed to outweigh the ability of individuals to assess their own abilities and limitations. Participants were contemplating the use of grab bars at some point in the future and also mentioned that they would consider grab bars once they slipped. Unfortunately, reactive installation of grab bars in the home bathing environment may be too late: an injury may occur the first time an individual slips or falls. Interestingly, participants recognized the benefits of grab bars for others and recommended them to people they knew.

STUDY LIMITATIONS

Although this study yielded interesting data, it was not possible to reach all the specific objectives originally identified. The platform used could only move backward and forward and could not be adapted to induce balance loss once the participants were in the bathtub (sitting down/standing up). Therefore, it was impossible to observe the use of grab bars in all phases of bathtub transfer. In this experimental set-up, it was easier to induce a loss of balance as participants exited the bathtub (stepped onto the moving platform). In reality, people may experience a loss of balance when getting into the tub as they step on a wet and slippery surface. Participants used the bars on the back wall less frequently than they did those on the sidewall since the latter were readily accessible to participants entering/exiting the tub. It was therefore not possible to determine which grab bar configuration was most successful in preventing a fall following balance perturbation when participants were in the tub. Furthermore, both configurations that included a bar on the sidewall used the same bar positioning (vertical bar). It is not possible to state whether this is the most useful bar position since it was not compared to different bar positioning on the sidewall (e.g., horizontally, as in the UFAS configuration). Finally, the effectiveness of the grab bars in preventing a complete fall could not be ascertained because the harness worn by participants prevented them from falling to the floor and because people did not always, in fact, use the bars.

CONCLUSION

As reported in previous studies, the presence of bathtub grab bars does not ensure their use when individuals are simply entering/exiting the tub. The use of the grab bars is increased, however, if an individual loses balance during a bath transfer. Most of the participants, both younger and older adults, preferred a grab bar configuration to the No Bar configuration, although the younger adults rarely used the bars (14.4% of trials). The presence of grab bars increases the sense of security about the task. However, if the bar is not already being held when a loss of balance occurs, the individual may not grab the bar properly enough to prevent a fall. In this instance, the presence of the bar may limit the consequences of the fall (limit injury), but not prevent it. Bars are more likely to help prevent falls if they are being used at the moment when balance is lost. There is a question as to whether as people grow older and their reaction time increases they will be able to reach the bar in time to prevent a fall. There is a strong need for education and training about bath grab bars to ensure safe bathtubs transfers. Initiatives must be taken to decrease the stigma associated with grab bars and to promote safety in the home. To ensure safety in all phases of bathtub transfer, there must be a minimum of two bars: a bar on the sidewall and another bar on the back wall.

RECOMMENDATIONS

- Seniors should install grab bars in their bathroom to decrease the risk of falls since bathrooms are the most common location of indoor falls.
- A minimum of two bars should be installed to ensure safety in all phases of bathtub transfer:
 - one on the sidewall to facilitate entry/exit, and
 - one on the back wall to help during sitting and standing in the tub
- The Ontario Building Code (OBC) requirements should be revised to include a bar on the sidewall to facilitate entry/exit, thus ensuring safety in all phases of bathing. The current configuration is not useful in helping people entering/exiting the bathtub.

FUTURE RESEARCH

The results of this study provide valuable information on the use of grab bars and their usefulness in helping people regain their balance; however, several questions remain unanswered. The following could prove highly useful:

- Replicating the current study to assess the use of bars when balance loss occurs when individuals are sitting down in or getting up from the bottom of the bathtub (having a new platform constructed)

- Examining the usefulness of various grab bars (horizontal, L-shaped) on sidewalls compared to that of a vertical bar
- Determining which grab bars (horizontal, angled, vertical or L-shaped) on the back wall are the most useful when individuals are sitting down in or standing up in the tub
- Examining the usefulness of a grab bar on the rim of the tub compared to that of one on the sidewall for individuals entering/exiting the bathtub
- Examining the effects of a wet and slippery surface (real life situation) on the use and usefulness of grab bars.

Appendix A: Terms of reference

SCHEDULE "A" -- TERMS OF REFERENCE

NO CHANGES SHALL BE MADE TO THIS SECTION AND THE FOLLOWING UNLESS WRITTEN PERMISSION OF THE CORPORATION IS GIVEN.

1. PROJECT MANAGEMENT

Employer: University of Ottawa

Principal Investigator: Paulette Guitard

Team Members: Heidi Sveistrup
Donna Lockett
Nancy Edwards

CMHC Project Officer: Luis Rodriguez

2. STATEMENT OF WORK

a) Scope and Objectives of Project

The purpose of this study is to examine the effectiveness of four (4) different bathtub grab-bar configurations when a loss of balance occurs, and to identify barriers to their acceptance and use. The four grab-bar configurations are: 1) no bars; 2) Vertical/horizontal combination (CSA); 3) vertical/angled combination (OCC); and 4) right angle combination (OBC). These grab-bar configurations are shown in Appendix A (attached).

The specific objectives for the project are to:

1. determine if, and how, people actually use grab bars following an experimentally-induced perturbation of balance;
2. determine which grab-bar configuration is more successful in preventing a fall following a perturbation of balance;
3. determine if the phase of the task performed (i.e., getting in/ out of the tub) has an influence on the grab bars used;
4. identify barriers to the acceptance and use of grab bars; and
5. explore the influence of experiencing a loss of balance on the acceptance of grab bars.

It is hypothesized that:

1. grab bars will be effective in re-establishing balance;
2. the type of activity performed may influence the effectiveness of the bath bar configuration; and
3. experiencing balance perturbation may increase the use and acceptance of bath grab bars.

b) Research Plan and Methods

This research consists primarily of laboratory testing and a follow-up telephone interview to determine the effectiveness of grab bars to prevent falls.

A total of eighty Subjects (Subjects healthy people) will be recruited. Although the primary population of interest is older adults, the researchers will recruit adults ($n=60$) between the ages of 50 and 60 years for the experiments. This will minimize age-related risks associated with losses of balance. Adults will be recruited from the community, through various channels such as walking groups, community centers, local gyms, pre-retirement workshops, the University of Ottawa (mainly RGN campus) and by word of mouth. Subjects must be capable of doing 32 independent transfers in and out of bathtubs without the use of a mobility aid, be cognitively intact, have functional vision (visual deficits that are corrected with eyeglasses), and be able to communicate in English or French. A representative number of male and female will be recruited.

The researchers will also recruit younger adults ($n=20$) between the ages of 20 and 30 years for the test. These will serve as a comparative group. Younger adults will be recruited through the student body within the University of Ottawa.

Procedures:

Informed consent: Testing will be done at the University of Ottawa. At the beginning of the experimental session, all subjects will be asked to read and sign an informed consent form.

Baseline procedures and measures. Participants who consent to participate will be asked to complete the full test battery (estimated time of completion: 90 minutes). Participants with questionable physical status will complete the baseline measures only (estimated time of completion: 30 minutes). The test battery and baseline measures are in Appendix B (attached). The following general measures will be used.

