science, engineering and health studies

Research Article

*Science, Engineering and Health Studies*
*https://lio1.tci-thaijo.org/index.php/sehs*
*ISSN (Online): 2630-0087*

# Physical factors and their relationship with falls among older people with low back pain: A systematic review

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## ABSTRACT

This study aimed to determine the physical factors related to falls among older people with low back pain (LBP) and identify the relationship between physical factors and falls among older people with LBP. This systematic review appraised evidence on physical factors and their relationship with falls among older people with LBP using Scopus, ClinicalKey, British Medical Journal, ScienceDirect and Google Scholar for the period of 2009-2019. The McMaster critical review form was used to appraise the selected articles. Results: A total of eight articles were eligible for this study, specifically, one randomized controlled trial study, four prospective cohort studies and three cross-sectional studies. The McMaster score showed the mean (12.50), standard deviation (1.20) and variance (1.43) of the included studies. The quality scores of the reviewed articles were generally satisfactory. The physical factors related to falls among older people with LBP are age, gender, gait, pain, muscle strength of lower limbs and physical activity. Although the results are inconsistent, each factor is related to falls among older people with LBP.

**Keywords:** low back pain; fall; physical factors; older people

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***Received***: *12 October 2020*
***Revised***: *19 March 2021*
***Accepted***: *12 April 2021*
***Published***: *4 December 2021*

***Citation***:
*Zahari, Z., Aziz, I. S., Justine, M., and Chua, S. K. (2021). Physical factors and their relationship with falls among older people with low back pain: A systematic review. Science, Engineering and Health Studies, 15, 21050012.*

## 1. INTRODUCTION

Recently, the issue of falls among older people received considerable critical attention. Causes or factors related to falling rates can be categorized as either intrinsic or extrinsic (Kwan et al., 2016). Intrinsic factors are related to an individual, who may experience impairment of system functions, including postural adjustment, illnesses or intellectual and behavioral disorders. Meanwhile, extrinsic factors are related to environmental hazards, such as loose carpets, walking surfaces, lighting or high and/or narrow steps (Kwan et al., 2016).

Low back pain (LBP) is a common disorder suffered by older people, which can lead to disability (Faulkner et al., 2009). In recent years, the issue of falls among older people received considerable critical attention; however, no exact research is related to older people with LBP.

According to international population reports, 8.5% of the 7.3 billion people in the world belong to the older population aged 65 years or above, and this number is predicted to increase by more than 60% by 2030 (He et al., 2016). Meanwhile, Noh et al. (2017) reported that falls among the elderly may be one of the factors decreasing their quality of life and increasing their dependency on others. In Malaysia, the prevalence of falls among older people varies,

from as low as 4.2% to as high as 61%, but these values are believed to be the highest among the general global and Asian population (Noh et al., 2017). Moreover, LBP among older people in Malaysia is one of the top five leading causes of years with disability (Institute for Health Metrics and Evaluation, 2010). This outcome is observed, because LBP among older people is related to certain harmful consequences, such as falls, disability or hospitalization.

Previous studies reported that several physical factors are not related to incidences of falls among healthy older people, such as muscle strength of lower limbs, gait and physical activity (Chan et al., 2007; Dai et al., 2012; van Schooten et al., 2019). The present study focuses on several physical factors, such as age, gender, pain, gait, muscle strength of lower limbs and physical activity. Such a study is necessary to increase knowledge and talents regarding the physical factors affecting falls among older people with LBP and improve attitude towards fall prevention (Bolding and Corman, 2019). Moreover, this study can encourage older people to physically engage in exercise routines to maintain their balance and strength (Bolding and Corman, 2019) and promote the development of a multiprofessional and interdisciplinary approach (Almeida et al., 2012) to reduce the rate of falls among older people. Therefore, the objective of this study is to determine the physical factors related to falls among older people with LBP.

## 2. MATERIALS AND METHODS

### 2.1 Research strategies

This study followed several steps for the literature search. Firstly, the inclusion and exclusion criteria were based on the population, intervention, comparison and outcome (PICO) technique. This technique was employed in designing the research criteria identification step, as follows:

Population: older people aged 60 years or above with LBP,

Intervention: not applicable,

Comparison: not applicable,

Outcome: age, gender, pain (numeric rating scale), gait (14 m and 15 m walk tests), muscle strength of lower limbs (chair stand test) and physical activity (international physical activity questionnaire and physical activity scale for the elderly).

