Lower extremity functioning and appropriate grab bars for bathing areas of community dwelling elderly

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Little research has been performed regarding the adequacy of bathing area safety devices of community dwelling elderly. Grab bars are easily accessible and inexpensive safety devices that can create a safer environment in the bathing area. Given that a risk factor for falls is poor lower extremity functioning, the present study was undertaken to determine the relationship between older adults' lower extremity functioning and grab bar adequacy in the bathing area. Participants were recruited from senior centers and churches. Sixty community-dwelling older adults over the age of 60 living in Northwest Ohio and Southeast Michigan participated. Data collected for the study include the presence or absence of appropriate grab bars in the bathing area observed independently by two researchers, The Short Physical Performance Battery (SPPB) to assess lower extremity functioning, information of subjects’ fall history in the past 12 months, and the University of Illinois at Chicago Fear of Falling Measure. Inclusion criteria were: at least 60 years old, able to walk without a wheelchair, and living in the community within 60 miles of The University of Toledo campus. The mean age of subjects was 75.6 years old ($SD = 9.5$), with 11 males and 49 females. The primary hypothesis revealed a statistically significant point-biserial correlation between grab bar adequacy and SPPB score $r = -.41$, $p < .01$. Ideally this correlation should be greater, to indicate a stronger negative correlation between lower extremity strength and adequate grab bars in the bathing area. There were 39 participants of 52 (75%) with less than perfect lower extremity functioning who had inadequate grab bars. Overall 47 of 60 participants, (78%) had inadequate grab bars. Seventeen people had a history of one or more falls, and thirteen of these participants had inadequate grab bars in the bathing area. These data may support the need for more services regarding safety equipment in the bathing area for older adults.
Literature Review

According to Buchner et al. (1993), a fall is defined as "unintentionally coming to rest on the ground, floor, or lower level, while excluding coming to rest on furniture or against a wall or similar structure,” (p.301). Falls are the primary cause of injury for older adults that result in high health care costs and functional disabilities. A person over 72 who experienced an injurious fall spent on average $19,440 in health care costs from the hospital, nursing home, emergency room, and home health care (Rizzo et al., 1998). About one in three community living seniors report at least one fall each year (Tinetti, Speechley, & Ginter, 1988). Falls also result in early institutionalization (Commodore, 1995), which is opposed by 83% of respondents in a survey conducted by the American Association of Retired Persons (AARP) who prefer to remain in their current residence for as long as possible (Bayer & Harper, 2000). Kannus concluded that the number of falls resulting in injury and death in older persons is increasing in rate (1999). With the increasing elderly population the number of fall occurrences can be predicted to increase.

It is important to identify primary risk factors for falls in order to respond with proper implementation of appropriate fall prevention interventions. In a study by DeVito et al. (1988), fifty-four percent of the falls causing injury \( (N = 986) \) occurred in and around the home. Thirty-eight percent of these had a particular area of the home recorded. Of this 38%, the most prevalent areas for falls were the bedroom at 42% and the bathroom at 34%. Aminzadeh and Edwards (2000) found that the bathroom is the location of 15% of falls in a sample of seniors with a fall history. Extrinsic factors in the bathroom that are considered potential hazards are absence of a grab rail, carpeting or rugs that are not secured, and a slippery floor surface (Huang, 2005). Occupational demands, such as entering and exiting a tub, may create a challenge for older adults due to the lower extremity function that is required. Weak lower extremity strength involved in lowering and raising oneself from the tub may increase the potential for slipping in
the tub and result in a fall. Intrinsic factors associated with falling include age-related changes, visual dysfunction, balance and gait impairment, disease, cognitive disorder, and side effects due to medications (Tideiksaar, 1997). Campbell, Borrie, and Spears, (1989) found the ability to rise from a chair, history of past falls, postural instability, lack of physical activity, loss of proximal muscle strength, and loss of stability when standing to be strongly associated with an increased risk of falling. The decrease in muscle strength associated with aging (Grimby, 1995) is well documented to be a statistically significant risk factor for falls (Moreland, Richardson, Goldsmith, 2004).

