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***RISK FACTORS FOR FALLS AND PREVENTIVE MEASURES IN
OLDER PEOPLE:***

A LITERATURE REVIEW

ÁREA CIENTÍFICA DE GERIATRIA

TRABALHO REALIZADO SOB A ORIENTAÇÃO DE:

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Risk Factors for Falls and Preventive Measures in Older People:

A Literature Review

Abstract

Background: Falls are a serious problem of public health that is becoming more prominent in an ageing society.

Methods: The search was made through the services offered by the library of the University Hospitals of Coimbra (CHUC), using the MEDLINE database. The keywords we proposed for the research were “falls”, “falling”, “old people” and “elderly”. We asked for recent articles (2011 and 2012) and the selection was made in order to approach holistically the thematic of the fall in the elderly, specifically the epidemiology, the most important risk factors (according to various authors) and their relation with fall prevention measures.

Results: We identified a series of risk factors that have a major impact in this matter, such as age, gender and race, posture and mobility, polipharmacy, physical impairments, executive function and cognitive impairments, home scenery. Proper interventions targeting to reduce the incidence of falling among the ageing population were evaluated. Several gaps on these preventive measures were brought to light.

Conclusions: The present analysis provides an updated comprehensive review of prospective studies on risk factors for falls and identifies a variety of fall prevention interventions. It emphasizes the need to invest in the development of this study area, once it is a vital part of an integrated care of the elderly.

Keywords: falls, falling, old people, elderly.

Factores de Risco para Quedas e Medidas Preventivas no Idoso: Uma Revisão da Literatura

Resumo

Contexto: A queda no idoso representa um sério problema de saúde pública que se tem vindo a tornar mais proeminente numa sociedade que se encontra a envelhecer.

Métodos: A pesquisa foi feita através dos serviços oferecidos pela biblioteca do Centro Hospitalar da Universidade de Coimbra, usando a base de dados da MEDLINE. As palavras-chave propostas para a pesquisa foram “queda” e “idosos”. Pedimos artigos recentes (2011 e 2012) e a selecção foi feita de modo a abordar holisticamente o tema da queda no idoso, especificando a epidemiologia, os principais factores de risco (de acordo com vários autores) e a sua relação com medidas preventivas.

Resultados: Identificámos uma série de factores de risco que assumem uma particular importância neste campo, tais como idade, género e raça, postura e mobilidade, polimedicação, deficiências físicas, alterações na função executiva e cognição, ambiente doméstico. Várias estratégias de intervenção procurando reduzir a incidência das quedas numa população envelhecida foram avaliadas. Algumas falhas relativas a estas medidas preventivas foram reconhecidas.

Conclusões: A presente análise fornece uma revisão actualizada de estudos prospectivos relacionados com factores de risco para quedas no idoso e identifica uma variedade de medidas de prevenção. Enfatiza a necessidade de investir no desenvolvimento desta área de estudo, uma vez que constitui uma parte vital de um cuidado integrado do idoso.

Palavras-chave: queda, idoso

1. Introduction

Falls are common in older persons. Although Gillespie and his colleagues (2012) or Bradley (2011) refer that 30% to 50% fall-related injuries are unimportant (like bruising, abrasions, lacerations, strains or sprains), the consequences of fall include serious physical injuries in 25% of cases (Pérula et al., 2012). Falls can also lead to psychological traumas. Falls are a key public health concern either as they have physically and psychologically adverse impacts on the older person or as they are a major cost to healthcare systems worldwide. Various factors have been identified that independently contribute to the risk of falling or a fall-related injury. A fall may be due to age related factors and the patients fading health. Physiological and psychological changes and also environmental changes may affect the older person. Identification of potentially modifiable risk factors for falls is important for developing fall prevention strategies and interventions. So, taken a multidisciplinary approach to the risk assessment of falls seems important to identify areas of interventions and support. Providing care for an ever-increasing ageing population encompasses recognizing the important crossing between age and the way in which health care interventions are supplied (Sinha & Detsky, 2012). The intention of any falls prevention program should be to prevent a person from becoming a faller and, if the person has fallen formerly, to diminish the potential to fall again. Current research has been done in the area that focus in particular aspects of either identification of risk factors (Muir, Gopaul, & Odasso, 2012) or fall prevention strategies (Dickinson et al., 2011). Some research included a systematic review of specific and precise features respecting risk factors for falls (Deandrea et al., 2010) or interventions for preventing falls in older people (Gillespie et al., 2012). Although previous studies have examine those issues separately, no previous studies have brought them together and, more, have synthetized areas that should be further investigated. This paper provides background relating to the revision of types of risk factors commonly identified in the literature,

summarizes types of fall prevention strategies most studied, and reviews the identifiable gaps of the research in the area of falls in older people. Aims of the present study are threefold: first, to provide an updated comprehensive review of prospective studies on risk factors for falls in the elderly; second, to identify the variety of fall prevention interventions proposed in the literature; and, third, to report lack of research in the area, in researchers own words.

2. Methodology

Once defined the faculty advisor, the theme of falling in the elderly was proposed by us, the same having been subsequently accepted. Bearing in mind the purpose of the study and the diversity of elements to be collected, the collection of information was made through the services offered by the library of the University Hospitals of Coimbra (HUC), using the MEDLINE database. The keywords we proposed for the research were “fall”, “falling”, “old people” and “elderly”. For a first approach, we asked for recent articles (2011 and 2012) either in Portuguese or in English. As a result came a list with five hundred articles containing the title, abstract, authors, dates and magazines where they were published.

Once we analyzed the presented list, we selected a great number of articles assuming that if we open our choices with an enlarged pattern, our results would be richer. The goal was to collect articles that would allow us to approach holistically the thematic of the fall in the elderly people, specifically the epidemiology, the most important risk factors (according to various authors) and their relation with fall prevention. The option of centralizing this review article in these topics is related with the increasing impact of the problem in an ageing population that needs to be taken care by improved methods and technics of prevention. The articles were also chosen by their actuality. After reading the first choice of articles, we noticed that some of the articles mentioned others with similar thematic. Most of them were

meta-analysis of the theme falls in older people. They were added to our list to complement our work.

3. Background and Epidemiology

A fall is defined as an unexpected event, including a slip, in which the person comes to rest on the ground, on the floor or on a lower level.