1. **Sociodemographic characteristics.** Questions in this area have been selected to allow ready comparisons with existing relevant data sets (age, gender, living arrangements, income etc.). All subjects will be asked to complete this measure.
2. **Indicators of health status.** Self-perceived health status relative to peers will be assessed using the perceived health status item from the widely used Older Adult American Research Service Centre Instrument (OARS). Convergent validity of the question has been established by its association with physicians' ratings of the health of older adults and a composite scale using both clinicians and subjects' reports. Perceived physical activity compared to peers was similarly established using a question developed for Canada's Health Promotion Survey. Younger adults will not be asked to complete this measure.
3. **Falls behavior.** The Falls Behavioural Scale (FaB) for the Older Person (REF) will be used to obtain data on day-to-day behavior and actions that can lead to undue risk of falling. The FaB was originally designed as an outcome measure in a randomized trial evaluating the effectiveness of a multi-faceted falls prevention program (REFS). Psychometric properties reported include high internal consistency, high test-retest reliability and high content validity. Younger adults will not be asked to complete this measure.

4. **Patterns and difficulties with independent bathing** will be assessed using questions from the Long-Term Disability Index and a needs assessment questionnaire developed by Canada Mortgage and Housing Corporation (1995). The questions were reviewed by clinicians in the field of nursing, occupational therapy and physiotherapy to ensure their relevance and completeness. Younger adults will not be asked to complete this measure.
5. **Utilization and acceptability of bathroom aids.** Questions concerning patterns of utilization and acceptability of bath grab bars were adapted from the Canadian Aging Research Network Needs Assessment Questionnaire. Items were added to permit evaluation of bath grab bars in the seniors' homes. Younger adults will not be asked to complete this measure.

DESIGN: A mixed design will be used to determine the effectiveness of four different bathtub grab-bar configurations for preventing a fall after a loss of balance: 1) no bars; 2) Vertical/horizontal combination (CSA); 3) vertical/angled combination (OCC); and 4) right angle configuration (OBC). The bathing area will consist of three walls at right angles designed to accommodate the different grab bar configurations and allow quick change of grab bar configurations. The walls and rims of the bathtub will be lightly padded. All grab bars will have non-slip surfaces. The bathtub and walls will be secured onto a platform that is capable of moving 20 cm forward and backward at adjustable speed up to 24 cm/sec (adequate for causing balance perturbation among younger and older healthy adults. The movement of the platform will be used to induce balance perturbation during the two different phases of the task, stepping into and stepping out of the tub. Two cameras will be used to videotape participants as they complete the bathtub trials and to record behavior when perturbations of balance are experienced.

Testing protocol:

Participants will be randomly divided into three groups (n=20 per group for older adults and n=7 for younger adults). Each group will test two of the four different configurations of grab bars. Group 1 will evaluate the No Bar and the CSA configurations. Group 2 will evaluate the No Bar and the OCC configuration. Group 3 will evaluate the No Bar and OBC configuration. The order of grab bar configuration will be randomized. Each participant will be asked to complete 16 trials (entry/exit tub) for the two different configurations assigned (for a total of 32 trials). In four of the sixteen trials (25%) within each configuration, the bathtub area will be moved abruptly and unexpectedly thus eliciting a balance perturbation by the participant.

Participants will be asked to wear padding over their clothing to protect their hips and buttocks from impact forces in the event of a fall. A harness system will be used to prevent participants from hitting the bottom of the tub and to limit lateral movements. Participants will be asked to remove their footwear and to complete the grab bar testing session barefoot. Participants will be asked to approach and climb into the bathtub, stand quietly for a few seconds, and climb out of the tub. Instructions will be to get in and out of the tub in any manner that they wish, using the grab bars or other structures around the tub, if necessary. Following the initial and final trial, participants will be asked to comment on the usefulness and safety of the configuration they just tested. The participants will be asked to rate the safety, ease or difficulty of use, and helpfulness of each grab bar configuration on 5-point Likert scale (Difficulty: 1 = very difficult to 5 = very

easy; Safety: 1 = very unsafe to 5 = very safe; Helpfulness: 1 = not at all helpful to 5 = very helpful).

Follow-up on the acceptance of bath-tub grab bars: Three months following the experiment, older adult participants will be contacted by telephone and asked if they have made any modifications to their home bathing environment and specifically if they have or intend to install bath grab bars. Specific questions will determine why grab bars were or were not added to the home environment, whether the participant has recommended grab bars for others (if so, for whom and for what reasons), and where applicable, how other individuals reacted to the installation of bars.

Ethics: This project has been submitted for ethical approval at the Research and Ethics Board of the University of Ottawa. The project will only start once approval is received

Analyses:

Two cameras will be used to videotape the participants as they complete the bathtub trials and to record behaviour when balance perturbations are experienced. One camera will be set to record from the side of the bath while the second will be mounted above the tub to record from overhead. Videotapes will be coded to determine which configuration of grab bar appears most effective in regaining stability when balance is challenged. Two independent raters will code the video data for frequency and location of grab bar use. Inter-rater reliability will be assessed. Basic descriptive statistics will serve to summarize participant demographic and health characteristics. Repeated measures analyses of variance (ANOVA) will be used to examine differences between configurations on our primary outcome measures (ratings of safety, ease of use, and helpfulness). Differences in the frequency and location of bar use and in the ranking of the configurations will be assessed using chi-square statistics. Results will be compared among both groups of participants (younger and older adults) to identify similarities or differences in the effectiveness of grab bars.

3. SCHEDULE OF WORK AND ALLOCATION OF RESEARCHERS BY TASKS

The research will be conducted in 18 months as follows.

Project Start:	September 1 st , 2004
Submission of interim Reports:	March 31 st and June 30 th 2005
Submission of Draft Final Report:	September 31 st 2005
Submission of Final Report:	December 31 st , 2005

Phase I: Construction of testing area/research instruments and pilot testing.
September 1st to December 31st 2004 (Guitard, Sveistrup)

In Phase I, the bathtub testing area will be constructed, and the research instruments (i.e., baseline procedures and measures, questionnaires and consent forms) will be finalized. The baseline measures and procedures are included in Appendix B (attached). After the final drafts of

the baseline measures, procedures and research instruments are prepared, they will be submitted to CMHC for review and approval.

- ❑ Construct bathtub testing area with interchangeable grab bar configurations
- ❑ Finalize measures and research instruments
- ❑ Obtain Ethics approval
- ❑ Hire and train research assistants
- ❑ Pilot testing the grab-bar configuration tests

Phase II: Participant recruitment/testing/data editing and first interim report
January 1st to March 31st 2005 (Guitard, Sveistrup, Lockett, Edwards)

Phase II will consist of recruiting participants; conducting grab-bar configuration tests; editing data; and preparing the first interim report for CMHC.

- ❑ Recruit participants
- ❑ Conduct of grab-bar configuration testing
- ❑ Code the data from the questionnaires
- ❑ Input, edit and clean the data from the questionnaires
- ❑ Prepare first interim report and submit 2 copies to CHMC for review -

- submit two (2) copies of the first interim report to CMHC for review. The report will include detailed information on the conduct of Phases I and II and preliminary results on the grab-bar configuration testing.

Phase III: Follow-up telephone interviews/data editing and second interim report
April 1st to June 30th 2005 (Guitard, Sveistrup)

Phase III will consist of coding the videotapes; conducting follow-up interviews; editing data from the videotapes and interviews; and preparing the second interim report for CMHC.