Secondly, a computer-aided literature search was performed on Scopus, Web of Science, PEDro, ClinicalKey, *British Medical Journal* (BMJ), ScienceDirect and Google Scholar for the period of 2009-2019. The article search was restricted to the past 10 years for studies on physical factors and their relationship with falls among older people with LBP. Several keywords were used for the database search, such as 'low back pain', 'older people', 'physical factor', and 'fall' as shown in Table 1. An article was chosen based on its title, study design, methodology and intervention. The PRISMA flowchart guideline was utilized to ensure that the selected articles met the inclusion criteria as illustrated in Figure 1. Thus, eight articles were included in this study, specifically, one randomized controlled trial (RCT) study, three cross-sectional studies and four prospective cohort studies. All the studies were ranked based on their level of evidence according to the National Health and Medical Research Council (NHMRC, 2008).

**Table 1.** Example of literature search for the period of 2009-2019 using ClinicalKey search strategy

| Search ID | Search term | Result |
|---|---|---|
| 1 | Low back pain OR back pain OR musculoskeletal pain | 1,617 |
| 2 | Older people OR older adults OR elderly OR geriatric | 15,975 |
| 3 | Physical factor OR risk factor OR intrinsic factor | 1,159 |

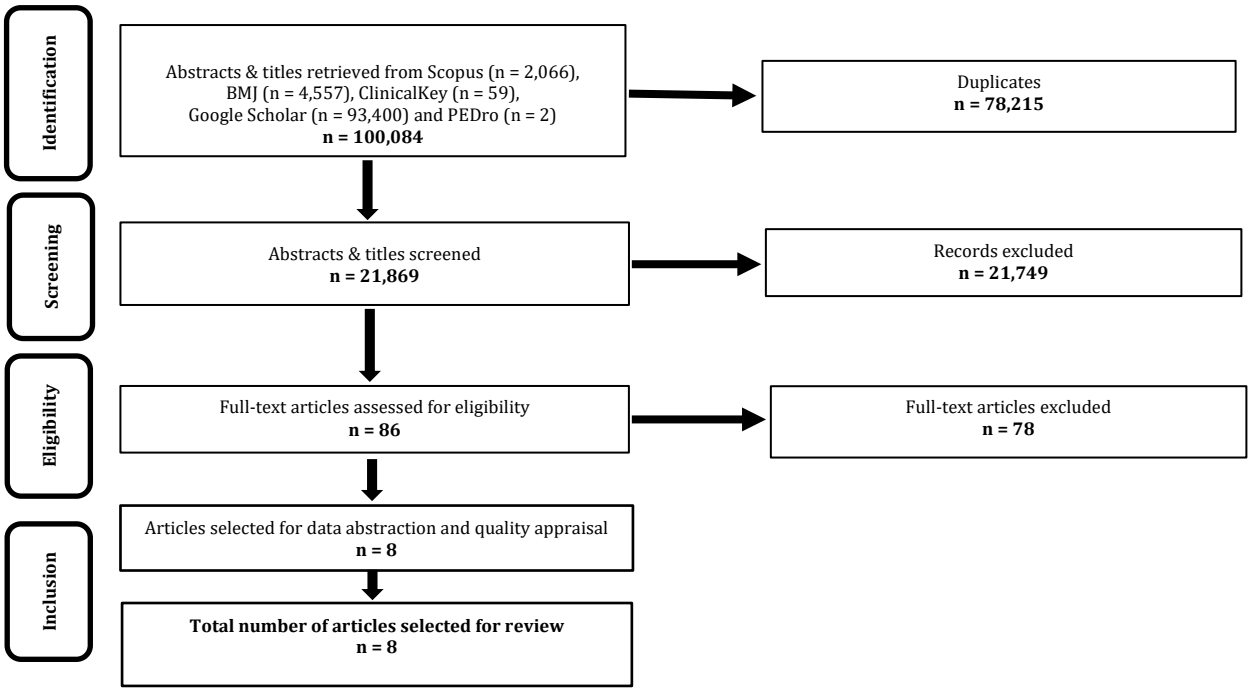


**Figure 1.** PRISMA flow diagram of search strategy

### 2.2 Study selection

#### 2.2.1 Inclusion criteria

This study included older people aged 60 years or above with either acute, subacute or chronic LBP or specific or nonspecific LBP and studies that included age, gender, pain, gait, muscle strength of lower limbs and physical activity as outcomes.

#### 2.2.2 Exclusion criteria

Studies that failed to meet the inclusion requirements were disqualified and excluded from this study.