After a person’s risks of falling are identified, preventive measures should follow in attempt to reduce the risk. The prevention of falls relies on several variables. The most widely accepted type of falls prevention program, according to a systematic review and meta-analysis of randomized clinical trials, is a multi-factorial falls risk assessment and management program (Chang et al., 2004). Tinetti et al. (1994) found the multiple-risk-factor intervention strategy, which includes medication adjustments, behavioral instructions, home modifications, and exercise programs, significantly reduced the risk of falling among elderly persons in the community when compared to a control group. Thirty-five percent of the intervention group fell, as compared with 47 percent of the control group ($p = .04)$. Gillespie et al. (2003) also suggests that multidisciplinary and multifactorial interventions reduce falls in the elderly through a systematic review. A specific component that has demonstrated a reduction in falls for elderly residents is modification to the home. Cumming et al. (1999) determined that home visits by occupational therapists directed at home modifications can prevent falls among older people who are at increased risk of falling.

There are several home modifications that can assist in fall prevention. Installing grab bars, placing nonskid strips on the floor, removing clutter, and securing rugs has been
documented to reduce falls (Plautz, Beck, Selmar, & Radetsky, 1996). However, only 23 percent of respondents in an AARP survey ($N = 1,628$), reported the presence of handrails or grab bars in the bathroom. A nationwide telephone survey ($N = 1003$) found that in homes reporting a household member who experienced a fall that required medical attention in the previous 12 months, 35% of households had grab bars in comparison to households reporting no falls where 25% had grab bars (Marshall, Runyan, & Yang, 2005). Murphy ($N = 89$) found that people often use inappropriate supports in the bathing area (2006). She found that 19% percent of the subjects using a tub used unsafe supports. More than 75% of subjects with a shower stall used the sliding glass doors for stability or balance, which is considered unsafe due to the inability of the shower door to support a person’s weight. About 50% of the subjects used a towel bar, which is also considered an unsafe support. She found that those with a grab bar were likely to use the home modification when it was present. In Murphy’s study, the prevalence of a grab-bar on the back wall was 89%, and 72% of persons with grab bars used them. Seventy-four percent of subjects had a vertical bar at the entry, with 84% used.

The current study focuses on two risk factors for falls: lower extremity weakness and the lack of needed safety equipment in the bathroom. Nelson’s Conceptual Framework of Therapeutic Occupation (CFTO) can be used to conceptualize the theoretical importance of this study. When problems in the developmental structure (DS) are identified, there is a need for extrinsic supports in the occupational form (OF). The OF should be matched with a person's DS to allow for optimum occupational performance (OP). Compensatory devices and home modifications, such as bathroom grab bars, provide extrinsic support for people with a disability, such as lower extremity dysfunction (Nelson, 1988).

Assessing lower extremity functioning can provide information on the degree to which a person is at risk of falling. In identifying recurrent fallers, Tinetti, Williams, and Mayewski
(1986) found that balance, gait and other lower extremity tests, including difficulty rising from a chair, are useful. The Short Physical Performance Battery (SPPB) is a widely accepted method for in assessing lower extremity functioning, a factor that is associated with falls in older adults (Guralnik et al., 1994). The SPPB is an objective assessment of lower extremity functioning through testing of side-by-side stand, semi-tandem stand, tandem stand, measured walk, and chair stands. This assessment has been shown to predict decline in functional abilities, which would allow for early intervention disability prevention (Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995).

The placement of the grab bars is dependent on the bathroom layout, the sub-occupations required for bathing or showering, and individual characteristics of the person. A representative of Kohler, a company that sells grab bars, reported that the number of grab bars is determined by the bathing layout and whether or not the compliance with the American with Disability Act (ADA) standards is required. The representative also stated that grab bar placement and the number of grab bars are based on personal preference if compliance to the ADA standards is not required (personal communication, April 20, 2007). According to the ADA (personal communication, April 9, 2007) the standards are for public buildings and not homes. The ADA standards are designed to provide accessibility to all individuals and accommodate for various disabilities; they are not specific to the person. According to area occupational therapists, grab bars for residential dwelling bathing areas are based on the best match for the person based on his/her abilities (G. Morrill & S. Banet, personal communication, April 9, 2007). P. Andrews, a contractor specializing in home modifications stated that grab bar location and the number of grab bars are individualized based on the person (personal communication, April 30, 2007).