- ❑ Code the videotapes
- ❑ Input, edit and clean the data from the videotapes
- ❑ Conduct follow-up telephone interviews
- ❑ Input, edit and clean the data from the telephone interviews
- ❑ Prepare substantial interim report and submit 2 copies to CHMC for review
 - At the end of Phase III, the Employer will submit two (2) copies of the second Interim Report for review and approval by CMHC. It will include detailed information on the conduct of Phase III and preliminary results on the follow-up telephone interviews.

Phase IV: Data analysis and draft final report.

July 1st to September 31st 2005 (Guitard, Sveistrup, Lockett, Edwards)

Phase IV will consist of analyzing the data collected, and preparing and submitting a complete draft final report for review and comments by CMHC.

- ❑ Analyze data collected
- ❑ Prepare a complete draft final report, including an abstract and an executive summary
 - submit two (2) copies of the complete draft final report, including an abstract and an executive summary, to CMHC for review and comment.

Phase V: Final report

October 1st 2005 to December 31st 2005
(Guitard, Sveistrup, Lockett, Edwards)

Following receipt of feed-back on the draft final report from CMHC, the final report will be prepared.

- ❑ Revise final draft report, if necessary, after CMHC review
- ❑ Submit final report
 - submit two (2) copies of the final report to CMHC, including an abstract and executive summary, in a hard copy format and on an IBM compatible diskette, CD, or electronic communication, and with illustrations, charts and diagrams saved separately

Appendix B: Certificate of ethical approval

August 11, 2004

Dr. Paulette Guitard
School of Rehabilitation Sciences
University of Ottawa
Roger-Guindon Hall
451 Smyth Road
Room 3055
Ottawa, ON K1H 8M5

Dr. Donna Lockett
Community Health Research Unit
University of Ottawa
Roger-Guindon Hall
451 Smyth Road
Room 3021C
Ottawa, ON K1N 8M5

Dr. Heidi Sveistrup
School of Rehabilitation Sciences
University of Ottawa
Roger-Guindon Hall
451 Smyth Road
Room 1123A
Ottawa, ON K1H 8M5

Dr. Nancy Edwards
School of Nursing
University of Ottawa
Roger-Guindon Hall
451 Smyth Road
Room 1118K
Ottawa, ON K1H 8M5

RE: How effective are bath grab bars for stopping a fall when you lose your balance?
(H 05-04-12)

Dear Researchers,

You will find enclosed the Health Sciences and Science REB ethical clearance for the abovementioned study.

Please note that it is the responsibility of the Researchers to:

- a) Inform the ethics office of any changes in the research project; and
- b) Fill out an annual status report to be sent to the Protocol Officer for Ethics in Research. Such report can be found on the ethics web site at:

http://www.uottawa.ca/services/research/rge/rebs/download/rapport_annuel_projets_anglais.doc

A copy of this approval will be sent to Research Services, if necessary.

If you have any questions, you may contact the undersigned at extension 5387.

Sincerely yours,

Rita D'Alessandro
Protocol Officer for Ethics in Research
For Dr. Hugh French, Chair of the Health Sciences and Science REB

HEALTH SCIENCES AND SCIENCE RESEARCH ETHICS BOARD

CERTIFICATE OF ETHICAL APPROVAL

This is to certify that the University of Ottawa Health Sciences and Science Research Ethics Board has examined the application for ethical approval of the research study entitled How effective are bath grab bars for stopping a fall when you lose your balance? (H 05-04-12) submitted by Paulette Guitard, Heidi Sveistrup, Nancy Edwards and Donna Lockett. The Board found that this research project met appropriate ethical standards as outlined in the Tri-Council Policy Statement and in the Procedures of the University of Ottawa Research Ethics Boards, and accordingly gave it a Category 1a (approval). This certification is valid for one year from the date indicated below.

Rita D'Alessandro
Protocol Officer for Ethics in Research
For Dr. Hugh French, Chair of the
Health Sciences and Science REB

August 11, 2004
Date

Appendix C: Recruitment forms

LETTERHEAD

Ottawa (*Mailing date*)

Association (*name, contact person and address*)

Object : Recruitment for a research project

Dear (Name of the contact person's name)

Could you please take a few minutes of your time to read this short letter informing you of a research project that requires your help? We are a group of researchers from the University of Ottawa. We are currently working on a study that wants to determine the effectiveness of grab bars to prevent falls once balance is disturbed.

To complete this study, we need 40 people in good health between 50 and 60 years of age. These people will participate in a session that will last approximately 90 minutes in which they will answer questions on their health status and then, be asked to enter/exit the tub a number of times to compare the use of bars versus no grab bars.

We would be much obliged if you could inform your members of the existence and format of this project by posting the recruitment poster included or/and presenting this letter to your members at your next meeting. We are also available to meet with you if you so desire. Kindly inform the interested parties to communicate with us by **March 31st, 2005**. It will be a pleasure to present them our research project in detail and to answer their questions.

All related information is included in the official recruitment letter, but do not hesitate to communicate with me by phone at 562-5800 ext 8031, by email at guitardp@uottawa.ca or by mail at the address below.

Thank you for your precious collaboration.

Sincerely,

Paulette Guitard PhD
Assistant professor

Documents included: recruitment poster

ARE GRAB BARS REALLY EFFECTIVE TO PREVENT FALLS?

Studies suggest that grab bars should be installed in bathrooms to prevent falls when bathing, especially for older adults. Yet no study has determined their effectiveness. Are grab bars really effective in preventing falls or not?

Have you ever asked yourself the question?

Are you between 50 and 60 years of age?

Are you in good health and able to walk without a cane or walker?

IF SO, YOU ARE THE PERSON WE ARE LOOKING FOR!

Goals of the study

This study is conducted by a group of researchers from the University of Ottawa. It seeks to better understand how grab bars are used to prevent falls when a loss of balance occurs.

Participation

After answering questions concerning your health, you will be asked to enter/exit a mock-up bathtub in a university laboratory a number of times. The bathtub will be situated on a surface that will occasionally move to simulate a balance loss. Each testing session will last approximately 90 minutes. There will also be a brief follow-up telephone interview three months following your participation in the laboratory. We will compensate you for your time (\$30) and travel costs (up to a maximum of \$10).

Help us increase knowledge in this domain.

Please communicate with us by March 31, 2005

At 562-5800 ext 8031 or guitardp@uottawa.ca

Thank you for your support and collaboration

Paulette Guitard PhD

Assistant Professor

University of Ottawa

Ottawa (*Mailing date*)

Student Association (*OT, PT, NSG...*)

Object : Recruitment for a research project

Dear (Name of the contact person's name)

Could you please take a few minutes of your time to read this short letter informing you of a research project that requires your help? We are a group of researchers from the University of Ottawa. We are currently working on a study that wants to determine the effectiveness of grab bars to prevent falls once balance is perturbed.

To complete this study, we need 20 people in good health between 20 and 30 years of age. These people will participate in a session that will last approximately 60 minutes in which they will answer questions on their health status and then, be asked to enter/exit the tub a number of times to compare the use of bars versus no grab bars. Participant will receive monetary compensation for their participation.

