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Review Article

Facilitators of and Barriers to Hip Protector Acceptance and Adherence in Long-term Care Facilities: A Systematic Review

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ABSTRACT

Keywords:
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Background: Hip protectors represent an attractive strategy for reducing hip fractures among high-risk fallers in long-term care facilities. However, clinical studies yield conflicting results regarding their clinical value. This is mainly due to poor acceptance and adherence among users in wearing these devices. As a result, there is an urgent need to identify potential barriers and facilitators to initial acceptance and continued adherence with hip protector use.

Purpose: The objective of this systematic review is to synthesize available research evidence to identify factors that influence acceptance and adherence among older adults living in long-term care facilities.

Methods: A key word search was conducted for studies published in English between 2000 and 2013 that employed quantitative, qualitative, or mixed-methods research designs. Two independent reviewers evaluated each article for inclusion, with a third reviewer when needed to resolve discrepancies.

Results: Twenty-eight articles met our inclusion criteria, and facilitators and barriers were clustered into 4 socio-ecological levels: system (eg, facility commitment, staff shortages), caregiver (eg, belief in the efficacy of protectors, negative perceptions), resident (eg, clinical risk factors for falls and related fractures, acute illness), and product (eg, soft shell, discomfort).

Discussion: The outcomes provide decision makers, health professionals, and caregivers with a greater awareness of strategies to improve compliance with the use of hip protectors. Furthermore, researchers can use this information to design clinical trials that yield high acceptance and adherence.

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About 1 in 3 older persons living in their own homes, and 1 in 2 residents living in long-term care (LTC) experience at least 1 fall each year.[1–4] Although a small percentage of falls (ie, 10%[5]) result in serious injury, falls persist as the leading category of injuries and injury-related deaths among Canadians over the age of 65.[6] One of the most debilitating injuries caused by falls are hip fractures, often

bringing excess mortality,[7,8] declines in functional independence,[8,9] diminished quality of life,[10] and psychological distress[11–13] (eg, delirium, depression, anxiety, and fear). In Canada, roughly 28,000 Canadians seniors are hospitalized for hip fractures each year, costing more than $1 billion in direct treatment costs.[14,15] The global incidence of hip fracture surpasses 1.7 million, and with baby boomers nearing old age, is projected to reach 3.94 million by 2025, and 6.26 million by 2050[16–18] (even though age-adjusted rates are plateauing[19]). Because of their profound frailty and tendency to fall more frequently and severely (from a loss of effective protective responses), institutionalized older adults are up to 10.5 times more likely to break their hip during a fall than their community dwelling counterparts.[20,21]

While the integrity of bone is crucial, the majority of hip fractures in older adults involve a sideways landed fall,[14] with risk for hip

fracture increasing 32-fold if direct impact occurs to the greater trochanter (GT).[22] Accordingly, hip protectors have been promoted as a cost-effective and relatively immediate approach for prevention in the high-risk LTC environment,[23–27] consisting of soft or hard shell pads embedded in specialized outer- or under-garments,[28] which utilize both energy cushioning and energy shunting mechanisms to mitigate the risk of hip fracture during falls.[29–35] According to laboratory-based studies, hip protectors reduce peak impact forces to the hip by up to 40% during simulated sideways falls from standing.[33–37]

Although findings are more optimistic for institutionalized than community-dwelling older adults, intention to treat type meta-analyses have yielded conflicting results regarding the clinical value of hip protectors.[38–40] This is mostly explained by limited user adherence in the wearing of these devices, resulting in a large number of falls (and subsequently, hip fractures) occurring without any hip protection.[38–40] However, when comparisons are drawn from analyses of protected vs unprotected falls, the relative risk of hip fracture is reduced between 69% and 80% when a hip protector is in place at the time of a fall.[41–43] Thus, despite the observation of good biomechanical efficacy (more than equivalent to the best osteoporosis pharmaceutical treatments[44]), poor adherence causes the intervention to appear ineffective. Still, there remains some controversy about the effectiveness of hip protectors even when compliance is good, mainly because of methodological flaws in design of clinical studies, and lack of performance regulations assuring the quality of available models for testing. For example, a randomized controlled trial by Kiel et al[45] (2007) conducted in US nursing homes found no evidence of a protective effect of an energy-absorbing/shunting hip protector on the risk of hip fracture, despite good adherence to protocol. However, the hip protector pad utilized in this trial (FallGard) has been shown to have very poor biomechanical performance in a recent laboratory-based study, attenuating only 2.9% and 12.4% of peak forces to the proximal femur at impact velocities of 2 m/s and 3 m/s, respectively.[34]

Motivated by the potential benefits of this intervention, many studies have been published to examine the complex factors that influence initial acceptance and continued adherence in the wearing of hip protectors. In 2002, van Schoor et al[46] lead a systematic review of factors that influence acceptance of hip protectors, and adherence with guidelines concerning their use. However, the review did not attempt to distinguish determinants of compliance between community dwelling older adults and residents of LTC. As more LTC residents compared with community-living seniors struggle to manage multiple comorbidities and frailty,[47,48] compliance in LTC should be determined less so by factors related to the individual user, and more so by caregiver and system-related factors. Furthermore, many studies have been conducted since publication of the initial review, with some producing contrary findings on the nature of barriers and facilitators in LTC. Therefore, the objective of this study is to synthesize available research to update our knowledge of perceived barriers and facilitators to initial acceptance and continued adherence in LTC, and to provide evidence-based strategies to improve these outcomes.

