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Physical independence and related factors among older adults: a systematic review and meta-analysis

Sahar Miri, MSc[a], Bahar Farhadi, MD[d], Poorya Takasi[b], Pooyan Ghorbani Vajargah[b,*], Samad Karkhah, MSc[b,c,*]

Background: Adopting a physically active lifestyle is advocated as a strategy to prevent loss of physical independence and support healthy aging. This study aimed to evaluate the physical independence and related factors among older adults.

Materials and methods: This systematic review and meta-analysis was conducted through electronic databases such as Scopus, PubMed, Web of Science, Iranmedex, and Scientific Information Database from the earliest to 1 April 2022. Two researchers independently extracted information from the studies and evaluated the quality of the studies. The analysis was conducted using CMA program version 3, and each study's importance was determined based on its inverse variance.

Results: Five thousand seven hundred thirty-three older adults participated in this review in six studies. All evaluated studies had high quality. The mean score of physical independence in older adults was 20.07 (SE = 0.76) out of 24 (95% CI: 18.58–21.56; $I^2 = 98.573\%$; $P < 0.001$). Physical activity is very important for physical independence and reduces the risk of physical dependence in older adults. Other factors, such as sex, BMI, age, abnormal performance, timed performance, sufficiently active, muscle function, handgrip strength, lower extremity function, lower body strength, maximal isometric knee extension power, lung function, aerobic endurance, sedentary time, agility, and the prevalence of arthritis, had a significant relationship with physical independence in older adults.

Conclusion: Older adults demonstrate favourable levels of physical independence. Notably, physical activity emerges as a significant determinant positively associated with such independence. Thus, policymakers and administrators are encouraged to strategize the creation of conducive environments for walking and exercise among older adults.

Keywords: aged, functional dependence, functional independence, functional status, systematic review

Introduction

The global trend towards increasing Life expectancy implies that individuals will live longer[1–4]. However, aging is associated with natural physiological changes, including a decline in muscle mass[5–11]. With the ongoing aging of populations in highly developed nations, there is a growing recognition of geriatric concerns within healthcare systems, particularly exemplified by the prevalence of frailty syndrome[12]. The diagnosis of frailty typically requires meeting a minimum of three out of five established criteria, including unintended weight loss, diminished grip strength, fatigue, decreased walking speed, and engagement in low levels of physical activity[12,13]. Such changes can impact individuals' functional abilities, potentially leading to a state of physical dependence and increased burdens on families and healthcare systems[14].

Increased physical activity has been linked to a reduced risk of non-communicable diseases and lower healthcare costs[15]. Epidemiological studies suggest that physical activity promotes healthier aging and improved cognitive function[16], potentially preventing disability and fostering an active lifestyle. Past engagement in sports activities has also been positively associated with current physical activity levels[17]. Conversely, sedentary behaviour, such as prolonged TV watching and reading, is identified as a risk factor for functional disability and reduced functional capacity[18], with sedentary time typically increasing with age[19]. Guidelines recommend at least 150 minutes of moderate-intensity physical activity per week to maintain

[a]Department of Corrective Exercise and Sport Injury, Faculty of Sport Sciences, University of Guilan, [b]Department of Medical-Surgical Nursing, School of Nursing and Midwifery, [c]Burn and Regenerative Medicine Research Center, Guilan University of Medical Sciences, Rasht and [d]School of Medicine, Islamic Azad University, Mashhad Branch, Mashhad, Iran

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*Corresponding authors. Address: Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran, Burn and Regenerative Medicine Research Center, Guilan University of Medical Sciences, Rasht, Iran, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran. Tel.: +98 903 259 8167. E-mail: sami.karkhah@yahoo.com (S. Karkhah); Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran. E-mail: Poyan.ghorbani@gmail.com (P. Ghorbani Vajargah).

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health[20]. Thus, adopting a physically active lifestyle is advocated as a strategy to prevent the loss of physical independence and support healthy aging[21].

Research from Portugal indicates that physical activity, particularly walking, and fitness training can enhance physical independence among older adults[1]. Moreover, increased physical activity levels are associated with a reduced duration of inactivity, with a minimum of 108 minutes of moderate to severe physical activity per day suggested to maintain physical independence in older adults[21]. Additionally, factors such as age, sex, and chronic diseases are known to influence physical independence in older adults[1].

