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# Prediction of physiological status, community participation, and daily activity function to sleep quality for outpatient dynapenic older people

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## Abstract

**Background** The global aging population has increased dynapenia prevalence, leading to mobility issues and poor sleep quality among older adults. Despite its impact, research on sleep quality in dynapenic outpatients is limited. This study investigates how physiological status, community participation, and daily activity function influence sleep quality in this group.

**Methods** This cross-sectional study employed purposive sampling to collect data from 192 dynapenic older outpatients in October 2022, assessing their basic attributes, physiological status, community participation, daily activity function, and sleep quality. Data were analyzed using SPSS 25.0 for descriptive statistics, independent samples t-tests, chi-square tests, and logistic regression analysis.

**Results** Findings indicated significant correlations between sleep quality and gender ($X^2 = 11.340$, $p < .001$), occupational status ($X^2 = 13.378$, $p < .05$), residence ($X^2 = 6.265$, $p < .05$), medication intake ($X^2 = 7.250$, $p < .05$), smoking history ($X^2 = 6.695$, $p < .01$), instrumental activities of daily living ($X^2 = 12.556$, $p < .01$), activities of daily living ($t = 2.74$, $p < .01$), instrumental activities of daily living ($t = 3.60$, $p < .001$), skeletal muscle mass ($t = 2.94$, $p < .01$), skeletal muscle index ($t = 2.65$, $p < .01$), grip strength ($t = 3.61$, $p < .001$), and walking speed ($t = 2.09$, $p < .05$). Furthermore, the type of occupational status (OR = 6.608, 95% CI = 1.124–3.744, $p < .05$), medication intake (OR = 3.916, 95% CI = 1.682–9.114, $p < .05$), and grip strength (OR = 0.891, 95% CI = 0.797–0.996, $p < .05$) were significant predictors of sleep quality in dynapenic older patients.

**Conclusion** This cross-sectional study reveals significant correlations between sleep quality and key factors such as physiological status, community participation, and daily functional activities in older adults with dynapenia. These findings underscore the importance of addressing these determinants to enhance sleep quality in this population.

**Keywords** Dynapenia, Physiological status, Community participation, Daily activity function, Sleep quality

## Background

According to the United Nations (UN), it is estimated that by 2050, the global population aged 65 and over will reach 2 billion, accounting for 28% of the total population, with one in every six individuals being over the age of 65 [1]. In Europe and North America, one in every four individuals will be over 65, and the population aged

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80 and above is expected to double from 143 million in 2019 to 426 million by 2050 [1]. In Taiwan, based on statistics from the Ministry of the Interior [2] from 2018 to March 2021, the population aged 65 and over increased from 3.43 million (14.6% of the total population) in 2018 to 3.83 million (16.3%) by March 2021. Starting in 2018, Taiwan entered an "aged society," and it is projected that by 2025, the older people population will further increase to 4.7 million, accounting for 20.1% of the total population, transitioning Taiwan into a "super-aged society."

Aging is a process where the physiological state ages over time, leading to a decline in overall memory and strength, and gradual aging in daily activity functional abilities. As the body ages and muscle strength decreases, conditions like dynapenia become more prevalent. Dynapenia and sarcopenia are closely related yet distinct concepts in the study of age-related muscle decline. Dynapenia specifically refers to the loss of muscle strength that occurs despite normal muscle mass. This term is important because it highlights that muscle strength can decrease even without significant changes in muscle mass. It focuses on the functional aspects of muscle performance, emphasizing the impact of reduced strength on mobility, balance, and overall physical function in older adults [3, 4]. Sarcopenia, on the other hand, traditionally refers to the loss of muscle mass, often accompanied by a decrease in muscle strength and physical performance. The European Working Group on Sarcopenia in Older People (EWGSOP2) has updated the definition of sarcopenia, emphasizing that it is primarily a condition characterized by both low muscle mass and reduced strength [5].

As the body ages and muscle strength decreases, conditions like dynapenia become more prevalent. Dynapenia, marked by diminished muscle strength or function despite normal muscle mass, frequently impacts older adults, compromising their community participation [6]. As muscle strength wanes, individuals with dynapenia faced challenges with mobility tasks such as walking and climbing stairs, which often reduces their participation in community participate [6]. In addition, dynapenia notably affects daily activity function including Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) in older adults. Peterson et al. [6] found that dynapenia correlates with decreased performance in both ADL and IADL tasks, increasing dependency. Chen et al. [7] reported significant challenges in performing IADL tasks, such as managing finances and transportation, which are essential for independence. Additionally, Gordon et al. [8] noted that dynapenia exacerbates limitations in ADL, including dressing and bathing.

