The Prediction of Falls Among older people in Saudi Arabia

Amer Al Saif [a], Ehab Waly [b] and Samira Alsenany [c]

[a] Assistant Professor in Physical Therapy, Physical Therapy Department, Faculty of Applied Medical sciences, King Abdulaziz University, Jeddah, Saudi Arabia. dr_amer112@hotmail.com.

[b] Assistant Professor in Physical Therapy, Physical Therapy Department, Faculty of Applied Medical science, King Abdulaziz University, Jeddah, Saudi Arabia. drehabwaly@yahoo.com.

[c] Assistant Professor in Gerontology , Nursing Department, Faculty of Applied Medical science, King Abdulaziz University, Jeddah, Saudi Arabia. ssenany@hotmail.com

Abstract: Falls and fall-induced injuries are a common problem in older people worldwide, and the current ageing population will further increase the burden and cost associated with this type of injury (Wayland et al, 2010). The main purpose of the study was to provide statistical data on the prediction of falls among older people in Saudi Arabia, and to examine which factors make the greatest contribution to the prediction of falls among this population. The Institutional Review Board at King Abdul-Aziz University Hospital approved this study for a one-year period. One hundred and twenty older adults (age range between 59 and 69) participated in the study. All subjects were asked to complete two experimental tasks involving answering questionnaires and performing tasks that assessed their specific balance and motor skills. Firstly, subjects were asked to complete a questionnaire, which consisted of fall history and health status. Secondly, the subjects were asked to complete the Berg Balance Scale (BBS). Results showed that age strongly correlated with Berg Balance Score ($r = -.93$, $p < .001$). A stepwise linear regression was conducted to determine the effect of age on Berg Balance Score. Results indicated that Age was a significant predictor of Berg Balance Score ($R^2 = .88$, $p < .001$). Approximately ninety percent of the variability in the Berg Balance Scale sore was explained by its relationship to Age. Results showed that the number of medications taken per day was also strongly correlated with the Berg Balance Score ($r = -.86$, $p < .001$): approximately ninety percent of the variability in the Berg Balance Score was explained by its relationship to the number of medications taken per day. Significant correlations were observed between subjects' activity level *(active vs. sedentary)* and Berg Balance Score ($r = -.79$, $p < .001$). A stepwise linear regression was conducted to determine the effect of activity level on Berg Balance Score. Results indicated that participants' activity level was a significant predictor of Berg Balance Score ($R^2 = .70$, $p < .001$). Approximately seventy percent of the variability in the Berg Balance Score was explained by its relationship to subject's activity level. Finally, the results showed that the subject's ambulatory status is strongly correlated with the Berg Balance Score ($r = -.82$, $p < .001$). A stepwise linear regression was conducted to determine the effect of ambulatory status on Berg Balance Score. Results indicated that ambulatory status was a significant predictor of BBS ($R^2 = .77$, $p < .001$). This study found that the three main factors that affect older persons' likelihood of falling are number of medications taken per day, sedentary lifestyle and use of assistive devices to help with ambulation. Thus, no single risk factor causes all falls, but the greater the number of risk factors to which an individual is exposed, the greater the probability of a fall. The results from this study indicate that efforts to reduce the risk from fall-related injuries should be directed at the development of a prevention program that identifies those at greatest risk due to factors such as age, medication and the use of assistive devices and the actions to modify these risk factors. This study recommends that reducing the incidence of falls must continue to be one of the highest priorities in health policy among Saudi care institutions for older people and more research is needed to better understand the prediction of fall among older patients in Saudi Arabia.