### 2.3 Research tools

Critical appraisal instruments: this study used the McMaster critical review form for quantitative studies to appraise the quality of the included research articles. This tool consists of 16 items of methodological quality related to the purpose of the study, literature review, design, sample, outcomes, intervention, results and conclusions. An 'A1' mark was given to a study if it met the criteria, and 0 otherwise. The total McMaster form score is 16 and classified as follows: excellent (15-16), very good (13-14), good (11-12), fair (9-10) and poor (0-8).

### 2.4 Risk of bias assessment

The Cochrane collaboration tool was used to assess the risk of bias of the selected articles. The tool evaluated these components, namely, random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment (self-reported outcomes and objective measures), incomplete outcome data, selective reporting and other biases. Each component was given a score equivalent to high, low or unclear risks.

### 2.5 Data extraction

Data on study design, sample size, inclusion criteria, exclusion criteria, interventions (if any), results and conclusions were extracted (Table 2).

### 2.6 Collection, analysis and interpretation of evidence

Firstly, evidence was collected by downloading all related articles from the available online databases at the Universiti Teknologi MARA (UiTM). Secondly, the articles were appraised critically using the McMaster critical review form for quantitative studies, and a score was given to each criterion. Thirdly, the articles were classified into a hierarchy level based on the NHMRC hierarchy level of evidence. The evidence trends are presented in Table 3. Fourthly, the data were analyzed using SPSS version 22.0 to obtain the mean McMaster score. Lastly, descriptive statistics were performed to identify the mean, median, minimum and maximum scores, standard deviation (SD) and variance.

## 3. RESULTS AND DISCUSSION

### 3.1 Articles presenting significant results on physical factors of falls among older people with LBP

In this review, eight studies were included (i.e., Marshall et al., 2017; Muraki et al., 2011; Marshall et al., 2016; Leveille et al., 2009; Sawa et al., 2017; Kitayuguchi et al., 2015; Teut et al., 2016; Kitayuguchi et al., 2017). The six physical factors related to falls among older people with LBP were divided into two groups, namely, demographic factors, such as age and gender, and physical health factors, such as pain, gait, muscle strength of lower limbs and physical activity.

#### 3.1.1 Demographic factors

A total of three studies (i.e., Marshall et al., 2017; Marshall et al., 2016; Kitayuguchi et al., 2015) revealed that age and gender, specifically female (Muraki et al., 2011; Leveille et al., 2009; Kitayuguchi et al., 2015), are related to falls among older people with LBP. The results of the studies proved that older individuals and older women with LBP may have high risks of falls.

#### 3.1.2 Physical health factors

A total of two studies (i.e., Marshall et al., 2017; Leveille et al., 2009) showed significant results for pain, gait and muscle strength of lower limbs (Sawa et al., 2017; Kitayuguchi et al., 2015) and supported the idea that gait may be related to falls among older people with LBP. Moreover, Kitayuguchi et al. (2015) presented significant results for physical activity.

### 3.2 Articles not presenting significant results for physical factors of falls among older people with LBP

#### 3.2.1 Demographic factors

A total of two studies (i.e., Muraki et al., 2011; Leveille et al., 2009) reported nonsignificant results for age and gender, thereby proving that these two factors are not related to incidences of falls among older people with LBP.

#### 3.2.2 Physical health factors

Similarly, two studies (i.e., Marshall et al., 2016; Teut et al., 2016) did not support the idea that pain is related to incidences of falls. Teut et al. (2016) presented non-significant results for gait, whilst Leveille et al. (2009) and Kitayuguchi et al. (2017) did not support the idea that physical activity is related to falls among older people with LBP.

The mean score of the eight reviewed articles was 12.50, with a minimum score of 11, a maximum score of 15, an SD of 1.20 and a variance of 1.43. Thus, the quality of the studies was fair.

### 3.3 Physical factors and their relationship with falls among older people with LBP

This study was designed to determine physical or intrinsic factors associated with falls among older people with LBP. To the best of our knowledge, this systematic review is the first to investigate the relationship between physical factors and falls among older people with LBP. A total of eight articles were reviewed, and the sample size was large. Furthermore, the rating of the selected studies ranged from good to excellent.