Despite the wealth of studies assessing physical independence and associated factors among older adults, there is a lack of comprehensive reviews on this topic. Hence, recognizing the significance of this issue and the diverse findings in this field, a systematic review and meta-analysis were undertaken to evaluate physical independence and related factors in older adults.

HIGHLIGHTS

- The mean score of physical independence in older adults was 20.07 (SE = 0.76) out of 24.
- Physical activity is very important for physical independence and reduces the risk of physical dependence in older adults.
- Older adults demonstrate favourable levels of physical independence.
- Physical activity emerges as a significant determinant positively associated with such independence.
- Policymakers and administrators are encouraged to strategize the creation of conducive environments for walking and exercise among older adults.

Methods

The present systematic review and meta-analysis was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist (Supplementary Table S1, Supplemental Digital Content 1, http://links.lww.com/MS9/A442)[22]. Also, this systematic review and meta-analysis study has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) database. Given that this study involves the analysis of previously published research, obtaining patient-informed consent and ethical approval were not deemed necessary.

Search strategy

This systematic review was conducted through electronic databases such as Scopus, PubMed, Web of Science, Iranmedex, and Scientific Information Database (SID) via keywords extracted from Medical Subject Headings such as "Functional Status", "Functional Independence", "Functional dependence", "Exercise", "Aged", and "Frail elderly" from the earliest to April 1, 2022. For example, the search strategy was in PubMed/MEDLINE database including (("Functional Status") OR ("Functional Independence") OR ("Functional dependence") OR ("physical independence") OR ("physical dependence") AND ("Exercise") OR ("Physical activity") AND ("Aged") OR ("Elderly") OR ("Frail elderly") OR ("Older adults")). Keywords were combined using Boolean operators including "AND" and "OR". Persian databases were searched using the words mentioned in Persian. Also, two researchers performed all the search steps separately. Gray literature, such as conference presentations, expert opinions, dissertations, research and committee reports, and ongoing research, were not included in this review. Gray literature is articles produced in print and electronic formats but not reviewed by a commercial publisher[23].

Inclusion and exclusion criteria

Cross-sectional, longitudinal, and cohort studies published in English and Persian on physical independence and related factors in older adults were included in this systematic review. According to the WHO criteria, people over 60 years old were considered older adults. Letters to the editor, case reports, conference proceedings, experiments, studies with qualitative designs, and reviews were excluded.

Study selection

The data of this systematic review is managed using EndNote X8 software. Based on the inclusion and exclusion criteria of the research selection, the elimination of duplicate studies, the evaluation of the title and abstract of the study, and the evaluation of the full text of the articles were evaluated independently by two researchers. The third researcher resolved the differences between the two researchers in evaluating the studies. Finally, the final list of study sources was manually evaluated by researchers to prevent data loss.

Data extraction and quality assessment

The information extracted in this review by the researchers includes the name of the first author, year of publication, location, sample size, male/female ratio, age, single/married ratio, years of education, history of chronic disease, BMI, physical independence score, questionnaire, and the key result. The appraisal tool for cross-sectional studies (AXIS tool) evaluates the quality of the included studies via 20 items with a two-point Likert, including yes (score of 1) and no (score of 0). This tool assesses report quality (7 items), study design quality (7 items), and the possible introduction of biases (6 items). Finally, AXIS rates the quality of studies at three levels: high (70–100%), fair (60–69.9%), and low (0–59.9%)[24]. Two researchers independently extracted information from the studies and evaluated the quality of the studies. Also, the AMSTAR 2 checklist was completed to evaluate the study quality (Supplementary File S2, Supplemental Digital Content 2, http://links.lww.com/MS9/A443)[25].

Statistical analysis

The analysis was conducted using CMA program version 3, and each study's importance was determined based on its inverse variance. To assess the variation among the studies, heterogeneity was visually represented using a forest plot. These plots display the average physical independence scores for each study, as well as the overall mean score. The degree of heterogeneity was quantified using I^2 statistics, with 25% indicating mild, 50% indicating moderate, and 75% indicating high heterogeneity.

Because of substantial result variability, a random effects model was utilized.

Sensitivity analysis

A sensitivity analysis was performed to assess how the exclusion of each study influenced the average physical independence score.

Publication of bias

To assess the potential presence of publication bias, the results of the Egger test and a Funnel plot were employed.