About a third of people over the age of 65 have one fall each year (Buracchio et al., 2011) with almost half of these experiencing more than one fall (O'Halloran et al., 2011). And this rates rises with the increasing age of the population (Pérula et al., 2012). Like Grundstrom (2012) refers, adults 80 years of age or older have about a 50% increased risk of fall-related injuries, compared with adults between 65 and 69 years of age. Even if falls result from multiple interacting factors, 15% of them result either from an external event (that would cause most people to fall) or, in the same proportion, from a single identifiable cause (like a syncope) (Gillespie et al., 2012). Previous studies have reported that about 50% of falls in older people occur outdoors, mainly if they are active and healthy people (Kelsey et al., 2012).

The consequences of falls among older people vary widely. Falls themselves include fractures in 5% to 6% of cases (Pérula et al., 2012), hip fractures in 87% of cases (Parijat & Lockhart, 2012), head injuries in 5% to 10% of cases (Deandrea et al., 2010) or fear of falling again between 30% and 75% of cases (Pérula et al., 2012). As Bradley (2011) details, this is particularly serious since, for example, the 1-year mortality after a hip fracture turns to be 25%, and only half of those surviving recover their baseline ability to perform their daily living activities.

Other authors also associate figures and falls. Hill and Wee (2012) list the most common injuries that cause hospitalization: forearm fractures (26.4%), femoral fractures (22.9%),

fractures of the lower leg and ankle (13.8%), open wound of the head (11.4%), shoulder or upper arm fracture (10.9%), lumbar spine or pelvic fracture (7.3%), traumatic brain injury (10%) and intracranial injury (7.3%). In 2006, 1 in 40 falls led to hospitalization with 50% of those dying within a year (Rubenstein, 2006). Falls represent a prominent cause of hospital admissions for trauma and deaths in older adults. Furthermore, 20% inpatients falls at least once during a hospitalization which, besides considerable incremental injuries, is responsible for increased lengths of stay (Sinha & Detsky, 2012).

Additionally, 50% of those who fall are unable to get up on their own afterward, which can lead to pneumonia, pressures sores or dehydration (Bradley, 2011). Many of these injuries cause lengthy hospitalizations and long-term disability. Hospitalized older adults have a high risk of falling (about 25%) especially within the first 3 days of admission. Of the older adults who fall in the hospital, 20% to 30% experience moderate to severe injuries and 11% of falls that occur in hospitals occur in rehabilitation settings (Ferrari, Harrison, & Lewis, 2012).

Falls can also lead to psychological traumas (Chen, Peronto, & Edwards, 2012) like loss of confidence (Gillespie et al., 2012), activity avoidance, health decline, loss of independence and admission to a long-term care facility or disability and fear for falling (Kelsey, Procter-Gray, Hannan, & Li, 2012; Perracini, Teixeira, Ramos, Pires, & Najas, 2012). More, falls can induce older people (>65) to limit their regular activities and so lead to social isolation (Pérula et al., 2012). As O'Halloran (2011) contend, following a fall, "old people often voluntarily restrict their activity fearing a reoccurrence" and so, falling in older age can start a vicious cycle of immobility and diminished self-confidence. As a result of fear of falling, up to 40% will restrict their activities which decreases their physical fitness, causes depression and social isolation, and leads to an even higher risk of falling (Bradley, 2011). More, falls can lead to social isolation and institutionalization (Clemson et al., 2012). Furthermore, falls are the major reason for 40% of nursing home placements (Bradley, 2011). For old people in long-

term care facilities, falling is a main concern requiring preventive intervention as 1 in 2 residents fall within a six month period. In fact, as the proportion of older people with physical, cognitive impairments or others frailties is high, the fall incidence raises to up 80%, annually (Nitz et al., 2012).

But falls in people over 65 years have important economic costs, apart from health and social ones. In fact, the direct medical costs associated with fall injuries are also of significant financial burden. For example, in the United States in 2000 these costs hovered approximately \$19 billion (Grundstrom et al., 2012). And the predicted costs for 2020 might reach over \$85 billions (Chen et al., 2012). As these statistics demonstrate, the impact of falls cannot be overlooked and, consequently, the need to explore ways to prevent them is demanding.

Various factors have been identified that contribute to the risk of falling. Not surprisingly, a person's risk of falling increases with an increasing number of risk factors, from an 8% risk of falling with zero risk factors to a 78% risk with ≥ 4 risk factors (Bradley, 2011). Nevertheless, some risk factors are associated with a higher risk of falling than others. The systematic research of Tinetti and Kumar (2010) found that the risk factors that were the most highly correlated with falling were previous falls, medications and impairments in strength, gait, and balance.

Mainly for all older adults who present a previous fall or problem with gait or balance, a multifactorial fall risk assessment (including a fall history, gait and balance evaluation, physical exam and environmental assessment) is recommended (Bradley, 2011). Several fall prevention strategies that emphasize balance, gait training, reduction in the use of some medications, improvement in vision, use of assistive devices or the elimination of home menaces, have been developed (Kelsey et al., 2012). Several strategies, like multiple-component exercise programs, tai chi, withdrawal of psychotropic medications, vitamin D

supplementation or early cataract surgery have all been shown to reduce fall rates. More, multifactorial interventions that include vision correction, medication review, environmental modification and balance, strength, and gait training can also be beneficial in preventing falls (Bradley, 2011). So, knowing which elders are likely to fall under certain circumstances should help prevention efforts by enabling different recommendations. The question is how to tailor fall prevention programs to personal characteristics or activities (Kelsey et al., 2012).

4. Risk Factors

A number of independent factors seem to predict falls in older adults. Even though Gillespie and his colleagues (2012) refer that many risk factors appear to interact, mainly in those who have already suffer fall related fractures, the majority of falls are the consequence of interactions between environmental and personal risks (Gillespie et al., 2012). Falls in older adults increased as their risk factors increased (Milat et al., 2011). Chen and Janke (2012) lists several physical health and function characteristics that have been identified as the most common risk factors: poor balance and gait, functional limitations or chronic conditions are some of them. But others can be listed.

Age, gender and race

Certain socio-demographic characteristics of adults have been associated with falls. Age, gender and race are three of them. On the one hand, people age 85 and older who fall have a rate of fall injury almost four times more than adults age 65 to 74 (Centers for disease control and prevention, 2012; T.-Y. Chen & M. C. Janke, 2012). On the other hand, among older adults, non-fatal fall related injuries disproportionately affected women. But, despite rates of fall-related fractures among older women more than doubles those for men, men are more likely to die from a fall (34% higher for men than for women). The study of Rapp, Becker,

Cameron, König, and Büchele (2012) shows that, in men, fall rates increases with increasing age categories, while fall rates in women slightly decrease with age. More, being caucasian has also been reported as a risk factor, with caucasian people aged 75 and over more likely to fall than black people with the same age (Centers for disease control and prevention, 2012). Of a special interest is the study of Kwan, Close, Wong, and Lord (2011) that revealed a consistently lower incidence of self-reported falls in chinese older people than in caucasian ones, even if the types and frequency of risk factors were not dissimilar. As these authors suggest, maybe the health, behavioral, and lifestyle factors have something to tell us.