After reviewing expert recommendations, literature, and national grab bar standards, the researcher discovered multiple grab bar configurations that were considered appropriate.
Horizontal, vertical, and angled grab bars of varying lengths and varying heights were suggested. For a walk-in shower without a chair; a minimum of one grab bar on the back wall of the shower and, depending upon the person, sometimes a second grab bar is recommended on the side wall to assist with entering/exiting and a third grab bar on the opposing side wall (P. Andrews, personal communication, April 30, 2007). The ADA standard 608.3.2 recommends grab bars on all three walls of a shower that is without a seat (United States Access Board, 2004). Two grab bar companies also recommend grab bars on all available walls in the shower to use in the incident of a slip or fall (C. Hayes, The Hardware Hut, personal communication May 1, 2007, & C. Robertson of Elcoma Metal Fabrication & Sales Inc., personal communication May 1, 2007). A grab bar to assist with standing from a chair if the person takes a seated shower, either in a shower stall or a tub, is important (P. Andrews, personal communication April 30, 2007). For the tub, grab bars on the back wall to assist with rising off the chair and also on the faucet wall to assist with stepping into and out of the tub are recommended (W. West of Lockhouse Company, personal communication May 1, 2007). If the chair extends past the rim in the tub so that the person can sit on the chair and then swing his/her legs into the tub then the following is suggested; a grab bar placed on the side wall to assist with sitting/standing from chair, and a grab bar on the back wall. (Beyond Barriers, personal communication May 1, 2007). Aminzadeh, Edwards, Lockett, and Nair’s findings suggest a minimum of two grab bars for individuals that take baths without a chair; a grab bar for entering/exiting the tub and another for lowering/raising oneself to/from the bottom of the tub (2000).

After conversing with occupational therapists working in the community, Sveistrup, Lockett, Edwards, and Aminzadeh (2006) concluded that an inverted U-shaped bar on the bathtub rim is a safety hazard. U-shaped bars have a tendency to slip off of the rim and are not meant to support a person’s full body weight. Grab bars that rotate within their fittings are not
appropriate according to 4.26.3 of the American’s With Disabilities Act standards (United States Access Board, 2004).

The primary hypothesis of this study tests the correlation between lower extremity functioning and the presence of adequate bath or shower grab bars in community-dwelling elderly. There may be people who have poor lower extremity function without adequate equipment, which might indicate a gap in service. The number of persons with problems in lower extremity functioning who do not have adequate equipment will be counted to supplement the correlational analysis. It is also possible that people with excellent lower extremity functioning may have excellent safety equipment. The number of persons with excellent lower extremity functioning with adequate safety equipment will also be counted to supplement the correlational analysis.

Secondary analyses included computations of correlations between adequate or inadequate grab bars and a) fear of falling, b) number of self-reported falls in the last 12 months, c) location of the fall if a fall occurred, and d) incidence of injurious fall or not. Tertiary hypotheses include the correlations between: a) history of falls and fear of falling, b) history of falls and lower extremity functioning, c) history of injurious falls and fear of falling, and d) fear of falling related to lower extremity functioning.

Method

Participants

The principal investigator and a fellow student studying floor slip surfaces recruited 60 participants from two local senior centers and three churches through verbal communication, posters, and presentations. Participants for this study met the following criteria: aged 60 and older, dwelling in a community home or apartment excluding assistive living, residing within 60 miles of University of Toledo, Health Science Campus, ambulatory, and capable of completing
an informed consent form. Gender, type of dwelling, and falls history were also recorded to describe the subject. In the cases where there was more than one bathing area, the primary bathing area was used for this study. The participant will be required to sign an informed consent form before participation.

