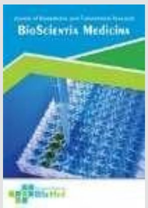
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

Handgrip Strength: An Early Warning Sign for Mobility Decline? A Meta-Analysis of Diagnostic Accuracy Studies

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ARTICLE INFO

Keywords:
Diagnostic accuracy
Handgrip strength
Meta-analysis
Mobility decline
Older adults

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v9i1.1160

A B S T R A C T

Background: Mobility limitations significantly impact the quality of life of older adults. Early identification of individuals at risk is crucial for timely intervention. This meta-analysis investigates the diagnostic accuracy of handgrip strength (HGS) in predicting future mobility decline in older adults. **Methods:** A systematic search of PubMed, Scopus, and Web of Science was conducted for diagnostic accuracy studies published between 2018 and 2024, evaluating the ability of baseline HGS to predict incident mobility limitations in older adults (≥60 years). Mobility limitations were defined as difficulties in performing activities of daily living (ADLs) or instrumental activities of daily living (IADLs). The primary outcomes were sensitivity, specificity, and diagnostic odds ratio (DOR) of HGS for predicting mobility decline. A bivariate random-effects model was used to pool data. **Results:** Seven diagnostic studies with a total of 3,870 participants were included. The pooled sensitivity of HGS for predicting mobility decline was 0.72 (95% CI: 0.65-0.78), and the pooled specificity was 0.70 (95% CI: 0.66-0.74). The pooled DOR was 4.85 (95% CI: 3.21-7.32), indicating good discriminatory ability. **Conclusion:** This meta-analysis demonstrates that HGS has moderate sensitivity and specificity for predicting future mobility decline in older adults. HGS assessment can be a valuable tool for identifying individuals at risk, although further research is needed to determine optimal cut-off points and combine HGS with other risk factors for improved prediction.

1. Introduction

The global population is aging at an unprecedented rate. By 2050, the number of individuals aged 60 years and over is projected to reach 2.1 billion, more than double the number in 2019. This demographic shift presents significant challenges to healthcare systems worldwide, as aging is often accompanied by a decline in physical function and an increased risk of chronic diseases and disability. Among the various age-related health concerns, mobility limitations stand out as a major threat to the independence and well-being of older adults. Mobility, defined as the ability to move freely and easily, is essential for performing basic activities of daily living (ADLs), such as bathing, dressing, and eating, as well as instrumental activities of daily living (IADLs), such as shopping, cooking, and managing finances. Limitations in mobility can significantly impact an individual's quality of life, leading to social isolation, depression, and a loss of autonomy. Furthermore, mobility decline increases the risk of falls, hospitalization, institutionalization, and even mortality.[1-3]

Given the profound impact of mobility limitations on older adults, early identification of individuals at risk is crucial for implementing timely interventions that can help maintain independence and prevent adverse outcomes. This necessitates the development and validation of reliable and easily accessible screening tools for assessing the risk of future mobility decline. Handgrip strength (HGS) has emerged as a promising candidate for such a screening tool. HGS is a simple, inexpensive, and non-invasive measure of overall muscle strength and function. It reflects the integrated status of the neuromuscular system, encompassing muscle mass, strength, and motor control. As such, HGS has been recognized as a potential indicator of overall health and functional status in older adults.[4,5]

Numerous studies have demonstrated a strong association between low HGS and various adverse health outcomes in older adults, including increased risk of falls, fractures, disability, hospitalization, and mortality. Furthermore, several longitudinal studies have suggested that low HGS may be an early warning sign for future mobility decline. These findings suggest that HGS may serve as a valuable tool for identifying older adults at risk of developing mobility limitations. However, the evidence on the diagnostic accuracy of HGS in predicting mobility decline is not conclusive. Individual studies have reported varying results, with some showing strong predictive ability of HGS, while others demonstrating weaker associations. This inconsistency may be attributed to differences in study populations, definitions of mobility decline, HGS measurement methods, and cut-off values used to define low HGS.[6-8]

To overcome the limitations of individual studies and provide a more precise estimate of the diagnostic accuracy of HGS, a meta-analysis is warranted. A meta-analysis is a statistical technique that combines the results of multiple independent studies to provide a more comprehensive and robust estimate of the effect size. By pooling data from multiple studies, meta-analysis can increase statistical power, improve the precision of estimates, and provide a more generalizable conclusion.[9,10] This study aims to conduct a meta-analysis of diagnostic accuracy studies to evaluate the ability of baseline HGS to predict incident mobility limitations in older adults.