Methods

The intention of this systematic review was to identify articles encompassing a wide spectrum of evidence on barriers and facilitators to hip protector acceptance and adherence in LTC, drawing upon published literature inclusive of qualitative, quantitative, and mixed methods research articles.

Terms for electronic database searching were first developed for OVID Medline and were adapted to suit the requirements of the other citation databases (CINAHL, Ageline, Cochrane Database of Systematic Reviews, Proquest). OVID Medline Medical Subject Headings included hip fractures; hip injuries; accidental falls; protective devices; and humans. Free-text search terms for Medline titles and abstracts included hip and protect*. Keyword search terms for other databases included: hip*, joint, injur*, protect*, pad*, fracture*, fall*, accidental, equipment, pad, and devices (*all variations of the keyword). Search results were restricted to English language articles published between January 2000 and December 2013. This time frame was selected for 2 reasons: (1) the previous systematic review by van Schoor and others (2002) included studies published up to June 2001[46]; and (2) because of the evolution of hip protector technologies, older models available prior to 2000 might not be reflective of new trends in hip protector design. A supplemental search was performed by cross-referencing selected studies, contacting experts in the field for additional references, and reviewing the references of systematic reviews. The search for literature on evidence of barriers and facilitators to hip protector compliance in LTC facilities was part of a larger search that included studies in community and hospital settings. It was only in the final stage of data extraction that LTC studies were extracted. The term LTC is used to describe facilities for older adults where personal and nursing care is provided on a 24-hour basis (eg, nursing homes, residential care facilities).

Studies were included if they focused specifically on hip protectors as an intervention, or in which hip protectors were included as part of a multifactorial intervention or subgroup analysis. The samples of interest were adults of 65 years or older living in LTC facilities, family caregivers, and/or health care providers. For inclusion, the article must have presented findings related to hip protector acceptance and/or adherence, even though the primary purpose of the study may have been hip protector effectiveness.

A team of falls prevention researchers and LTC clinicians screened all abstracts for inclusion. Full text documents were obtained for those that met the inclusion criteria. Two independent members of the research team were then randomly selected to review each article. In the event of a disagreement, a third member of the research team was called upon to resolve the discrepancy.

In order to accommodate a diversity of reports, we adopted the narrative synthesis method described by Popay et al,[49] whereby reports were analyzed using tabulation and vote counting based on the following key data abstraction components: methodological approach, level of evidence, sample characteristics, hip protector characteristics, measurement of acceptance and adherence, and facilitators and barriers.

As the objectives of this synthesis are primarily to describe, classify, and explore relationships between studies rather than to conduct a meta-analysis of effects, assessments of risk of bias and other study quality appraisal techniques were not undertaken. However, to account for susceptibility to bias, each study was assigned a level of evidence (ie, I, II, III, IV) and a strength of recommendation (ie, A, B, C, D) using guidelines described in Shekelle, Woolf, Eccles, and Grimshaw[50] (Figure 1). Accordingly, barriers and facilitators derived from randomized controlled trial (I, A/B) were considered least susceptible to bias, whereas those from expert opinion (IV, D) were considered most susceptible to bias. The second stage of the synthesis involved an exploration of relationships between and within studies. If discrepancies existed in the nature of barriers and facilitators across studies, the highest level of evidence and/or strongest recommendation was used to discern the direction of relationships between factors and measures of acceptance or adherence.

Results

A total of 1086 potential articles were identified. Of those, 112 appeared potentially relevant and a hard copy was obtained for

Categories of evidence	
Class I	Evidence from at least one randomized controlled trial or a meta-analysis of randomized controlled trials.
Class II	Evidence from at least one controlled study without randomization or evidence from at least one other type of quasi-experimental study.
Class IV	Evidence from expert committee reports or opinions and/or clinical experience of respected authorities.
Strength of recommendation	
A	Directly based on Class I evidence.
B	Directly based on Class II evidence or extrapolated recommendation from Class I evidence.
C	Directly based on Class III evidence or extrapolated recommendation from Class I or II evidence.
D	Directly based on Class IV evidence or extrapolated recommendation from Class I, II or III evidence.