Results

Study selection

By searching the electronic database, 1607 studies were obtained. One thousand two hundred fifty-one studies remained after the removal of duplicate studies. One thousand one hundred twenty-three studies were excluded due to inconsistency with the purpose of the present systematic review, and sixty-three studies were excluded due to their non-cross-sectional nature. After reviewing the full text of the articles, thirty-four studies were deleted due to inadequate design, two articles were excluded due to non-English or non-Persian publication language, and fifteen studies were deleted due to lack of required information. Finally, six studies[1,14,21,26–28] remained in the systematic review (Fig. 1).

Study characteristics

In total, 5733 older adults participated in this review in six studies[1,14,21,26–28]. 67.99% of older adults were female. The mean age of participants was 72.24 (SD = 7.03) years. The mean BMI was 25.52 (SD = 3.70) kg/m^2[1,14,21,26,28]. 74.89% of older adults had a history of chronic disease[21,26,27]. 27.72% of older adults had one or more physical dependence[1,14,26–28]. The mean physical activity in these subjects was 241.03 (SD = 114.32) min per day[1,21,26,28]. Most studies[1,14,21,28] used the composite physical function scale (CPFS) to measure physical independence. The CPFS, originating from the United States, fulfills this criterion through its 12-item hierarchical scale. This scale evaluates physical function, encompassing basic activities of daily living, instrumental activities of daily living, and more intricate tasks, including strenuous sports and exercise activities[29]. The original CPFS utilizes a scoring system where scores of 2 represent "can do", scores of 1 denote "can do with difficulty or with assistance", and scores of 0 signify "cannot do". These scores yield a total ranging from 0 to 24, with a cumulative score of 24 indicating full functional capacity, while a score of 0 indicates the individual's inability to perform any of the activities assessed[30]. The characteristics of the studies are presented in Table 1.

Methodological quality of included study

All evaluated studies[1,14,21,26–28] had high quality. Three studies[14,21,28] did not report the selection process representative; two studies[26,27] did not report research limitations; three studies[26–28] did not report funding sources or conflicts of interest (Fig. 2).

Physical independence in older adults

As shown in Figure 3, the mean score of physical independence in older adults based on CPFS[1,14,21,28] was 20.07 (SE = 0.76) out of 24 (95% CI: 18.58–21.56; $I^2 = 98.573\%$; $P < 0.001$).