#### 3.3.1 Demographic factors

The study by Marshall et al. (2017) involved American men aged 65 years or above and determined a moderate relationship between back pain and risks of falls. The other study by Marshall et al. (2016) demonstrated that age may influence the relationship between back pain and risks of

**Table 2.** Data extracted from selected articles

| Reference | Study | n | Sample | Intervention | Results | Conclusion |
|---|---|---|---|---|---|---|
| Marshall et al., 2017 | Prospective cohort study | n = 5,568 | Older men aged 65 years; must mark a drawing of posterior torso | Not applicable | Repetitive fall incidence increases as number of back pain site increases | Older men with history of back pain have high risks of falls |
| Muraki et al., 2011 | Cross-sectional study | n = 1,675 | Elderly living in three communities and able to walk; must be interviewed regarding knee and back pain | Not applicable | Prevalence of single and multiple falls differs significantly | LBP and knee pain are associated with multiple falls in women |
| Marshall et al., 2016 | Prospective cohort study | n = 6,841 | White women aged 65 years or above; must mark a drawing to indicate location of back pain | Not applicable | Risks of recurrent falls increase 1.6-fold in women with back pain | Back pain is determined as an independent risk factor for recurrent falls |
| Leveille et al., 2009 | Prospective cohort study | n = 749 | Individuals aged 70 years or above | Not applicable | Older people with chronic MS pain have high rates of falls during follow up | Chronic MS pain is associated with increased risks of falls |
| Sawa et al., 2017 | Cross-sectional study | n = 176 | Individuals aged 65 years or above with MS pain | Not applicable | Pain intensity and MS pain in multiple sites are significantly associated with slow gait speed | Severe MS pain in multiple sites among individuals is associated with slow gait speed |
| Kitayuguchi et al., 2015 | Cross-sectional study | n = 499 | Individuals aged 60 years or above | Not applicable | Gait speed of older people with severe LBP is slow | Severe LBP is related to single and multiple falls |
| Teut et al., 2016 | RCT | n = 176 | Elderly aged 65 years or above with chronic LBP for > 6 months | Yoga group will receive 24 classes; qigong group will receive 12 classes | Adjusted pain intensity in each therapy shows no significant difference | Both treatments do not improve back pain |
| Kitayuguchi et al., 2017 | Prospective cohort study | n = 1,890 | Older people aged 60–79 years | Not applicable | Prevalence and intensity of LBP are related to injurious falls | Injurious falls are related to intensity and chronicity of LBP |

**Table 3. Evidence trends**

| Reference | Study | Hierarchy level | McMaster score | Quality | Statistical precision |
|---|---|---|---|---|---|
| Marshall et al., 2017 | Prospective cohort study | IV | 12/16 | Good | CI = 95%<br>$p < 0.05$ |
| Muraki et al., 2011 | Cross-sectional study | IV | 12/16 | Good | CI = 95%<br>$p < 0.05$ |
| Marshall et al., 2016 | Prospective cohort study | IV | 13/16 | Very good | CI = 95%<br>$p < 0.05$ |
| Leveille et al., 2009 | Prospective cohort study | IV | 13/16 | Very good | CI = 95%<br>$p < 0.05$ |
| Sawa et al., 2017 | Cross-sectional study | IV | 12/16 | Good | CI = 95%<br>$p < 0.05$ |
| Kitayuguchi et al., 2015 | Cross-sectional study | IV | 11/16 | Good | CI = 95%<br>$p < 0.05$ |
| Teut et al., 2016 | Randomized controlled trial | II | 15/16 | Excellent | CI = 95%<br>$p < 0.05$ |
| Kitayuguchi et al., 2017 | Prospective cohort study | IV | 12/16 | Good | CI = 95%<br>$p < 0.05$ |

recurrent falls. The findings further supported the idea of age as one of the physical factors related to falls among older people with LBP. This result could indicate that age is a nonmodifiable risk factor, because the normal aging process may impair musculoskeletal physiological functions (Rosa et al., 2016)

Moreover, age may have a significant impact on risks of falls among older people with LBP owing to work exposure before retirement age, such as persistent exposure to work-related physical factors or terrible working conditions (Docking et al., 2011; Palacios-Ceña et al., 2015). Contrary to expectation, the study by Leveille et al. (2009) failed to determine a significant relationship between age and risks of falls and to relate the two factors clearly.

The prospective cohort study by Muraki et al. (2011) found a relationship between women with LBP and knee pain and numerous incidences of falls, as such incidences are higher among women than among men. Moreover, these results match those obtained by a study of Wijnhoven et al. (2006) on Dutch residents aged between 25 and 64 years, showing that women have a higher prevalence of experiencing musculoskeletal pain than men owing to changes in sex-linked biological factors such as hormone levels or physiology, and because women are more likely to report pain regularly than men (Punnett and Herbert, 2000; Strazdins and Bammer, 2004).