Fig. 1. Categories of evidence and strength of recommendations adapted from Shekelle, Woolf, Eccles, and Grimshaw.[49]

screening. After full text reviews, 28 publications of studies specific to LTC settings met the inclusion criteria and were included in this review (Figure 2). The most important characteristics of these studies are presented in eTable 1. Seven studies took place in the United

Kingdom,[51–57] 4 each in Australia[41,58–60] and the US, [61–64] 3 each in Norway[65–67] and Germany,[68–70] 2 in Ireland,[71,72] and 1 each in Switzerland,[73] Belgium,[74] Canada,[75] The Netherlands,[76] and Hong Kong.[77] Research designs for the 28 studies included quantitative methods (n = 22), qualitative methods (n = 2), and mixed methods (n = 4). In 3 of the 22 quantitative studies, and 1 of the mixed methods studies, the main outcome was hip protector effectiveness, with acceptance and adherence reported as secondary outcomes.[59,68,71,78] For these studies, the level of evidence reported only refers to the design for the compliance portion of the study. Six studies are supported by level I evidence on factors related to HP compliance, 2 by level II, 18 by level III, and 2 by level IV (eTable 1).

Findings showed considerable variability on how often hip protectors were worn and how compliance was measured among the studies (eTable 2). Data on both acceptance and adherence was provided in 12 studies, while information on acceptance only and adherence only was provided in 1 and 11 studies, respectively. For the remaining 4 studies, measures of compliance were not applicable as they explored staff opinions on hip protector design and usage[53,54,62] and staff exposure to hip protectors.[75] Of the 13 studies reporting on acceptance, rates ranged from 32%[64] to 85%[74] with a median acceptance of 48%.[58] Of the 23 studies reporting on adherence, rates ranged from 3% at nighttime[51,52] to 93%.[61] However, clear comparisons cannot be drawn across studies because of the wide variety of definitions and methods used to report and measure adherence, as well differences in the amount of time from initial exposure to follow-up (14 days to 18 months).

Data extraction from the 28 studies revealed that factors influencing hip protector acceptance and adherence span different socio-ecological levels. Guided by previous studies, we sorted factors into 4 major thematic groups: (1) system-related, (2) caregiver-related, (3) resident-related, and (4) hip protector-related. Determinants of acceptance and adherence for each of these levels are summarized in eTables 3–6, respectively. Furthermore, a description of select barriers and facilitators follows which, based on frequency of reporting, robustness of study design, or clinical relevance were believed to be deserving of greater attention.

System Level Characteristics

Facilitators
Facility commitment to a hip protector program. In 5 of the studies, facility commitment to protector use was linked with acceptance and adherence.[53,55,67,69,71,78] Although there was no shared
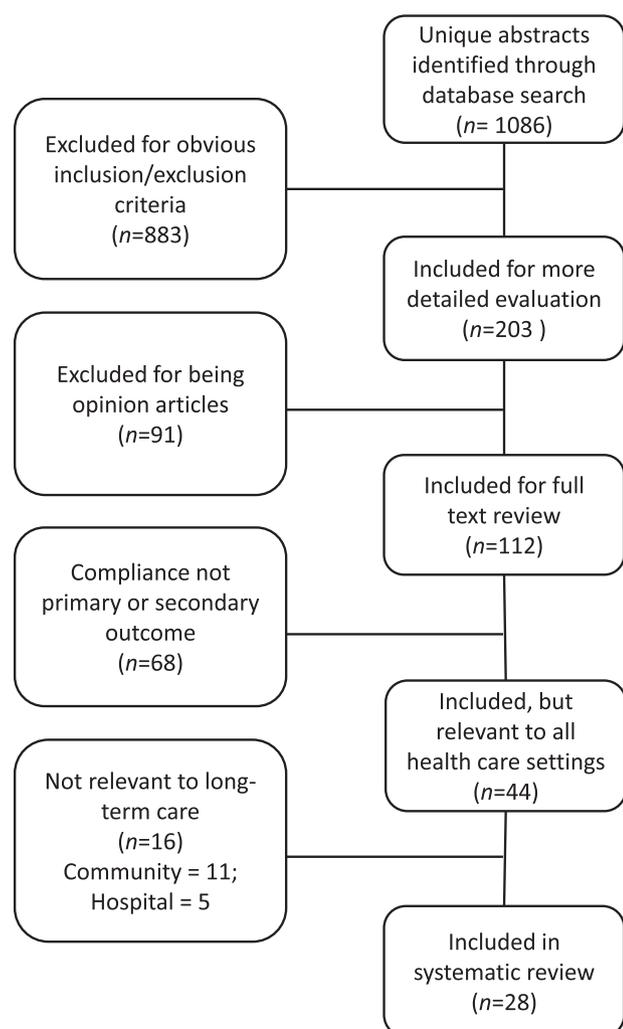

Fig. 2. Flow diagram of the selection process for included studies.

definition of facility commitment, Zimmerman et al[64] (2010) operationalized it as "whether or not mechanisms were in place to ensure adherence such as consequences for lack of use, staff commitment to protector use, quality of interaction between research and facility staff, the general working environment, and quality of care" (p 108). Some indicators of facility commitment included whether a champion (ie, team or person) existed within the home to assume accountability for measuring compliance and for attending to general issues, such as ordering, storing, and marking hip protectors,[53,61,67] and clear and effective leadership of the senior manager.[53,55,69] For example, the importance of a champion is best demonstrated in the 13-month prospective study by Burl et al[61] (2003), where facilities enlisted a rehabilitation department to champion the program and average adherence remained at or above 90% between the third and thirteenth month of observation.