Description of subjects can be referred to in Table 1. The mean age of subjects was 75.6 years old ($SD = 9.5$), with 11 males and 49 females. There were 36 subjects who had no fall, 7 had a near fall, 15 had one fall, and two subjects had more than one fall. Nine people had a near fall or fall in the home, three occurred on the property (not within the home), and twelve off of the participant’s property. Of the total falls and near falls that occurred in the home, one was in the kitchen, three were in the living room, three people fell in the bedroom, one was in the bathroom (not in bathing area), one was in the bathing area, and three were in other areas of the home.

Five people endured severe injury due to falls. The occurrence of a joint dislocation or sprain requiring specific medical intervention, lacerations requiring sutures, pain requiring specific medical intervention, head injury requiring hospitalization, or fracture denoted a fall that caused severe injury. One person acquired a joint dislocation/sprain requiring specific medical intervention, one person had laceration requiring sutures, and three people had pain requiring specific medical intervention. Eleven subjects had only non-severe falls. Non-severe injuries including bruises, swelling, lacerations not requiring sutures, and pain not requiring specific medical intervention. No injury was recorded if stated by the participant or none of the previous injuries were indicated.

Participant’s total SPPB scores ranged from 1 to 12, with the mean being 8.18 ($SD = 2.9$). There was a possibility of four points each for the balance, timed walk, and chair sub-categorical tests, with four being the highest possible score and zero being the lowest possible score. The
mean score for the balance test was 2.77. The mean score of the timed walk was 3.08, and the mean of the SPPB chair test was 2.33.

**Instrument**

The Short Physical Performance Battery (SPPB) evaluates the lower extremity functioning of the participant through side-by-side stand, semi-tandem stand, tandem stand, two timed 4-meter walks, single chair stand, and timed five chair stands. Performance measures can indicate different ranges of functioning in persons who are not disabled (Guralnik, Seeman, Tinetti, Nevitt, & Berkman, 1994). Guralnik, Simonsick, and Ferrucci stated that the performance-based test of lower extremity functioning is found to be “efficient, practical, and safe” (1994, p. M85). In a study of lower body function in a women’s health and aging study, the summary performance measure was found to have excellent reliability (Ostir, Volpato, Fried, Chaves, & Guralnik, 2002). The assessment has been shown to be valid in predicting decline in functional abilities up to six years after the administration, which would allow for early intervention disability prevention (Guralnik et al., 2000).

The summary performance score of the Short Physical Performance Battery ranges from 0 – 12. A score of 0 denotes the inability to complete skill and a score of 4 represents the highest level of performance in each of the areas: ability to stand with feet in various feet positions, repeated chair stands, and measured walk. The validity of this scale is supported in a study analyzing the association between lower extremity functioning and the risk of admission to a nursing home as well as mortality. The Short Physical Performance Battery showed a gradient along the full range of the scale (Guralnik, Simonsick, & Ferrucci, 1994). The summary performance scores of the Short Physical Performance Battery can be divided into groups with 10 - 12 being in the high performance group, 7 - 9 in the middle-high performance group, 4-6 in the middle-low performance group, and 0-3 in the lowest performance group. When compared
to the high-performance group, the relative risk for ADL disability was 6.2 for low-performance group and 2.0 for the middle-performance group. (Guralnik, Ferrucci, Pieper, Leveille, Markides, Ostir, et al., 2000).

The University of Illinois at Chicago Fear of Falling Measure (Velozo & Peterson, 2001) can be administered as a questionnaire or an interview, as in this study. This assessment rates the participants’ fear of falling if performing 16 various occupations on a 3-point scale. The possible responses include very worried, moderately worried, and not at all worried. If the person stated the inability to do a task in the fear of falling measure, the number three was marked. This was only applicable to one person for this particular study. According to Rasch analysis, the 16 items included in the instrument were in the acceptable criteria for infit statistical analysis ($\text{MnSq} \leq 1.4$; $\text{ZSTD} \leq 2.0$). Person separation reliability was found to be .93, indicating the ability of the instrument to discriminate different levels among participants. The instrument construct validity from a Rasch perspective was .97.

