

**Table 1: Characteristics of the included studies**

Author, Year	Country	Study design	Objective of the study	Sample size	Participants included	Anaemia Definition and estimation method	Dynamometer with HGS threshold
Thein M et al., 2009	USA	Cross sectional study	To evaluate the association of anaemia with health-related quality of life, functional status, depression, disability, and physical strength in older adults, independent of chronic disease.	328	≥ 65 years	WHO standards (anaemia if Hb <13 g/dL in men and <12 g/dL in women)	Handheld Dynamometer (in kg)
Hidayat G et al, 2011	Indonesia	Cross-sectional study	To determine whether anaemia is a risk factor for reduced muscle strength, measured by handgrip strength, in elderly nursing home residents.	118	≥60 years	Females: less than 12 gr/dl and males less than 13 gr/dl were categorized as anaemic	Dynamometer.
Hirani V et al, 2016	Australia	Cross-sectional Longitudinal	To assess the associations between haemoglobin levels and sarcopenia, muscle strength, functional measures, and ADL/IADL disabilities in older Australian men.	1705	Men ≥ 70 years	Absorption spectrophotometry, used for Hb. WHO criteria (anaemia if Hb level < 13 g/dL)	JAMAR Dynamometer (Promedics, Blackburn, UK). grip strength less than 26.0 kg versus grip strength 26.0 kg and more
Amaral C et al., 2020	Brazil	Cross-sectional study on secondary data	To examine factors associated with low handgrip strength in older adults in Rio Branco, Acre, Brazil.	1016	≥60 years	anaemia (haemoglobin ≤13 mg/dL in males, or ≤ 12 mg/dL in females)	SAEHAN SH5001 brand hydraulic hand Dynamometer
Yu-mi Gi et al, 2020	Korea	Cross-sectional study	To examine the association between handgrip strength and anaemia in Korean adults using data from the 6th and 7th KNHANES, addressing previous inconsistencies in the literature.	16,638	> 19 years	The haemoglobin levels were measured using the cyanide-free sodium lauryl sulphate method. WHO standards (Anaemia if Hb <13 g/dL in men and <12 g/dL in women)	Digital grip strength dynamometer (TKK 5401; Takei Scientific Instruments Co, Ltd, Tokyo, Japan) was used 26 kg for men, 16 kg for women is considered
C.-T. LEE et al, 2021	Singapore	Cross-sectional	To estimate the prevalence of anaemia in community-dwelling adults ≥65 years in Singapore and examine its association with cognitive function, physical function, and frailty.	480	≥ 65 years	Automated haematology analyser used for HB, WHO standards (Anaemia if Hb <1 g/dL in men and <12 g/dL in women; Hb level of >10 g/dL for mild, 7–10 g/dL for moderate, and <7 g/dl for severe)	Dynamometers (Takei A5401, Japan) Low grip strength <28 kg for men and <18 kg for women
Vanda Ho, 2022	Singapore	Cross sectional on secondary data	To examine the association of handgrip strength (HGS) with iron indices and inflammation.	477	≥60 years	Not specified	hand dynamometers (Takei A5401, Japan) was used where Low muscle strength was defined as HGS < 28 kg for men and < 18 kg for women
Sutandyo N. et al, 2022	Indonesia	Cross-sectional study	To determine the prevalence of anaemia and its association with handgrip strength in Indonesian older adults, addressing gaps in data on anaemia in Southeast Asia using a large, multiprovince sample.	3192	≥60 years	HemoCue method used for HB estimation. WHO standards (Anaemia if Hb <13 g/dL in men and <12 g/dL in women)	Smedley Spring type dynamometer used Weak HGS = <28 kg for men and <18 kg for women
Lee B et al., 2023	Korea	Cross-sectional study on secondary data	To assess the association of anaemia with absolute and relative hand grip strength (HGS) and evaluate whether relative HGS indices are useful as risk markers compared to other cost-effective methods.	24,022	≥30 years	WHO standards (Anaemia if Hb <13 g/dL in men and <12 g/dL in women, less than 11.0 g/dL for pregnant women)	Digital grip strength dynamometer (T.K. K 5401, Japan)
Almari S & Simbawa M, 2024	Saudi Arabia	Cross-sectional study	To examine the correlation between handgrip strength (HGS) and nutritional status, and to evaluate whether HGS can predict nutritional status in hospitalized older adults in Saudi Arabia.	135	≥60 years	Not specified	Electronic handgrip dynamometer (CAMRY, Model 1 EH101) was used to measure HGS. low grip = <16 kg for women and < 27 kg for men
Hammer T. et al., 2024	Germany	Cohort study	To analyse the association between haemoglobin and grip strength, accounting for ferritin as an indirect marker of iron storage, in community-dwelling older adults.	1294	≥ 65 years	Photometry, 4.4–11.3 Giga/L.	JAMAR
MacLean B et al, 2024	Australia	Cross Sectional study	To develop a non-invasive screening tool for iron deficiency in women aged 18–49 years and evaluate its acceptability in the community.	640	Woman of 18-49 age group	Hemocue Hb801 used for Hb estimation. Anaemia was defined as Hb < 120 g/L, a threshold of Hb < 130 g/L. ferritin <30 µg/L were classed as iron deficient	JAMAR Hydraulic Hand Dynamometer