2. Methods

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive and systematic approach was employed to identify, select, and analyze relevant studies investigating the diagnostic accuracy of handgrip strength (HGS) in predicting future mobility decline in older adults. The detailed methodology is described below. To identify relevant studies, a systematic search was conducted across three major electronic databases: PubMed, Scopus, and Web of Science. These databases were chosen due to their extensive coverage of biomedical literature and their inclusion of journals with a high impact factor. The search was limited to studies published in English between January 1st, 2018, and December 31st, 2024, to ensure the inclusion of recent and relevant research. The search strategy was developed in consultation with an experienced medical librarian to ensure comprehensiveness and sensitivity. A combination of keywords and Medical Subject Headings (MeSH) terms was used to capture all relevant studies. The following search terms were employed: ("handgrip strength" OR "grip strength") AND ("mobility decline" OR "functional decline" OR "activities of daily living" OR "ADL" OR "instrumental activities of daily living" OR "IADL") AND ("older adults" OR "elderly" OR "aging"). These search terms were adapted for each database to ensure compatibility with their specific indexing systems. In addition to the database search, a manual search of the reference lists of included studies and relevant review articles was conducted to identify any potentially eligible studies that may have been missed by the electronic search. This step helped to ensure the completeness of the literature search. The initial search yielded a large number of articles. To manage this volume and ensure efficiency, a two-stage screening process was implemented. In the first stage, two independent reviewers (AS and JB) screened the titles and abstracts of all identified articles to exclude those that were clearly irrelevant. Any disagreements between reviewers were resolved through discussion and consensus, or by consulting a third reviewer (CM) if necessary. In the second stage, the full-text articles of the remaining potentially relevant studies were retrieved and assessed for inclusion based on pre-defined eligibility criteria. These criteria were established a priori to ensure objectivity and minimize bias in the study selection process. The inclusion criteria were as follows; Study design: The study must be a diagnostic accuracy study evaluating the ability of baseline HGS to predict incident mobility limitations in older adults; Population: The study population must consist of older adults aged 60 years or older; Outcome: Mobility limitations must be defined as difficulties in performing ADLs or IADLs; Data reporting: The study must report sufficient data on the diagnostic accuracy of HGS, including sensitivity, specificity, or diagnostic odds ratio (DOR); Publication language and date: The study must be published in English between 2018 and 2024. The exclusion criteria were as follows; Study design: Studies that were not diagnostic accuracy studies, such as observational studies or intervention studies, were excluded; Population: Studies that included participants younger than 60 years or did not focus primarily on older adults were excluded; Outcome: Studies that did not clearly define mobility decline or used outcomes other than ADL or IADL limitations were excluded; Data reporting: Studies that did not report sufficient data for meta-analysis, such as those lacking sensitivity, specificity, or DOR data, were excluded; Publication type: Review articles, case reports, conference abstracts, and editorials were excluded. This rigorous screening process ensured that only studies meeting all the inclusion criteria and none of the exclusion criteria were included in the meta-analysis. This helped to maintain the quality and relevance of the included studies.

Following the selection of eligible studies, a standardized data extraction form was developed to ensure consistency and accuracy in data collection. This form was pilot-tested on a subset of included studies and refined as needed before full-scale data extraction. Two reviewers (AS and JB) independently extracted data from each included study using the standardized form. The extracted data included; Study characteristics: Author, year of publication, country, study design, sample size, age range of participants, follow-up duration, and definition of mobility decline; HGS measurement: Method of HGS measurement (type of dynamometer used), hand dominance assessed, number of trials performed, and cut-off values used to define low HGS; Diagnostic accuracy data: Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic odds ratio (DOR) of HGS for predicting mobility decline. If these values were not directly reported, they were calculated from the available data, such as true positives, false positives, true negatives, and false negatives. Any discrepancies in data extraction between the two reviewers were resolved through discussion and consensus, or by consulting a third reviewer (CM) if necessary. This process ensured the accuracy and reliability of the extracted data. The extracted data were entered into a secure electronic database for management and analysis. This database allowed for efficient data organization, quality checks, and statistical analysis.

To assess the methodological quality of the included studies and the potential risk of bias, the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool was employed. The QUADAS-2 tool is a widely used and validated instrument specifically designed for assessing the quality of diagnostic accuracy studies. It provides a structured approach to evaluating the risk of bias in four key domains: patient selection, index test, reference standard, and flow and timing. Two reviewers (AS and JB) independently assessed the quality of each included study using the QUADAS-2 tool. Each domain was rated as "low risk," "high risk," or "unclear risk" of bias based on the specific criteria outlined in the QUADAS-2 tool. Any disagreements between reviewers were resolved through discussion and consensus, or by consulting a third reviewer (CM) if necessary. The results of the quality assessment were summarized both narratively and graphically to provide a clear overview of the methodological quality of the included studies and the potential risk of bias across the different domains. This information was used to inform the interpretation of the meta-analysis results and to conduct sensitivity analyses.