1. Introduction

People aged 60 and over numbered around 600 million worldwide in 2000, and these figures are expected to reach 1.2 billion by 2025 and 2 billion by 2050. Of these, about two thirds currently live in the developing world, and by 2025 it is estimated that this figure will rise to 75% (WHO, 2005). Globally, this increase in both overall numbers of older people and the relative percentage compared to the total population has considerable implications both for older people themselves and for the health services generally. In particular, Saudis are becoming older and the percentage of the population over 60 is rising, and is expected to more than double by 2020 (Earth

Trends Report, 2003). By this date, the number of old people is expected to grow from approximately 1 million (4 % of the population) to roughly 2.5 million (7 % of the population). This increase in numbers of older people presents numerous challenges to the health care system in Saudi Arabia (Alsenany, 2009). However, little prior research has been undertaken examining older people falls in Saudi Arabia. The aim of this study was to determine the predictors of the main risk factors for falls among Saudi older people by applying the specific cutoff score in predicting falls among older adults, which is 45 points on Berg Balance Scale (BBS), the most commonly used clinical too in predicting falls among older people (Berg et al,1992). To our knowledge, this was the first study to investigate the key factors in the prediction of falls among Saudi older people by applying the Berg Balance Scale (BBS). This study has tried to fill the gap in the literature on Predicting Patient Falls as a serious problem in Saudi Arabia in order to obtain the risk factors on the designated fall assessment guide.

More specifically, falls are considered as the main public health problem among older people in the United States, and are related to significant morbidity and mortality (Finlayson and Peterson, 2010). Similarly, in the UK, thirty per cent of people aged over 65 fall each year. This number increases to more than 60% among those in care homes, exemplifying the contextual nature of falls (Kinirons et al, 2006). In Sweden, almost one-third of all hip fractures occurs in the hospital population (Svensson et al, 1992). Furthermore, there has been very little research investigating whether falls in general have an effect on declining movement (Tinetti and Williams 1998). It has been found that outside falls are more common among well and vigorous elderly people, while falls inside institutions are frequently associated with intrinsic risk factors, such as deprived health and poor balance (Bergland,2003). This has a significant outcome for social and community care and the social effects are considerable, with fear of falling among the most common. Fear of falls influences the patient's quality of life and increases dependency and social isolation (Gallagher et al 2001; Salkeld et al, 2000). Studies have shown that among persons living in institutions, specific risk factors exist that significantly increase of falls on only a temporary basis, whereas others may be related to chronic conditions. Risk factors for falls been reported in several studies, such as fall incidents having a significant negative influence on the balance, gait, and Activities of Daily Living functioning in community-dwelling older adults (Chu, 2006). Another study that investigated 379 older people who fell during a three-year period at

King Faisal Specialist Hospital and Research Centre in Riyadh, Saudi Arabia, to decide whether commonly reported risk factors apply to the Saudi patient population and whether cultural values, beliefs, and practices such as the recital of ablutions before prayer, fasting during the holy month of Ramadan, and the need for socialization influence the rate of patient falls (Hilliard et al,1999). Despite this, very few prevention strategies have been developed and tested.

Providing a hazard-free environment for patients is the shared responsibility of all health care workers (Svensson et al , 1992). Environmental hazards that frequently contribute to these falls include wet floors caused by episodes of incontinence, poor lighting, bedrails, and improper bed height (Gurwitz et al,1994). Falls have also been reported to increase when nurse staffing is low, such as during breaks and at shift changes, presumably because of lack of staff supervision "Change-in-support" (CIS) balance-recovery reactions that engage rapid stepping or reaching movements play a critical role in fall prevention; however, age-related discrepancy in the neuro-musculoskeletal systems may slow down the ability to carry out these reactions effectively (Brian et al , 2008). The majority of events happened in the day time and in the patients' room during the first week of hospitalisation and during the interval when hospital density was greatest (Corsinovi et al., 2009).

The lifestyle adopted can make a difference to an individual's risk of falls. As well as exercising regularly, reducing alcohol intake, not smoking and ensuring a balanced diet will help to reduce the risk of falls and osteoporosis (Pluijm et al , 2006). Furthermore, aging is generally associated with steady decreases in muscle strength and muscle mass, often resulting in reduced functional capacity, physical frailty, impaired mobility and associated accidental falls (Bendall et al, 1993). Many of the pathological and morphological changes attributed to the aging process are identical to those seen with a sedentary lifestyle (Lee et al, 1997). Relative to the sedentary older person, the individual who is habitually inactive has less lean body tissue, a higher percentage of body fat, and lesser bone density (Lee and Kim,1997). Previous studies have stressed the need to prevent falls, a systematic therapeutic approach to patient who have fallen is necessary, and close attention must be paid to identifying and rescuing risk factors for falls among frail older persons who have not yet fallen. The problem of falls, focusing on identifiable causes, risk factors, and preventive approaches. The extensive prior literature have confirmed that a focused history and physical examination after a fall can usually determine both the immediate underlying causes of the fall and

contributing risk factors. In addition, regular evaluation in the hospital can help identify patients at high risk who can then be targeted for specific treatment and prevention strategies.