Procedure

This study was conducted simultaneously with a different research project that focused on non-slip floor surfaces in the bathing area. Subjects scheduled an appointment for the two student researchers to meet at the subject’s home. At the home the subjects signed an informed consent. Each participant was interviewed concerning falls and administered the Short Physical Performance Battery and The University of Illinois at Chicago Fear of Falling Measure (Velozo & Peterson, 2001) by one of two student researchers (the other is studying non-slip floor surfaces).

The appropriate placement of the grab bar was dependent on the bathing design layout and the occupation being performed. Data relevant to the adequacy of the grab bar were obtained by evaluating the verbalization and gestures of subjects, and by observing the bathing
area. Subjects were asked if they take primarily showers, baths, or both. For each grab bar present, the researcher asked the subject what sub-occupations the grab bar(s) assist with and documented the location of the grab bar. Even if the subject stated he/she did not use the grab bar, the grab bar adequacy was still judged by the researchers. The raters determined if the grab bar was at an appropriate height. The primary student researcher recorded the diameter, height, length, space between the grab bar and wall, location of grab bar in bathing area, and grab bar line of position for each grab bar present in the bathing area. First the student investigator independently evaluated the bathing area and completed the Grab Bar Data Form. The primary researcher then repeated this process and independently evaluated the bathing area and completed the Grab Bar Data Form. Appendix A refers to a shortened version of the Grab Bar Data Form.

Sub-occupations required for taking a bath in a tub are to enter the tub by lifting one foot at a time over the rim of the tub, lowering self down into the tub, raising self from the floor of the tub, and exiting the tub by lifting one foot at a time over the rim of the tub. For subjects who take baths in a tub, appropriate grab bars were defined as the presence of a grab bar to assist with entering/exiting the tub and a grab bar to assist with lowering/raising from the bottom of the tub. The grab bar for entering/exiting the tub must be accessible from the time one foot leaves the ground to clear the rim of the tub until the time that both feet are firmly planted on the ground to be considered adequate. The grab bar for entering or exiting the tub should not be so low that the person has to lean over to get to it and should not be so high that the person can not adequately grasp the bar while entering and exiting the tub.

A bathroom with a free standing tub that is not enclosed with walls on the side should have a vertical pole running from the ceiling to the floor to assist with entering and exiting the tub (Yost & Martinr, 2007). A grab bar located on the back wall would serve the purpose of
lowering/raising self into and out of the tub. This grab bar should be at a height so that it is not so low that the person has to provide a great degree of hip flexion while standing to reach the bar and not so high that the individual can not reach the bar while seated in the tub.

Adequacy of grab bars for taking a standing shower in a tub involves one grab bar for entering/exitng the tub, similar to that explained above for entering and exiting a tub to take a bath, and a second grab bar for stabilization while standing in the shower. The grab bar for stabilization while standing in the shower should be on the back wall at a height that the person can reach at a comfortable level while standing.

Subjects who take a seated shower in the bathtub using a non-permanent chair need a grab bar to assist with entering/exiting the tub and a grab bar on the back wall to assist with steadying self on the chair and standing from the chair. Bath chairs that extend over the rim of the tub will also require a grab bar on the side wall for the purpose of assisting with standing from the chair and a grab bar on the back wall to assist with steadying self on the chair.