Falls, posture and mobility

Walking is a keystone of independent living and an important element of quality of life for elders. It is a multifactorial motor skill that mobilizes different organ systems (Viljanen et al., 2012). The ability to move and maintain an upright posture is crucial to human survival. Either because the protection of organ systems or because the preservation of body functions. Gait variability and walking difficulties have been associated with several chronic systemic diseases. With increasing age, maintaining an upright posture and good mobility turn out to be increasingly difficult and falls become an expression of this phenomenon (Sinha & Detsky, 2012). But, if fall rates are progressively being used to connote the quality of care provided by hospitals and the easiest way to prevent falls is to decrease the chance they may occur, we can understand that the concern with preventing falls may lead, at times, to active discouragement of mobilization (Sinha & Detsky, 2012). And resting in bed is physiologically, anatomically and psychologically unsound.

A lasting concern that leads to an individual avoiding activities that one is capable of performing is fear of falling (Viljanen et al., 2012). Previous research identified a correlation between fear of falling and falls, but it is unclear which comes first. The research of Viljanen

et al. (2012) indicated that mobility decline in old age can be attributable to the combined effect of fear of falling and coexisting sensory difficulties. In fact, it is possible that the coexistence of multiple sensory difficulties can hinder older people from getting compensatory information about their body position, thus increasing fear of falling. Which, in turn, can jeopardize outdoor mobility.

Polypharmacy

Polypharmacy, defined as using >4 medications seems to increase the risk of fall. In geriatric patients, polymedication is associated with a significant increase in risk of falls in elderly patients, regardless of drug class (Freeland et al., 2012). As Kojima et al. (2010) state, elderly patients with polymedication are at a high risk of falls, mainly if they receive five or more drugs.

Medications are often considered to be an intrinsic fall risk factor, given the internal effects that some can have on the systems related to effective balance performance (Hill & Wee, 2012). And, as Tinetti and Kumar (2010) states, the use of certain classes of medications are more likely to be taken by older adults. For example, more than 20% of older people in the community take one or more of psychotropic medications and up to 80% of older people in residential care settings take at least one psychotropic medication (Hill & Wee, 2012). There is also increasing evidence that these medications can be fruitfully reduced or even ended in dosage, and that these action can be associated with a reduced risk of falls and other adverse events (Hill & Wee, 2012).

Physical impairments

Impairment of gait and balance, vision impairment, orthostatic hypotension, diabetes, hypertension, chronic liver disease and musculoskeletal problems (arthritis) are some of the previous identified risk factors for falls (Buracchio et al., 2011; Frith et al., 2012).

The results obtained by Frith and others (2012) verified that falls are prevalent in older people with chronic liver disease but unrelated to the disease severity.

Older adults are at the greatest risk for obstacle collision as visual processing time increases and reacting time decreases with age (Reed-Jones, Dorgo, Hitchings, & Bader, 2012).

Several studies (e.g. Eggermont, Penninx, Jones, & Leveille, 2012) estimates that the prevalence of depression in older adults ranges from 13% to 23%, occurs more frequently in women and is related with poorer social status. More, research show evidence (e.g. Anstey, Burns, von Sanden, & Luszcz, 2008) that depressive symptoms are associated with fall risk in older adults. But, as stated by Eggermont et al. (2012), certain depressive symptom clusters may be more associated with falls than others. In fact, on the one hand the studies of Anstey et al. (2008) concluded that depressive symptoms, together with control and moral are risk factors for subsequent falling and an increase in depressive symptoms or a reduction in moral are associated with an increasing fall rate. On the other hand, the research of Kerse and others (2008) sustain that depressive symptoms and the use of antidepressants (typically selective serotonin re-uptake inhibitors) are independently associated with enlarged risk of falls in later life. More, they sustain that different risk factors are responsible for a single and multiple falls. Interestingly, the findings of Eggermont et al. (2012) emphasize that among more active older people the occurrence of depressive symptoms (but not depression itself) can play some role in fall protection. Indeed, as older adults with mood disorders lean towards a lack of interest in social activities, tend to reduce their exposure to outside activities, which in turn may possibly diminish the risk of falls.

The presence of chronic pain is also strongly associated with increased fall risk (Eggermont et al., 2012). Indeed, as several authors state (e.g. Onder et al., 2005), pain is associated with depression, particularly among women. So, chronic pain acts as a mediator between depressive symptomatology and fall risk.

Another physical impairment, not typically considered a risk factor for falls, is hearing loss. The contribution of Lin and Ferrucci (2012) show consistent results with prior research studies that explain the observed association of hearing loss with falls. Particularly, it is possible that decreased hearing sensitivity may limit access to auditory reminders that are needed for environmental consciousness. Further, it is also possible that falls and hearing loss are mediated through reduced attentional resources responsible for sustaining postural control. This approach justifies why hearing loss may impair the maintenance of postural balance in daily life situations and increase the risk of falling (Lin & Ferrucci, 2012).

The analysis of Grundstrom et al. (2012) about risk factors for falls and related injuries proved evidence that increasing body mass index, health problems requiring assistive devices, consumption of alcoholic beverage, number of days of insufficient sleep or the history of a stroke, was found to be associated with greater fall risk.

An unexpected arena of risk factors results from the research of Chung-Hao, Kuo-Chen, Shou-Jin, Yung-Chang, and Maw-Sen (2011). In fact, they show evidence that larger waist circumference should be included as a novel risk factor for falls.

Executive function impairment and cognitive impairment

Executive function deficits may increase fall risk, even among older adults with no obvious cognitive impairment (Yogev-Seligmann, Hausdorff, & Giladi, 2008). In fact, the recent conclusions of Mirelman et al. (2012) seem to demonstrate that the evaluation of executive function and attention can provide very important information about the risk of falling. The

same conclusion is strengthened by others (e.g. O'Halloran et al., 2011). The work of Muir et al. (2012) confirms that cognitive deficits are associated with an increased fall risk. This means that the method used to define cognitive impairment and the types of fall outcome are important in quantifying risks. More, subtle executive function impairment can exist in healthy people.