2. Material and Methods

One hundred twenty older adults (N= 120) participated in the study (age range between 59 and 69), Tables (1 and 2) illustrates the descriptive statistics with regards to our study population. Informed consent was acquired prior to the beginning of the study. The Institutional Review Board at King AbdulAziz University Hospital approved the study protocol. Participants were recruited based on the following criteria; (1) older adults who are between 59 and 69 years old. (2) Need to have the ability to do Activity of Daily Living (ADL) independently with or without using ambulatory aid. Subjects were instructed that they had the right to withdraw at any time during the testing trials. For the present study, we have adopted the definition of a fall as an "event which results in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of a violent blow, loss of consciousness or sudden onset of paralysis" (Bogle and Newton, 1996). All subjects were asked to complete two experimental tasks ranging from answering questionnaires to performing specific balance and motor skills. Firstly, subjects were asked to complete the questionnaire, which consisted of fall history and health status. This provided us with important background information regarding general health, history of falling, disorders, medication consumption and the activities of daily living of each participant. This information allowed us to establish health status among subjects in order to determine if they have any problems that could significantly affect their performance in this study. Secondly, the subjects were asked to complete the Berg Balance Scale(BBS). This test consists of a 14-items related to balance and participants were scored on a scale of 0–4 and ranked depending on their ability to successfully complete the tasks (Muir et al, 2008). The tools that used during BBS were: measurement tape, two chairs one with back support and the other without, stairs and pen (Shumay,1997). Scores from objective clinical measures of balance have been frequently associated with falls in older adults (Alzayer et al, 2009). Ideally, the Cronbach alpha coefficient of a scale should be above 0.70, and Polit and Beck (2006) report that "for most purposes, reliability coefficients higher than 0.70 are satisfactory, but coefficients in the 0.85 to 0.95 range are far preferable" (p.326). On the other hand, the BBS was used because it is reported to have high internal consistency (Cronbach α = 0.92-0.98) and

intra-rater reliability is first rate in older adults (intraclass correlation coefficient [ICC] = 0.91) (Berg et al, 1995).

This study looks at the problem of falls in Saudi Arabia, focusing on identifying the strongest predictive risk factors of falls. The target population for this study was made up of One hundred twenty older adults (with an age range between 59 and 69) participated in the study from the central, western and eastern provinces of Saudi Arabia. Significantly, Gerrish and Lacey (2006) suggest that sample sizes should be increased to increase the power of analysis and minimize sample error. Similarly, Seaman (1987) points out that the size of the sample depends on the size and nature of the population and large samples are better. Sample size is a crucial issue in quantitative research to enable researchers to generalize their findings to the wider world. It is therefore essential to consider whether the sampling method and the sample size were appropriate for the purpose of generalisability in this study. Similarly, Polit and Beck (2006) suggest that if the characteristics of the sample are representative of those of the population, the generalisability of the results to the population is enhanced. This study consider that achieved representativeness in selecting sample from One hundred twenty older adults (with an age range between 59 and 69) from the central, western and eastern provinces of Saudi Arabia. On the other hand, the limitations of this study should also be considered. All participants were Saudi older adults. Therefore, the results may only reflect and be generalized to Saudi older adults. allowed to achieve representativeness in the sample to generalize the findings from this study sample to a wider population such as Saudi older adults.