**Table 2: Summary of Findings**

Author, Year	Participants	Outcome	Effect size	Other Key Findings
Thein M et al. (2009)	328	Anemic participants had lower HGS compared to nonanemic individuals (21.3 kg vs. 24.1 kg; $p = 0.014$ ).	21.3 vs. 24.1 kg; $P = 0.014$	Anemia was associated with low HGS, along with higher fatigue, depressive symptoms, and increased disability
Hidayat G et al (2011)	118	In women, mild anemia was linked to lower HGS in women	12.36 kg vs. 14.68 kg; $p = 0.027$ . $B = 3.172$ , $SE = 1.179$ , $\beta = 0.230$ , $p = 0.008$	Each 1 g/dL increase in hemoglobin was associated with a 3.1 kg increase in HGS; age, physical activity, and anemia were independent predictors of reduced HGS
Hirani V et al (2016)	1705	A consistent positive association between hemoglobin and grip strength was observed	$\beta = 1.52$ , 95% CI: 1.27–1.78, age-adjusted ( $\beta = 1.05$ , 95% CI: 0.80–1.30), and multivariate-adjusted ( $\beta = 0.82$ , 95% CI: 0.55–1.08).	1 gm increase in Hb was associated with reduced risk of sarcopenia, slow walking speed, poor HGS, activities of daily life, instrumental activities of daily life, and inability to stand from a chair.
Amaral C et al. (2020)	1016	Low HGS was associated with anemia in both men and women	Anemic men had more than fourfold increased odds of low HGS (aOR = 4.15; 95% CI: 2.09–8.21), and anemic women had nearly double the odds (aOR = 1.80; 95% CI: 1.06–3.06), compared to their nonanemic counterparts.	Low BMI and anemia were independently linked to reduced handgrip strength (HGS) in both sexes. Diabetes was associated with low HGS in men. Other factors in males were current or past smoking, poorer self-rated health, and dependence for daily activities. Among women, altered waist-to-hip ratio, insomnia, and physical activity related to commuting or work were also associated with low HGS.
Yu-mi Gi et al (2020)	16,638	Anemia was associated with weak HGS, particularly in men and older adults	Anemia occurs in the weak HGS group than the strong HGS group with OR = 1.92, 95% CI: 1.58–2.33 Association was greater for males (OR = 2.13, 95% CI: 1.35–3.34) and for those aged $\geq 65$ years (OR = 1.92, 95% CI: 1.42–2.58).	High prevalence in participants with $\geq 65$ years than below 65 years. Anemic Men reflected twice the odds of weak HGS
C.-T. LEE et al (2021)	480	Anemia was significantly associated with weak HGS and frailty	Hemoglobin levels and anemia were significantly associated with frailty (OR=2.28; 95% CI=1.02–5.10) odds after adjusting for potential covariates (OR = 0.94, 95% CI: 0.90–0.99).	Each 1 g/dL increase in hemoglobin was associated with a 6% decrease in frailty
Vanda Ho et al. (2022)	477	Higher HGS was correlated with higher hemoglobin and iron indices	In univariate analysis revealed that HGS was significantly associated with higher Hb ( $\beta = 2.10$ 95%CI 1.67–2.53, $p < 0.01$ )	High hand grip strength was also associated with high iron, ferritin, TSAT, and lower transferrin and TIBC. Ferritin, TSAT, and hsCRP were independent predictors of HGS in multivariate analysis.
Sutandyo N. et al (2022)	3192	Hb was positively correlated with HGS ( $r = 0.349$ , $p < 0.001$ ). Anemia increased the risk of weak grip (OR = 1.557), especially in those $\geq 80$ years ( $p < 0.001$ ).	OR: 1.557; 95% CI: 1.314–1.846; $p$ value: $< 0.001$	Weak HSG was associated with age $\geq 80$ (OR: 5.234), age 70–79 (OR: 3.152), low BMI (OR: 1.827), and hypertension (OR: 1.340)
Lee B et al. (2023)	24,022	Mean HGS was higher in nonanemic vs. anemic individuals 38.97 kg vs. 30.84 kg in men, and 22.64 kg vs. 21.85 kg in women—with a stronger association observed in men.	Adjusted OR of association of anemia and HGS in dominant hand in Men was 0.58 (0.51–0.66) $< 0.001$ (Age) 0.63 (0.55–0.72) $< 0.001$ (Other covariates) and in women 0.81 (0.76–0.86) $< 0.001$ (Age adjusted) 0.87 (0.81–0.93) $< 0.001$ (Other covariate adjusted)	The mean value of HGS was lower in anemic individuals. Relative HGS was associated with anemia.
Almari S & Simbawa M (July 2024)	135	Low hemoglobin was an independent predictor of weak HGS	Participants with low HGS had low hemoglobin levels ( $p < 0.001$ )	Participants with low HGS had low lymphocyte levels ( $p = 0.040$ ), high creatinine levels ( $p = 0.004$ ), high blood urea nitrogen levels ( $p = 0.007$ ), high CRP levels ( $p = 0.007$ ), high HbA1c levels ( $p = 0.029$ ), and high vitamin B12 levels ( $p = 0.042$ ). Also 16% were malnourished and 38.74% were at the risk of malnutrition with low HGS.
Hammer T. et al. (2024)	1294	Positive association between hemoglobin and HGS in women $< 80$ years and in men $< 80$ years with ferritin $\geq 300$ $\mu\text{g/L}$ . No association was found in those $> 80$ years.	The average grip strength in the study population was $38.73 \pm 9.35$ kg for men and $23.99 \pm 7.14$ kg for women. In women $< 80$ years, $\beta$ 0.923 [95% CI 0.196, 1.650], In Men $< 80$ years, the association was significant when ferritin was $\geq 300$ $\mu\text{g/L}$ , $\beta$ 2.028 [95% CI 0.910, 3.146]	In men with ferritin $\geq 300$ $\mu\text{g/L}$ 1 gm of HB was associated with 2.559 kg in HGS. Each 1 g/dL increase in Hb corresponded to a 0.923 kg gain in women and 2.028 kg in men.
MacLean B et al (2024)	640	HGS was positively linked to Hb ( $p = 0.004$ ) and ferritin level ( $p = 0.005$ ).	Adjusted $R^2 = 0.012$ , $p = 0.004$	HGS demonstrated potential as a noninvasive marker of iron deficiency in women of reproductive age