But deficits in executive function can turn out to be a vicious circle. Indeed, as losses in executive function increase with age, this may prejudice the capability of the elders to compensate age related changes in posture or mobility. And this, in turn, may compromise the ability to deal and manage with day to day surroundings (O'Halloran et al., 2011).

Attention is a specific component of executive functioning. Research from several authors (e.g. O'Halloran et al., 2011) revealed that small marks on tests of attention have been correlated with increasing gait variability and postural unsteadiness, both of which are related to falls. Further, and as older people allocate a significant part of their attentional resources to their gait, the changes related with attention that occur during ageing increase the risk of falls. But the studies of O'Halloran et al. (2011) also investigated whether performance and variability in sustained attention is associated with falls in older adults. Sustained attention measures the ability to direct and focus cognitive activity on specific stimuli. So, in order to complete any cognitively planned activity one must use sustained attention. The conclusion was that variability in sustained attention is strongly correlated with falls. Cognitive impairment includes attentional impairment, which is associated with impulsivity, a known fall risk factor and cognitive impairment has been associated with impulsivity-related falls (Ferrari et al., 2012).

Home scenery

Around 50% of falls occur at home. Therefore, taking particular measures to adjust the home environment to prevent falls can be advantageous for high-risk people (Pérula et al., 2012).

Although several researchers were interested in knowing risk factors for falling (e.g. Deandrea, 2010), currently strategies for fall prevention only managed to reduce the recurrence of falls in less than 40% (O'Halloran et al., 2011). So, for these reasons, it seems imperative not only to identify additional risk factors but also to develop effective strategies for fall prevention in a long term. Further, as more as one knows fall risk factors more effective interventions can be taken to decrease the incidence of falls and related injuries in older age.

5. Fall Prevention and Risk Factors

Once risk factors for falls are identified, proper interventions targeting to reduce the incidence of falling among the ageing population can be thought. Many preventive intervention programs based on reported risk factors for falls have been established and evaluated. The revision work of Gillespie and his colleagues (2012) has shown that while there is strong evidence of effect for some interventions in preventing falls, there is no evidence of effect for others. In general, those conclusions do not include older people with dementia and so, evidence may not be applicable to them. Overall, falls prevention is a main question in endorsing positive ageing and raising independence among the older population.

Exercises

Although many risk factors for falls have been identified, intervention programs have found that the effects of exercise as a single fall prevention intervention are comparable to those

from multifaceted interventions (Campbell & Robertson, 2007). Therefore, widespread implementation of physical activity as a single intervention seems to be a very good approach to falls prevention.

Research indicates that exercise of moderate-intensity may be one approach not only to decrease risk factors of falls but also to reduce the incidence of falling in older people (Campbell & Robertson, 2007). But the intensity of the activity performed appears to be a risk factor as high-intensity exercises seem to be associated with an increased risk of falling. In fact, the results of Peeters and his colleagues (2010) suggest that the relationship between recurrent falling and physical activity is modified by physical performance and differs per type of activity. While, in physically fit older people, doing activities or sports with high intensity demands are associated with an increased risk of recurrent falling, doing moderate activities are associated with a lessened risk of recurrent falling (in women).

Overall, physical activity has been associated with having a positive effect on balance, gait, functional limitations and chronic conditions (T.-Y. Chen & M. C. Janke, 2012). The recognized importance of exercise and training lead different sports and geriatrics institutions to provide specific guidelines recommending either aerobic and muscle-strengthening activities or flexibility and balance actions to older adults (Reed-Jones et al., 2012).

Quite a few fall prevention interventions have arose in the last several years. According to the review studies for the efficacy of interventions to prevent falling by Gillespie and his colleagues (2012), programs containing various categories of exercises (either delivered as group classes or individually prescribed at home) are strongly effective in reducing both risk of falling and rate of falls. Most common, are muscle strengthening and balance retraining exercises. However, there was no evidence that single category programs were effective. One interesting point is that group classes seem effective whether or not it involves only people at higher risk of falling.

Tai Chi, Yoga and dancing are typically classified as moderate-intensity activities (T.-Y. Chen & M. C. Janke, 2012). Most of the research on specific physical activities and fall risk has explored the effects of Tai Chi (e.g. Wooton, 2010). More specifically, the review studies of Liu and Frank (2010) indicates that Tai Chi may be an effective exercise program for improving balance in older adults. As well as exercise significantly seems to reduce the risk of having a fracture, also Tai Chi classes reduces the risk of falling but are less effective when participants are at a high risk. However, Yoga (Omkar, Vishwas, & Tech, 2009) and dance-based interventions are increasingly evident in the literature, as well. In fact, while Yoga exercises have given a new dimension to the understanding of yogic postures and breathing techniques with regard to core stability training, dancing seems to improve the physical function of older adults (more aerobic power, lower body muscle endurance, strength and flexibility, static and dynamic balance and agility, and gait speed of older people, especially female adults).

Another moderate-intensity activity is gardening. As Chen and Janke (2012) write, gardening is one of the most commonly activities older adults use to engage in. Not only gardening is an activity that many older adults are familiar with and enjoy, it also appears to be suitable to use in fall-prevention as it is significantly associated with better gait speed and better balance in the ageing population (Keogh, Kilding, Pidgeon, Ashley, & Gillis, 2009).

A combination of exercise and daily life activity is another area of emergent research interest. The study of Clemson and others (2012), gives evidence that the integration of balance and strength training into daily life activity reduces the rate of falls in older people. In this kind of approach, movements prescribed are specifically embedded within everyday activities. The objective is that the movements can be done multiple times all through the day, leading the occurrence of exercises whenever the opportunity arises. This makes the program unique and new, providing an additional choice to traditional exercises.

The identification of effective interventions in preventing slip-induced accidents in older people is vital for fall prevention. Targeted to improve specific motor skills related to recover from a slip-induced fall, some training programs were designed. The intention is to promote muscle coordination directly related to the ability of recovering from a postural perturbation like a slip. Overall, several studies (e.g. Lam, Anderschitz, & Dietz, 2006) provide evidence that repeated slip-perturbation training is responsible for the improvement in adaptive responses to slip distresses. Parijat and Lockhart (2012) analyze the effects of using moveable apparatus in improving recovery reactions and reducing fall frequency among the elderly. In an active preventive way, the review of Campbell and Robertson (2007) lists an extended group of best practice guidelines which highlight features of exercise programs which, in turn, are likely to be associated with greater falls prevention effects.