We would be much obliged if you could inform your members of the existence and format of this project by posting the recruitment **poster** included or/and presenting **this letter** to your members at your next meeting. Kindly inform the interested parties to communicate with us by **December 15th, 2004**. It will be a pleasure to present them our research project in detail and to answer their questions.

All related information is included in the official recruitment letter, but do not hesitate to communicate with me by phone at 562-5800 ext 8031, by email at guitardp@uottawa.ca or by mail at the address below.

Thank you for your precious collaboration.

Sincerely,

Paulette Guitard PhD
Assistant professor

Documents included: recruitment poster

LOOKING FOR

YOUNG ADULTS
BETWEEN 20 AND 30
IN GOOD PHYSICAL CONDITION
TO PARTICIPATE IN A RESEARCH
PROJECT ON THE
**EFFECTIVENESS OF GRAB BARS TO
PREVENT FALLS**

PARTICIPANTS WILL RECEIVE A SMALL FINANCIAL
COMPENSATION

You have 60 minutes to devote to science?
Help us increase knowledge in this domain.

Please communicate with us by

December 15th, 2004

At 562-5800 ext 8031 or

guitardp@uottawa.ca

Thank you for your support and collaboration

Paulette Guitard PhD

Assistant professor

University of Ottawa

Appendix D: Letter of information and consent



uOttawa

L'Université canadienne
Canada's university

(OLDER ADULTS)

LETTER OF INFORMATION AND CONSENT

HOW EFFECTIVE ARE BATH GRAB BARS FOR STOPPING A FALL WHEN YOU LOSE YOUR BALANCE?

This letter of information and consent, which you are being asked to read and sign, indicates that you agree to participate in the study being conducted at the University of Ottawa by Dr. Paulette Guitard, Dr. Heidi Sveistrup, Dr. Donna Lockett and Dr. Nancy Edwards. This research is funded by the Canadian Mortgage and Housing Corporation. The letter is designed to outline the research project and to explain what your involvement in the project will entail.

PURPOSE: The aim of this research is to learn more about how effective are bath grab bars for stopping a fall when you lose your balance.

PROCEDURE: You will be asked to complete a pencil and paper survey that consists of several components. Answers to questions of age, marital status, education and income will allow us to compare the data we obtain in our study with data from other studies. We will also ask you questions about how you perceive your own health, if you have had any falls, and if you use any aids such as canes or walkers to help you get around. The next series of questions will ask you whether you usually take a bath or shower and whether you need help with certain bathing activities such as getting in or out of the tub. Finally, we will ask you your feelings about bath bars. Answering the questionnaire should take about 30 minutes.

For the final part of the study, we will ask you to take off your shoes and socks. We will then ask you to approach and climb into a bathtub and climb out of the tub. You can get in and out of the tub in any manner that you wish by using the structures around the tub, if necessary. We will ask you to repeat the bathtub entry/exit 16 times. After a short pause, we will ask you to repeat the same exercise but this time grab bars will have been added. In total, you will perform 32 bathtub entries/exits. While you are climbing in and out of the tub, we will videotape you

with two cameras. The platform on which the tub is located may move during some of the trials, this is to provoke a balance loss. After all the trials are completed, we will ask you to tell us how safe, easy to use, and helpful the bath bar(s) were.

Three months after your presence in the lab, one of the researchers will contact you for a follow-up telephone interview that is expected to last no longer than 30 minutes.

RISKS AND BENEFITS OF THESE TESTS

There are no identifiable psychological, social, or legal risks associated with this experiment. However, you may feel tired during the experiment. Regular rest breaks will be scheduled as part of the experimental protocol. You are free to indicate the need for a rest period at any point if you feel tired. **YOU MAY STOP THE TEST AT ANY TIME.** You may stop the test at any time simply by telling the person controlling the test that you do not wish to continue. You may also withdraw from the experiment at any time. **The researches may also decide to withdraw you from the study, at any time and without your consent, if they judge that this would be best for your health or if you do not meet the requirements of the study.**

THERE IS ALSO A RISK OF FALL caused by the balance perturbation. To reduce the risk of injury, we have padded the bathtub area. One of the researchers will be standing behind you as you get into and out of the tub to ensure your safety. We also require that you wear the protective garments (hip protectors) and be hooked to a harness to prevent any injury. The test results will be used solely for the purpose of research. We estimate that we will need approximately 90 minutes to complete the testing.

Although you will receive \$30.00 for your time (\$25 for session + \$5 for the follow-up telephone interview) and will be compensated for travel costs (maximum 10\$), you will receive no other direct benefit from this research. The information which results from your tests will be used to further understand the placement for bath bars that will best allow ambulatory people over the age of 60 years to remain independent with bathing.

All records from this research will be kept confidential and will not be given to anyone unless you give us written permission to do so. Your results may appear in publication, but you will not be identified by name. You will receive a signed copy of the consent form for your files. The results (videotapes, **questionnaires** and transcriptions) will be kept under key and only the researchers and their research assistants will have access to these. The videotapes, **questionnaires** and transcriptions will be kept until May 2014 in Dr. Guitard's office and will then be destroyed.

If you have any questions about this research, you may contact Dr. Paulette Guitard at 562-5800 ext. 8031. Any information, requests or complaints about the ethical conduct of this research may be addressed to the University of Ottawa Health Science and Science Research Ethics Board, or by addressing the **Protocol Officer for Ethics in Research, University of Ottawa, 550 Cumberland street, Tabaret Hall, room 159, Ottawa, Ontario, K1N 6N5, tel: (613) 562-5841** or ethics@uottawa.ca.

CONSENT

In signing this informed consent form, I acknowledge that I have read and understood all the information of this document. Before signing, I have been allowed to observe the procedures that will be used in the research project. I acknowledge that I will be videotaped. I have been instructed that I am free to withdraw my consent to participate in the project at any time. I also acknowledge that I will be given \$30.00 on completion of my participation in this study and that I will receive \$10 to cover parking expenses. I understand that Dr. Paulette Guitard will answer any questions about the experimental procedures. I understand that the Protocol Officer of the Human Research Ethics Committee will answer any questions about human ethics procedures.

DATE: _____

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE: _____

Researcher's Name: _____

Researcher's signature: _____

INFORMED CONSENT FOR THE USE OF VIDEOTAPES FOR TEACHING, RESEARCH, OR MEDICAL PRESENTATION

I understand that the videotapes taken of me during this experiment may be used for educational purposes to demonstrate how bath bars can be used to prevent falls while getting into and out of the bathtub. I understand that this includes the use of videotapes for teaching, research presentations, and medical presentations. I have been given the opportunity to ask questions about the possible use of the videotape for these purposes. By signing this document I hereby consent to and authorize the use and reproduction of any and all videotapes taken of me during my participation in this research project for the purpose of teaching, research, or medical presentation, with the understanding that my identity will remain confidential. I acknowledge that I have been informed that I may withdraw my permission for the use of the videotape at any time without penalty.

I agree to have the videotape used as is, that is, I agree to have my face shown on videotape for all intended purposes (teaching, research or medical presentation).

Yes___ No___

I would like my face blackened before the videotape is used for all intended purposes (teaching, research or medical presentation).