3. Results

Approximately 65% of total subjects (77 out 120) scored on Berg Balance Score (45) or less. Results showed that the Age strongly correlated with the Berg Balance Score ($r = -.93$, $p < .001$). A stepwise linear regression was conducted to determine the effect of Age on Berg balance score. Results indicated that Age was a significant predictor of Berg Balance Score ($R^2 = .88$, $p < .001$), (Figure 1). Approximately ninety percent of the variability in the Berg Balance Score was explained by its relationship to the Age. Results showed that the number of medications taken per day is strongly correlated with the Berg Balance Score ($r = -.86$, $p < .001$), approximately ninety percent of the variability in the Berg Balance Score was explained by its relationship to the number of medications taken per day ($R^2 = .86$, $p < .001$). Significant correlations were observed between subjects activity level *(active vs.*

sedentary) and Berg Balance Score (r = -.79, p < .001) A stepwise linear regression was conducted to determine the effect of activity level on Berg Balance Score. Results indicated that Participants Activity level was a significant predictor of Berg Balance Score (R^2 =.70, p < .001). Approximately seventy percent of the variability in the Berg Balance Score was explained by its relationship to subject's activity level. Finally, Results showed that the subject's ambulatory status is strongly correlated with the Berg Balance Score (r = -.82, p < .001). A stepwise linear regression was conducted to determine the effect of ambulatory status on Berg Balance Score. Results indicated that ambulatory status was a significant predictor of BBS (R^2 = .77, p < .001). Approximately eighty percent of the variability in the Berg Based on this study results, we found a strong correlation between age and risk of fall (88%), which explains that the risk of falling increases with age**.**

Table 1: Demographic & baseline clinical characteristic of study group (N =120)

	Valid	Frequency
Sex	**Male** **Female**	76 (63.3%) 44 (36.7%)
Fall History	**No** **Yes**	67 (55.8%) 53 (44.2%)
Medications	**No medications** **≥3 medications**	57 (47.5%) 63 (52.5%)
Activity Level	**Active** **Sedentary**	53 (44.2%) 67 (55.8%)
Ambulatory Status	**Normal** **With ambulatory aid**	59 (49.2%) 61 (50.8%)

Table 2. Baseline frequency of characteristic study group (N=120)

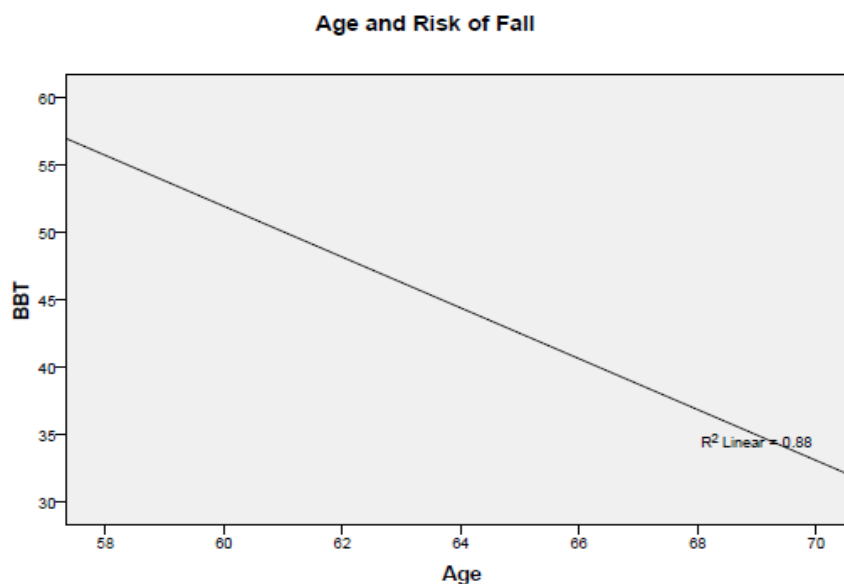|	N	Minimum	Maximum	Mean	Std Deviation
Age	120	59	69	64.72	3.672
Berg Balance Score	120	30	58	43.05	7.381

Figure 1: Negative correlation between Age and Berg Balance Score (R2 = 88 %)

