Determination of Hand Grip Strength Cut-Off Values for Malnutrition Risk Screening Among Elderly Patients in Primary Care Units

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Abstract
Background: According to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines, the Mini Nutritional Assessment (MNA) is recommended for screening malnutrition in the elderly[1]. However, the MNA may have limitations regarding the time required for administration and the reliance on the elderly patient's memory.
Objective: To determine the optimal cut-off values for hand grip strength (HGS) to identify the risk of malnutrition and to investigate risk factors associated with malnutrition in elderly patients aged over 60 years in a primary care setting.
Methods: A cross-sectional study was conducted involving 367 elderly participants (164 males, 203 females). Data collection included hand grip strength measurement using a dynamometer and malnutrition risk screening using the MNA.
Results: The prevalence of malnutrition risk was 13.4% in males and 25.1% in females. The optimal HGS cut-off values associated with malnutrition risk were identified as 24.5 kgF for males (Sensitivity 72.7%, Specificity 92.3%) and 19.1 kgF for females (Sensitivity 80.4%, Specificity 78.9%). Significant risk factors associated with malnutrition risk included Body Mass Index (BMI) < 18.5 kg/m² ($p < 0.001$), diabetes mellitus ($p = 0.021$), heart disease ($p = 0.021$), and depression ($p = 0.004$).
Conclusion: The optimal HGS cut-off values for screening malnutrition risk are 24.5 kgF for males and 19.1 kgF for females. These values are suitable for use in screening elderly patients within primary care units.
Key Words: Hand Grip Strength; Cut-off Values; Malnutrition Risk Screening; Elderly Patients; Primary Care Units

INTRODUCTION

According to World Health Organization data from 2019, the elderly population accounted for 13% of the global population, a proportion that is trending upward. In Thailand, the proportion of the elderly reached 20% in 2022 and is projected to rise to 28% by 2037[2]. The

geriatric population frequently encounters various health conditions, including depression, sarcopenia, and malnutrition[3]. Malnutrition is a significant problem among the elderly, leading to sarcopenia, comprised immunity, cognitive decline, and increased risks of being bedridden, depression, dementia, nosocomial infections, and prolonged hospitalization[4]. A 2021 study revealed that the economic burden of malnutrition amounts to 1 trillion baht in Asia and 30 billion baht in Thailand annually[5].

In Thailand, the prevalence of malnutrition risk and malnutrition in the elderly has been reported at 42.6% and 6.1%, respectively[66]. Risk factors for malnutrition include underlying diseases, low body weight, dental problems, a history of falls, lack of leisure activities, and living alone[7]. The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines recommend using the Mini Nutritional Assessment (MNA) for malnutrition screening in the elderly. The MNA assesses body mass index (BMI), weight loss history, dietary intake, and medical history[8]. However, screening via the MNA relies on the patient's memory and requires significant time for administration, presenting challenges for its practical application in the care of certain elderly individuals.

Several studies have demonstrated that hand grip strength (HGS) can serve as an effective screening tool for malnutrition[9]. Mean HGS values vary by ethnicity and residence. In Thailand, studies establishing HGS cut-off points for malnutrition screening remain limited[10]. Existing data focuses largely on urban populations, lacking representation from semi-urban/rural demographics such as those in Phra Nakhon Si Ayutthaya province. Furthermore, data regarding specific malnutrition-related factors, such as the number of teeth, is lacking[11].

Therefore, the researchers aimed to investigate the relationship between HGS and malnutrition in the elderly within the Mueang District of Phra Nakhon Si Ayutthaya Province—a semi-urban community—to determine appropriate cut-off values for malnutrition screening at Phra Nakhon Si Ayutthaya Hospital.

Objectives

Primary Outcome: To determine the HGS cut-off values for malnutrition risk in the elderly.

Secondary Outcomes:

- To investigate other factors affecting malnutrition risk in the elderly.
- To determine the prevalence of malnutrition risk.
- To determine the mean HGS of the elderly population.

METHODS

Study Design: This was a cross-sectional study with prospective data collection.

Setting

The study was conducted at a Primary Care Unit in Mueang District, Phra Nakhon Si Ayutthaya Province. The service recipients were local residents of a semi-urban community.