Yes___ No___

DATE:

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE: _____

RESEARCHER'S NAME: _____

RESEARCHER'S SIGNATURE: _____



(For students)

LETTER OF INFORMATION AND CONSENT

HOW EFFECTIVE ARE BATH GRAB BARS FOR STOPPING A FALL WHEN YOU LOSE YOUR BALANCE?

This letter of information and consent, which you are being asked to read and sign, indicates that you agree to participate in the study being conducted at the University of Ottawa by Dr. Paulette Guitard, Dr. Heidi Sveistrup, Dr. Donna Lockett and Dr. Nancy Edwards. This research is funded by the Canadian Mortgage and Housing Corporation. The letter is designed to outline the research project and to explain what your involvement in the project will entail.

PURPOSE: The aim of this research is to learn more about how effective are bath grab bars for stopping a fall when you lose your balance?

PROCEDURE: You will be asked to complete a pencil and paper questionnaire containing questions of age, marital status, education and income will allow us to compare the data we obtain in our study with data from other studies. We will also ask you how you perceive your health, whether you usually take a bath or shower and your feelings about bath bars. Answering the questionnaire should take about 15 minutes.

For the final part of the study, we will ask you to take off your shoes and socks. We will then ask you to approach and climb into a bathtub and climb out of the tub. You can get in and out of the tub in any manner that you wish by using the structures around the tub, if necessary. We will ask you to repeat the bathtub entry/exit 16 times. After a short pause, we will ask you to repeat the same exercise but this time grab bars will have been added. In total, you will perform 32 bathtub entries/exits. While you are climbing in and out of the tub, we will videotape you with two cameras. The platform on which the tub is located may move during some of the trials, this is to provoke a balance perturbation. After all the trials are completed, we will ask you to tell us how safe, easy to use, and helpful the bath bar(s) were.

RISKS AND BENEFITS OF THESE TESTS

There are no identifiable psychological, social, or legal risks associated with this experiment. However, you may feel tired during the experiment. Regular rest breaks will be scheduled as part of the experimental protocol. You are free to indicate the need for a rest period at any point if you feel tired. **YOU MAY STOP THE TEST AT ANY TIME.** You may stop the test at any

time simply by telling the person controlling the test that you do not wish to continue. YOU MAY ALSO WITHDRAW FROM THE EXPERIMENT AT ANY TIME. **The researchers may also decide to withdraw you from the study, at any time and without your consent, if they judge that this would be best for your health or if you do not meet the requirements of the study.**

THERE IS ALSO A RISK OF FALL caused by the balance perturbation. To reduce the risk of injury, we have padded the bathtub area. One of the researchers will be standing behind you as you get into and out of the tub to ensure your safety. We also require that you wear the protective garments (hip protectors) and be hooked to a harness to prevent any injury. The test results will be used solely for the purpose of research. We estimate that we will need **approximately 60 minutes** to complete the testing.

Although you will receive \$15.00 compensation for your time, you will receive no other direct benefit from this research. The information which results from your tests will be used to further understand the placement for bath bars that will best allow ambulatory people to remain safe and independent with bathing.

All records from this research will be kept confidential and will not be given to anyone unless you give us written permission to do so. Your results may appear in publication, but you will not be identified by name. You will receive a signed copy of the consent form for your files. The results (videotapes, **questionnaires** and transcriptions) will be kept under key and only the researchers and their research assistants will have access to these. The videotapes, **questionnaires** and transcriptions will be kept until May 2014 and will then be destroyed.

If you have any questions about this research, you may contact Dr. Paulette Guitard at 562-5800 ext. 8031. Any information, requests or complaints about the ethical conduct of this research may be addressed to the University of Ottawa Health Science and Science Research Ethics Board, or by addressing the **Protocol Officer for Ethics in Research, University of Ottawa, 550 Cumberland street, Tabaret Hall, room 159, Ottawa, Ontario, K1N 6N5, tel: (613) 562-5841** or ethics@uottawa.ca.

CONSENT

In signing this informed consent form, I acknowledge that I have read and understood all the information of this document. Before signing, I have been allowed to observe the procedures that will be used in the research project. I acknowledge that I will be videotaped. I have been instructed that I am free to withdraw my consent to participate in the project at any time. I also acknowledge that I will be given \$15.00 on completion of my participation in this study. I understand that Dr. Paulette Guitard will answer any questions about the experimental procedures. I understand that the Protocol Officer of the Human Research Ethics Committee will answer any questions about human ethics procedures.

DATE: _____

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE: _____

RESEARCHER'S NAME: _____

RESEARCHER'S SIGNATURE: _____

**INFORMED CONSENT FOR THE USE OF VIDEOTAPES FOR
TEACHING,
RESEARCH, OR MEDICAL PRESENTATION**

I understand that the videotapes taken of me during this experiment may be used for educational purposes to demonstrate how bath bars can be used to prevent falls while getting into and out of the bathtub. I understand that this includes the use of videotapes for teaching, research presentations, and medical presentations. I have been given the opportunity to ask questions about the possible use of the videotape for these purposes. By signing this document I hereby consent to and authorize the use and reproduction of any and all videotapes taken of me during my participation in this research project for the purpose of teaching, research, or medical presentation, with the understanding that my identity will remain confidential. I acknowledge that I have been informed that I may withdraw my permission for the use of the videotape at any time without penalty.

I agree to have the videotape used as is, that is, I agree to have my face shown on videotape for all intended purposes (teaching, research or medical presentation).

Yes___ No___

I would like my face blackened before the videotape is used for all intended purposes (teaching, research or medical presentation).

Yes___ No___

DATE: _____

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE:_____

RESEARCHER'S NAME: _____

RESEARCHER'S SIGNATURE:_____

Appendix E: Questionnaire

N

BATH GRAB BAR EFFECTIVENESS DURING BALANCE PERTURBATION

MAIN SURVEY

September 2004

Participant identification # : _____

BATH GRAB BAR EFFECTIVENESS DURING BALANCE PERTURBATION

September 2004

Senior's identification #: Primary tester: Date of testing: Day Month Year Time testing started (24 hour clock): Time testing finished (24 hour clock): Order of configuration: _____ Participant completed: _____ all questionnaire _____ missed sections Reason incomplete:
If there was a problem or need for follow up, please specify reason: Project leader(s) notified: Day Month Year
Secondary tester (please initial): Scanning completed Data entry (please initial): Coding completed Data entry completed

Placement of faucet in primary bathtub at home (from vantage of facing bathtub)

1. RIGHT 2. LEFT

SECTION A. HEALTH AND ACTIVITY LEVELS

I would like to ask you some questions about your health.

- 1.** I will read a list of some common health problems seniors report and I would like you to tell me whether you have any of these problems. Do you have

	Yes	No	Comments
a. Problems with your balance.	_____	_____	_____
b. Problems with your hip, leg or knee joints.	_____	_____	_____
c. Problems with back and/or neck	_____	_____	_____
d. Problems with your vision.	_____	_____	_____
e. Other problem. Specify: _____.	_____	_____	_____
f. Other problem. Specify: _____.	_____	_____	_____

- 2.** *Compared to other people your own age*, how would you rate your overall health at the present time?

- 1 ____ very good
 2 ____ good
 3 ____ fair
 4 ____ poor

- 3.** *Compared to other people your own age*, how would you rate your overall activity level at the present time?