Structured education on hip protectors and provision of garments at no cost. Only 2 randomized control trials examined the efficacy of structured education to enhance compliance.[58,68] Meyer et al[68] (2003) compared adherence between homes proving usual care (control), and those offering education for staff along with the provision of hip protectors at no cost (3 pairs per resident). After adjusting for cluster randomization, the authors reported a mean difference in adherence of 53% [95% confidence interval (CI) 38%–67%; $P = .0001$], and a reduction in hip fractures of approximately 40%, between intervention and control homes at 14 months. The second allocated homes to control, no cost intervention, or combined intervention (education and no cost) groups.[58] After 6 months, no difference was reported in mean adherence between the 2 intervention groups (25% in the no cost group and 24% in the combined group), while none receiving usual care purchased hip protectors at any point. However, the authors advised caution when interpreting these results, as overall attendance in educational sessions was low, and sessions were often cut short to accommodate nursing staff availability.

Support from external sources. In 3 studies, ongoing support from external agencies, such as general practitioners and quality and safety boards, emerged as a system-related incentive for acceptance and/or adherence.[53,62,75] In the qualitative study by Davies et al[53] (2004), positive reinforcement by external agencies was linked to positive staff attitudes regarding the use of hip protectors. Furthermore, efforts to encourage use were often much less likely to be resisted when physicians prescribed or recommended hip protectors.[62,75]

Barriers
Laundering. Issues surrounding the laundering of hip protectors were identified as system-related barriers to adherence in 2 studies.[58,61] For example, Burl et al[61] (2003) observed that clean hip protectors were not always available when needed (especially over weekends) and that residents with incontinence were particularly affected, as their garments required frequent laundering.

High turnover and/or insufficient staffing. High turnover of nursing or managerial staff[53,55,58] and workforce shortages resulting in excessive workload[53,64,76] have been linked to lower levels of adherence. For example, in the observational study by O'Halloran et al[55] (2007), greater adherence was associated with fewer changes in senior manager during the study period [odds ratio (OR) = 2.93, 95% CI 1.01–8.51]. In addition, Zimmerman et al[64] (2010) observed a negative association between the number of eligible residents owning hip protectors and adherence (estimated

coefficient = −0.47, $P < .01$), which they felt may have been due to shortages of staff, as there was not enough time to dress all residents in hip protectors.

Communication breakdown at the frontline. Communication breakdown at the frontline was also identified as a potential system-related barrier to adherence.[53,58] For example, Davies et al[53] (2004) observed that in homes where hip protectors were being used effectively, decisions about the need for protection were usually clearly documented in care plans, and health care assistants were aware of and understood the benefits of hip protectors. However, in a few homes where hip protectors were not being used effectively, health care assistants had been told to use hip protectors with certain residents, but they were not informed why hip protectors should be used.

Caregiver Level Characteristics

Facilitators
Positive attitudes regarding the effectiveness of hip protectors. Compliance was enhanced when caregivers were convinced of the ability of hip protectors to reduce risk for injury from falls,[52,53,57,63] and diminished when caregivers were conflicted about their effectiveness.[53,54,67,75,78] Davies et al[53] (2004) concluded that residents were more likely to wear hip protectors when caregivers understood the value of their use. According to Sawka et al[75] (2007), staff frequently cited (33.3%) lack of evidence of benefit in LTC populations as a major barrier to adherence. In addition, Davies et al[53] (2004) reported that some staff members felt no obligation to use hip protectors when they were unconvinced of their efficacy to prevent hip fractures.

Staff commitment to work with hip protectors. In 13 studies, investigators acknowledged the importance of staff commitment to work with hip protectors in determining compliance.[51,52,54,56,57,60,61,63,64,67,69,73,76] For example, in the comparative study by Zimmerman et al (2010), a one unit increase in the commitment of registered nurses to hip protector use (scored from 0 to 4) was associated with a 3.1% (95% CI: 0.83–5.3) increase in adherence ($P < .01$).[64] No others attempted to quantify the strength of this relationship.

Barriers
Negative perceptions of hip protectors. Lack of acceptability often arose from concerns about hygiene,[59,62] cost-effectiveness,[62] maintaining the dignity of residents,[54,59] the development of unwanted side effects (ie, pressure damage, redness of the skin),[54,56] and most often, the amount of effort required when helping residents to don and doff hip protectors.[53,58–60,74] In 1 study, night shift respondents were more likely to rate a hip protector policy as time-consuming (50% vs 13.7%; $P = .021$) and stressful (75% vs 24.1%; $P = .006$) compared with day-time caregivers, even though nearly all (97.3%) considered a hip protector policy in LTC as feasible.[74]

Perceived clash with residents' rights to individual choice and autonomy. According to 1 study, compliance was sometimes compromised when caregivers experienced difficulty understanding a residents' decision to wear hip protectors.[54] Often, caregivers had to interpret consent through behavioral signs, such as a lack of protest. In some situations, staff made the decision not to offer hip protectors because they perceived they would have been forcing residents to wear the garment against their will and were dedicated to upholding their rights' to individual choice and autonomy.