Promote and reward mobility

In order to prevent the harmful consequences of immobility, several authors (e.g. Sinha & Detsky, 2012) recommend routine strength and balance training as a priority to improve mobility. This focus not only can potentially lower the risk of hospitalization due to falls and fractures but also, and more important as age advances, can improve quality and extension of life.

As multiple sensory difficulties can increase fear of falling and jeopardize mobility, Viljanen et al. (2012) suggest that a regular screening of sensory functions can be at great help to prevent both the development of fear of falling and consequent mobility decline.

Medication

The systematic analysis about drug target of Gillespie and his colleagues (2012), includes vitamin D supplementation and medication withdrawal interventions. The evidence is that

vitamin D does not reduce either risk of falling or rate of falls, unless when administered to those selected on the bases of lower vitamin D levels at enrolment. More, vitamin D analogues (like calcitriol and alfacalcidol) may be effective but limited as the evidence base is associated with a significantly raised incidence of reported hypercalcaemia compared with placebo. On the other hand, it is possible that detailed recommendations on medication and patient involvement significantly reduce the risk of falling in older people (Gillespie et al., 2012). Notwithstanding permanent withdrawal is very difficult to achieve, the research of Campbell and Robertson (2007) shows evidence that gradual withdrawal of psychotropic medication significantly reduces the rate of falls, even if it does not reduce the risk of falling. In a broader sense, also Freeland et al. (2012) give merit to concern for the overall amount of medications prescribed to elderly patients and alert prescribers to carefully weigh the benefits of additional medication against the potential risk of falling in elder people.

Surgery

The review of Gillespie and colleagues (2012) on surgery only involved insertion of pacemakers and cataract surgery. Overall, cardiac pacing in fallers with carotid sinus hypersensitivity seems to be associated with a reduced rate of falls but not with the risk of falling. On the other hand, expedited first eye cataract surgery in women also seems to significantly reduce the rate of falls but a second surgery does not.

Fluid or nutrition therapy

Older people receiving oral nutrition supplementation do not seem to have reduced their risk of falling (Gillespie et al., 2012).

Visual training

The assumption that visual impairments are a risk factor for fall in older people, justifies the importance of the studies of several authors (e.g. Reed-Jones et al., 2012). Planned to examine the effect of visual training on obstacle course performance of older people, the study of Reed-Jones and colleagues (2012) shows evidence that visual training may be a significant consideration for fall prevention programs.

Control of chronic pain and depressive symptoms

The findings of Eggermont et al. (2012) direct support the idea that managing depressive symptoms and pain is an important step to reduce the occurrence of falls and the consequences that arise. So, if falls prevail with depressive symptoms, the management of depression in older people should be a routine in fall prevention strategies (Kerse et al., 2008).

Hearing rehabilitation

Another possible fall preventive measure results from the association between hearing loss and the adjustment of hearing rehabilitation (Lin & Ferrucci, 2012).

Executive function and attention

Once there is evidence that executive function is related to falls, and as part of the fall prevention process, it is suggested that the assessments of executive function and attention could be applied in the clinical evaluation of old people. That is why Mirelman et al. (2012) support the idea that, to augment the early identification of fall risk, tests of executive function and attention can incorporate screening batteries among old people. Since impairment in executive function can exist even with normality in global cognitive status,

assessment of this cognitive domain should be encompassed as part of a fall risk evaluation in older adults (Muir et al., 2012).

As previous research provide evidence (e.g. O'Halloran et al., 2011), greater variability in sustained attention is strongly correlated with event of falls in older adults. More, as declining in sustained attention seems to contribute to an increasing risk of falls, the opportunity exists to implement strategies to develop attention and, as a consequence, to decrease the risk and prevalence of falls in the older community. In short, sustained attention variability may, not only, afford a valuable and new biomarker for falls in older adults but also a potentially preventive intervention strategy for early detection of falls.

As already mentioned, impulsivity is a risk factor for older adult falls. The work of Ferrari et al. (2012) states that prompt identification of risk factors associated with impulsivity related falls can improve identification and reduce fall rates among hospitalized older adults. So, by identifying the risk factors for impulsivity related falls, health professionals can play a major role in the prevention of falls and, by this means, reducing related injuries.

Psychological interventions

The trials revisited by Gillespie and others (2012) show no evidence of effect either on rate of falls or on risk of falling.

Environment

The majority of falls among elders are the result of interfaces between personal and environmental risk factors (Pérula et al., 2012). Home safety assessment and interventions to improve it appear to reduce rate of falls and risk of falling. These modification interventions are even more effective when carried out by occupational therapists, specially in people with higher risk of falling (Currin, Comans, Heathcote, & Haines, 2012).

Although it is clear that the ability to independently and safely move oneself from place to place is an important key component necessary to improve mobility, when performing activities of daily living, some aspects are not so well known. Namely, what aspect of the home environmental assessment reduces the risk of falling. But some recommendations are made. These include modifying or removing potential hazards that can muddle the path, increasing lighting levels or applying nonslip tapes to step edges (Currin et al., 2012). Nevertheless, the full potential of home safety assessment will be accomplished only if suggested modifications are actually implemented. So, an important point is the understanding of the factors that influence whether older people implement or not, a recommendation. Which leads to the development of strategies that can improve uptake of home modifications (Currin et al., 2012). The identification of factors that potentially affect the level of adherence to home interventions among the oldest, are usually and usefully categorized into intrinsic and extrinsic factors (to the elderly). While, typically, the first include demographic details (for example, age, gender, educational level achieved, cognitive function or mobility level) and physical measures (such as whether a mobility device was used and the type of it), extrinsic factors include type of accommodation, living arrangements or the knowledge that there is a carer. Most falls are due to a combination of contributory intrinsic, extrinsic and/or behavioral risk factors (Hill & Wee, 2012).

So, the question is about the interplay of intrinsic and extrinsic factors that influence the adherence so that the full effect of home intervention for fall prevention can be realized. Or, as Currin and her colleagues (2012) emphasize, the uptake of recommendations depends on the type of the intervention, the individual itself and on the carer.