- 1 ____ more active
 2 ____ about the same
 3 ____ less active

- 4.** Do you use a mobility aid such as a cane or a walker?

1. No

IF NO, GO TO QUESTION 5

2. Oui

IF YES, what type of mobility aid do you use? (circle as many as apply)

1. Cane
 2. Walker
 3. Other. Specify : _____

SECTION B. DIFFICULTIES IN BATHING/SHOWERING

I would like to ask you a few questions about how you normally bathe or shower and any difficulties you may have with these activities.

1. Please tell us about *your normal bathing routine*?

1. Always or almost always take a bath sitting at the bottom of bathtub
2. Always or almost always take a shower standing
3. Sometimes take a bath and sometimes take a shower
4. Takes a bath or a shower sitting on a bath bench or bath seat (stool)
5. Other. Please specify : _____

IF YOU NEVER TAKE A BATH, ... is it because you would have difficulty getting into and out of the bottom of a bathtub?

1. No
2. Yes

IF NO,...could you tell me why you do not take a bath?

2. Does anyone help you to take a bath/shower?

1. No
2. Yes

IF YES, ... who usually helps you to take a bath/shower?

1. a health care professional
2. a friend or family member
3. Other : _____

3. Are you able to sit in and get up from the bottom of a bathtub?

1. No
2. Yes

IF YES : Are you comfortable doing so here today?

1. No (do not ask to sit in bottom of tub)
2. Yes

4. Now, I will read a list of activities that deal with bathing. Many seniors have difficulties with some of these activities. I would like you to tell me whether you have no difficulty, a little difficulty, a lot of difficulty or cannot do them. PLEASE IMAGINE DOING THESE ACTIVITIES ON YOUR OWN WITHOUT ANYONE HELPING YOU.

NOTE: IF THE PARTICIPANT DOES NOT NORMALLY PERFORM THESE ACTIVITIES, PLEASE ASK HOW MUCH DIFFICULTY THEY WOULD HAVE IF THEY HAD TO DO THEM

SCORE DIFFICULTIES AS FOLLOWS:

- 1. No difficulty
- 2. A little difficulty
- 3. A lot of difficulty
- 4. Cannot do
- 8. Don't know

a. Getting in /getting out of your bathtub? 1 2 3 4 8

b. Sitting in/getting up from the bottom of the tub? 1 2 3 4 8

Relevant participants' comments:

GRIP STRENGTH MEASURE: _____

SECTION C. FALL HISTORY

I would like to ask you some questions about any falls you may have had since January of this year (2004). By a fall, I mean an event where you landed on the ground, tripped on the stairs, slipped, lost your balance and hit against an object like a chair or bed.

I would like you to think back to January 2004. Have you had a fall since then?

1. No **GO TO SECTION D**
2. Yes

IF YES, how many falls have you had since January 2004?

1. one fall only
2. >1 fall (# stated _____)
3. >1 fall (# unknown)

....did any of these falls happen as you were getting in or out of the bathtub or during a bath/shower

1. No **GO TO SECTION D**
2. Yes **CONTINUE**

DESCRIPTION OF BATH FALL #1

- a. When did you have that fall? _____
- b. Did you have that fall in your home? Yes ☐ No ☐ if NO Where: _____
- c. What were you doing at the time of the fall? _____
- d. Was there a grab bar in the bathtub where you had the fall? Yes ☐ No ☐
 IF YES, were you using or attempting to use the grab bar at the time of the fall? No ☐ Yes ☐ , please tell us more: _____
- e. Did you knock or hit anything? _____
- f. Did you fall on the ground? Yes ☐ No ☐
 IF YES, how did you land? _____
 IF NO, how did you manage not to land on the ground? _____
- g. Did you injure yourself as a result of the fall? (describe injuries) _____

IF MORE THAN ONE FALL IN BATH CONTINUE' OTHERWISE GO TO SECTION D

DESCRIPTION OF BATH FALL #2

- d. When did you have that fall? _____
- e. Did you have that fall in your home? Yes ☐ No ☐ if NO Where: _____
- f. What were you doing at the time of the fall? _____
- d. Was there a grab bar in the bathtub where you had the fall? Yes ☐ No ☐
 IF YES, were you using or attempting to use the grab bar at the time of the fall? No ☐ Yes ☐ , please tell us more: _____
- f. Did you knock or hit anything? _____
- f. Did you fall on the ground? Yes ☐ No ☐
 IF YES, how did you land? _____
 IF NO, how did you manage not to land on the ground? _____
- g. Did you injure yourself as a result of the fall? (describe injuries) _____

IF MORE THAN ONE FALL IN BATH CONTINUE' OTHERWISE GO TO SECTION D

SECTION D.

ID No. _____

The Falls Behavioural (FaB) Scale for the Older Person

The FaB Scale is a list of 30 statements that describes things we do in our everyday lives. Please read each statement carefully.

Circle how much each statement describes the things you do in your daily life. For example:

Never	Some- times	Often	Always
-------	----------------	--------------	--------

Only circle 'Doesn't apply' if the situation is something to which you are not exposed (for example, if you do not have a phone).

Would this describe the things you do in your daily life?	Circle which one applies				
1. When I stand up I pause to get my balance.	Never	Some-times	Often	Always	
2. I do things at a slower pace.	Never	Some-times	Often	Always	
3. I talk with someone I know about things I do that might help prevent a fall.	Never	Some-times	Often	Always	
4. I bend over to reach something only if I have a firm handhold.	Never	Some-times	Often	Always	Doesn't apply
5. I use a walking stick or walking aid when I need it.	Never	Some-times	Often	Always	Doesn't apply
6. When I am feeling unwell I take particular care doing everyday things.	Never	Some-times	Often	Always	Doesn't apply
7. I hurry when I do things.	Never	Some-times	Often	Always	
8. I turn around quickly.	Never	Some-times	Often	Always	

ID No. _____

Would this describe the things you do in your daily life?	Circle which one applies
------------------------------------------------------------------	---------------------------------

Now, these are things you do indoors

9. To reach something up high I use the nearest chair, or whatever furniture is handy, to climb on.	Never	Sometimes	Often	Always	Doesn't apply
10. I hurry to answer the phone.	Never	Sometimes	Often	Always	Doesn't apply
11. I get help when I need to change a light bulb.	Never	Sometimes	Often	Always	
12. I get help when I need to reach something very high.	Never	Sometimes	Often	Always	
13. When I am feeling ill I take special care of how I get up from a chair and move around.	Never	Sometimes	Often	Always	Doesn't apply
14. When I am getting down from a ladder or step stool I think about the bottom rung/step.	Never	Sometimes	Often	Always	Doesn't apply

Now, these are about lighting and eyesight

15. I notice spills on the floor.	Never	Sometimes	Often	Always	
16. I use a light if I get up during the night.	Never	Sometimes	Often	Always	
17. I adjust the lighting at home to suit my eyesight.	Never	Sometimes	Often	Always	
18. I clean my spectacles.	Never	Sometimes	Often	Always	Doesn't apply
19. When wearing bifocals or trifocals I misjudge a step or do not see a change in floor level.	Never	Sometimes	Often	Always	Doesn't apply