Resident Level Characteristics

Facilitators
Clinical risk factors for falls and fragility fractures. Clinical risk factors for falls and fragility fractures that emerged as important facilitators of acceptance and/or adherence included a history of falls and fall-related injuries,[52,57,63–65,72] a high risk for falling,[56,61,65,72,73] and a diagnosis of osteoporosis.[63–65] For example, in the comparative study by Hubacher and Wettstein[73] (2001), the probability of accepting hip protectors increased with the number of existing fall risk factors (2 risk factors: OR = 1.47, 95% CI 0.83–2.60; 3 or more risk factors: OR = 2.02, 95% CI 1.10–3.71). Also, in O'Halloran et al (2005), estimated differences in mean percentage daytime use between residents with and without a history of falls, and with and without a history of fall-related injuries in the past year, were 18.0% (95% CI: 2.9-33.2; *P* = .02) and 19.2% (95% CI 4.2-34.2; *P* = .012), respectively.[72]

Recognition of the need for hip protection. It appears important that residents recognized their vulnerability for falls and injuries, and subsequent need for hip protection. For example, in 2 studies, a strong fear of falling was found to facilitate acceptance[57] and adherence.[69] Cryer, Knox, and Stevenson[57] (2006) observed greater odds of acceptance among residents who had stopped at least 3 activities because of fear of falling (OR = 9.21; 95% CI 2.31-36.71; *P* < .001), and although only marginally significant, Warnke et al[69] (2004) found that residents who had a strong fear of falling were at slightly lower risk of falling without hip protection that those without a strong fear [hazard ratio (HR) = 0.78; 95% CI 0.60–1.02; *P* = .065]. Furthermore, a poor understanding of fracture risk was negatively associated with acceptance in another study.[59] Here, Chan et al[59] (2000) noted that some residents felt that they were presently safe from injury and were in no need of hip protection, as they had already experienced one fractured hip, and considered it unlikely they would experience another. Further, one resident explained that her first fracture was pathologic, and, therefore, felt hip protectors would afford her no extra protection.

Positive attitudes regarding the effectiveness of hip protectors. Belief of the benefits associated with hip protector use was also linked with acceptance and adherence in 3 studies.[54,73,74] For example, in the comparative study by Hubacher and Wettstein[73] (2001), 60% of wearers considered hip protectors to be useful compared with 10% of nonwearers (*P* < .001).

Peer and family advocacy. In 4 studies, differences in acceptance and adherence were linked with peer and family advocacy.[59,60,63,72] In the 6-week observational study by Honkanen et al[63] (2007), residents with occasional visits from family, as opposed to frequent visits, were less likely to have used hip protectors or to have indicated intended future use (OR = 0.01; 95% CI 0.00–0.09; *P* < .001). Furthermore, in the qualitative study by Tavener-Smith and De Vet[60] (2006), full adherence (reported as wearing hip protectors for 24 hours of the day, except when bathing) was only achieved among those individuals with family members who were committed to monitoring and encouraging their use, and who were able to assist with the purchase cost.

Wearing of incontinence materials. The relationship between incontinence and compliance was complicated, and in 3 studies,[52,57,76] the wearing of incontinence materials was related to increased levels of acceptance and/or adherence. In Cryer, Knox, and Stevenson[52] (2008), residents who used incontinence pads most days had 13.3% (95% CI 2.0–24.5; *P* = .01) higher adherence than those who did not.

Physical and mental disability. Indicators of physical and mental disability that emerged as facilitators of acceptance and/or adherence were cognitive decline consistent with dementia,[64,74] memory impairment,[56,65] restricted mobility[57,64,65,73] (with the exception of wheelchair use [64,73]), and the need for moderate assistance with activities of daily living (ADLs).[55,58,60,63,65,67,70,72,74,76] For example, Bentzen et al (2008) observed greater odds of acceptance among residents who needed some help when dressing than in those who were completely independent (OR = 1.56; 95% CI 1.08–2.26; *P* = .043). In addition, those with very high (HR = 0.41; 95% CI 0.21–0.78; *P* = .007) and high (HR = 0.44; 95% CI 0.29–0.69; *P* < .001) disability had lower risk of terminating the use of hip protectors than residents with low disability.[65] Furthermore, in the randomized controlled trial by O'Halloran et al[72] (2005), the estimated difference in mean percentage daytime use between individuals with high (ie, Barthel scores of 0–12) and low (ie, Barthel scores of 13-20) levels of disability was 30.3% (95% CI 15.8–44.8; *P* < .0005).