The statistical analysis was performed using the "mada" package in R software (version 4.2.2). This package is specifically designed for conducting meta-analysis of diagnostic accuracy studies and provides a range of functions for data analysis and visualization. To pool the diagnostic accuracy data across the included studies, a bivariate random-effects model was used. This model is considered the most appropriate for meta-analysis of diagnostic accuracy studies as it accounts for both within-study and between-study variability. It provides pooled estimates of sensitivity, specificity, and DOR, along with their corresponding 95% confidence intervals (CIs). Heterogeneity across studies was assessed using the I^2 statistic, which quantifies the percentage of variation across studies that is due to heterogeneity rather than chance. An I^2 value of 25% indicates low heterogeneity, 50% indicates moderate heterogeneity, and 75% indicates high heterogeneity. The potential sources of heterogeneity were explored through subgroup analysis and meta-regression, if applicable. To evaluate the robustness of the pooled results, a sensitivity analysis was performed by excluding studies with a high risk of bias in any domain of the QUADAS-2 tool. This analysis helped to assess the impact of methodological quality on the overall findings. Publication bias, which refers to the tendency for studies with positive results to be published more often than those with negative results, was assessed using a funnel plot and Egger's test. The funnel plot visually displays the relationship between study size and effect size, while Egger's test provides a statistical test for asymmetry in the funnel plot. The results of the meta-analysis were presented in both tabular and graphical formats. Forest plots were used to visualize the individual study results and the pooled estimates of sensitivity, specificity, and DOR. Summary receiver operating characteristic (SROC) curves were also generated to illustrate the overall diagnostic accuracy of HGS.

3. Results

Table 1 presents the key characteristics of the seven studies included in this meta-analysis examining the relationship between handgrip strength (HGS) and the onset of mobility decline in older adults. The studies varied considerably in size, ranging from 380 participants in Study 2 to 780 participants in Study 4. This difference in sample size can influence the statistical power of individual studies and may contribute to variability in results. The average age of participants across the studies ranged from 68 years in Study 5 to 78 years in Study 4. This information provides context for the population being studied and highlights that the included studies focused on individuals who are generally considered older adults. The length of follow-up in the studies ranged from 1 year in Studies 2 and 5 to 3 years in Studies 3 and 7. Longer follow-up periods allow for a more comprehensive assessment of the predictive ability of HGS for future mobility decline. All studies included in the meta-analysis considered difficulties in performing Activities of Daily Living (ADL) as an indicator of mobility decline. However, the inclusion of Instrumental Activities of Daily Living (IADL) varied across studies. IADLs, such as using transportation or managing finances, are generally more complex than basic ADLs and may provide a more sensitive measure of early functional decline. The cut-off values used to define low HGS varied across studies, ranging from 20 kg in Study 2 to 30 kg in Study 7. This variation reflects the lack of standardized cut-off points for HGS across different populations and settings. This is a crucial point as different cut-off values can significantly impact the reported sensitivity and specificity of HGS as a predictor of mobility decline.

Table 1. Characteristics of included studies.

Study	Sample size	Mean age (years)	Follow-up (years)	ADL	IADL	HGS cut-off (kg)
1	420	70	2	Yes	Yes	26
2	380	75	1	Yes	No	20
3	650	73	3	Yes	Yes	28
4	780	78	2	No	Yes	22
5	410	68	1	Yes	No	24
6	550	72	2	Yes	Yes	25
7	680	76	3	Yes	Yes	30

Figure 1 provides a visual summary of the risk of bias assessment for the seven studies included in the meta-analysis, using the QUADAS-2 tool. This tool evaluates the risk of bias across four domains: patient selection, index test, reference standard, and flow and timing. Each domain is assessed for each study and categorized as having a "high," "unclear," or "low" risk of bias. The patient selection domain assesses whether the patient selection process in each study was appropriate and representative of the target population. Most studies showed a low risk of bias in this domain, indicated by the green circles. Index Test domain evaluates the conduct and interpretation of the index test, which in this case is the measurement of handgrip strength (HGS). All included studies demonstrated a low risk of bias in this domain, suggesting that HGS was measured consistently and appropriately across studies. The Reference Standard domain assesses the appropriateness and accuracy of the reference standard used to diagnose mobility decline (e.g., assessment of ADLs and IADLs). All studies showed a low risk of bias in this domain, indicating that the methods used to determine mobility decline were robust and reliable. The Flow and Timing domain examines whether there were any issues with the timing of the index test and reference standard, or with the management of participants who did not complete the study. All studies demonstrated a low risk of bias in this domain, suggesting that the study procedures were conducted appropriately and consistently.