Furthermore, researches indicate a relationship between dynapenia and sleep quality, suggesting that poor sleep quality is more common among the older people and particularly prevalent in those with dynapenia [9, 10] . Sleep quality is a crucial determinant of health and well-being in dynapenic older adults, who suffer from significant muscle strength and function loss [11]. Poor sleep quality can intensify physical weakness, resulting in decreased mobility, an elevated risk of falls, and impaired daily functioning. Moreover, inadequate sleep is linked to increased inflammation, which further accelerates the deterioration of muscle strength [9, 12].

Synthesis of existing literature reveals that most studies indicate a correlation between dynapenia and sleep quality in community-dwelling older adults. However, there is a relative scarcity of research focused on dynapenic older patients in outpatient settings. Therefore, this study provides a novel investigation into the predictive factors for sleep quality in dynapenic outpatients, offering valuable insights for healthcare professionals to enhance the sleep quality of these patients.

### Aim

The major aim of this study is to investigate the prediction of basic characteristics, physiological status, community participation, and daily activity functions on the sleep quality of dynapenic older outpatients.

## Methods

### Research design

This cross-sectional study employed purposive sampling to collect questionnaire data from 192 dynapenic older outpatients in October 2022. It assessed their basic attributes, physiological status, community participation, daily activity function, and sleep quality, with the consent of the participants.

### Dynapenia assessment

The Asian Working Group for Sarcopenia (AWGS) [7] provided updated guidelines for the diagnosis of sarcopenia but did not specifically address a detailed section on the interpretation of dynapenia. Dynapenia, generally defined as an age-related decline in muscle function without concurrent loss of muscle mass [13, 14], has been assessed through various physical performance tests [3]. However, consensus on the diagnostic criteria for dynapenia remains elusive. Therefore, this study relies on research conducted by Japanese scholars [9] within the Asian region, which defines dynapenia as normal muscle mass (men $\geq 7.0$ kg/m$^2$, women $\geq 5.7$ kg/m$^2$) with reduced grip strength (men $< 26$ kg, women $< 18$ kg) or slow walking speed ($< 0.8$ m/s).

### Participants and setting

The study targets dynapenic older patients attending a geriatric medicine outpatient clinic. Dynapenia is defined according to the criteria set by Japanese researchers Kobayashi et al. [9].

Purposive sampling is employed for participant selection. Inclusion criteria include: (a) outpatients aged 65 or older diagnosed with dynapenia, (b) able to understand and follow simple commands, (c) capable of clear communication and expressing their own will, and (d) completion of the informed consent form. Exclusion criteria are: (a) inability to communicate in Mandarin or Taiwanese, impeding the interview process, (b) severe impairment in vision or hearing preventing participation in the study, and (c) refusal to complete the informed consent form.

The study employs the effect size calculation method by Kobayashi et al. [9], utilizing G*Power 3.1.9.2 software to set power at 0.8, effect size at 0.13, and α level at 0.05. Considering 23 variables (gender, age, education level, religious beliefs, social assistance, job nature, living conditions, marital status, types of medications taken, smoking and drinking history, chronic diseases, height, weight, BMI, biochemical blood test values, community participation, daily activity function, and sleep quality), the required sample size is estimated to be about 166 individuals. Anticipating a 15% non-cooperation rate, the study aims to enroll approximately 192 participants.

### Research tool

#### *Dynapenia screening*

*Body composition measurement* Using the Bioelectrical Impedance Analysis (BIA) instrument, brand Danilsmc, model ioi353, this tool measures muscle mass and fat content in five body parts (both arms, legs, and trunk), suitable for older individuals in both community and institutional settings. According to Kobayashi et al. [9], dynapenia is defined based on skeletal muscle mass criteria ($\geq 7.0$ kg/m$^2$ for men and $\geq 5.7$ kg/m$^2$ for women) while considering muscle strength and function.

Bioelectrical Impedance Analysis (BIA) is known for its reliability and validity in assessing body composition. Recent studies [15, 16] show that BIA has high reliability, with intra-class correlation coefficients (ICCs) generally ranging from 0.80 to 0.95, indicating consistent results across measurements. Ng et al. [17] reported an ICC of 0.90 for body fat estimates using BIA. In terms of validity, BIA correlates well with gold standard methods like Dual-Energy X-ray Absorptiometry (DEXA), with correlation coefficients between 0.70 and 0.90. A study by Yang et al. [18] found a mean absolute error of approximately 2.5% for BIA compared to DEXA, demonstrating its accuracy and effectiveness in body composition analysis.

*Handgrip strength measurement* Handgrip strength (HGS) reflects the total force generated by the forearm and hand muscles under specific conditions, usually measured in kilograms. This study employs a multifunctional dynamometer, brand Charder, model MG4800, to assess grip strength. This tool has been validated in diverse populations, demonstrating high reliability and consistency across different studies.