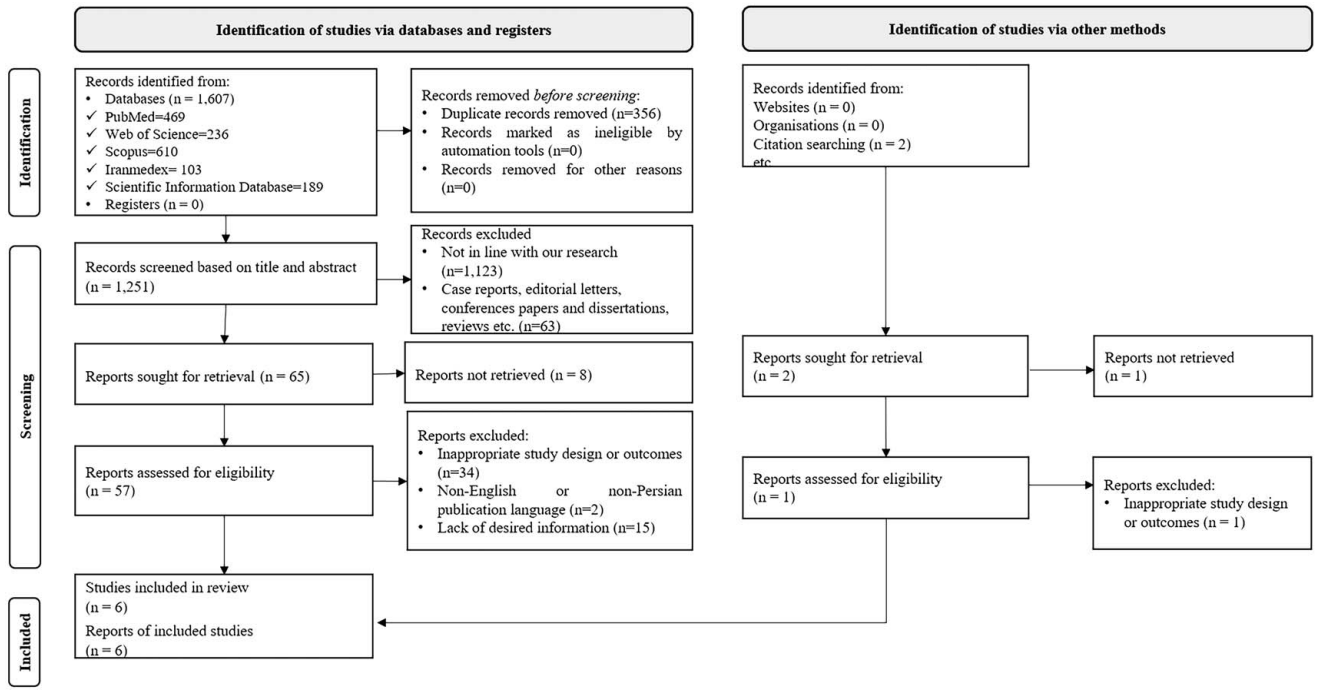

Figure 1. Flow diagram of the study selection process.

Table 1

Basic characteristics of the included studies in this systematic review.

First author/ year	Location	Sample size	M/F ratio (%)	Age (mean ± SD)	Single/ married ratio (%)	Years of education (lower 4 years/4-12 years/higher 12 years) %	History of chronic disease (%)	BMI (mean ± SD)	Questionnaire	Key results	Physical independence score (meant ± SD)	AXIS score
Gill *et al.*, 1995[16]	USA	563	26.29/ 73.71	79.10 (SD = 4.70)	75.51/ 21.49	NA	95.55	NA	•Modified Katz instrument •Qualitative performance tests •Timed performance test	•At the one-year follow-up, 9.41% of older adults were dependent on one or more basic ADLs. •The most common functional dependence on older adults was bathing (5.51%), walking (3.37%), and dressing (1.95%).	NA	High
den Ouden *et al.*, 2013[15]	Netherlands	400	NA	62.00 (SD = 10.5)	NA	16.50/28.50/55.00	48.50	26.50 (SD = 3.45)	•HAQ •Voorrips questionnaire	•The mean physical activity score was 17.85 (SD = 7.55). •26.50% of older adults had a grade of physical dependence.	NA	High
Marques *et al.*, 2014[17]	Portugal	371	35.31/ 64.69	74.70 (SD = 6.90)	NA	NA	NA	28.00 (SD = 4.30)	12-item CPF scale	•The mean score for physical activity was 229.60 min/d (SD = 102.50). •25.61% of older adults were at high risk of physical dependence.	19.40 (SD = 5.90)	High
Pereira *et al.*, 2016[1]	Portugal	85	34.12/ 65.88	67.40 (SD = 5.40)	NA	NA	NA	16.95 (SD = 2.15)	•12-item CPS scale •IPAQ •FAB	•The mean score of physical activity was 210.00 MET-min/ day (SD = 126.14) •47.06% of older adults gained physical dependence. •58.82% of females lost physical independence by the end of follow-up ($P = 0.003$).	21.30 (SD = 3.00)	High
Dos Santos *et al.*, 2017[3]	Portugal	3,493	33.38/ 66.62	75.05 (SD = 7.30)	NA	NA	NA	28.03 (SD = 4.30)	12-item CPF scale	30.00% of older adults were at high risk of physical dependence.	18.62 (SD = 6.40)	High
Hetherington-Rauth *et al.*, 2021[10]	Portugal	821	30.94/ 69.06	75.50 (SD = 7.40)	62.48/ 37.52	16.93/71.86/11.21	80.63	28.10 (SD = 4.30)	12-item CPF scale	The mean score for physical activity was 283.50 min/d.	21.00	High

ADLs, activities of daily living; CPF, composite physical function; F, female; FAB, Fullerton advance balance; HAQ, health assessment questionnaire; IPAQ, international physical activity questionnaire; M, male.