**Table 3: Risk of bias (JBI)**

Study No.	First Author (Year)	Was the sample frame appropriate to address the target population?	Were study participants sampled in an appropriate way?	Was the sample size adequate?	Were the study subjects and the setting described in detail?	Was the data analysis conducted with sufficient coverage of the identified sample?	Were valid methods used for the identification of the condition?	Was the condition measured in a standard, reliable way for all participants?	Was there appropriate statistical analysis?	Was the response rate adequate, and if not, was the low response rate managed appropriately?	Overall Appraisal	Comments
1	Alamri (2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Include	Appropriate sampling, valid measures, but response rate not reported.
2	Sutandyo (2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include	Very large national dataset with robust methodology.
3	Lee B (2023)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Include	Large sample, consistent tools, strong statistical analysis.
4	Hammer (2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Include	Response rate was 20% but data are available of 1294
5	Hidayat (2011)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	include	Valid measurement tools, but small sample size (~118).
7	Gi yu (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include	Survey based study
8	MacLean (2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include	Well-designed, high response rate, solid methodology.
9	Lee C.-T. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include	Well-designed, high response rate, solid methodology.
10	Vanda ho (2022)	Yes	No	No	Yes	unclear	Yes	Yes	Yes	unclear	Exclude	No randomization in the sampling of participants, no evidence on the sample size calculation, no evidence on the response rate
11	Amaral (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include	structured methodology and concrete statistical analysis
12	Thein (2010)	Yes	Unclear	Unclear	Yes	Unclear	Yes	Yes	Unclear	Unclear	Exclude	No evidence on randomization of participants, sample size calculation and response rate, unstructured methodology