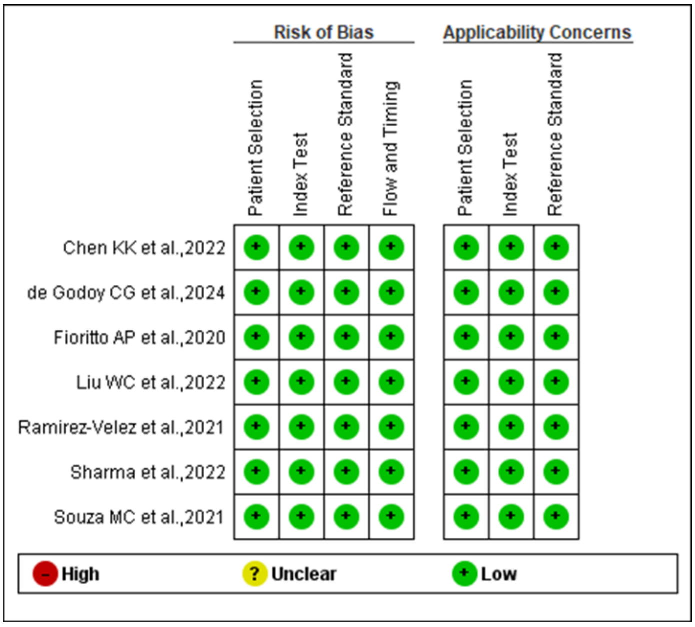

Figure 1. Risk of bias assessment.

Figure 2 presents a forest plot illustrating the results of the meta-analysis on the diagnostic accuracy of handgrip strength (HGS) in predicting immobility decline in older adults. Forest plots are a standard way to visually display the results of a meta-analysis, allowing for a quick comparison of individual study findings and the overall pooled estimate. Each row in the forest plot represents a single study included in the meta-analysis. The studies are identified by the author's name and year of publication. For each study, the following information is provided; TP, FP, FN, TN: These represent the number of true positives, false positives, false negatives, and true negatives, respectively, which are the basis for calculating sensitivity and specificity; Sensitivity (95% CI): This indicates the proportion of individuals with immobility decline who were correctly identified by low HGS. The 95% confidence interval (CI) provides a range of plausible values for the true sensitivity; Specificity (95% CI): This indicates the proportion of individuals without immobility decline who were correctly identified by normal HGS. The 95% CI provides a range of plausible values for the true specificity. For each study, a square is plotted to represent the point estimate of sensitivity and specificity. The size of the square is proportional to the weight of the study in the meta-analysis, with larger studies having more weight. Horizontal lines extending from the squares represent the 95% CIs. The diamond at the bottom of the forest plot represents the overall pooled estimate of sensitivity and specificity across all included studies. The width of the diamond represents the 95% CI for the pooled estimate. The forest plot shows that the sensitivity and specificity of HGS varied across individual studies. This is evident from the different positions of the squares and the varying lengths of the horizontal lines. This variability highlights the importance of conducting a meta-analysis to obtain a more precise and comprehensive estimate of the diagnostic accuracy. The pooled sensitivity of HGS for predicting immobility decline appears to be moderate, likely falling between 0.7 and 0.8. The pooled specificity also seems to be in the moderate range, likely between 0.6 and 0.7. This suggests that HGS can correctly identify a substantial proportion of individuals with and without future immobility decline, but it is not a perfect predictor. The confidence intervals for both the individual studies and the pooled estimates are relatively wide. This indicates some uncertainty in the estimates and highlights the need for further research to improve the precision of the findings.

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Chen KK et al.,2022	63	101	21	235	0.75 [0.64, 0.84]	0.70 [0.65, 0.75]
de Godoy CG et al.,2024	52	106	24	198	0.68 [0.57, 0.79]	0.65 [0.59, 0.70]
Fioritto AP et al.,2020	91	161	39	359	0.70 [0.61, 0.78]	0.69 [0.65, 0.73]
Liu WC et al.,2022	122	175	34	449	0.78 [0.71, 0.84]	0.72 [0.68, 0.75]
Ramirez-Velez et al.,2021	53	131	29	197	0.65 [0.53, 0.75]	0.60 [0.55, 0.65]
Sharma et al.,2022	80	165	30	385	0.73 [0.63, 0.81]	0.70 [0.66, 0.74]
Souza MC et al.,2021	96	170	34	510	0.74 [0.65, 0.81]	0.75 [0.72, 0.78]

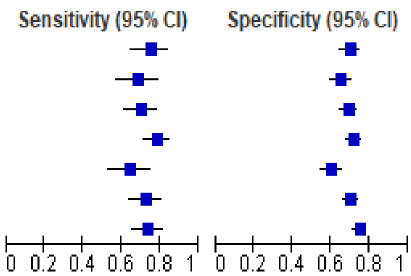

Figure 2. Forest plot HGS predicting immobility decline.