Assistive technology

The review of Gillespie and colleagues (2012) also included interventions to improve vision and footwear modifications (devices to increase grip in winter outdoor conditions and balance-enhancing insoles). In fact, during major changes in spectacles prescription or while adjusting to new ones, the risk of falling increases. So, vision improvement by providing single lenses glasses can reduce falls mainly in those that spend more time outdoors. But, the other side of the story is that this same aspect increases outdoor falls in poor health people. Regarding footwear, one trial prove that anti-slip shoes worn in icy conditions can also reduce, significantly, outside falls in winter. Appropriate walking aids may then be introduced to promote safety and ensure that the older person has a stable base on which they can maintain balance (Jones & Whitaker, 2011).

Education interventions

The analysis of Gillespie and others (2012) was not conclusive for the provision of educational materials in preventing falls. This means that future studies shall include this point.

Residential aged care facilities are locations with particularly high risks for falls. So, specifically in these nursing homes, there is a great need to target preventive measures. The findings of Gillespie et al. (2012) suggest that multiple and pertinent decisions to the specific circumstances appears to have resulted in cultural change. In the opinion of Nitz et al. (2012) and to effectively participate in falls prevention in their workplace, an important aspect is that all workers in long-term care facilities need to gain knowledge to empower them to engage preventive actions.

The level of care was also strongly associated with fall risk. In fact, particularly high risk is observed in older people with medium care needs (Rapp et al., 2012).

The uptake of fall prevention interventions: role of health professionals

Even though the prevention and management of falls in elders is a key public health priority of governments and quite a lot intervention programs have been established and evaluated, uptake of interventions averages only 50% and can be as low as 10% (Dickinson et al., 2011). So, an important point is to pinpoint the fences and the facilitators to participation in fall prevention. The systematic review of Bunn, Dickinson, Barnett-Page, McInnes, and Horton (2008) have concluded that, while social support, low intensity exercise, greater education, involvement in decision-making, and a perception of life-enhancing programs act as factors that facilitate participation, others do not. The factors that hinder participation included fatalism, denial and under-estimation of the risk of falling, no previous history of exercise, poor self-efficacy, low health expectations, fear of falling, poor health and functional ability and the stigma associated with programs that targeted older people.

The research of Dickinson et al. (2011) brings up to discussion the inclusion of routine and opportunistic questioning of older people about recent falls by practitioners in primary care settings. This means that health professionals have an important role in the prevention and management of falls. So, and in line with the barriers previous identified with falls-prevention programs, a major hurdle is the reluctance of elders to report falls to health professionals. The same study (Dickinson et al., 2011) mentions that whilst for some elders finding information relating to falls and locating fall prevention interventions can be an enormous problem, others refer to health professionals as navigators, referrers and information providers.

A huge variation in their interactions with health professionals is described by older people, which impacts either negatively or positively on their uptake of fall prevention interventions. From the discussion proposed by Dickinson et al. (2011) it appears that those professionals working in primary community settings can have a major role to play in the proactive screening and case finding, promoting fall prevention and facilitating older people's access to

fall prevention programs. Still, there is a need for better spreading of information about fall prevention and related services either to the general public or to health professionals.

According to Jones and Whitaker (2011), referral to the physiotherapist may also be essential to assess the individual's gait and balance.

Risk assessment

A key tool in the process of identifying those at risk of falling is risk assessment. But even that has to be carefully planned. In fact, for a risk assessment to be of use it must not only be manageable and accessible but also effective in a way to boost accurate and appropriate interventions. As mentioned, a central aspect concerning falls prevention is the accurate reporting of a fall event. Overriding to fall reporting is the understanding of what constitutes a fall. In order to do that reporting one should include all the maximum circumstances as possible that surround an occurrence of fall. Besides info like time, place, activity carried out at the time of the fall, medication in use or personal impairments, also circumstantial data is important to assist future fall prevention (Nitz et al., 2012).

Another interesting point is the one of Rapp et al. (2012) who observed that, in nursery homes, the occurrence of falls differ within the course of the day. Two main peaks were observed: in the later morning and in the afternoon till the early evening. This means that, particularly in resting houses, working personal have to pay particular attention to the elders during these periods.

Older adults with cognitive impairment are a growing population in need of inpatient rehabilitation services and will need more effective fall risk assessment measures. Screening for impulsivity to prevent falls, is one of them (Ferrari et al., 2012).

Several multifactorial fall-risk assessments (e.g. Bradley, 2011) recommend health professionals to found out about the patient's fall history, a physical examination including a

gait and balance evaluation, and an environmental assessment. Basically, the fall history should include questions about chronic medical conditions, medication review, substance use, associated symptoms, circumstances of falls, injuries, and ability to perform daily living activities.

As fear of falling and falls share predictors, individuals who are at a high risk of developing these can also be identified (Friedman, Munoz, West, Rubin, & Fried, 2012).

Economic evaluations

The comprehensive economic evaluation made by the revision work of Gillespie and colleagues(2012) provided some evidence that falls prevention strategies can save costs during the trial period, and it can be also cost-effective over the participants' remaining lifetime.

Multiple interventions

While several studies proposed by Gillespie and others (2012) consist of singles interventions of one major category only, multifactorial interventions consist of more than one main category of intervention with participants receiving different combinations of them. The study does not identify different combinations of components, since there were several interventions components in each trial. Overall, only a few multifactorial interventions significantly reduce the rate of falls. Multifactorial intervention is also mentioned by Frith et al. (2012) as a potential prevention for fall in older people with chronic liver disease.

Older people living in residential aged care facilities are at a greater risk of experiencing a fall (Nitz et al., 2012). So, as the need for a change is demanding, multiple prevention practices must be undertaken. Eventually, the findings of Nitz et al. (2012) suggest that outcome

elapses from the combined effect of environmental improvement and education of staff, residents and families concerning factors contributing to falls.

The findings of Kelsey et al. (2012) have indicated that even though fall prevention efforts shall reach all older people, they are likely to be more effective if tailored to certain activities amongst certain groups. In other words, Kelsey and her colleagues suggest that it would be important to develop separate prevention programs for relatively frail people who are likely to fall at home and for active people who are likely to fall outdoors.

Nevertheless, current intervention strategies targeted to minimize risk factor for falls only result in a 30% to 40% reduction in the recurrence of falls (Gillespie et al., 2012), which mean that there still is a strong need to identify additional risk factors and, as important as that, to make effective intervention strategies (O'Halloran et al., 2011).

6. Identifying gaps

Fall prevention begins by identifying fall risk factors. Many recommendations and interventions have already been done (e.g. American Geriatrics Society and British Geriatrics Society, 2011). Nevertheless, as research suggests, fall prevention strategies aimed at older people is still insufficient. Either because previous studies have been either inconsistent or based on small populations or, even, been limited to individuals specific conditions (Grundstrom et al., 2012). It is therefore necessary to conduct studies for verifying the efficiency of these interventions.