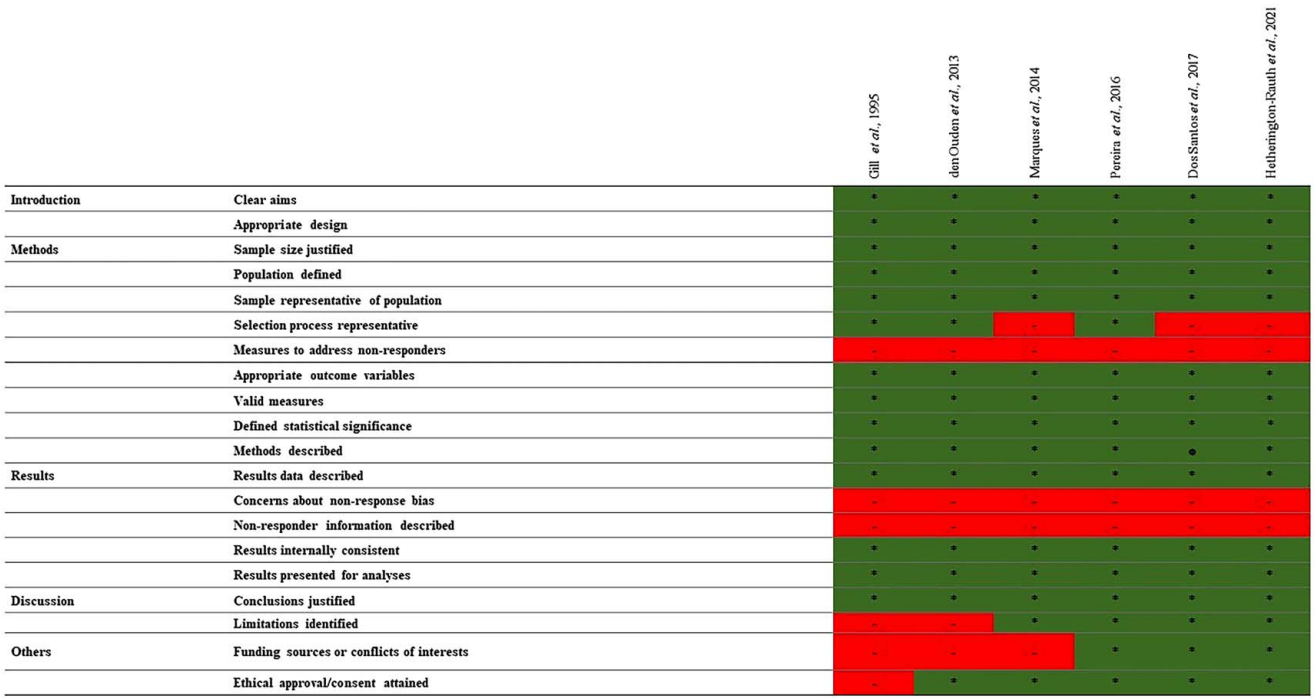

Figure 2. Assessment of the quality of the included articles.

Sensitivity analysis

As depicted in Figure 4, we systematically conducted sensitivity analyses, excluding one study at a time to assess the impact of each study on the overall results and the level of heterogeneity among the studies.

Publication of bias

As illustrated in Figure 5, a funnel plot was utilized to investigate the possible presence of publication bias in the evaluation of patients' physical independence scores. The Egger regression test yielded no indication of publication bias in the assessment of patients' physical independence ($t = 0.676$, $P = 0.569$).

Factors associated with physical independence

Factors such as gender[27,28], abnormal performance[27], and timed performance[27] had a significant relationship with physical independence among older adults. There was a significant positive relationship between physical independence and factors such as physical activity[1,21,26,28], BMI[1], sufficiently active[28], muscle function[14], handgrip strength[26], lower extremities function[26], lower body strength[1], maximal isometric knee extension power[26], lung function[26], and aerobic endurance[1]. However, factors such as age[1,26–28], sedentary time[21,28], agility[1], prevalence of arthritis[27], smoking[26], taking more medication[27], comorbidities[1], and low socioeconomic[26] had a significant negative relationship with physical independence among older adults. The related factors of the studies are presented in Table 2.

Discussion

The present systematic review includes 6 studies and 5733 older adults and has been done to summarize physical independence