Barriers
Social or economic disadvantages. Differences in compliance were also linked with social or economic disadvantages in 2 studies, including non-white racial origins, migration backgrounds, and the receipt of welfare assistance.[64,70] Klenk et al[70] (2011) observed lower availability of hip protectors for residents with migration backgrounds (OR = 0.30; 95% CI 0.09–0.99), and among those who were in receipt of welfare assistance (OR = 0.60; 95% CI 0.44–0.81). Furthermore, in the comparative study by Zimmerman et al[64] (2010), residents who were non-white had, on average, 8.76% [standard error (SE) = 1.92%] lower adherence (*P* < .01).

Fatalism and depression. In another 4 studies, a fatalistic view of end of life, depression, or other mood symptoms associated negatively with acceptance and/or adherence.[59,60,63,64] For example, in one, the consistent display of depressed, sad, or anxious mood indicators related to a 6.90% (SE = 2.17) reduction in adherence (*P* < .01).[64] Similarly, Honkanen et al (2007) observed that anxious (OR = 0.15; 95% CI 0.04–0.50; *P* = .02) or resistive (OR = 0.43; 95% CI 0.21–0.85; *P* < .001) behaviors negatively predicted adherence in a multivariate analysis of variables affecting hours of hip protector use.[63] Finally, in the mixed methods study by Chan et al[59] (2000), 1 resident stated that she would not wear hip protectors because she was nearing the end of her life, and was therefore, "too old to care."

Persistent incontinence. Again, the relationship between incontinence and compliance was mediated by the frequency of incontinent episodes, where persistent urinary and bowel incontinence were identified as a potential barrier to acceptance and adherence.[56,58,60,64,65,69,74,77] In the observational study by Bentzen et al (2008), a greater proportion of residents who declined hip protectors (39%) vs accepted (27%) were always incontinent (*P* < .001).[65] Also, Zimmerman et al[64] (2010) observed 5.94% (SE = 2.06) less adherence among residents who were always incontinent of the bowel than among those who were always continent (*P* < .01).[64]

Prioritization of other care needs because of illness. A deterioration of health resulting in nonambulatory status was encountered as a reason for noncompliance in 3 studies.[53,61,72] In the 13-month prospective study by Burl et al[61] (2003), certified nursing assistants often stated that nonadherence was related to the contraction of an acute illness, which resulted in a significant change in condition or a decline in functional status. The authors commented that this might have been because staff de-prioritized the use of

hip protectors in favor of other care issues, especially when residents were confined to their beds.

Hip Protector Characteristics

Facilitators
Color steadfastness. In 1 study, color steadfastness was considered a hip protector-level facilitator of acceptance and adherence.[62] In the qualitative study by Honkanen, Dehner, and Lachs[62] (2006), there was consensus among certified nurse assistants that tan or beige, neutral colored garments were the most likely to be accepted and continuously worn, as they were least likely to fade, discolor, or tinge. In addition, in the qualitative study by Honkanen, Dehner, and Lachs[62] (2006), certified nursing assistants believed that residents would be dissuaded from continuing use if garments became stained or discolored after washing with chlorine.

Soft shell hip protectors. Type of hip protector (ie, soft pad, hard shell) has also been shown to influence adherence, especially during the night.[62,66] In a cluster randomized study by Bentzen et al (2008),[66] type of hip protector had no effect on acceptance; however, the probability of a resident terminating their use was marginally higher for hard dome compared with soft pad hip protectors (relative risk = 1.38; 95% CI 1.002–1.902; P = .048). In addition, a significantly greater proportion of individuals assigned soft pad hip protectors (63%) were considered 24-hour users compared with those provided hard dome hip protectors (43%) after 12 months of follow-up.[66]

Barriers
Discomfort and side effects. The most prevalent hip protector-level barrier of both acceptance and adherence was discomfort, named in 16 studies.[54,55,57–61,65–67,73–78] For example, Burl et al[61] (2003) reported that, despite attempts to optimize fit, a few individuals would not wear hip protectors because they complained of discomfort. In addition, in the cluster-randomized study by Bentzen et al[66] (2008) comparing adherence between soft- and hard-shelled users, the main reason provided for ending hip protector use in both groups related to discomfort (42% and 40% for soft- and hard-shelled hip protectors, respectively). Likewise, Cameron et al[58] (2011) observed a positive correlation between lack of comfort and low adherence at 6 months (Spearman's rho 0.357, P < .001). Discomfort often arose from poor fit (ie, hip protector was too small or too tight)[57,60,61,67] or bulkiness,[54,55,58–60] restrictions with sleeping among those who were not used to wearing undergarments at night,[60] and pre-existing medical conditions (ie, pressure ulcers, pain postsurgery).[60,67] The development of unwanted side effects was also shown to negatively influence acceptance and adherence.[54,65–67,73,74] Typical side effects included aches or pains, swelling, itchiness, and skin irritation (ie, heat rash, redness).