In view of the large personal and social problematic from falls in general, and all kinds of different consequences in particular, further fall prevention efforts are urgently needed.

Gender

Even though the research of Rapp et al. (2012) shows that, fall rates in women slightly decrease with age while, in men, fall rates increases with increasing age categories, the same authors recommend that, apart some potential reasons they present, more investigation is needed to sustain the general conclusion.

Physical impairments

As previous studies suggest (e.g. Anstey et al., 2008) depression increases the risk of falls, low bone mineral density and fractures. Particularly, the research of Whitson et al. (2008) with a large community cohort with depressive symptomatology, did not predict a five-year risk of clinical fracture in older adults. Nevertheless, the author suggests that further research is needed to conclude if individuals with major depressive disorder are at a higher risk of fracture and whether hormonal deregulation might contribute to such risk.

As well, Eggermont et al. (2012) settled that depressive symptoms and chronic pain are associated with fall risk. So, and due to the modifiable nature of both depression and pain, further investigation research is needed to evaluate if intervention strategies managing depressive symptoms and pain can, potentially, diminish the occurrence of falls and associated consequences.

As previously presented, some other different risk factors were also studied by Grundstrom et al. (2012). Mainly, the author and her colleagues notice that further research is needed for those with a very high body mass index.

In addition to other associated factors, Chung-Hao et al. (2011) propose that waist circumference should be included as a novel risk factor for falls. As it is not largely studied, the same authors also suggest that waist circumference should be included in a future screening tool to identify risk for falls and help to articulate strategies for fall prevention.

Also within physical impairments, the findings of Lin and Ferrucci (2012) are consistent with prior research studies that have associated hearing loss with falls. Still, they recommend that additional prospective research is needed to decide whether hearing loss is an amendable risk factor for falls that may be acquiescent to hearing rehabilitative strategies that remain underused.

Environment

Like Currin et al. (2012) concluded, home scenery audits are effective in reducing falls in the older person. But the full potential of an environment intervention will only be achieved if recommended modifications are, in fact, implemented. The problem is, as those same authors stress, that there is a lack of research into the complex area of observance of community older fallers to recommendations intended to decrease falls risk.

Visual training

The work of Reed-Jones et al. (2012) about how to incorporate visual training in older communities into programs for fall prevention, suggest that visual training improves obstacle avoidance and, consequently, reduces the number of falls. The problem that remains uncertain is to study the mechanisms that occur with this training.

Exercises

As Parijat and Lockhart (2012) found out, it seems that there is a valuable effect of perturbation training in reducing slip harshness and recovery kinematics. Nevertheless, some aspects still remain not clear. The first one is about how these same conclusions happens with different populations, since the study presented only recruited healthy adults. The second aspect has to do with the generalization of the conclusions to a larger group, since the study

only addressed a small number of participants. A third gap that has to be explored is about understanding for how long the improvements will be retained in older people. Finally, Parijat and Lockhart (2012) recommend that more research is needed to realize how older participants are capable of learning specific motor skills in order to transfer them to daily slip situations.

Findings from T.-Y. Chen and M. C. Janke (2012) indicate that gardening may be a potential activity to incorporate into fall prevention programs, as gardeners report significantly better gait speed and balance and seem to have fewer chronic conditions and functional limitations than non gardeners. However, and on the one hand, to more accurately examine the effects of gardening and determine which subtasks are more beneficial, more trials are recommended. On the other hand, and since the balance tests of the study of T.-Y. Chen and M. C. Janke (2012) only used static balance, future studies that also incorporate dynamic balance tests should be done.

As mentioned (Clemson et al., 2012) lifestyle integrated functional exercises seems to provide an alternative method to traditional exercise to take in consideration for fall prevention. But, as Clemson et al. (2012) declare, this is a possibility that also needs to be deeper studied to validate those findings.

Concerning the potential benefits of dancing, Keogh et al. (2009) believe that future research in this area is most necessary and should concentrate on a number of areas. To be precise, some research should investigate how to better structure dance programs for older adults to ensure participant safety and enjoyment while maximizing gains in physical function. This includes investigating the optimal duration and frequency of dancing, as well as comparing the relative effectiveness and safety of a variety of dance styles with other activities such as Tai Chi and resistance training. More, and because any group will have older adults with varying limitations and physical abilities, these studies should use dance programs that allow

differentiation of ability and ensure appropriate progression for all participants. Additionally, research into the factors that influence the commitment and adherence to a dance-based exercise program in this population should also be conducted.

Polypharmacy

In line with others, the study of Freeland et al. (2012) concludes that medication is associated with a significant increase in risk of falls in elderly patients, regardless of drug class. Nevertheless, as the authors recommend, more studies are needed to confirm that the more medication a patient takes the more likely he or she may be to fall. The same idea is spread by Kojima et al. (2010) stating that more studies investigating the effect of drug reduction for the prevention of falls are mandatory in the future.

Particularly, and like Freeland et al. (2012) mentioned, polypharmacy treatments of depression also have been associated with an increased risk for falling. However and for those same authors, it remains unclear whether the increased fall risk of pharmacological treatment of depression is related to the depression itself or to adverse effects of antidepressant use. More, Eggermont and her colleagues (2012) suggest that future studies should try to untangle whether better management of depression through the use of non-pharmacological therapies would reduce depressive symptoms and fall risk or, instead, in some way aggravate that risk. Hill and Wee (2012) still address another problem, this time with the usage of psychotropic medications. As already mentioned, all patients receiving psychotropic drugs should be aware of the related increased risk of falling, and should have a fall risk assessment to isolate other risk factors in order to shrink the risk of subsequent falls and related injuries. Those authors claim that, besides additional rigorous methods in future studies are needed to accurately investigate associations between medications and falls, there is also a need for further

research in order to evaluate alternatives to the use of psychotropic medications, and methods to reducing dosages if these medications are initiated.

Multiple interventions

In the specific situation of residential aged care, the epidemiological study of Rapp et al. (2012) reported descriptive data about falls and fall rate with exhaustive information about time, place and activity leading to the fall. The research found out that, in a rest house context, it seems the fall rates in the afternoon exceed those in the morning, the same with individual areas (rooms and bathrooms) versus common areas. More, the research found out that fall risk differed by degree of care need with the least and highest care categories experiencing lower falls risk. Though authors suggest potential reasons to explain the differences achieved, more accurate investigation is needed to confirm and support those findings.