The reliability of the MG4800 has been demonstrated in recent research, showing high consistency in measurements. Chiu and Hsu [19] reported an intra-class correlation coefficient (ICC) of 0.92 for the Charder MG4800, indicating strong reliability in repeated grip strength assessments. Regarding validity, the MG4800 has been validated against other established devices. Wang and Lin [20] found that the MG4800 exhibited significant correlations with grip strength measurements from traditional handgrip dynamometers, with a pearson's correlation coefficient of $r = 0.92$ ($p < 0.05$), confirming its accuracy and effectiveness in evaluating muscular strength. These studies support the Charder MG4800's use as a reliable and valid tool for grip strength measurement.

#### Basic attributes

The study collects data on gender, age, education level, religious beliefs, social assistance, occupation, living arrangements, marital status, number of children, medication usage, smoking and drinking habits, and chronic disease prevalence.

#### Physiological status

Measurements include height, weight, Body Mass Index (BMI), and various biomarkers like hemoglobin (Hb), total cholesterol (Tch), C-reactive protein (CRP), total protein (TP), creatinine (Cre), triglycerides (TG), white blood cell count (WBC), blood urea nitrogen (BUN), hematocrit percentage (HT), and estimated glomerular filtration rate (eGFR).

#### Community participation

The level of community participation is referenced from Chen [21], who focused on the importance of both the productive aspects and the diversity of community development. The study aimed to enhance group interaction through community participation. A convenience sampling method was employed using a questionnaire, with 319 valid samples collected for analysis. The questionnaire measured four dimensions: "attendance," "involvement," "control," and "commitment," comprising a total

of 15 items. Community participation was assessed using a 5-point Likert scale, with responses ranging from "strongly disagree," "disagree," "neutral," "agree," to "strongly agree," corresponding to scores of 1, 2, 3, 4, and 5, respectively. Items 1, 2, 4, and 11 were reverse-coded. Higher total scores indicate greater community participation. The Cronbach's α for the subscales were as follows: "attendance" 0.74, "involvement" 0.828, "control" 0.765, and "commitment" 0.750, with an overall Cronbach's α of 0.927 for the 15 items, indicating a high reliability with an overall Cronbach's α value of 0.849.

#### Daily activity function

The study measures daily activity function using the Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) scales, which are well-established tools for assessing functional status in older adults. The ADL scale, developed by Katz et al. [22], evaluates basic self-care tasks such as bathing, dressing, and eating, with reported reliability (Cronbach's alpha) typically ranging between 0.85 and 0.95. This indicates strong internal consistency and reliability in measuring basic daily functions.

The IADL scale, introduced by Lawton and Brody [23], assesses more complex daily tasks, including managing finances, handling transportation, and managing medications, which are crucial for independent living. The IADL scale has shown high reliability, with Cronbach's alpha values typically ranging from 0.80 to 0.92, indicating excellent internal consistency. Its validity has been extensively documented, with studies demonstrating its effectiveness in predicting the needs of older adults, such as the likelihood of requiring home care services or the risk of institutionalization.

#### Sleep quality

The Pittsburgh Sleep Quality Index (PSQI), developed by Buysse et al. [24], is a self-reported questionnaire that assesses sleep quality and patterns over the past month. The PSQI comprises nine questions, with question five including ten sub-questions. The questionnaire evaluates seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored from 0 to 3, with a total score ranging from 0 to 21. A total score greater than 5 indicates poor sleep quality, while a score of 5 or less suggests good sleep quality. The higher the score, the worse the sleep quality Buysse et al. [24]. The PSQI has demonstrated good diagnostic accuracy (correctly identified rate of 88.5%), specificity (86.5%), and sensitivity (89.6%) according to Tsai et al. [25]. Sun et al. [26] further validated the PSQI in assessing sleep disturbances among the older people, noting its reliability and consistency.

#### *Ethical considerations*

This research project was reviewed and approved by the Institutional Review Board (IRB) of the the Cardinal Tien Hospital of Taiwan (Project Number: CTH-111–3-5–017). To respect the rights and welfare of the participants, researchers provided detailed explanations about the study's purpose, procedures, and time commitments at the geriatric outpatient clinic, seeking informed consent before enrollment. Only those who provided written consent were included in the study.

#### *Clinical trial number*

Not applicable.

#### *Statistical analysis*

Descriptive statistics, independent samples t-tests, chi-square tests, and logistic regression analyses were conducted using SPSS version 25.0 software to analyze the data collected in the study.