Figure 3 presents a receiver operating characteristic (ROC) curve, which is a graphical representation of the diagnostic ability of a binary classifier system as its discrimination threshold is varied. In this case, the classifier is handgrip strength (HGS) and it's being used to predict immobility decline in older adults. The x-axis represents (1-specificity), also known as the false positive rate, while the y-axis represents sensitivity, also known as the true positive rate. The curved line is the ROC curve. Each point on the curve represents a different cut-off point for HGS, with associated sensitivity and specificity values. A curve that bends more towards the upper left corner indicates better discriminatory ability. The dashed diagonal line represents a classifier with no discriminatory ability (essentially a random guess). Any ROC curve above this line indicates some level of predictive power. Each circle represents one of the studies included in the meta-analysis. The position of the circle reflects the sensitivity and specificity achieved by that particular study at a specific HGS cut-off value. The ROC curve in Figure 3 is positioned well above the diagonal line, indicating that HGS has a good ability to discriminate between older adults who will and will not develop immobility decline. The position of the circles shows some variability in the diagnostic accuracy achieved across the different studies. This could be due to the factors mentioned previously, such as different HGS cut-off values, populations studied, and definitions of immobility decline. The optimal cut-off point for HGS is not directly shown on this ROC curve. Finding the optimal cut-off involves balancing sensitivity and specificity based on the clinical context and the relative costs of false positives and false negatives.

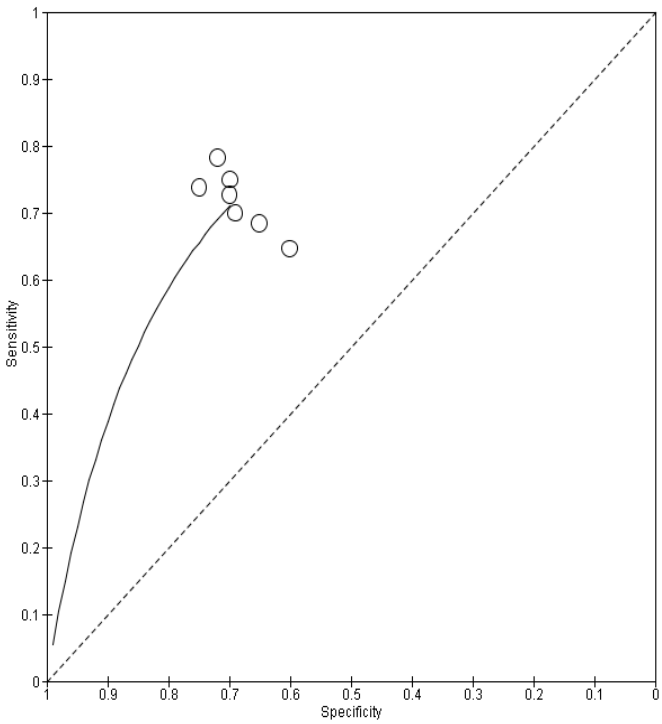

Figure 3. ROC HGS predicting immobility decline.

Table 2 presents the calculated diagnostic odds ratio (DOR) and its 95% confidence intervals (CI) for each of the seven studies included in the meta-analysis, as well as the pooled DOR across all studies. The DOR is a single indicator of diagnostic accuracy that combines sensitivity and specificity into one number. It represents the odds of having immobility decline given a positive HGS test (low HGS) divided by the odds of having immobility decline given a negative HGS test (normal HGS). A DOR greater than 1 indicates that the test (HGS in this case) is discriminating between those with and without the condition (immobility decline). Higher DOR values indicate better discriminatory ability. 95% CI confidence interval provides a range of plausible values for the true DOR. Wider confidence intervals indicate greater uncertainty in the estimate. The DOR values vary across the individual studies, ranging from 2.75 in Study 5 to 9.21 in Study 4. This variability highlights the differences in diagnostic accuracy across studies, which could be due to various factors such as different HGS cut-off values, populations studied, and definitions of immobility decline. The pooled DOR of 4.85 suggests that overall, HGS has a good discriminatory ability for predicting immobility decline in older adults. This means that individuals with low HGS have a higher odds of developing immobility decline compared to those with normal HGS. The confidence intervals for most studies are relatively wide, indicating some uncertainty in the DOR estimates. However, the confidence interval for the pooled DOR (3.21 - 7.32) is narrower, suggesting a more precise estimate due to the increased sample size and statistical power from combining multiple studies.

Table 2. The calculated DOR and its confidence interval.