From another point of view, the conclusions that Kelsey et al. (2012) support about the importance to tailor fall prevention programs to personal characteristics, locations and activities of each elder, also need to be evaluated in other studies.

Aligned with these same ideas, Gillespie et al. (2012) recommend that future studies should be focus on methods for increasing uptake and adherence to effective programs by older people. Namely, peer exercise instructions or academic detailing.

Education interventions

The investigation of Nitz et al. (2012) was designed to study if the implementation of a fall prevention intervention facilitated by an action research group decreased falls among residents living in long-term care facilities. Though the findings suggest that the specific circumstances of the study have resulted in cultural change regarding fall prevention, the

authors refer that a gap in the literature exists for the research of fall risks related to the outdoors in residential aged care facilities.

The work of Pérula et al. (2012), though aimed to determine the effectiveness of a multifactorial intervention program to prevent falls versus a single intervention, concluded that the extended approach was no more effective than the brief intervention. Even if intermediate results were incorporated (professionals should include health advices and preventive actions), it suggests that existing information is still insufficient and it will be necessary to continue research in order to verify the efficiency of these interventions and achieve greater consistency in the results.

Particularly interesting is the opinion of Grundstrom et al. (2012) that further research is needed on fall reduction strategies either for those who are usually thought to be at enlarged risk of falling or for those in the oldest age groups to recognize the ones with the greatest risk. Thereby it would be possible to take full advantage of the impact of fall prevention education interventions.

Executive function impairment and cognitive impairment

The findings of Mirelman et al. (2012) demonstrated that the risk of future falls was predicted by performance on executive function. If that is indeed the case, then interventions designed to improve executive function and dual tasking abilities are expected to decrease the risk of falls. Nevertheless, those same authors sustain that to more fully evaluate this possibility, additional work is requested. Namely, the impact of management programs for risk factors such as cognitive impairment or urinary incontinence.

More, as cognitive impairment and impulsivity related falls seems to be associated with falls, but are still poorly understood, Ferrari et al. (2012) advises that prospective studies are needed

using measures which assess the cognitive impairment and test the effect of implementing a cognitive intervention and a monitoring plan on impulsivity related falls prevalence.

Also Muir et al. (2012) warns for other questions that must be taken into consideration. More precisely, details about how to quantify impairment and which dimensions of cognition should be evaluated. These same authors advise a critical analysis of the literature in order to provide further comprehension of which methods of cognitive assessment most toughly predict fall risk and if a particular domain such as executive function plays a major role, as suggested.

The study of Chen et al. (2012) found out that concentrating interventions on modifiable risk factors others than cognition may be the most effective methods of decreasing the risk of falling. Still, direct studies and comparison of different intervention types are needed to confirm this possibility.

Promote and reward mobility

In order to explore fall-related factors among older adults, Perracini et al. (2012) suggested that falling can, maybe, trigger some protective behavior. In fact, falling seems to activate slower gait speed and depressive symptoms and, so, a certain kind of protection. Nevertheless, these same authors refer that the casual relation between falls and those outcomes should be further investigated.

Aligned with these ideas, also recommend that further knowledge on the effectiveness of preventive actions (such as regular screening of sensory functions or appropriated actions to minimize fear of falling and consequent mobility decline) is needed. Mainly, further studies with a larger and more heterogeneous populations.

The uptake of fall prevention interventions: role of health professionals

The contribution of Dickinson et al. (2011) supports that health professionals have a key role in encouraging fall prevention and facilitating older people's contact with preventive programs. Nevertheless, they also believe that their research needs to be carefully extrapolated. Particularly to people from enlarged ethnic groups that may have different needs and life experiences.

Also, Pérula et al. (2012) asserts that it will be necessary to continue research about the way how health advice and preventive actions suggested by health professionals can prevent falls among older adults, in order to achieve greater consistency in the results.

Or, as Gillespie et al. (2012) refer, future studies should address the translation of research into practice, i.e. further research must be done targeting health professionals to increase implementation of effective interventions.

Cultural factors

If, as Kwan et al. (2011) reports, chinese older people reveal a consistently lower incidence of self-reported falls than caucasian older people, a greater understanding of the health, behavioral, and lifestyle is required for elucidating fall prevention strategies in chinese and non-chinese older people. So, future research directions should include exploring cultural factors on falls, for example the effect of squatting on falls incidence among certain populations. Furthermore, large prospective studies containing validated assessment tools should be undertaken in different populations in their native countries, as well as populations residing in the same country.

Falls

As many risk factors interact in those who suffered fall-related fractures, Gillespie et al. (2012) agree that it is still not clear to what extent interventions designed to prevent falls will also prevent fall-related fractures. So, once again, more research has to be done in this arena.

Risk assessment.

A basic matter should also be taken in consideration: the definition of a fall. In fact, as there are different definitions of falls, studies can be influenced by this difficulty and so, consistent studies should be replicated in order to found out more about the question of how to prevent falls in elder people (T.-Y. Chen & M. C. Janke, 2012).

As a general conclusion for overall studies evaluating fall prevention, Gillespie et al. (2012) recommends the usage of a standard definition of fall, and also the empowerment of every study achieved by a researcher blind to group allocation. The suggestions of Gillespie et al. (2012) also refer that fall events should be described by an extended number of pinpoints such as total number of falls, fall-related fractures and the rate of falls per person in each analysis. For the empowerment of each study, those same authors recommend results to be analyzed using appropriated methodologies and group comparisons expressed as incidence rate ratios and risk ratios with 95% confidence intervals.

Economic evaluations

Hartholt et al. (2011) and Gillespie et al. (2012) refer that all-inclusive studies on the social impact of falls in older people focusing on both economic costs and quality of life are also lacking. In order to establish the cost-effectiveness of each intervention, economic evaluations should be conducted alongside randomizes controlled trials. Meaning that several aspects

should be involved: measuring health-related quality of life as an outcome, defining the perspective and timeframe for costs, collecting data on healthcare use or costing healthcare resources.

7. Conclusions

In summary, the present analysis provides an updated comprehensive review of prospective studies on risk factors for falls and identifies a variety of fall prevention interventions. It also shows the need to improve the quality of the reporting studies on risk factors in this area, as well as to further research on potentially important neglected factors and to stimulate an improvement in comparability of risk-factor measurement.

The future looks bright in this area. Systematic attention to fall prevention is a vital part of a comprehensive care of the elderly.

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