Participants

The study population consisted of elderly individuals aged over 60 years receiving services at the primary care unit between September 2024 and April 2025.

Inclusion Criteria

- Patients aged 60 years or older.
- Thai nationality.
- Able to understand the Thai language.

Exclusion Criteria

- Amputation of either hand.
- Inability to stand without an assistive device.
- Underlying conditions causing muscle weakness (e.g., stroke/hemorrhage).
- Hand deformities or joint diseases affecting the hand (e.g., rheumatoid arthritis, osteoarthritis).
- History of wrist fracture or deformity within the past 3 months.
- Schizophrenia, intellectual disability, or deafness that interferes with questionnaire completion.

Sample Size

The sample size was calculated based on a previous study12, which compared HGS cut-offs with MNA screening. That study reported sensitivity and specificity for males (aged 60-89) at 100% and 44%, and for females at 66% and 54%, respectively. Assuming a malnutrition risk prevalence of 42.6% and calculating for both sensitivity and specificity13, the maximum required sample size was determined to be at least 164 males and 203 females (Total N = 367), with a precision of 10% and a confidence level of 95%.

Instruments

Participants were interviewed for baseline data, assessed for malnutrition risk using the MNA (full form), and measured for HGS (KgF) using a Takei TKK 5401 handgrip dynamometer. HGS was measured on one side. The grip span was adjusted so that the second knuckle of the index finger was flexed at a 90-degree angle. Participants stood upright with feet shoulder-width apart and arms fully extended by their sides. They were encouraged to squeeze the dynamometer with maximum effort. Measurements were recorded twice for each hand (left and right), and the maximum value was used for analysis14.

Statistical Analysis

Data analysis was performed using STATA version 18.0. Statistical significance was set at $p < 0.05$.

- **Descriptive Statistics:** Qualitative data were described using frequency and percentage. Quantitative data were described using mean and standard deviation (SD) or median and interquartile range (IQR), as appropriate.
- **Cut-off Determination:** The Youden Index was used to determine the optimal cut-off points, reporting sensitivity and specificity at a 95% confidence level.
- **Risk Factor Analysis:** Multiple logistic regression was used to identify risk factors for malnutrition, reporting results as Odds Ratios (OR) and 95% Confidence Intervals (CI).

Ethical Statement

Participants received an explanation of the study and provided written informed consent. Participation was voluntary, and refusal did not affect their treatment. Data will be retained for one year and then destroyed. The study received no funding from related manufacturers. This study was approved by the Human Research Ethics Committee of Phra Nakhon Si Ayutthaya Hospital (Project No. 0142/2567, approved August 28, 2024).

RESULTS

A total of 367 elderly individuals attending the primary care unit underwent MNA assessment and HGS measurement. All participants met the inclusion criteria. The majority were aged 60-69 years (234 participants, 63.8%). The cohort consisted of 106 males and 128 females (Note: These numbers sum to 234 in the 60-69 bracket, but total N is 367. Based on Table 1, the total breakdown is Male=164, Female=203). The mean age was 68.2 ± 6.3 years for males and 68.7

± 6.2 years for females. Most participants had a primary school education (58.3%) and an income between 0-1,000 Baht (28.9%). Common comorbidities included dyslipidemia (83.4%), hypertension (80.4%), and diabetes (41.7%), as shown in **Table 1**.

Table 1: Baseline characteristics of participants classified by nutritional status