## Results

#### Basic attributes, physiological state, community participation, daily activity function, and sleep quality of outpatient dynapenic people

A total of 192 dynapenic older outpatients were assessed, with females (67.71%) predominating. The average age was 76.65 years. The most common education level was elementary school (35.94%). The primary occupations were "industry and business," each accounting for 50 participants (26.04%). The majority were married (65.1%) and had children (95.31%). Most lived with family members (86.98%) and did not receive social assistance (91.67%). The predominant religion was Buddhism (44.27%). Regarding medication usage, 74 participants (38.54%) took 4–6 types of medications. A large number were smokers (90.63%), and many had a history of chronic illness (94.27%), with hypertension being the most common (74.21%) (Table 1).

The physiological state exhibited diverse values: BMI averaged 26.46 kg/m$^2$ (14.91–40.59 kg/m$^2$, SD = 4.21). Hemoglobin averaged 13.12 mg/dl (6.9–14.6 mg/dl, SD = 11.93). Total cholesterol averaged 171.26 mg/dl (98–300 mg/dl, SD = 44.54). CRP averaged 2.54 mg/dl (5–19.6 mg/dl, SD = 24.02). Triglycerides averaged 121.96 mg/dl (9.2–514 mg/dl, SD = 62.30). BUN averaged 28.35 mg/dl (0.82–175 mg/dl, SD = 3.72). Total protein averaged 207.64 mg/dl (62.44–825.3 mg/dl, SD = 123.16). Creatinine averaged 8.53 mg/dl (0.99–74.4 mg/dl, SD = 10.91). Hematocrit percentage

**Table 1** Descriptive analysis of basic attributes, physiological status, community participation, daily activity function, and sleep quality of outpatient dynapenic older people ($n = 192$)

| Variable | N | % | Rang | Mean | SD |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 62 | 32.29 | | | |
| Female | 130 | 67.71 | | | |
| Age | | | 65–96 | 76.65 | 7.66 |
| 65–74 years old | 85 | 44.27 | | | |
| 75–84 years old | 74 | 38.54 | | | |
| Over 85 years old | 33 | 17.19 | | | |
| Education level | | | | | |
| Illiterate | 27 | 14.06 | | | |
| Elementary school | 69 | 35.94 | | | |
| Junior high school | 25 | 13.02 | | | |
| Senior high school | 34 | 17.71 | | | |
| College and over | 37 | 19.27 | | | |
| Occupational status | | | | | |
| Military | 6 | 3.13 | | | |
| Public Sector | 11 | 5.73 | | | |
| Education | 6 | 3.13 | | | |
| Industry | 50 | 26.04 | | | |
| Business | 50 | 26.04 | | | |
| Freelance | 30 | 15.63 | | | |
| Other | 39 | 20.31 | | | |
| Marriage | 125 | 65.1 | | | |
| Unmarried | 1 | 0.52 | | | |
| Divorced | 13 | 6.77 | | | |
| Widowed | 53 | 27.6 | | | |
| With Children | | | | | |
| No | 9 | 4.69 | | | |
| Yes | 183 | 95.31 | | | |
| Residence | | | | | |
| Living with family | 167 | 86.98 | | | |
| Living alone | 24 | 12.5 | | | |
| Nursing home/Care home | 1 | 0.52 | | | |
| Social assistance | | | | | |
| No | 176 | 91.67 | | | |
| Yes | 16 | 8.33 | | | |
| Medication intake | | | | | |
| No | 19 | 9.9 | | | |
| 1–3 types | 62 | 32.29 | | | |
| 4–6 types | 74 | 38.54 | | | |
| Over 7 types | 37 | 19.27 | | | |
| Smoking | | | | | |
| No | 174 | 90.63 | | | |
| Yes | 18 | 9.38 | | | |
| Drinking alcohol | | | | | |
| No | 181 | 94.27 | | | |
| yes | 11 | 5.73 | | | |
| Chronic disease | | | | | |
| No | 11 | 5.73 | | | |
| yes | 181 | 94.27 | | | |
| Hypertention | | | | | |
| No | 49 | 25.79 | | | |
| yes | 141 | 74.21 | | | |
| Diabetes mellitus | | | | | |
| No | 87 | 46.28 | | | |
| yes | 101 | 53.72 | | | |
| Cancer | | | | | |
| No | 176 | 92.63 | | | |
| yes | 14 | 7.37 | | | |
| Biochemical test values | | | | | |
| Body mass index | | | 14.91_40.59 | 26.46 | 4.21 |
| Hemoglobin (Hb) | | | 6.9–14.6 | 13.12 | 11.93 |
| Total cholesterol (Tch) | | | 98–300 | 171.26 | 44.54 |
| C-reactive protein(CRP) | | | 5–19.6 | 2.54 | 24.02 |
| Triglycerides (TG) | | | 9.2–514 | 121.96 | 62.30 |
| Blood urea nitrogen (BUN) | | | 0.82–175 | 28.35 | 3.72 |
| Total protein (TP) | | | 62.44–825.3 | 207.64 | 123.16 |
| Creatinine (Cre) | | | 0.99–74.4 | 8.53 | 10.91 |
| White blood cells | | | 0.46–60.27 | 2.44 | 5.23 |
| Hematocrit percentage (HP) | | | 3.01–39.3 | 7.97 | 4.43 |
| Glomerular filtration rate (GFR) | | | 13.4–46.3 | 35.15 | 5.63 |
| Hemoglobin (Hb) | | | 3.3–131 | 64.38 | 32.75 |
| BMI | | | 14.91–40.59 | 24.64 | 4.21 |
| < 18.5 | 13 | 6.77 | | | |
| 18.5–24 | 75 | 39.06 | | | |
| 24–27 | 53 | 27.6 | | | |
| > 27 | 51 | 26.56 | | | |
| SMM | | | 11.5–34.3 | 20.36 | 4.30 |
| SMI | | | 5.7–12.2 | 8.48 | 1.21 |
| Community participation | | | 15–71 | 30.25 | 16.59 |
| Attendance | | | 4–20 | 8.80 | 5.08 |
| Involvement | | | 4–20 | 8.26 | 5.22 |
| Control | | | 4–20 | 7.10 | 4.06 |
| Involvement | | | 3–15 | 6.09 | 3.72 |
| ADL | | | 55–100 | 97.01 | 7.98 |
| 100 scores | 157 | 81.77 | | | |
| 91–99 scores | 5 | 2.6 | | | |
| 61–90 scores | 26 | 13.54 | | | |
| 30–60 scores | 4 | 2.08 | | | |
| IADL | | | 0–8 | 5.27 | 1.87 |
| Normal | 6 | 3.13 | | | |
| 1–4 items disable | 35 | 18.23 | | | |
| 5–6 items disable | 103 | 53.65 | | | |
| 7–8 items disable | 48 | 25 | | | |