4.Discussion

Focusing on identifying the strongest predictive risk factors of falls among older adults in Saudi Arabia. Significantly, this study noted a strong positive correlation between age and risk of fall (88%), such that risk of falling increases with age. Consequently, several studies have identified a significant relationship between falling and age and, even more obviously, between gait problems and age (Hausdorff, 2007). Similarly, another study examining falls in older people in the hospital found that Saudi older persons had high rates of accidents (62.5%), mostly occurring in patients aged 60 years or above (Alsenany, 2010). Literature suggests that about third of persons who are above 65 are at high risk of falls annually (Studenski and Wolter ,1998; Tinetti et al,1994). While, Rubenstein and Josephson (2002) found that the incidence of falls rises steadily from middle-aged people and peaks in those who are over 80 years. This rate rises with age, with functional impairment and disability being highest in those older than 90 years (Kannus,1999). However, this study argues that the relationship between age and falls reflects physiological ageing, which is clearly associated with a decrease in sensory acuity, reaction time, muscle strength and balance among saudi older adults (Al-Abdulwahab,1999).

Consequently, the significant relationship between age and muscle strength and functional ability recommends that age-related changes may be used as a predictor for such reduction (Maki et al, 2008). Therefore, this study found that falls can occur as a result of aging due to the gradual decrease in muscle strength and functional ability. Moreover, this decline is related to normal aging processes in older adults. In other words, research has clearly demonstrated a relationship between age, lower extremity muscle strength and functional ability (Punakallio et al, 2007). Together with the current findings, this suggests that the greater risk of falling in those aged 60 and older is likely to be due to the deterioration of overall health status with age, such as due to loss of control related to physiologic changes in the musculo-skeletal system, including postural changes and osteoarthritis. In Saudi Arabia the fourth and the eighth decades of life could indicate an increased risk of falling due to reduction in balance ability (Al-Abdulwahab,1999). Aging is generally associated with steady decreases in muscle strength and muscle mass, often resulting in reduced functional capacity, physical frailty, impaired mobility and associated accidental falls (Brown et al,1995). Therefore, it is essential to establish an effective fall prevention programs for the Saudi older population above 60 years as part of the falls screening tools.

Interestingly, this study found that the three main factors that affect older persons' likelihood of falling are number of medications taken per day, sedentary lifestyle and use of assistive devices to help with ambulation. These factors have not been examined in longitudinal studies and further research is imperative. However to gain insight into this issue, a review on the risk factors for falls in hospital settings showed as strong predictors of falling: gait instability, lower limb weakness, urinary incontinence, frequency or need for assisted toileting, previous fall history, agitation, confusion, impaired judgment and prescription of "culprit" drugs, and in particular centrally acting sedative hypnotics (Oliver et al., 2004). Thus, no single risk factor causes all falls, but the greater the number of risk factors to which an individual is exposed, the greater the probability of a fall and the more likely the results of the fall will threaten the person's independence (Desme et al, 2005). Other studies demonstrated that the main risk factors associated with recurrent falls are female gender, advanced age, low weight, previous falls and fractures, current use of psychotropic medication, muscle weakness, reduced gait speed, functional disability, sedentary lifestyle, fear of falling, cognitive deterioration, presence of hazards in the home and diverse illnesses, such as diabetes mellitus, arthritis, depression, urinary incontinence, Parkinson's disease, dizziness and stroke (Pluijm et al, 2006).

This study confirmed that Saudi older people undertake relatively little physical activity and this can lead to the risk of developing a disability that will adversely affect mobility and the ability to perform the basic activities of daily life. This decline in physical function eventually results in greater risk for loss of functional independence as a result of poor general health and/or falls. Making a paradigm move from a sedentary lifestyle to a lifestyle of exercise and activity is at the focal point of fall prevention in Saudi older people. Consequently, to lower health care expenditure for Saudi people aged 40 and over, it is important to eliminate the noted reduction in functional ability.