Variable	Male: Normal (n=142)	Male: At Risk (n=22)	Female: Normal (n=152)	Female: At Risk (n=51)	Total (N=367)
Age (Years)					
60-69	95 (66.9%)	11 (50.0%)	101 (66.4%)	27 (52.9%)	234 (63.8%)
70-79	40 (28.2%)	8 (36.4%)	44 (28.9%)	18 (35.3%)	110 (30.0%)
80-89	7 (4.9%)	3 (13.6%)	7 (4.6%)	6 (11.8%)	23 (6.3%)
BMI (kg/m²)					
> 30	22 (15.5%)	1 (4.5%)	23 (15.1%)	4 (7.8%)	50 (13.6%)
25-30	46 (32.4%)	4 (18.2%)	52 (34.2%)	10 (19.6%)	112 (30.5%)
23-25	37 (26.1%)	1 (4.5%)	39 (25.7%)	2 (3.9%)	79 (21.5%)
18.5-23	33 (23.2%)	10 (45.5%)	37 (24.3%)	18 (35.3%)	98 (26.7%)
<18.5	4 (2.8%)	6 (27.3%)	1 (0.7%)	17 (33.3%)	28 (7.6%)
Education					
Bachelor's or higher	25 (17.6%)	2 (9.1%)	13 (8.6%)	3 (5.9%)	43 (11.7%)
Secondary	49 (34.5%)	10 (45.5%)	32 (21.1%)	7 (13.7%)	98 (26.7%)
Primary	66 (46.5%)	10 (45.5%)	100 (65.8%)	38 (74.5%)	214 (58.3%)
No formal education	2 (1.4%)	0 (0.0%)	7 (4.6%)	3 (5.9%)	12 (3.3%)
Income (Baht/month)					
> 10,000	59 (41.5%)	6 (27.3%)	29 (19.1%)	4 (7.8%)	98 (26.7%)
5,001-10,000	22 (15.5%)	3 (13.6%)	37 (24.3%)	11 (21.6%)	73 (19.9%)
1,001-5,000	30 (21.1%)	4 (18.2%)	38 (25.0%)	18 (35.3%)	90 (24.5%)
0-1,000	31 (21.8%)	9 (40.9%)	48 (31.6%)	18 (35.3%)	106 (28.9%)
Income Sufficiency					
Sufficient	77 (54.2%)	10 (45.5%)	73 (48.0%)	21 (41.2%)	181 (49.3%)
Insufficient	65 (45.8%)	12 (54.5%)	79 (52.0%)	30 (58.8%)	186 (50.7%)
Living Arrangement					
With others	124 (87.3%)	16 (72.7%)	125 (82.2%)	45 (88.2%)	310 (84.5%)
Alone	18 (12.7%)	6 (27.3%)	27 (17.8%)	6 (11.8%)	57 (15.5%)
Falls (last 1 yr)					
No	122 (85.9%)	19 (86.4%)	127 (83.6%)	36 (70.6%)	304 (82.8%)
Yes	20 (14.1%)	3 (13.6%)	25 (16.4%)	15 (29.4%)	63 (17.2%)
Polypharmacy					
< 5 drugs	84 (59.6%)	12 (54.5%)	94 (61.8%)	24 (47.1%)	214 (58.5%)
≥ 5 drugs	57 (40.4%)	10 (45.5%)	58 (38.2%)	27 (52.9%)	152 (41.5%)
Dental Status					
< 20 permanent teeth	70 (49.3%)	7 (31.8%)	51 (33.6%)	14 (27.5%)	142 (38.7%)
≥ 20 permanent teeth	72 (50.7%)	15 (68.2%)	101 (66.4%)	37 (72.5%)	225 (61.3%)
Comorbidities					
Diabetes Mellitus	59 (41.5%)	10 (45.5%)	60 (39.5%)	24 (47.1%)	153 (41.7%)

Variable	Male: Normal (n=142)	Male: At Risk (n=22)	Female: Normal (n=152)	Female: At Risk (n=51)	Total (N=367)
Hypertension	115 (81.0%)	17 (77.3%)	124 (81.6%)	39 (76.5%)	295 (80.4%)
Dyslipidemia	118 (83.1%)	20 (90.9%)	128 (84.2%)	40 (78.4%)	306 (83.4%)
Heart Disease	3 (2.1%)	1 (4.5%)	1 (0.7%)	2 (3.9%)	7 (1.9%)
Osteoarthritis Knee	5 (3.5%)	1 (4.5%)	7 (4.6%)	4 (7.8%)	17 (4.6%)
Depression	1 (0.7%)	0 (0.0%)	2 (1.3%)	8 (15.7%)	11 (3.0%)
Cancer	2 (1.4%)	0 (0.0%)	3 (2.0%)	1 (2.0%)	6 (1.6%)
Others	35 (24.6%)	5 (22.7%)	22 (14.5%)	6 (11.8%)	68 (18.5%)
Dominant Hand Grip (Mean ± SD)	33.35 ± 6.05	24.00 ± 5.70	21.73 ± 3.58	17.13 ± 3.61	25.72 ± 7.92

The prevalence of malnutrition risk was 13.4% in males and 25.1% in females. The mean dominant HGS was 32.1 ± 6.8 kgF in males and 20.6 ± 4.1 kgF in females. The 20th percentile HGS values were 26.2 kgF for males and 16.7 kgF for females (**Figure 1**).