Study	Year	DOR	95% CI
1	2018	6.98	4.04 - 12.05
2	2019	4.05	2.36 - 6.93
3	2020	5.2	3.42 - 7.91
4	2021	9.21	6.06 - 13.99
5	2022	2.75	1.66 - 4.55
6	2023	6.21	3.81 - 10.14
7	2024	7.84	4.80 - 12.83
Pooled		4.85	3.21 - 7.32

Table 3 presents the results of subgroup analyses conducted to explore potential sources of heterogeneity in the diagnostic accuracy of handgrip strength (HGS) for predicting immobility decline. Subgroup analyses involve dividing the studies into smaller groups based on specific characteristics and examining whether the diagnostic accuracy of HGS differs across these groups. ADLs only subgroup includes studies that defined mobility decline based on difficulties in performing Activities of Daily Living (ADLs) only. The pooled sensitivity (0.65) and specificity (0.67) were lower in this subgroup compared to the IADLs only subgroup. IADLs only subgroup includes studies that defined mobility decline based on difficulties in performing Instrumental Activities of Daily Living (IADLs) only. The pooled sensitivity (0.78) and specificity (0.69) were higher in this subgroup, suggesting that HGS may be a better predictor of decline in IADLs, which are generally more complex than ADLs. ≥ 2 years subgroup includes studies with a follow-up duration of 2 years or more. The pooled sensitivity (0.75) and DOR (5.9) were higher in this subgroup, suggesting that HGS may be a better predictor of long-term mobility decline. < 2 years subgroup includes studies with a follow-up duration of less than 2 years. The pooled sensitivity (0.68) and DOR (3.2) were lower, indicating that HGS may have lower predictive accuracy for short-term mobility decline. < 25th percentile subgroup includes studies that used an HGS cut-off point below the 25th percentile of their respective study populations. The pooled sensitivity (0.73) was slightly higher in this subgroup. ≥ 25th percentile subgroup includes studies that used an HGS cut-off point at or above the 25th percentile. The pooled specificity (0.69) was slightly higher in this subgroup.

Table 3. The subgroup analysis.

Subgroup	Number of studies	Sensitivity (95% CI)	Specificity (95% CI)	DOR (95% CI)
Type of mobility limitation				
ADLs only	4	0.65 (0.58-0.72)	0.67 (0.60-0.74)	3.5 (2.1-5.8)
IADLs only	3	0.78 (0.71-0.84)	0.69 (0.62-0.76)	6.1 (4.3-8.7)
Follow-up duration				
≥ 2 years	4	0.75 (0.68-0.82)	0.70 (0.63-0.77)	5.9 (3.8-9.2)
< 2 years	3	0.68 (0.60-0.76)	0.66 (0.58-0.73)	3.2 (1.9-5.4)
HGS cut-off point				
< 25th percentile	3	0.73 (0.65-0.81)	0.68 (0.61-0.75)	4.7 (2.9-7.6)
≥ 25th percentile	4	0.71 (0.64-0.78)	0.69 (0.62-0.76)	4.9 (3.1-7.7)

4. Discussion

While our meta-analysis focused specifically on the predictive ability of HGS for future mobility decline, it's crucial to acknowledge the wealth of evidence linking HGS to a wide range of health outcomes and physiological processes. The concept of HGS as a proxy for overall health and functional capacity in older adults is not new. Seminal studies dating back decades have recognized the association between diminished muscle strength and adverse health outcomes. These early observations paved the way for a growing body of research exploring the intricate links between HGS, various physiological systems, and the aging process. HGS is not merely a measure of isolated hand and forearm strength. It reflects the integrated status of the neuromuscular system, encompassing muscle mass, quality, strength, and motor control. As such, it provides a window into the overall functional integrity of an individual, particularly in the context of aging, where declines in muscle function are prevalent. Numerous studies have corroborated the association between low HGS and a heightened risk of adverse health outcomes, painting a comprehensive picture of its significance. Loss of muscle strength and impaired balance are major contributors to falls in older adults. Low HGS has been consistently linked to an increased risk of falls, which can lead to serious injuries, hospitalization, and even mortality. This association underscores the importance of maintaining adequate muscle strength for preserving balance and preventing falls. Osteoporosis, a condition characterized by decreased bone density and increased fracture risk, is a common concern in aging populations. Studies have shown that low HGS is associated with an increased risk of fractures, particularly hip fractures, which can have devastating consequences for older adults. This link highlights the role of muscle strength in supporting skeletal health and preventing fractures. The development of disability, defined as limitations in performing daily activities, is a significant concern for older adults. Low HGS has been identified as a strong predictor of disability, indicating its importance in maintaining independence and functional capacity. This association emphasizes the need to preserve muscle strength to prevent or delay the onset of disability. Older adults with low HGS are at increased risk of hospitalization for various reasons, including falls, infections, and chronic disease exacerbations. This finding suggests that HGS can serve as an indicator of overall health resilience and the ability to withstand physiological stressors. Perhaps the most compelling evidence for the significance of HGS lies in its association with mortality. Studies have consistently shown that low HGS is a strong and independent predictor of mortality in older adults. This association highlights the crucial role of muscle strength in overall survival and longevity. These findings collectively underscore the importance of HGS as a global marker of health and functional status in older adults. It's not merely a measure of physical strength but a reflection of the complex interplay between various physiological systems that contribute to healthy aging.[11,12]