Now, these are about shoes

20. When I buy shoes I check the soles to see if they are slippery	Never	Sometimes	Often	Always	
Now, these are things outdoors					
21. When I walk outdoors I look ahead for potential hazards	Never	Sometimes	Often	Always	
22. I avoid ramps and other slopes	Never	Sometimes	Often	Always	

ID No. _____

Would this describe the things you do in your daily life?	Circle which one applies				
23. I go out on windy days.	Never	Some-times	Often	Always	
24. When I go outdoors I think about how to move around carefully.	Never	Some-times	Often	Always	
25. I cross at traffic lights or pedestrian crossings whenever possible.	Never	Some-times	Often	Always	Doesn't apply
26. I hold onto a handrail when I climb stairs.	Never	Some-times	Often	Always	Doesn't apply
27. I avoid walking about in crowded places.	Never	Some-times	Often	Always	
28. I keep shrubbery and plants trimmed back on the pathways to my front/back doors.	Never	Some-times	Often	Always	Doesn't apply
29. I carry groceries up the stairs only in small amounts.	Never	Some-times	Often	Always	Doesn't apply

And, finally, these are about medications

30. I ask my pharmacist or Dr. questions about side effects of my medications.	Never	Some-times	Often	Always	Doesn't apply
--------------------------------------------------------------------------------	-------	------------	-------	--------	---------------

Thank you for completing the Falls Behavioural Scale for the Older Person

SECTION E. SOCIODEMOGRAPHIC CHARACTERISTICS

I would like to ask you a few questions about your background so that we learn a little more about people who participate in this study. Please remember that information that you provide us is confidential.

1. Gender: (interviewer noted)

1. Female
2. Male

2. What is your current marital status?

1. Never married/single
2. Married/common-law
3. Divorced/separated
4. Widowed
5. Refused

3. Does anyone live with you?

- b. No
- c. Yes....

IF YES, who lives with you?

1. Spouse/partner
2. Children
3. Other (specify) : _____
4. Refused

4. What is your mother tongue?

1. English
2. French
- d. Other (Specify) : _____
- e. Refused

5. In general, how well does your income satisfy your needs?

1. Totally
2. Somewhat
3. Mostly
4. Not at all
- f. Refused

6. Date of birth: _____

SECTION F. EVALUATION OF STUDY BATH GRAB BARS

Instructions to participant: “Now we will ask you to step into the bathtub and to exit the bathtub. You can enter/exit the bathtub the way that is most convenient for you. We will ask you to repeat this task 16 times. We will then take a pause and we will repeat the same process but with the presence of bathtub grab bars. You do not have to use the grab bars each time. Immediately after the set of trials, I will ask your impressions on the security, facility to use the grab bars and how they were useful. Do you have any questions? ”

INSTRUCTIONS FOR EVALUATION:

I will now present you with various 5-point scales to help you evaluate the bath grab bars. Please rate according to how the grab bar was easy to use, how much it helped you get in/out of the bathtub, how safe you felt using it, how comfortable you were using it and whether you would use it at home

Evaluation of _____ configuration :

a) Degree to which it was easy to use :

1	2	3	4	5
Very difficult to use		Somewhat easy to use		Very easy to use

b) Degree to which it helped you get in and out of the bathtub :

1	2	3	4	5
a little		somewhat		a lot

c) Degree to which you felt safe using this set of bars:

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
a little		somewhat		a lot	

d) Would you use this configuration of grab bars if they were in your bathtub?

1	2	3	4	5
certainly not		maybe		certainly yes

e) In general, are you comfortable using this configuration of grab bars?

1	2	3	4	5
not comfortable		somewhat		very comfortable

Comments:

Comparison between two testing scenarios**1. HELPFUL :**

Which of the two situations (with or without grab bars) helped you MOST?

2. EASE OF USE:

Which of the two situations (with or without grab bars) was MOST easy to use?

Why? _____

3. SAFETY :

Which of the two situations (with or without grab bars) was SAFEST to use?

4. LEVEL OF COMFORT :

Which of the two situations (with or without grab bars) was MOST comfortable to use?

5. PREFERENCE :

Which of the two situations (with or without grab bars) do you prefer the MOST?

6. ACCEPTANCE :

Do you think you will use grab bars in your home in the future ?

WHY? _____

Appendix F. References

REFERENCES

1. National Advisory Council on Aging (2001) Report Card Seniors in Canada, Accessed Oct 28 2003
(http://www.hc-sc.gc.ca/seniors-aines/naca/report_card/report1_e.htm#overview)
2. Aminzadeh, F., Edwards, N., Lockett, D., Nair, R.(2000). 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.
3. Sveistrup, H. Lockett, D., Edwards, N., Aminzadeh, F. (2002) Evaluation of optimal bath grab bar placement for seniors: Final Report. Research Report submitted to the CMHC External Research Program.
4. Campbell, A.J., Borrie, M.J., & Spears, G.F. (1989). Risk factors for falls in a community-based prospective study of people 70 years and older. Journal of Gerontology, 44 (4), M112-117.
5. Graafmans, W.C., Ooms, M.E., Hofstee, M.A., Bezemer, P.D., Bouter, L.M., & Lips, P. (1996). Falls in the elderly: A prospective study of risk factors and risk profiles. American Journal of Epidemiology, 143 (11), 1129-1136.
6. Hale, W.A., Delaney, M.J., McGaghie, & W.C. (1992). Characteristics and predictors of falls in elderly patients. The Journal of Family Practice, 34 (5), 577-581.
7. Lord, S.R., Ward, J.A., Williams, P., & Anstey, K.J. (1993). An epidemiological study of falls in older community-dwelling women: The Randwick falls and fracture study. Australian Journal of Public Health, 17 (3), 240-245.
8. Nevitt, M.C., Cummings, S.R., Kidd, S., & Black, D. (1989). Risk factors for recurrent nonsyncopal falls. Journal of American Medical Association, 261 (18), 2663-2668.
9. Nevitt, M.C., Cummings, S.R., & Hudes, E.S. (1991). Risk factors for injurious falls: A prospective study. Journal of Gerontology, 46 (5), M164-170.
10. O'Loughlin, J., Robitaille, Y., Boivin, J.F., & Suissa, S. (1993). Incidence and risk factors for falls and injurious falls among the community living elderly. American Journal of Epidemiology, 137, 342-54.
11. Robbins, A.S., Rubenstein, L.Z., Josephson, K.R., Schulman, B.L., Osterweil, D., & Fine, G. (1989). Predictors of falls among elderly people: Results of two population-based studies. Archives of Internal Medicine, 149, 1628-1633.
12. Sorock, G.S., & Labiner, D.M. (1992). Peripheral neuromuscular dysfunction and falls in an elderly cohort. American Journal of Epidemiology, 136 (5), 583-591.