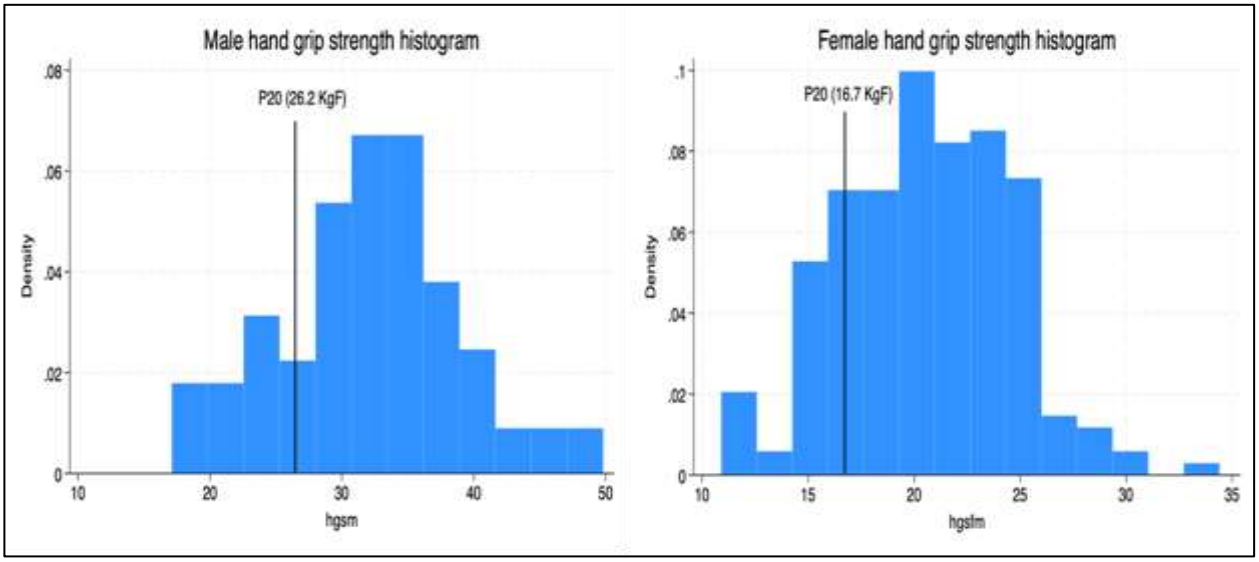

Figure 1: Histogram of handgrip strength distribution for males and females

Using the Youden Index, the optimal HGS cut-off for predicting malnutrition risk in males was **24.5 kgF** (AUC = 0.82 [0.73-0.92]; Sensitivity 72.70%, Specificity 92.30%). For females, the cut-off was **19.1 kgF** (AUC = 0.80 [0.73-0.86]; Sensitivity 80.40%, Specificity 78.90%), as shown in **Table 2** and **Figure 2**.

Table 2: Hand Grip Strength cut-off values determined by Youden Index and alternative points

Sex	Cut-point (KgF)	Sensitivity	Specificity	AUC
Male (Youden)	**24.5**	**72.70%**	**92.30%**	**0.82**
Cutpoint 1	27.5	77.27%	85.21%	
Cutpoint 2	30.2	81.82%	71.83%	
Cutpoint 3	31.2	86.36%	64.79%	
Female (Youden)	**19.1**	**80.40%**	**78.90%**	**0.80**

Cutpoint 1	20.0	86.27%	65.79%	
Cutpoint 2	20.7	88.24%	58.55%	
Cutpoint 3	22.6	90.20%	40.13%	