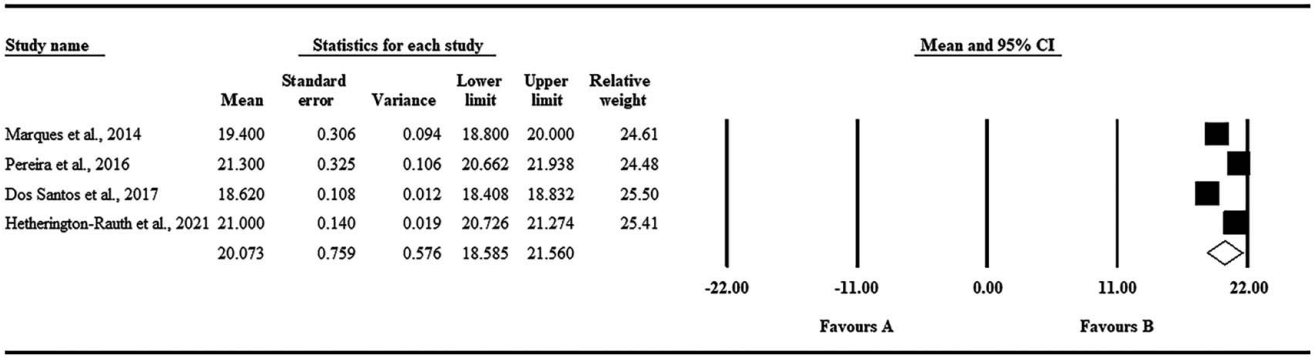

Figure 3. Forest plot patients' physical independence.

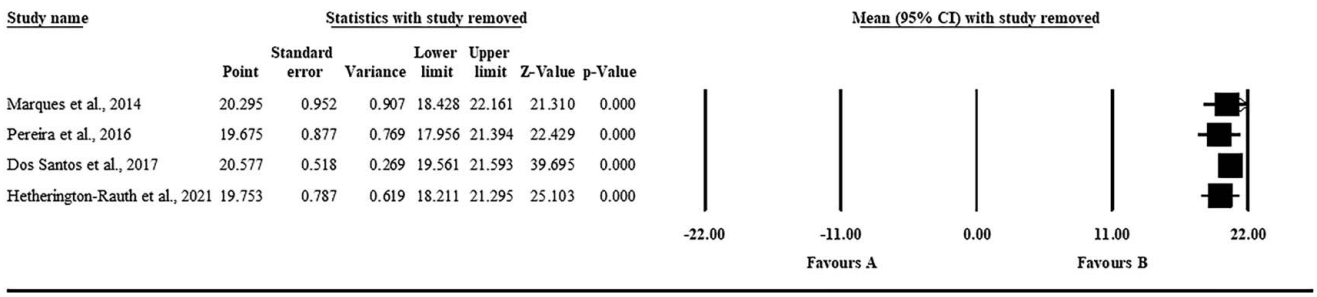

Figure 4. Sensitivity analysis of patients' physical independence.

and its related factors in them. The results of studies showed that older adults had good physical independence. Physical activity is very important for physical independence and reduces the risk of physical dependence in older adults. Other factors such as sex, BMI, age, abnormal performance, timed performance, sufficiently active, muscle function, handgrip strength, lower extremity function, lower body strength, maximal isometric knee extension power, lung function, aerobic endurance, sedentary time, agility, the prevalence of arthritis, taking more medication, comorbidities, and low socioeconomic had a significant relationship with physical independence in older adults.

Any activity that results in muscle movement and energy consumption is called physical activity[31]. Physical activity also has significant benefits, such as preventing falls and injuries. However, there are barriers to physical activity in older adults, such as lack of physical health, lack of will, competence, time, and social support[32]. Despite these barriers to activity, physical activity should be appropriate and adequate in the daily program for older adults.

The results of a longitudinal study in Taiwan showed that physical activity can reduce the risk of disease and premature death in older adults[33]. Another study in Spain showed that physical activity plays an important role in the physical fitness of people over 65 years old[34]. Based on the above results, policymakers and managers can increase the mobility of older adults by planning and preparing places for them to walk and exercise and consequently reduce their physical dependence.

The association between gender and physical independence among older adults is intricate and influenced by a multitude of factors[27,28]. Biological dissimilarities, encompassing variations in muscle mass, body composition, and hormonal profiles, are known to impact physical functioning and autonomy[35]. While gender may contribute to determining physical independence in older adults, its effects are likely modulated by a complex interplay of biological, social, and environmental variables[36,37]. Therefore, a comprehensive understanding of this relationship necessitates consideration of diverse populations and contexts.