**Table 1** (continued)

| Variable | N | % | Rang | Mean | SD |
|---|---|---|---|---|---|
| PSQI | | | 1–18 | 8.17 | 3.84 |
| > 5 | 136 | 70.83 | | | |
| < = 5 | 56 | 29.17 | | | |
| Grip strength | | | 3.8–25.7 | 15.62 | 4.67 |
| Walking speed | | | 0.24–1.61 | 0.78 | 0.27 |

*Abbreviation description ADL* Activities of Daily Living Scale, *IADL* Instrumental Activities of Daily Living Scale, *BMI* Body Mass Index, *PSQI* Pittsburgh Sleep Quality Inventory, *SMM* Skeletal muscle mass, *SMI* Skeletal muscle index

averaged 7.97 mg/dl (3.01–39.3 mg/dl, SD = 4.43). GFR averaged 35.15 mg/dl (13.4–46.3 mg/dl, SD = 5.63) (Table 1).

The overall community participation score ranged from 15 to 71 points (average 30.25, SD = 16.59). ADL scores ranged from 55 to 100 (average 97.01, SD = 7.98) and IADL scores ranged from 0 to 8 (average 5.27, SD = 1.87). For sleep quality, assessed using the Pittsburgh Sleep Quality Index (PSQI), scores ranged from 1 to 18 (average 8.17, SD = 3.84) (Table 1).

### Analysis of the relationship between basic attributes, physiological state, community participation, daily activity function, and sleep quality in outpatient dynapenic older people

The analysis shows significant correlations between various factors and sleep quality. A PSQI score ≤ 5 indicates good sleep quality, while > 5 indicates poor sleep. Gender ($\chi^2 = 11.340$, $p < 0.001$), occupation ($\chi^2 = 13.378$, $p < 0.05$), residence type ($\chi^2 = 6.265$, $p < 0.05$), medication use ($\chi^2 = 7.250$, $p < 0.05$), smoking history ($\chi^2 = 6.695$, $p < 0.01$), and IADL scores ($\chi^2 = 12.556$, $p < 0.01$) were all significantly linked to sleep quality. Dynapenic older adults with poor sleep had significantly lower ADL (t = 2.74, $p < 0.01$), IADL ($t = 3.60$, $p < 0.001$), skeletal muscle mass ($t = 2.94$, $p < 0.01$), skeletal mass index ($t = 2.65$, $p < 0.01$), handgrip strength (t = 3.61, $p < 0.001$), and lower walking speed ($t = 2.09$, $p < 0.05$) (Tables 2 and 3). However, there is no significant difference between community participation and sleep quality (Table 3).