Subjects who take standing showers in a walk-in shower must have at least one grab bar within reach while showering. This grab bar can be on any wall of the shower at a height that can be reached at a comfortable level while standing. A grab bar to assist with entering and exiting the shower must be present near the entrance of the shower at a height the subject is satisfied with. Participants who take a seated shower will be required to have a grab bar to assist with standing from the chair. A grab bar is also required to assist with entering/exiting the shower and should be within reach while the person steps into and out of the shower. It should be at a height that is not so low that the person must flex at the hip or knees in order to reach the bar and not so high that the person has difficulty grasping the grab bar. If the layout does not allow for a grab bar, for example it is enclosed in glass, the area was considered to not have appropriate grab bars regardless of the feasibility of installation.
This study did not classify U-shaped bathtub grab bars as adequate for assisting with entering/exiting the tub. Grab bars that rotate within their fittings were also considered inadequate. Reported utilization of towel bars as hand-holds was also considered inadequate because of the inability to support a person’s body weight. Reported use of any bar on the glass door of a shower was not considered a grab bar and was defined as inadequate. It is important to note that the presence of a towel bar or bar on a glass door was not recorded as inadequate unless the participant reported using the towel bar or glass door for support.

The primary bathing area was the location used if there were more than one bathroom in the home. A bathroom safety brochure was distributed to the subjects at the completion of the observation.

Results

The test of the primary hypothesis indicated a statistically significant point-biserial correlation between grab bar adequacy and the total SPPB score $r = -.41, p < .001$. This negative correlation supports that people with relatively low lower extremity function tended to have adequate grab bars when studied in relation to people with relatively high lower extremity function. Even though a statistically significant negative correlation was found between adequacy and lower extremity function, the correlation was far from perfect, and there were substantial numbers of persons with lower extremity functioning who did not have adequate grab bars. Grab bar adequacy across four ranges of the SPPB is illustrated in Table 2. Problems of grab bar adequacy were mostly related to the absence of grab bars. Other problems were: the grab bar was too low; presence of a U-shaped bathtub mounted grab bar; and reported use of towel bars, shower door, and/or soap dishes for support (Table 3).

Secondary analyses included the relationship between fall incidence and grab bar adequacy, summarized in Table 4. There was no statistically significant relationship found
between grab bar adequacy and falling ($\chi^2 = -.05, p = .83$). Thirteen people (77%) with one or more falls had inadequate grab bars in the bathing area, and four people with one or more falls had adequate grab bars. The planned analysis between injurious falls and grab bar adequacy was not completed due to so few people with injurious falls. Of the five persons with severely injurious falls, none had adequate grab bars. Additional secondary analyses included a point-biserial correlation between fear of falling and adequacy of grab bars, with $r = .14, p = .29$ indicating no statistically significant correlation. The mean measure of fear of falling was 24.1, $SD = 7.25$. The mean for fear of falling in the bathroom was 1.48 ($SD = .67$), with 1 indicating not at all worried and 3 indicating very worried. A point-biserial statistical analysis of fear of falling while getting out of the tub and grab bar adequacy was $r = -.08, p = .56$, indicating no significant correlation. A planned point-biserial correlation of bathroom falls and adequacy of grab bars was not completed because only two falls occurred in the bathroom.

Point-biserial correlations were also performed for tertiary analyses (Table 5). For history of falls and total fear of falling $r = .0015, p = .99$. For history of falls and lower extremity functioning $r = .02, p = .86$. For history of injurious falls and total fear of falling, $r = .01, p = .92$. For history of injurious falls and fear of getting in and out of the bathtub, $r = -.13, p = .33$. Analysis of the relationship between the fear of falling and lower extremity functioning indicated a statistically significant correlation at $r = -.54, p = <.0001$.

The primary researcher and student researcher individually rated grab bar adequacy through observation and communication with the participant. Using kappa, the interrater reliability of adequacy was found to be good at .849.

Ottenbacher’s percent error rate statistic (PE) (Ottenbacher, 1998) to test for possible Type I errors due to multiplicity in secondary and tertiary statistical tests was performed. With one test being statistically significant and seven not being statistically significant PE = 40%.
This indicates that the correlation between fear of falling and lower extremity functioning must be interpreted with some caution.