Regular physical exercises, such as balancing, strength training, low-impact aerobic exercise, body flexibility exercise and functional exercise, as well as health promotion in the workplace, are essential. The awareness of losing muscle strength and endurance was also reported to occur at about age 50 (Tseng et al,1995). The individual who is habitually inactive has less lean body tissue, a higher percentage of body fat and lower bone density (O'Reilly et al,1997). Therefore, Muscle weakness in individuals of advanced age with sedentary lifestyle places them at an increased risk for falls. Nearly 30% report

functional limitations in the performance of instrumental activities of daily living and recreation. Furthermore, such individuals exhibit a loss of confidence, a greater degree of dependence and 80% avoid performing activities in which there is a risk of falling. The fear of falling is related to several psychological, social and physical conditions, especially isolation, cognitive impairment, reduced mobility and impairment in quality of life among older adults (Austin et al, 2007). The President's Council on Physical Fitness and Sports recommended resistance training as a preventive measure against falls among older adults. Specifically, it was suggested that older adults perform resistance training exercises for 8-10 muscle groups, 2-3 days per week, using 8-15 repetitions of each exercise (Pollock et al, 1996). With slower gait velocity and difficulty walking were among the main risk factors associated with falls and hip fractures (Dargent-Molina et al,1996).

On the other hand, this study suggest that number of medications taken and the use of assistive devices can put Saudi older patients at high risk of falls. Many studies found that use of inappropriate medications increased the risk of falls in elderly people. Consumption of long-acting benzodiazepines was responsible for the main part of this increase. But regular exposure to inappropriate psychotropic drugs or to inappropriate medication with anticholinergic properties was also associated with an increased risk of falling. Most of the drugs potentially inappropriate for the elderly have known side-effects that can contribute to the risk of falling: drowsiness, decreased postural reflexes, extrapyramidal symptoms, drugging and myorelaxant effect (Fick et al ,2003). The use of inappropriate psychotropic drugs, and particularly of long-acting benzodiazepines, has been found to be associated with an increased risk of falling in persons aged 65 years and over (Berdot et al, 2009). To avoid common, but often preventable problems, there must be early recognition of drug – related cognitive impairment through careful monitoring of cognitive performance when new drugs are prescribed. The family physician should now all the medication the elder takes to properly evaluate the safety of the combination.

Furthermore, age-related changes in drug metabolism and polypharmacy can increase the severity of these side effects, which in turn can increase the risk of falls (Campbell et al ,1999). Medication can increase the risk for falls Inappropriate dosages, adverse drug reactions, omissions, incorrect administration of medications, and incorrect administration of medications, present "risks" and increase patient accidents for falling in

hospital. These factors can also predispose residents to other risks with compounding effects (Boyle et, 2010). Furthermore, the relationship between drugs and falls has been widely studied in the past three decades, with increasingly vigorous evidence of a causal bond. Both specific classes of drugs and the total number of drugs taken are associated with falls. One review examines some of the reasons why older people are at greater risk of drug-related adverse events such as falls. These medications are benzodiazepines and antidepressants, which increase the risk of falling; falls can be prevented through interventions that target medications . Moreover, the cause of falling can vary, and many risk factors have been identified. In developed countries. Due to concurrent prescription of several drugs, the risk of inappropriate drug combinations is increased in older persons (Hanlon, 2001).

Moreover, medication metabolism is affected by aging-related pharmacokinetic and pharmacodynamic changes. For all these reasons, older persons are at higher risk of experiencing adverse drug effects (Woolf and Akesson, 2003). The number of falls attributable to the use of inappropriate drugs depends on the exposure prevalence. The results from this study indicate that efforts to reduce the risk from fall-related injuries should be directed at the development of a prevention program that identifies those at greatest risk due to factors such as age, medication and the use of assistive devices' and the actions to modify these risk factors. For example, older patients need regular care to monitor their medications regimen, especially if three or more types of medication are taken per day. Efforts should be made to reduce falls and their risk of disabling consequences through appropriate medical care, evaluation and prompt intervention.