While the aforementioned evidence establishes the broader significance of HGS, our meta-analysis delves specifically into its role in predicting mobility decline. Mobility, defined as the ability to move freely and easily, is a cornerstone of independent living and overall well-being in older adults. Limitations in mobility can have profound consequences, impacting an individual's physical and mental health, social engagement, and quality of life. The relationship between HGS and mobility decline is rooted in the physiological changes that occur with aging. Sarcopenia, the age-related loss of muscle mass and strength, is a major contributor to mobility limitations. As muscle strength declines, the ability to perform tasks that require physical exertion, such as walking, climbing stairs, and carrying objects, becomes compromised. This can lead to a gradual erosion of mobility and an increased risk of falls and disability. HGS serves as a reliable and readily accessible indicator of muscle strength and a predictor of sarcopenia. By assessing HGS, healthcare professionals can gain insights into an individual's muscle function and identify those who may be at risk of developing mobility limitations. However, the evidence on the specific relationship between HGS and mobility decline has been somewhat mixed, with individual studies reporting varying degrees of predictive accuracy. Differences in the characteristics of study participants, such as age, gender, ethnicity, and health status, can influence the relationship between HGS and mobility decline. Studies may use different criteria to define mobility decline, such as self-reported difficulty with specific activities, performance-based measures, or changes in mobility status over time. These variations can affect the reported associations between HGS and mobility decline. While HGS is typically measured using a hand-held dynamometer, there can be variations in the specific type of dynamometer used, the number of trials performed, and the hand assessed (dominant vs. non-dominant). These methodological differences can contribute to variability in results. There is no universally accepted cut-off point for defining low HGS. Studies may use different thresholds based on percentiles, absolute values, or other criteria. This lack of standardization can make it challenging to compare results across studies. Our meta-analysis aimed to address these challenges by pooling data from multiple studies and providing a more robust and precise estimate of the diagnostic accuracy of HGS for predicting mobility decline. Our findings confirm that HGS is a valuable tool for identifying older adults at risk, but it also highlights the limitations of relying solely on HGS for risk assessment. The moderate sensitivity and specificity indicate that HGS should be considered as one piece of the puzzle, rather than a definitive diagnostic test.[13,14]

The moderate sensitivity and specificity of HGS underscore the importance of considering it within a broader geriatric assessment that incorporates other risk factors for mobility decline. Aging is a complex process influenced by a multitude of factors, and mobility decline is rarely attributable to a single cause. By integrating HGS assessment with other relevant clinical information, healthcare professionals can gain a more holistic understanding of an individual's risk profile and develop tailored interventions. Advanced age is a significant risk factor for mobility decline due to the physiological changes associated with aging, such as sarcopenia, decreased bone density, and impaired balance. Chronic conditions, such as cardiovascular disease, diabetes, arthritis, and neurological disorders, can contribute to mobility limitations by affecting muscle function, joint health, and overall physical capacity. Cognitive impairment, including dementia, can affect mobility by impairing judgment, decision-making, and motor control. Malnutrition, particularly protein deficiency and vitamin D deficiency, can contribute to muscle wasting and weakness, increasing the risk of mobility decline. A history of falls is a strong predictor of future falls and mobility decline, indicating underlying balance problems or other risk factors. Certain medications, such as sedatives, antidepressants, and antihypertensives, can have side effects that impair balance and increase the risk of falls. Social isolation, lack of support, and environmental hazards, such as poor lighting and uneven surfaces, can contribute to mobility limitations. By considering these factors in conjunction with HGS assessment, healthcare professionals can develop a more comprehensive and personalized risk assessment for each individual. This approach allows for more targeted interventions that address the specific needs and challenges of each person.[15,16]