Discussion

Grab bars in the bathing area are recommended for all persons, but if anyone is going to lack grab bars, it should not be older persons with lower extremity dysfunction. Ideally the correlation between grab bar adequacy and lower extremity functioning should be stronger than - .41. Overall, 47 people of the 60 in the study had inadequate grab bars, or 78.3%. Thirteen people (76.4%) who had a history of falling had inadequate grab bars, 34 people (79.17%) who did not have a history of falling had inadequate grab bars in the bathing area, and only four people (23.5%) who had a history of falling had adequate grab bars, whereas nine people (20.9%) who did not report a history of falling had adequate grab bars. These percentages are different from Marshall, Runyan, and Yang (2005), who using a nationwide telephone survey found 35% of people who had a history of falling had grab bars versus 25% who did not report a history of falling and had grab bars. The difference in rates may be accounted by the stringent criteria in the current study. Marshall, Runyan, and Yang (2005) considered presence of grab bars in the bathroom, whether in the bathing area or near the toilet. The present study considered not only presence, but adequacy of grab bars depending on the bathing situation and was specific to the bathing area.

It is interesting to note that even after one or more falls, only four participants had appropriate grab bars in the bathing area, while thirteen still had inappropriate grab bars in the bathroom. This suggests that even after a fall, older adults did not seek out nor otherwise received appropriate home modification services in the bathing area to prevent future falls.

There seems to be no connection between participants’ substantial fear of falling while getting in and out of the tub and the adequacy of grab bars. If people are afraid of falling, why
have they not taken action to reduce the risk of falling in the bathroom by installing grab bars? Lack of fall prevention education may be a factor that influenced grab bar inadequacy. A person may not be aware of the increased risk of falling in the bathing area and the importance of having environmental support to help prevent falls. A lack of knowledge regarding the number of grab bars necessary to be considered adequate, the appropriate placement of grab bars that supports the occupational performance, and inappropriate dependence on towel bars as support may also be factors influencing inadequacy. Insufficient knowledge of home modification services in the area may limit the request for such services, such as home evaluation and grab bar installation. Financial implications may limit the purchase of grab bars or the hiring of a qualified professional to complete the installation. However, the financial factor does not appear to be a factor according to Marshall, Runyan, and Yang (2005), who found 27.4% with a household income of less than $50,000 had grab bars in comparison to 23.2% with those with a household income of $50,000 or more who had grab bars. One person in the current study stated that she wanted to install grab bars, but was afraid of damaging the tile. Individuals renting a home may have difficulty obtaining permission to modify the home by installing grab bars from the property owner.

If fear has little or nothing to do with grab bar adequacy and if leg function has only a moderate correlation with adequacy, then it is interesting to speculate as to why some people have adequate grab bars. Further research should include queries of participants as to whether the grab bars were installed previous to buying the home or whether the grab bars were intended for another family member.

These data may support the need for additional home modification services targeted toward older adults. Occupational therapists are ideal in implementing such services because of
their knowledge of the relationship between the person and the occupational forms challenging them..

There are no universally accepted standards for grab bar adequacy in the home. Adequacy rating criteria were based on literature review, expert opinion, and analysis of the interaction of the occupation and environment that would support safe functioning. The criteria used to rate adequacy may not be appropriate. Gender was uneven, with the majority of participants being female. This may or may not impact the results. It is also important to consider the effect the recruitment sites had on the participants. People who attend senior centers and churches may be different from the majority of older adults. Many older adults living at home may have difficulties getting out into the community, which decreases chance of recruitment for this particular group. It is also possible that the majority of the participants were from a middle socioeconomic status based on observation of the subjects’ homes.

More research on the barriers to grab bar adequacy is necessary. Research on older adults’ knowledge of fall prevention interventions in the bathing area would help to further understanding this area. Older adults’ knowledge of grab bar adequacy in regards to placement, number of grab bars necessary, and unsafe use of towel bars as support would be interesting. Further research on older persons’ awareness of home modification services and how such services can be accessed may help to understand why older adults do not have adequate grab bars. Research on financial barriers and difficulty obtaining permission from property owners to implement home modifications could also be conducted.
References


Interventions for preventing falls in elderly people. *Cochrane database of systematic reviews (Online)*, no. 4, CD000340.