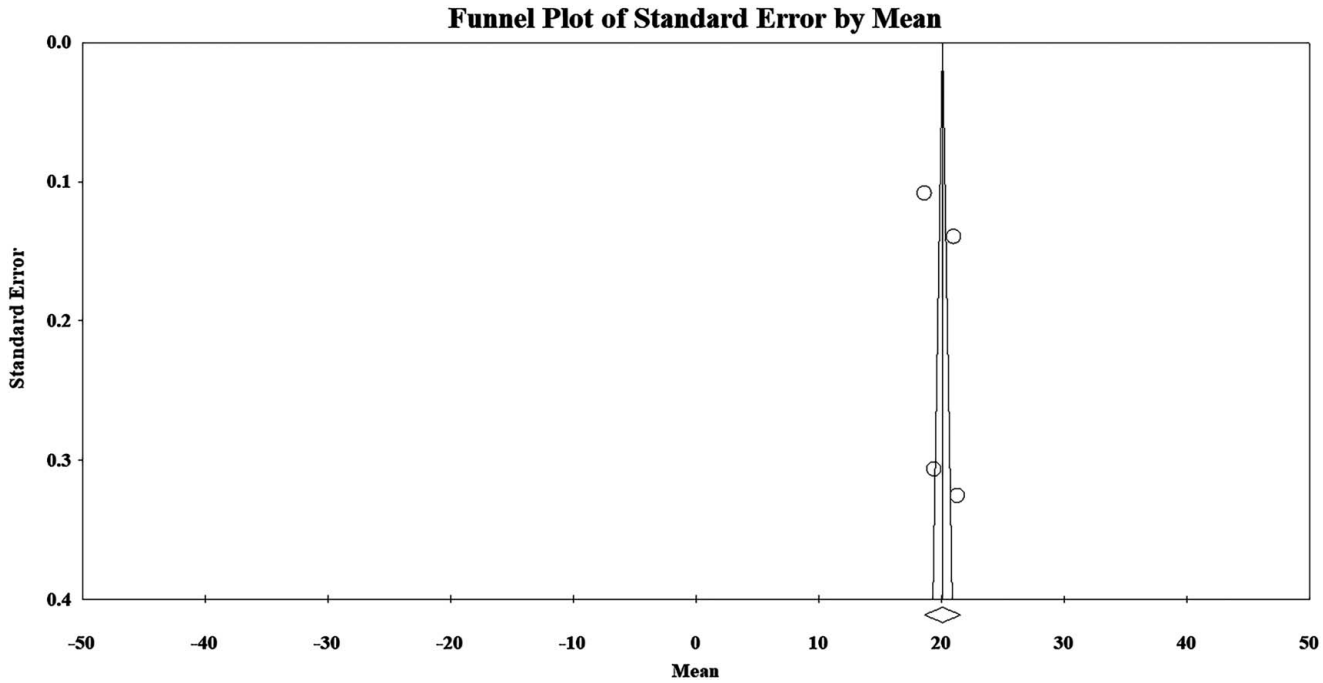

Figure 5. Funnel plot of patients' physical independence.

Table 2

Factors associated with physical independence among older adults.

First author/year	Factors associated with physical independence
Gill *et al.,* 1995[16]	•There was a significant negative relationship between age and physical independence in older adults ($P < 0.05$). •There was a significant negative relationship between taking more medications and physical independence ($P < 0.05$). •There was a significant negative relationship between the prevalence of arthritis and physical independence ($P < 0.05$). •Females significantly had more physical dependence ($P < 0.05$). •There was a significant relationship between abnormal performance and ADL dependence ($P < 0.05$). •There was a significant relationship between the timed performance test and the onset of physical independence ($P < 0.05$).
den Ouden *et al.,* 2013[15]	•There was a significant negative relationship between age and physical independence in older adults ($P < 0.05$). •There was a significant negative relationship between smoking and physical independence in older adults ($P < 0.05$). •There was a significant negative relationship between low socioeconomic status and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between lung function and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between handgrip strength and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between maximal isometric knee extension power and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between lower extremity function and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between sport (physical activity) and physical independence in older adults ($P < 0.05$).
Marques *et al.,* 2014[17]	•There was a significant negative relationship between age and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between sufficiently active and physical independence in older adults ($P < 0.05$). •There was a significant negative relationship between sedentary time and physical independence in older adults ($P < 0.05$). •There was a significant positive relationship between total physical activity and physical independence in older adults ($P < 0.05$). •There was a significant relationship between gender and physical independence in older adults ($P < 0.05$).
Pereira *et al.,* 2016[1]	•There was a significant negative relationship between age and change in physical independence ($P = 0.002$). •There was a significant negative relationship between comorbidities and physical independence after five years ($P < 0.05$). •There was a significant positive relationship between total physical activity and physical independence after five years ($P < 0.05$). •There was a significant positive relationship between BMI and physical independence after five years ($P < 0.05$). •There was a significant negative relationship between agility and physical independence after five years ($P < 0.05$). •There was a significant positive relationship between aerobic endurance and physical independence after five years ($P < 0.05$). •There was a significant positive relationship between lower body strength and physical independence after five years ($P < 0.05$).
Dos Santos *et al.,* 2017[3]	•There was a significant positive relationship between muscle function and physical independence ($P < 0.05$).
Hetherington-Rauth *et al.,* 2021[10]	•There was a significant negative relationship between sedentary time and physical independence ($P < 0.001$). •There was a significant positive relationship between physical activity and physical independence ($P < 0.008$).