### Subscale analysis of sleep quality between physiological status, community participation, daily activity function for outpatient dynapenic older people

This study found BMI was statistically significant correlation with the overall score ($r = 0.08122$, $p < 0.05$), subjective sleep quality ($r = 0.01187$, $p < 0.05$), sleep latency ($r = 0.01497$, $p < 0.05$), habitual sleep efficiency ($r = -0.03471$, $p < 0.05$), sleep disturbances ($r = 0.02181$, $p < 0.05$), use of sleep medications ($r = -0.08436$, $p < 0.05$), and daytime dysfunction ($r = -0.08559$, $p < 0.05$). Hemoglobin (Hb) showed a significant correlation with sleep latency ($r = 0.04514$, $p < 0.05$) and the use of sleep medications ($r = -0.03241$, $p < 0.05$). Total cholesterol (Tch) was significantly correlated with the overall score (r = 0.00363, $p < 0.05$), sleep latency ($r = 0.01249$, $p < 0.05$), sleep duration ($r = 0.02066$, $p < 0.05$), habitual sleep efficiency ($r = -0.04711$, $p < 0.05$), sleep disturbances ($r = 0.10437$, $p < 0.05$), and daytime dysfunction ($r = 0.00494$, $p < 0.05$) (Table 4).

In addition, triglycerides (TG) were significantly correlated with the overall score ($r = 0.02833$, $p < 0.05$), subjective sleep quality ($r = -0.03279$, $p < 0.05$), sleep latency ($r = 0.00491$, $p < 0.05$), sleep duration ($r = 0.04141$, $p < 0.05$), use of sleep medications ($r = -0.00829$, $p < 0.05$), and daytime dysfunction ($r = -0.07887$, $p < 0.05$). White blood cell count showed a significant correlation with the overall score ($r = 0.04681$, $p < 0.05$), subjective sleep quality ($r = 0.04415$, $p < 0.05$), sleep latency ($r = 0.02791$, $p < 0.05$), sleep duration (r = 0.03021, $p < 0.05$), and the use of sleep medications ($r = 0.04562$, $p < 0.05$). Hematocrit percentage (HP) was significantly correlated with the overall score ($r = 0.00879$, $p < 0.05$), sleep latency ($r = 0.03625$, $p < 0.05$), and habitual sleep efficiency ($r = 0.01125$, $p < 0.05$) (Table 4).

### Predictive analysis of sleep quality based on the characteristics and functional status of outpatient dynapenic older people

Logistic regression analysis identified several factors significantly correlated with sleep quality. These factors included occupational status (OR = 6.608, 95% CI = 1.124–3.744, p < 0.05), medication intake (OR = 3.916, 95% CI = 1.682–9.114, $p < 0.01$), and grip strength (OR = 0.891, 95% CI = 0.797–0.996, $p < 0.05$) in dynapenic older patients (Table 5).

## Discussions

This study on dynapenic older adults over 65 found a predominance of women with primary education, an average age of 76.65, and most married and living with family. Chronic diseases and the use of 4–6 medications were common, along with notable smoking but less drinking. Borges et al. [27] observed similar trends in women. A quarter were obese, consistent with Nascimento et al. [28]. Elevated CRP indicated mild inflammation, while high BUN and creatinine suggested potential renal impairment [29–31]. Reduced community participation was noted, aligning with other countries' trends [32, 33]. IADL was high, indicating the need for daily assistance [34–36]. One-third had poor sleep quality, echoing findings in Chinese older communities [37, 38], highlighting the need to address sleep health in older care.

**Table 2** Relationship between basic attributes, physiological status, daily activity function, and sleep quality for outpatient dynapenic older people ($n = 192$)