Table 1

*Participant Demographics*

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<td>Age</td>
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<td>Non-Severe</td>
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Table 2

Grab Bar Adequacy and Lower Extremity Functioning as Measured by the Short Physical Performance Battery (SPPB)

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<th>SBBP score</th>
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<tr>
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<td><strong>Total</strong></td>
<td><strong>13</strong></td>
<td><strong>47</strong></td>
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Note. SBBP score of 12 represents the highest level of functioning.
Table 3

*Problems with Grab Bar Adequacy*

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<thead>
<tr>
<th>Inadequate</th>
<th>Inadequate</th>
<th>Adequate</th>
<th>Problems other than absence of grab bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>No adequate grab bars</td>
<td>Only 1 criterion adequate</td>
<td>Both criteria adequate</td>
<td></td>
</tr>
</tbody>
</table>

**Layout: Bathtub**

<table>
<thead>
<tr>
<th></th>
<th>Inadequate</th>
<th>Inadequate</th>
<th>Adequate</th>
<th>Problems other than absence of grab bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>U-shaped on rim (1)</td>
</tr>
<tr>
<td>Shower</td>
<td>14</td>
<td>2</td>
<td>2</td>
<td>soap dish (1), towel bar (2)</td>
</tr>
<tr>
<td>Bath &amp; shower</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>too low (1), towel bar (1)</td>
</tr>
<tr>
<td>Standing shower &amp; chair shower</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bath &amp; seated shower</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Chair; seated shower</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Layout: Walk-in shower**

<table>
<thead>
<tr>
<th></th>
<th>Inadequate</th>
<th>Inadequate</th>
<th>Adequate</th>
<th>Problems other than absence of grab bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing shower</td>
<td>13</td>
<td>3</td>
<td>6</td>
<td>shower door(1), soap dish(1)</td>
</tr>
<tr>
<td>Seated shower</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Table 4

*Fall Incidence and Grab Bar Adequacy*

<table>
<thead>
<tr>
<th>Fall incidence</th>
<th>Adequate grab bars</th>
<th>Inadequate grab bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fall</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>Near fall</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>1 fall</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>&gt;1 fall</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 5

**Correlations of Short Physical Performance Battery, Grab Bar Adequacy, History of Falls, Injurious Falls, and Fear of Falling**

<table>
<thead>
<tr>
<th></th>
<th>Short Physical Performance Battery Score</th>
<th>Grab bar adequacy</th>
<th>History of falls</th>
<th>Injurious falls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab bar adequacy</td>
<td>-.41&lt;sup&gt;a, c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of Falling</td>
<td>-.54&lt;sup&gt;a, c&lt;/sup&gt;</td>
<td>.14&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.0015&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.01&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>History of Falls</td>
<td>.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.**

<sup>a</sup> p < .01

<sup>b</sup> Pearson correlation

<sup>c</sup> Point-biserial correlation
Appendix A

Grab Bar Data Form

Layout: Tub    Occupation: Bath

- Grab bar to assist with entering/exiting tub
- Grab bar on back wall for lowering/raising from tub

*Must have both checked to be considered appropriate.*

Layout: Tub    Occupation: Standing Shower

- Grab bar to assist with entering/exiting tub
- Grab bar on back wall for stabilizing while standing

*Must have both checked to be considered appropriate.*

Layout: Tub with chair    Occupation: Seated Shower

- Grab bar to assist with entering/exiting tub
- Grab bar to assist with standing/stabilizing on chair

*Must have both checked to be considered appropriate.*

Layout: Walk in Shower    Occupation: Standing Shower

- Grab bar to assist with entering/exiting shower
- Grab bar to utilize while standing in shower

*Must have both checked to be considered appropriate.*

Layout: Shower with Chair    Occupation: Seated Shower

- Grab bar to assist with entering/exiting shower
- Grab bar to assist with standing from chair

*Must have both checked to be considered appropriate.*