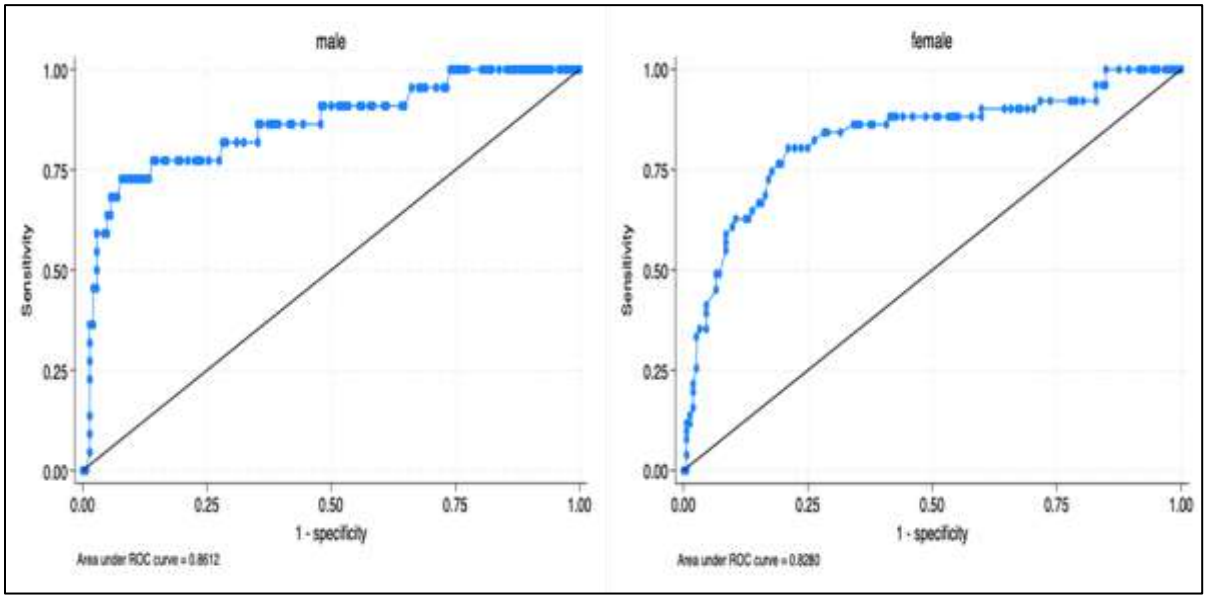

Figure 2: Receiver Operating Characteristic (ROC) curve for handgrip strength in predicting malnutrition risk for males and females

Analysis of factors affecting malnutrition risk identified four statistically significant factors: BMI < 18.5 kg/m² (p = 0.001), diabetes mellitus (p = 0.021), heart disease (p = 0.021), and depression (p = 0.004), as shown in **Table 3**.

Table 3: Multivariate Logistic Regression Analysis for Factors Associated with Malnutrition Risk

Variable	Adjusted Odds Ratio	95% CI	P-value
Sex (Female vs Male)	1.82	0.89 - 3.75	0.103
Age (Ref: 60-69)			
70-79	0.88	0.42 - 1.87	0.744
80-89	0.85	0.21 - 3.44	0.818
BMI (Ref: >30)			
25-30	1.43	0.44 - 4.66	0.556
23-25	0.46	0.09 - 2.29	0.344
18.5-23	7.13	2.21 - 22.97	**<0.001****
<18.5	116.17	22.75 - 593.21	**<0.001****
Education (Ref: Bachelor+)			
Secondary	2.34	0.50 - 10.93	0.281
Primary	2.14	0.49 - 9.30	0.311
None	1.91	0.22 - 16.36	0.554
Income (Ref: >10k)			
5,001-10,000	1.85	0.59 - 5.81	0.292
1,001-5,000	2.19	0.76 - 6.34	0.146
0-1,000	2.04	0.72 - 5.79	0.180