Further research is imperative to elucidate the nuanced dynamics between gender and physical independence in older age, thus facilitating the development of tailored interventions and support mechanisms to enhance overall well-being and functional autonomy among older adults.

The correlation between age and physical independence among older adults is firmly established, with increasing age typically linked to a decrement in physical functioning and autonomy[1,26–28]. With advancing age, individuals commonly undergo physiological alterations, including declines in muscle mass, bone density, and sensory acuity, thereby affecting their capacity to carry out daily activities autonomously[38,39]. Furthermore, age-related chronic ailments such as arthritis, cardiovascular disorders, and neurodegenerative conditions exacerbate limitations in mobility and functional prowess[40,41]. Despite the general association between aging and diminished physical independence, interventions aimed at promoting healthy aging, encompassing regular exercise regimens, appropriate dietary practices, and preventive healthcare strategies, offer avenues to attenuate the impact of age-related changes on physical autonomy. Furthermore, the implementation of assistive technologies, home adaptations, and community support initiatives serve to bolster older adults' capacity to uphold their independence and sustain a high quality of life throughout the aging process.

Another factor affecting physical independence is the amount of muscle mass and its function, which is positively associated with increased physical independence. The results of a study show that increasing the level of physical activity, especially endurance exercise, increases the amount of muscle mass in older adults[42]. Therefore, older adults should include daily exercise in their daily planning.

Based on the results of the present systematic review and meta-analysis, it is suggested that future studies address the impact of various interventions on reducing physical dependence in older adults by focusing on the factors associated with it.

Limitations

The systematic review and meta-analysis conducted in this study had certain limitations that should be acknowledged. Notably, there was substantial heterogeneity among the studies included in this analysis. The conclusions drawn and the results obtained from the meta-analysis are dependent on the presence and quality of data collected from the selected studies. Despite an exhaustive search of various databases, it is possible that some relevant studies in this field may not have been identified. Additionally, it is important to note that only studies in English and Persian were considered for inclusion, which means that articles in other languages may not have been incorporated into this research.

Implications for health managers and policymakers

Physical independence is one of the most important issues in older ages because increasing dependence on older adults can cause

problems for both older adults and their families. Physical activity is one of the most important factors associated with physical independence in older ages. Policymakers and managers can increase the mobility of older adults by planning and preparing places for them to walk and exercise and consequently reduce their physical dependence.

Implications for future research

Based on the results of this review study, it is suggested that future studies address the impact of various interventions on physical dependence in older adults by focusing on related factors.

Conclusion

In sum, according to CPFS, older adults had good physical independence. The physical activity factor is of great importance in this physical independence and increases it. Other factors such as sex, BMI, age, abnormal performance, timed performance, sufficiently active, muscle function, handgrip strength, lower extremity function, lower body strength, maximal isometric knee extension power, lung function, aerobic endurance, sedentary time, agility, the prevalence of arthritis, taking more medication, comorbidities, and low socioeconomic affect physical independence. Therefore, policymakers and managers can increase the mobility of older adults by planning and preparing places for them to walk and exercise and consequently reduce their physical dependence.

Ethical approval

None.

Consent

This study is a systematic review and meta-analysis and does not require ethical approval and consent.

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None.

Author contribution

Study concept and design by all authors; Data acquisition by all authors; Data interpretation by all authors; drafting the manuscript by all authors; Revision of the manuscript by all authors; the final version of the manuscript is approved by all authors.

Conflicts of interest disclosure

The authors declare no conflict of interest.

Research registration unique identifying number (UIN)

We do not receive any funding for our research and we cannot pay for our research. Please excuse us from registering this manuscript in the Research Registry UIN: www.researchregistry.com

1. Registry used: International Prospective Register of Systematic Reviews (PROSPERO).
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3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=483838

Guarantor

Samad Karkhah.

Data availability statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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