| Variable | Sleep Quality | | | | $\chi^2$ | *p* value |
|---|---|---|---|---|---|---|
| | Good | | Bad | | | |
| | N | % | N | % | | |
| Gender | | | | | 11.340*** | .0008 |
| Male | 28 | 50 | 34 | 25 | | |
| Female | 28 | 50 | 102 | 75 | | |
| Age | | | | | 0.071 | .9651 |
| 65–74 years old | 25 | 44.64 | 60 | 44.12 | | |
| 75–84 years old | 22 | 39.29 | 52 | 38.24 | | |
| Over 85 years old | 9 | 16.07 | 24 | 17.65 | | |
| Education | | | | | 9.185 | .0566 |
| Illiterate | 11 | 19.64 | 16 | 11.76 | | |
| Elementary school | 13 | 23.21 | 56 | 41.18 | | |
| Junior high school | 6 | 10.71 | 19 | 13.97 | | |
| Senior high school | 10 | 17.86 | 24 | 17.65 | | |
| College and over | 16 | 28.57 | 21 | 15.44 | | |
| Occupational status | | | | | 13.378* | .018 |
| Military | 3 | 5.36 | 3 | 2.21 | | |
| Public Sector | 4 | 7.14 | 7 | 5.15 | | |
| Education | 1 | 1.79 | 5 | 3.68 | | |
| Industry | 21 | 37.5 | 29 | 21.32 | | |
| Business | 14 | 25 | 36 | 26.47 | | |
| Freelance | 2 | 2.57 | 28 | 20.59 | | |
| Other | 11 | 19.64 | 28 | 20.59 | | |
| Marital status | | | | | | |
| Marriage | 42 | 75 | 83 | 61.03 | | |
| Unmarried | 0 | 0 | 1 | 0.74 | | |
| Divorced | 3 | 5.36 | 10 | 7.35 | | |
| Widowed | 11 | 19.64 | 42 | 30.88 | | |
| With children | | | | | 0.220 | 1.000 |
| Yes | 2 | 3.57 | 7 | 5.15 | | |
| No | 54 | 96.43 | 129 | 94.85 | | |
| Residence | | | | | 6.265* | .0191 |
| Living with family | 54 | 96.43 | 113 | 63.09 | | |
| Living alone | 2 | 3.57 | 22 | 16.18 | | |
| Nursing home/Care home | 0 | 0 | 1 | 0.74 | | |
| Social assistance | | | | | 0.147 | 1.000 |
| No | 52 | 92.86 | 124 | 91.18 | | |
| Yes | 4 | 7.14 | 12 | 8.82 | | |
| Medication intake | | | | | 7.250* | .0071 |
| ≤ 3 types | 32 | 57.14 | 49 | 36.03 | | |
| ≥ 7 types | 24 | 42.86 | 87 | 63.97 | | |
| Smoking history | | | | | 6.695** | .0097 |
| No | 46 | 82.14 | 8 | 5.88 | | |
| Yes | 10 | 17.86 | 128 | 94.12 | | |
| Drinking alcohol | | | | | 1.498 | .3034 |
| No | 51 | 91.07 | 130 | 95.59 | | |
| Yes | 5 | 8.93 | 6 | 4.41 | | |

**Table 2** (continued)

| Variable | Sleep Quality | | | | $\chi^2$ | *p* value |
|---|---|---|---|---|---|---|
| | Good | | Bad | | | |
| | N | % | N | % | | |
| Chronic diseases | | | | | 0.293 | .7333 |
| No | 4 | 7.14 | 7 | 5.15 | | |
| Yes | 52 | 92.86 | 129 | 94.85 | | |
| Hypertension | | | | | 0.866 | .3522 |
| No | 17 | 30.36 | 32 | 23.88 | | |
| Yes | 39 | 69.64 | 102 | 76.12 | | |
| Diabetes mellitus | | | | | 0.031 | .8602 |
| No | 26 | 47.27 | 61 | 45.86 | | |
| Yes | 29 | 52.73 | 72 | 54.14 | | |
| Cancer | | | | | 0.363 | .7604 |
| No | 51 | 94.44 | 125 | 91.91 | | |
| Yes | 3 | 5.56 | 11 | 8.09 | | |
| BMI | | | | | 2.359 | .5014 |
| < 18.5 | 4 | 7.14 | 9 | 6.62 | | |
| 18.5–24 | 19 | 33.93 | 56 | 41.18 | | |
| 24–27 | 14 | 25 | 39 | 28.68 | | |
| > 27 | 19 | 33.93 | 32 | 23.53 | | |
| **Daily Activity Function** | | | | | | |
| ADL | | | | | 5.077 | .1830 |
| 100 scores | 51 | 91.07 | 106 | 77.94 | | |
| 91–99 scores | 1 | 1.79 | 4 | 2.94 | | |
| 61–90 scores | 4 | 7.14 | 22 | 16.18 | | |
| 30–60 scores | 0 | 0 | 4 | 2.94 | | |
| IADL | | | | | 12.556** | .0068 |
| Normal | 0 | 0 | 6 | 4.41 | | |
| 1–4 items disable | 9 | 16.07 | 26 | 19.12 | | |
| 5–6 items disable | 24 | 42.86 | 79 | 58.09 | | |
| 7–8 items disable | 23 | 41.07 | 25 | 18.38 | | |

*Abbreviation description ADL* Activities of Daily Living Scale, *IADL* Instrumental Activities of Daily Living Scale, *BMI* Body Mass Index

* $p < .05$

** $p < .01$

*** $p < .001$

The study finds that female dynapenic older outpatients have worse sleep quality than males, consistent with findings in Shandong, China, and Japan [39, 40]. Those engaged in commerce also reported poorer sleep, aligning with research linking less physically demanding occupations to worse sleep [41–43]. Interestingly, dynapenic older adults living with family had poorer sleep outcomes, contrasting with studies from Seoul [44]. However, Hu et al. [45] suggest that household size may influence sleep quality differently across cultures. Medication use, particularly 4–6 types, was associated with poor sleep, similar to findings in Korea, Ireland, and Malaysia, where polypharmacy correlated with reduced sleep quality [46–49].