13. Tinetti, M.E., Speechley, M., & Ginter, S.F. (1988). Risk factors for falls among elderly persons living in the community. England Journal of Medicine, 319 (26), 1701-1707.
14. Cwikel, J. (1992). Falls among elderly people living at home: Medical and social factors in a national sample. Israel Journal of Medical Science, 28 (7), 446-453.
15. Speechley, M., & Tinetti, M. (1991). Falls and injuries in frail and vigorous community elderly persons. Journal of American Geriatrics Society, 39 (1), 46-52.
16. Tinetti, M.E., Doucette, J., Claus, E., & Marottoli, R. (1995). Risk factors for serious injury during falls by older persons in the community. Journal of American Geriatric Society, 43 (11), 1214-1221.
17. Alexander, B.H., Rivara, F.P., & Wolf, M.E. (1992). The cost and frequency of hospitalization for fall-related injuries in older adults. American Journal of Public Health, 82 (7), 1020-1023.
18. Grisso, J.A., Schwarz, D.F., Wishner, A.R., Weene, B., Holmes, J.H., & Sutton, R.L. (1990). Injuries in an elderly inner-city population. Journal of American Geriatrics Society, 38 (12), 1326-1331.
19. Riley, R. (1992). Accidental falls and injuries among seniors. Health Reports, Statistics Canada, 4 (4), 341-354
20. Riley, R., & Paddon, P. (1989). Accidents in Canada: Mortality and hospitalization. Health Reports, Statistics Canada, 1 (1), 23-50.
21. Kellogg International Work Group on the Prevention of Falls by the Elderly. (1987). The prevention of falls in later life. Danish Medical Bulletin, 34 (4), 1-24.
22. Smallegan, M. (1983). How families decide on nursing home admission. Geriatric Consultant, 1 (5), 21-24.
23. Ashe C & Gallagher E (in press) The cost of falls among Older Canadians. Journal of Gerontology.
24. Cwikel, J., Kaplan, G., & Vita, B. (1990). Falls and subjective health rating among the elderly: Evidence from two Israeli samples. Social Science Medicine, 31 (4), 485-490.
25. Tinetti, M.E., & Powell, L. (1993). Fear of falling and low self-efficacy: A cause of dependence in elderly persons. The Journal of Gerontology, 48 (special issue), 35-38.
26. Tinetti, M.E., Baker, D.I., McAvay, G., Claus, E.B., Garrett, P., Gottschalk, M., Koch, M.L., Trainor, K., & Horwitz, R.I. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. The New England Journal of Medicine, 331 (13), 821-827.

27. Vellas, B., Cayla, F., De Pemille, F., & Albarede, J.L. (1987). Prospective study of restriction in activity in old people after falls. Age and Ageing, 16 (3), 189-193.
28. Blake, A.J., Morgan, K., Bendall, M.J., Dallosso, H., Ebrahim, S.B., Arie, T.H., Fentem, P.H., & Bassey, E.J. (1988). Falls by elderly people at home: Prevalence and associated factors. Age and Ageing, 17 (6), 365-372.
29. Craven, R., & Bruno, P. (1986). Teach the elderly to prevent falls. Journal of Gerontological Nursing, 12 (8), 27-33.
30. Devito, C.A., Lambert, D.A., Sattin, R.W., Bacchelli, S., Ros, A., & Rodriguez, J.G. (1988). Fall injuries among the elderly: Community-based surveillance. Journal of the American Geriatric Society, 36 (11), 1029-35.
31. O'Loughlin, J. (1991). The incidence and risk factors for falls and fall-related injury among elderly persons living in the community. Unpublished doctoral dissertation, McGill University, Montreal.
32. Aminzadeh, F. (1997). Perceptions, attitudes, and subjective norms influencing seniors' decisions to accept or reject mobility aids in fall prevention: An application of the theory of planned behaviour. Unpublished Masters' thesis, University of Ottawa, Ottawa.
33. Lundgren-Lindquist, B., Grimby, G., & Landah, S. (1983). Functional studies in 79-year-olds. Scandinavian Journal of Rehabilitation Medicine, 15, 109-115.
34. Zimmer, A., & Chappell, N.L. (1994). Mobility restrictions and the use of devices among seniors. Journal of Aging and Health, 6 (2), 185-208.
35. Axtell, L.A., Yausda, Y.L. (1993). Assistive devices and home modifications in geriatric rehabilitation. Geriatric Rehabilitation, 9 (4), 803-21.
36. Tideiksaar, R. (1997). Falling in old age: Prevention and management (2nd ed.). New York: Springer Publishing Company.
37. Chamberlain, A. (1979). Aids and appliances in the home: A critical survey of bath aids and their use. International Rehabilitation Medicine, 1, 204-207.
38. George, L., Binns, V.E., Clayden, A.D., & Mulley, G.P. (1988). Aids and adaptations for the elderly at home: Underprovided, underused, and undermaintained. British Medical Journal, 296, 1365-1366.
39. Parker, M.G., & Thorslund, M. (1990). The use of technical aids among community-based elderly. The American Journal of Occupational Therapy, 45 (8), 712-718.
40. Sonn, U., & Grimby, G. (1994). Assistive devices in an elderly population studied at 70 and 76 years of age. Disability and Rehabilitation, 16 (2), 85-92.

41. Thornely, G., Chamerlain, M.A., & Wright, V. (1977). Evaluation of aids and equipment for the bath and toilet. British Journal of Occupational Therapy, 40, 243-246.
42. Trickey, F., Maltais, D., Gosselin, M.A., Robitaille, Y. (1993). Adapting older persons' homes to promote independence. Physical & Occupational Therapy in Geriatrics, 12 (1), 1-14.
43. Edwards, N., Birkett, N., Murphy, M., & Nair, R. (1993). Fall prevention: Results of baseline interviews. Paper presented at the Canadian Gerontology Conference, Montreal, Quebec.
44. Plautz, B., Beck, D., Selmar, C., & Radersky, M. (1996). Modifying the environment: a community-based injury-reduction program for elderly residents. American Journal of Prevention: Research Linkages Between Academia and Public Health Practice, 12(4), 33-38).
45. Aminzadeh, F., & Edwards, N. (1998). Exploring seniors' views on the use of assistive devices in fall prevention. Public Health Nursing, 15(4), 297-304.
46. Mann, W.C., Hurren, K., & Tomita, M. (1993). Comparison of assistive device use and needs of home-based older persons with different impairments. The American Journal of Occupational Therapy, 47 (11), 980-987.
47. Canadian Mortgage and Housing Corporation. (1994). Focus groups to examine barrier-free and adaptable housing design. Ottawa: Hichling Corporation RBO Architecture.
48. Sattin, R.W., Rodriguez, J.G., DeVito, C.A., Wingo, P.A. Home environmental hazards and the risk of fall injury events among community-dwelling older persons. Journal of the American Geriatrics Society. 46 (6):669-76.
49. Maki, B. (2003) The Role of Stairway Handrails in Postural Stabilization (pilot phase)
Accessed Oct 28 2003
(<http://www.sunnybrook.utoronto.ca:8080/~csia/research/fallsprojs.htm>)
50. Sveistrup, H., Lockett, D., Edwards, N., Aminzadeh, F. (2006). Evaluation of bath grab bar placement for older adults, *Technology and Disability*. 18 (2), 45 – 55.
51. Clemson, L., Cumming, R.G. & Heard, R. (2003). The development of an assessment to evaluate behavioral factors associated with falling. The American Journal of Occupational Therapy. 57 (4), 380-388.
52. Stevens, J.A. & Sogolow, E.D. (2005). Gender differences for non-fatal unintentional fall related injuries among older adults. Injury Prevention 11, 115-119.

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