### 3.3.2 Physical health factors

According to the study by Marshall et al. (2017), significant differences exist between musculoskeletal pain such as hip pain and knee pain, and older people with LBP. Meanwhile, the study by Kitayuguchi et al. (2017) also found significant difference between LBP and knee pain and falls among older people. These outcomes can be attributed to several mechanisms such as low physical functions, fear of falling or pain that disrupts cognitive functions, which may be responsible for the relationship between pain and risks of falls (Leveille et al., 2009; Stubbs et al., 2014a; Stubbs et al., 2014b). However, two studies (Marshall et al., 2016; Teut et al., 2016) did not find significant differences between pain and falls among older people with LBP owing to the age-related degeneration process and between the experimental and control groups.

In terms of gait, the studies by Marshall et al. (2017) and Leveille et al. (2011) demonstrated the significant relationship between slow gait speed and risks of falls among older people with LBP. The results of these studies showed that the participants aged 70 years or above with chronic musculoskeletal pain may experience gait alterations such as slow gait speed. The study by Seay et al. (2011) supported this statement, because patients with LBP experience decreased motion between the pelvis and trunk and have a short step length when walking (de Kruijf et al., 2015). However, the RCT study by Teut et al. (2016) failed to show a significant relationship between gait and falls among older people with LBP owing to a lack of adequate studies.

In addition, muscle strength of lower limbs is related to falls among older people with LBP. This idea was supported by two studies (i.e., Marshall et al., 2017; Leveille et al., 2011), which found a significant relationship between chair stand test results and older men with LBP. These findings further supported the idea that older people with reduced lower limb strength are prone to increased risks of falls (Cho et al., 2012). These results should be compared with those of Ishak et al. (2016), who reported that back muscle strength has a moderate correlation with lower limb functions, because the weakening of trunk muscles is related to chair stand test performance among older people (Hicks et al., 2008).

Lastly, only one cross-sectional study (i.e., Kitayuguchi et al., 2015) showed a significant relationship between weekly exercise and falls among older people with LBP. Similar to these results, previous studies on osteoporotic men showed the same effect, specifically, the participants who self-reported high levels of physical activity had high risks of falls (Chan et al., 2007). This result may be attributed to older people who enjoy performing house chores such as gardening, home fixing or cleaning. At a certain level, older people may place themselves at risk of falls when performing mandatory tasks on their own (Chan et al., 2007).

By contrast, a few studies (i.e., Leveille et al., 2009; Kitayuguchi et al., 2017) proved that minimal physical activity increases risks of falls. This outcome may be because older people with musculoskeletal pain experience considerable fear of falls and therefore are prone to controlling their movement and participation in physical activities, which may result in weakness of the muscles of lower extremities (Martin et al., 2005). Subsequently, this

outcome may affect the continuation of personal tasks and other daily activities (Benavent-Caballer et al., 2016).

### 3.4 Strengths and limitations

This study has several strengths such as the quality of the assessment evaluation through the use of the McMaster critical appraisal tool and high scores obtained after the intensive review of the selected articles. For instance, the RCT study by Teut et al. (2016) received a score of 15 out of 16, which is 'excellent', while the prospective cohort study by Marshall et al. (2016) scored 13 out of 16, which is considered as 'very good'.

However, this study has several limitations. Firstly, it only included studies from the UiTM databases, which limited the search. Secondly, only one RCT study was selected, and the other articles were prospective cohort and cross-sectional studies. Studies on the physical factors affecting falls among older people with LBP within the past 10 years are lacking. Thus, checking whether each selected article met the inclusion criteria was difficult, as many of the studies combined their outcome measures with other internal and external factors.

Thirdly, most of the older population included in the selected studies were from Western countries, such as the United States and Germany. To a certain extent, this review did not represent the elderly population of Asian countries, especially Malaysia, who may present results differing from those of the elderly population of Western countries. Hence, future research should assess the relationship between physical factors and falls among older people with LBP living in Asian countries to engage local health practitioners to improve the quality of life of older people.

The findings of this systematic review are novel, informative and evidence based, which may benefit clinicians by providing them with increased knowledge and awareness of risks of falls among older people with LBP. Witnessing physiotherapists adopting a protective mechanism before prescribing any form of exercise to older people with LBP would be interesting. Moreover, appropriate fall assessments should be conducted for all geriatric patients with musculoskeletal problems. Furthermore, correct and proper interventions should be given to elderly individuals exhibiting modifiable risk factors of falling to improve their physical functions and enhance their quality of life.

## 4. CONCLUSION

This study identified several physical factors related to falls among older people with LBP, which were divided into two groups. The first group was demographic factors such as age and gender, and the second group was physical health factors such as pain, gait, muscle strength of lower limbs and physical activity. Further studies are necessary to increase understanding on the relationship between other physical factors and falls among older people with LBP.

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