The study also provides a limited discussion of the fact that older people may have multiple chronic diseases, such as osteoporosis, which is a chief cause of fractures in older adults, especially among women (Luukinen et al,1994). Thus, future researches should expand on the relationship between osteoporosis and risk of falling, as it is predicted that a decrease in bone density contributes to falls and resultant injuries. Furthermore, the Kingdom is in the early stages of development, despite the fact that chronic diseases such as diabetes in the older population are now the primary conditions for which older people seek healthcare (Al-Shammari et al, 2000). So more research is needed to explore the risk of falls among diabetic patients. Furthermore, the 10-15 minutes required to complete the Berg Balance Scale (BBS) may constrain its use in the clinical setting, where limited time and patient exhaustion is a concern. The research, the first of its kind undertaken in Saudi

Arabia, concludes with some reflections and suggestions for further research and the actions needed to prevent falls in older people and improve quality of life for Saudi older people in the future.

This study has confirmed that a focused history and physical examination in older fall patients can usually determine both the immediate underlying causes of the fall and contributing risk factors. In addition, regular evaluation in the hospital can help to identify patients at high risk, who can then be targeted for specific treatment and prevention strategies. This study recommends that reducing the incidence of falls must continue to be one of the highest priorities in health policy among Saudi care institutions for older people and more research is needed to better understand the prediction of fall among older patients in Saudi Arabia. Therefore, that mechanisms must be provided to ensure that every older adult or frail person is educated about fall prevention and its risk factors. Environmental assessment identifies and removes potential hazards (for example, clutter, poor lighting, and uneven floor surfaces), and leads to modification of the environment to improve mobility and safety. Specific environmental interventions should include the following: adequate lighting in all hallways and stairwells, bathroom grab bars next to the toilet and, in the tubs or shower, non-skid mats in tubs or shower, raised toilet seats, handrails in the hallways, secure stair way banisters, and furniture that is easy to rise from. Of special importance is bed height. Better physical design of hospital equipment such as patient beds may reduce patient falls and injuries (Tzeng and Yin, 2008). Most beds are adjustable and are often in an inappropriately raised position for the convenience of the staff. Proper bed height is such that when the patient sits on the side of the bed with feet touching the floor, the knees are bent at a 90-degree angle. Furniture can also be rearranged to support an unstable patient for ambulating to the bathroom. Strategies that reduce mobility through use of restraints may prevent falls but also attract other problems and in the majority of cases should be avoided (Nyman and Oliver, 2010).

Saudi older patients with multiple chronic disease must have their medication regimens monitored regularly, we recommend future research to expand in this area specifically in order to understand which types of medications make the greatest contribution, including sedatives, anti-depressants and antipsychotics. Furthermore, health promotion that encourages regular exercise in the workplace could also encourage people in Saudi Arabia to reduce their loss of functional ability. Physicians may advocate cautiously monitored exercise programs or arrange a referral to a physical therapist who can work out an adapted exercise program aimed at preventing falls. Therefore, Measures for minimizing the risk of falls can be easily implemented by a multidisciplinary team involving physicians (adequate management of illness and medication), physical therapy (better neuromuscular function and encouragement of regular physical activities), nutritionists (optimizing calcium and vitamin D intake and/or supplementation) and psychologists (improvement in cognitive aspects and those related to quality of life and the fear of falling). With the development and use of falls assessment tools is vital as part of an effectual fall prevention program for Saudi older people. Prospective research is needed to validate these findings relative to fall prediction.

Corresponding Authors:
1.Dr. Amer A. Al-Saif, PT, MPT, DPT, PhD
Assistant Professor, Physical Therapy Department
Neuro Rehab Track; Balance and Dizziness Therapy
Faculty of Applied Medical Sciences
King Abdulaziz University
dr_amer112@hotmail.com

2. Dr. Samira Alsenany, BSc (Hons), RN, MSc,
PGCert ANP, Mphil, PhD
Assistant Professor in Gerontology, Nursing School
College of Applied Medical Sciences
King Abdulaziz University
ssenany@hotmail.com

3. Dr. Ehab Waly, Doctoral Degree Faculty of
Physical Therapy
Assistant Professor in Physical Therapy, Physical Therapy Department, Faculty of Applied Medical science, King Abdulaziz University, Jeddah, Saudi Arabia.
drehabwaly@yahoo.com.

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