

## 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.<sup>1</sup> 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.<sup>2</sup> 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.*

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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.<sup>3</sup>

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.

<sup>3</sup> 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% (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% (831/1,040) of the bathtub entry/exits with platform activation recorded resulted in a balance loss. In 79.3% (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% (212/426) of instances, while younger adults used the bars in 14.4% (7/118) 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.

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- 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.

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

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