Distaste. Issues with style or appearance of hip protectors were also identified as potential barriers to acceptance and adherence.[54,56,67,73,74] For example, in a comparative study by Forsen et al[67] (2004), 12% of residents refused the offer of hip protectors, and 28% terminated their use because of distaste with their appearance. Doherty et al[54] (2004) reported that female residents, in particular, were offended by the masculine appearance of hip protector pants, which made them look bulky and unattractive. Furthermore, Hubacher and Wettstein[73] (2001) observed that roughly 3 times more drop outs than wearers found their appearance while wearing hip protectors unattractive (P < .001). Unsightly stains and discoloration of garments appeared to exaggerate this concern.[54,62]

Relative complexity. Identified in 10 studies, another common resident-level barrier to adherence related to difficulty donning and doffing hip protectors independently,[54,55,58–60,65–67,74,77] sometimes leading to the incorrect placement of hip protectors.[64,76] In the qualitative study by Tavener-Smith and De Vet[60] (2006), older adults expressed difficulty with usage as a major barrier — specifically that they now required assistance from others to perform activities (eg, going to the toilet) they otherwise had been able to do independently. Doherty et al[54] (2004) also observed that hip protectors had reduced the independence of a small number of residents, who previously had been completely independent when toileting, and were now unable to use the toilet without assistance. The authors considered this to be a major obstacle to continued adherence. Arthritis, particularly afflicting the hands[54] and lower limbs,[52] was reported to exacerbate this difficulty.

Discussion

Despite the observation of good biomechanical performance of hip protectors[33–37] and evidence of the benefits of hip protectors in reducing hip fractures in LTC facilities,[79–82] recent intention to treat type meta-analyses have indicated that poor user compliance is the most important barrier to the improved clinical efficacy of hip protectors.[39,40] Therefore, the purpose of this review was to identify perceived barriers to initial acceptance and continued adherence with hip protectors in LTC.

Consistent with findings from van Schoor et al,[46] we observed lack of clarity and consistency in definitions of adherence, which limited our ability to explore relationships between studies. Some reported adherence as the percentage of users who were adherent at multiple times,[74] whereas others the percentage of time in which hip protectors were worn as directed,[61] the percentage of falls in which hip protectors were worn,[78] or the percentage of users who wore a protector during at least one fall.[68] Definitions also ranged from the wearing of a hip protector at least once during the past 3 months[56] to a month,[66] at least once a day for more than 1 hour,[63] for all hours of the daytime,[71] or at all times except when bathing.[51] Therefore, we advocate that investigators comply with recommendations from Kurrle et al[83] (2004), and report adherence as the percentage of time hip protectors are worn as directed using a standardized definition, or alternatively, whether hip protectors are being used at the time of falling through examination of fall reports or clinical records.

According to the prior systematic review of factors affecting acceptance and adherence, discomfort from poor fit, and the extra effort and time needed to don and doff hip protectors, were cited as the most common features of garments contributing to noncompliance.[46] Despite improvements in the design of hip protectors over the last decade, we observed that discomfort, unwanted side effects, and poor ergonomics (eg, complexity of use) persist as substantial barriers to their continued use. Distaste with the aesthetics of hip protectors was another commonly reported reason for noncompliance, especially among females, with about 1 in 3 residents forgoing protection because of issues with style.[67]

To overcome hip protector level concerns, residents should be given the opportunity to select and try on a variety of models to maximize potential for proper fit. This should include both soft pad and hard shell types, as rigidity had no meaningful effect on adherence, with the exception of greater nighttime use with soft pads.[66,72] However, not all hip protectors are equally effective. A study by Laing et al[34] (2011) observed a wide range in biomechanical capacity among 26 commercially available models, with force attenuation ranging from 2.5% to 40%. Accordingly, residents should be encouraged to select from hip protectors with documented protective effect. Designers and engineers should direct their efforts to creating

garments that are more comfortable (airy, light, breathable), easy to take on and off, especially for those with arthritis, and aesthetically appealing with designs tailored to gender-specific tastes. Some suggestions offered by investigators to enhance compliance included differentiating the front and back sides of garments to facilitate proper application,[76] using snaps or Velcro for fastening,[62] and selecting neutral colored fabric.[62]

At the resident level, van Schoor et al[46] (2002) identified illness (dementia), urinary incontinence and physical disabilities as common reasons for noncompliance. Consistent with these findings, we observed that deterioration of health from an acute illness frequently interfered with adherence, as caregivers were forced to prioritize other care needs over that of hip protection. However, we were unable to confirm that the presence of urinary incontinence and physical or mental disabilities consistently associated with declines in adherence. According to van Schoor et al[46] (2002), persons who suffered from physical disability needed more assistance to don and doff hip protectors, and this was perceived as unfavorable. We too observed that difficulty with use was an obstacle to adherence and that difficulty was exacerbated by upper and lower limb arthritis; however, this was selective to the most independent residents who were otherwise able to perform many activities of daily living (eg, toileting, dressing) on their own, and who experienced a sense of overwhelming loss of independence with protector use. In fact, it was this cohort of residents who consistently displayed the lowest levels of adherence, whereas those with more severe disability responded more favorably to hip protectors. Furthermore, the relationship between urinary incontinence and compliance was complex and nonlinear. In particular, adherence was compromised among those with frequent incontinent episodes (because of the need for frequent laundering of soiled garments), but unexpectedly improved among those who wore incontinence materials. To explain this, investigators suggested that hip protectors might have helped to hold in place incontinence materials,[69] or that residents who were used to wearing incontinence materials might have been desensitized to tight fitting undergarments and experienced less discomfort.[76]