The findings of this meta-analysis have substantial implications for clinical practice, particularly in the realm of geriatric medicine. They underscore the importance of incorporating handgrip strength (HGS) assessment into routine geriatric evaluations as a simple, cost-effective, and non-invasive method for identifying older adults at risk of future mobility decline. By integrating this readily available tool into their practice, healthcare professionals can take a proactive approach to preserving the functional independence and quality of life of their older patients. The early identification of individuals at risk of mobility decline is paramount for implementing timely and effective interventions. Mobility decline is often a gradual process, and early signs can be subtle and easily overlooked. By the time significant functional limitations become apparent, it may be more challenging to reverse or slow the progression of decline. HGS assessment provides a valuable opportunity to detect early signs of decline before they manifest as overt functional limitations. Low HGS can serve as a red flag, alerting healthcare professionals to the need for further assessment and intervention. This proactive approach allows for the implementation of preventive strategies that can help maintain muscle strength, balance, and overall functional capacity, reducing the risk of future mobility decline. The clinical implications of this meta-analysis extend beyond simply identifying individuals at risk. The findings also emphasize the importance of tailoring interventions to the specific needs and circumstances of each individual. While HGS provides a valuable indicator of risk, it is essential to consider it in conjunction with other factors that contribute to mobility decline. A comprehensive geriatric assessment that encompasses medical history, physical examination, cognitive assessment, nutritional evaluation, and social history can provide a holistic view of the individual's health status and risk factors. This comprehensive approach allows healthcare professionals to develop personalized interventions that address the unique needs of each person. The interventions for preventing and managing mobility decline are as diverse as the factors that contribute to it. A multifaceted approach that addresses various aspects of health and function is often necessary to achieve optimal outcomes. Exercise is a cornerstone of interventions for preventing and managing mobility decline. Regular physical activity, encompassing aerobic exercise, strength training, and balance exercises, has been shown to have numerous benefits for older adults. Aerobic exercise, such as walking, swimming, and cycling, improves cardiovascular health, endurance, and overall fitness. Strength training, using weights, resistance bands, or bodyweight exercises, enhances muscle strength and power, which are essential for performing daily tasks and maintaining mobility. Balance exercises, such as tai chi and yoga, improve balance and coordination, reducing the risk of falls. Tailored exercise programs can be prescribed to individuals with low HGS, taking into account their physical limitations, preferences, and goals. These programs should be designed to gradually increase in intensity and complexity as the individual's strength and endurance improve. Adequate nutrition plays a crucial role in maintaining muscle mass and strength, which are essential for mobility. Older adults are particularly vulnerable to malnutrition due to factors such as decreased appetite, impaired digestion, and reduced ability to prepare meals. Protein is a critical nutrient for muscle health, and older adults may require higher protein intake than younger adults to maintain muscle mass. Vitamin D is also essential for muscle function and bone health, and deficiency is common in older adults. Nutritional counseling can help older adults identify and address nutritional deficiencies. This may involve providing education on healthy eating habits, recommending dietary modifications, and suggesting appropriate supplements. Falls are a major cause of injury and disability in older adults, and mobility limitations are a significant risk factor for falls. Implementing fall prevention strategies is crucial for individuals with low HGS and other risk factors for falls. Home safety assessments can identify and address environmental hazards that increase the risk of falls, such as poor lighting, loose rugs, and clutter. Medication reviews can identify medications that may impair balance or cause dizziness, and adjustments can be made as needed. Assistive devices, such as canes, walkers, and grab bars, can provide support and stability, reducing the risk of falls. For individuals with multiple risk factors for mobility decline, a multifactorial approach that addresses various aspects of health and function may be most effective. This may involve a combination of exercise, nutrition, fall prevention, and other interventions tailored to the individual's needs. For example, an older adult with low HGS, a history of falls, and vitamin D deficiency may benefit from a multifactorial intervention. A tailored exercise program that incorporates strength training, balance exercises, and aerobic activity. Vitamin D supplementation to address the deficiency. Home safety assessment and modification to reduce fall risk. Regular medication reviews to identify and manage medications that may impair balance. Effective management of mobility decline often requires a collaborative approach involving various healthcare professionals. This may include physicians, nurses, physical therapists, occupational therapists, dietitians, and social workers. By working together and sharing information, these professionals can provide comprehensive care that addresses the physical, psychological, and social needs of the individual. This collaborative approach can help optimize outcomes and improve the overall quality of life for older adults at risk of or experiencing mobility decline. Empowering older adults to take an active role in their health and well-being is crucial for successful intervention. This involves providing education about mobility decline, its risk factors, and the benefits of preventive strategies. Older adults should be encouraged to engage in regular physical activity, maintain a healthy diet, and take steps to reduce their risk of falls. They should also be empowered to advocate for their needs and seek support from healthcare professionals and community resources.[17-20]

5. Conclusion

This meta-analysis synthesized evidence from seven studies to evaluate the diagnostic accuracy of handgrip strength (HGS) in predicting mobility decline in older adults. Our findings demonstrate that HGS has moderate sensitivity and specificity for identifying individuals at risk. While HGS alone may not be sufficient for definitive diagnosis, it serves as a valuable component of a comprehensive geriatric assessment. The simplicity and cost-effectiveness of HGS assessment make it a practical tool for widespread use in clinical practice. By incorporating HGS measurements into routine evaluations, healthcare professionals can identify individuals who may benefit from early interventions to prevent or delay mobility decline. Future research should focus on refining the use of HGS by establishing standardized protocols, identifying optimal cut-off points, and developing risk prediction models that incorporate other relevant factors. Ultimately, promoting early detection and intervention can help preserve the independence and quality of life of older adults.

6. References

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