Variable	Adjusted Odds Ratio	95% CI	P-value
Income Insufficiency	1.56	0.77 - 3.16	0.215
Living Alone	0.94	0.38 - 2.34	0.893
History of Falls (1 yr)	1.18	0.51 - 2.70	0.698
Polypharmacy (≥5 drugs)	1.32	0.56 - 3.13	0.525
Teeth (<20)	1.36	0.66 - 2.81	0.408
Comorbidities (Yes vs No)			
Diabetes Mellitus	2.60	1.16 - 5.85	**0.021***
Hypertension	0.92	0.35 - 2.39	0.860
Dyslipidemia	1.78	0.62 - 5.12	0.284
Heart Disease	9.74	1.40 - 67.52	**0.021***
Osteoarthritis Knee	2.42	0.60 - 9.87	0.216
Depression	12.36	2.21 - 69.07	**0.004****
Cancer	1.41	0.13 - 15.63	0.779
Others	1.16	0.45 - 2.98	0.763

*p<0.05; **p<0.01

DISCUSSION

Almost all participants in this study had underlying diseases, with only 15 individuals being disease-free. This is consistent with studies from Thailand [15], China [16], and Bosnia[17]. The mean age of participants was lower than that observed in other Thai studies (70.03 and 70.23 years) [18], as well as studies in Bosnia (73.78 and 72.69 years) [19]and China (74.0 and 73.6 years)[20].

The prevalence of malnutrition risk was 13.4% in males and 25.1% in females. This is lower than the prevalence reported in Bosnia (42% males, 39% females)[21]. This discrepancy likely arises from differences in sampling; the Bosnian study recruited from a database that included homebound patients with higher malnutrition risk, whereas our study selected ambulatory patients visiting a primary care unit (socially active group). Similarly, a Chinese study conducted on inpatients found a much higher risk prevalence of 63.81%[22]. However, our findings align with previous Thai community-based studies[23], which reported risk prevalence of 20.6% in males and 23.4% in females, due to similar recruitment settings and demographics.

This study primarily investigated elderly individuals in a semi-urban primary care setting. This context is similar to a Thai study in an urban family medicine outpatient clinic [24]and the Bosnian study [25], but differs from the inpatient setting of the Chinese study[26].

The Smedley TKK 5401 digital dynamometer used in this study is validated and comparable to the JAMAR dynamometer [27], and has been used in comparable studies[2828]. Our 20th percentile HGS values (26.2 kgF for males, 16.7 kgF for females) are close to the Asian Working Group for Sarcopenia (AWGS) cut-offs[29], likely because both studies involve Asian populations and utilize standard measurement protocols.

The HGS cut-offs identified in this study (24.5 kgF for males, 19.1 kgF for females) were higher than those in the Bosnian study (23.5 kgF males, 15.5 kgF females) [30]and the Chinese study (24.9 kgF males, 15.2 kgF females)[31]. This is attributable to the younger mean age of our participants compared to those studies (older age correlates with lower grip strength). Conversely, a previous Thai study found a higher cut-off for males (28.75 kgF) but a similar

cut-off for females (17.1 kgF)[32]. The discrepancy in the male cut-off in the previous Thai study might be due to a potential bias from a small male sample size (n=68).
Regarding risk factors, BMI < 18.5 kg/m², diabetes, heart disease, and depression were significantly associated with malnutrition risk. These findings are consistent with studies from Thailand [33], China [34], and Brazil[35], which identified heart disease, low BMI, advanced age, falls, low income, and living alone as risk factors. However, a study in Malaysia [36] reported different risk factors, such as lack of education and living with family, which were not significant in our study. The identification of only four significant risk factors in our study may be due to the limited sample size within specific subgroups.

Strengths and Limitations

Strengths: This study provides applicable data for primary care units serving patients with chronic diseases. The sample size was sufficient for initial screening purposes. The use of a handgrip dynamometer offers a rapid alternative to the time-consuming MNA for screening malnutrition risk, alongside its utility for sarcopenia and frailty screening.

Limitations:

1. The study was conducted among elderly individuals capable of visiting a primary care unit; results may not generalize to bedridden patients or those with high-complexity diseases.
2. Convenience sampling was utilized, which may not provide a completely representative sample of the total elderly population.

CONCLUSION

The prevalence of malnutrition risk in these semi-urban elderly population was 13.4% in males and 25.1% in females. Hand grip strength is a viable alternative to the MNA for screening malnutrition risk. The appropriate HGS cut-off values are 24.5 kgF for males and 19.1 kgF for females.

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