We uncovered some knowledge of the causes of, and the types of residents who engaged in, compliance in wearing hip protectors. Some important predictors of acceptance and/or adherence at the resident level were clinical risk factors for falls and fragility fractures, recognition of the need for hip protection, positive attitudes regarding the effectiveness of hip protectors, and peer and family advocacy. As such, strategies to overcome resident level barriers could incorporate interventions to increase client (family, friends, residents) awareness of risk factors for falls, risk factors for fall-related hip fractures, and the potential benefits associated with protector use. Whenever possible, we advocate that education programs enlist older adult peer educators and/or family to facilitate knowledge transfer and exchange. Notably, in 1 study, convincing residents about the positive effects of hip protectors became more difficult each time a hip fracture occurred while protected,[67] suggesting that it is especially important to inform caregivers, residents, and families that hip protectors cannot prevent fracture in all circumstances[42] (eg, in situations of spontaneous fracture without any obvious external impact,[84] when the hip breaks because of a backward fall or a fall to the knees,[85] or when the hip protector is not correctly positioned[86]).

Unlike the previous review, we identified negative perceptions of caregivers regarding the amount of effort needed to apply hip protectors, hygiene, side effects, and maintaining the dignity and autonomy of residents as damning reasons for noncompliance. According to 1 study, some staff members made the decision to apply hip protectors even without gaining the clear consent of residents, whereas others decided not to offer hip protectors to those whom they felt would be unable to express their wishes.[54] Furthermore, in another study, 68% of caregivers responded that they had more impact on the wearing of hip protectors among residents with dementia.[74] These findings highlight the importance of training staff to balance safety issues with residents' rights to individual choice and autonomy,[87] and the need for educating staff on how to communicate effectively with residents who have difficulty making themselves understood or understanding others (eg, cognitively impaired).

In line with results from van Schoor et al[46] (2002), staff commitment was a key facilitator of compliance. Only 1 study attempted to quantify the strength of the relationship between caregiver commitment and adherence. It was shown that a 1-unit increase in the commitment of registered nurses, scored by research staff on a scale of 0 to 4, associated with a 3.1% increase in adherence.[64] However, as the criteria in which research staff evaluated commitment are unclear, and no definition of commitment was reported, a priority of future research should be to confirm this relationship using definitions of commitment established a priori. In future research, it might also be interesting to explore whether targeting commitment, via modifications to job- or work-setting variables (eg, leadership behaviors, emotional exhaustion), translates into improvements in compliance. As leaders in implementation science suggest, key drivers of success in effective implementation of new 'best practices' are competency, organization, and leadership, where qualified leaders are empowered to make decisions, provide guidance and access the necessary resources to support organizational goals.[88]

Implementation scientists have also long observed that commitment to change must happen at the staff and organizational levels for diffusion of new evidence into practice, and it is the combination of these that "result in consistently effective outcomes that can be sustained across generations of recipients, practitioners, and organization leaders (p. 421)."[89] The most significant contribution of this review, perhaps, is the novel synthesis of system level barriers and facilitators to acceptance and adherence. Here, determinants of noncompliance related to workforce shortages or excessive workload, frequent turnover of frontline and managerial staff, and inadequate communication with frontline staff, whereas features linked with improved acceptance and adherence included facility commitment, offering structured education on hip protectors, provision of hip protectors are no cost, and ongoing support from external sources, especially the recommendation of hip protectors by physicians. However, a recently published survey of US health care providers' perceptions of hip protectors revealed that only 38% (53/139) of respondents were aware of hip protectors, and of those who had heard of them, 62% (33/53) indicated that they hadn't recommended hip protectors to at least a few patients.[90] None of the providers who doubted the efficacy of hip protectors recommended them to any of their patients.[90] A potentially fruitful mechanism to enhance compliance, consequently, may be through improved health care provider awareness of the efficacy of hip protectors, especially for patients who are willing and able to wear them.

Conclusions

Findings from this systematic review should provide decision makers, health professionals, and caregivers with a greater awareness of strategies to improve acceptance and adherence with hip protectors in LTC. Furthermore, researchers can use this information to design better clinical trials that will yield high compliance. Also, manufacturers working on the development of hip protectors can use this information to identify improved approaches to product design that are more acceptable to hip protector users and those who care for them. Because acceptance and adherence are significant factors in hip protector efficacy, a better understanding of these factors may

ultimately lead to a reduction in the frequency and burden of hip fractures among older adults in LTC facilities.

Supplementary Data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jamda.2014.12.004.

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