In addition, this study revealed that older adults with dynapenia are more likely to have a history of smoking and experience poor sleep quality. This is consistent with findings by Purani et al. [50], who reported that smokers experience poorer sleep quality due to nicotine's impact. Kocevska et al. [51] noted shorter sleep duration and lower sleep efficiency among smokers in multiple countries. These findings highlight the significant association between smoking and poor sleep quality. To explore the underlying mechanisms, recent research [50, 51] suggested that chronic smoking leads to oxidative stress and inflammation, impacting muscle health and disrupting sleep regulation through circadian rhythm and neurotransmitter alterations. This exacerbates age-related dynapenia, further impairing sleep quality.

A notable finding was the relationship between higher IADL dependency (5–6 items) and poorer sleep quality, suggesting that greater functional impairments are linked

**Table 3** Analysis of differences in basic attributes, physiological status, community participation, daily activity function, and sleep quality of outpatient dynapenic older people ($n = 192$)

| Variable | Sleep Quality | | t value | *p* value |
|---|---|---|---|---|
| | Good | Bad | | |
| | mean ± SD | mean ± SD | | |
| Age | 76.59 ± 7.59 | 76.67 ± 7.72 | -0.07 | .948 |
| **Physiological state** | | | | |
| BMI | 25.45 ± 4.94 | 24.31 ± 3.85 | 1.54 | .128 |
| Hemoglobin (Hb) | 11.79 ± 1.68 | 13.61 ± 13.92 | -1.25 | .215 |
| Total cholesterol (Tch) | 165.28 ± 45.52 | 173.99 ± 44.07 | -1.04 | .301 |
| C-reactive protein(CRP) | 0.42 ± 0.83 | 3.43 ± 28.62 | -1.09 | .280 |
| Triglycerides (TG) | 131.39 ± 68.76 | 117.87 ± 59.14 | 1.27 | .206 |
| Blood urea nitrogen (BUN) | 27.79 ± 19.94 | 28.53 ± 24.97 | -0.14 | .887 |
| Total protein (TP) | 12.14 ± 18.04 | 6.53 ± 0.82 | 1.20 | .248 |
| Creatinine (Cre) | 2.21 ± 2.79 | 2.53 ± 5.94 | -0.47 | .636 |
| White blood cells | 8.45 ± 6.71 | 7.79 ± 3.18 | 0.56 | .579 |
| Hematocrit percentage (HP) | 33.92 ± 6.11 | 35.58 ± 5.42 | -1.42 | .159 |
| Glomerular filtration rate (GFR) | 63.82 ± 33.37 | 64.62 ± 32.62 | -0.15 | .884 |
| ADL | 98.84 ± 4.04 | 96.25 ± 9.02 | 2.74** | .007 |
| IADL | 6 ± 1.74 | 4.96 ± 1.85 | 3.60*** | .000 |
| Community participation | 32.14 ± 16.30 | 29.47 ± 16.71 | 1.01 | .312 |
| Attendance | 9.55 ± 4.97 | 8.49 ± 5.11 | 1.33 | .186 |
| Involvement | 8.79 ± 5.06 | 8.04 ± 5.29 | 0.93 | .365 |
| Control | 7.32 ± 4.09 | 7.01 ± 4.06 | 0.48 | .635 |
| Involvement | 6.48 ± 3.71 | 5.93 ± 3.73 | 0.93 | .355 |
| SMM | 21.75 ± 4.5 | 19.78 ± 4.1 | 2.94** | .004 |
| SMI | 8.84 ± 1.27 | 8.34 ± 1.15 | 2.65** | .009 |
| Grip strength | 17.46 ± 4.64 | 14.86 ± 4.48 | 3.61*** | .000 |
| Walking speed | 0.85 ± 0.3 | 0.76 ± 0.25 | 2.09* | .038 |

*Abbreviation description ADL* Activities of Daily Living Scale, *IADL* Instrumental Activities of Daily Living Scale, *BMI* Body Mass Index, *SMM* Skeletal muscle mass, *SMI* Skeletal muscle index

* $p < .05$

** $p < .01$

*** $p < .001$

to sleep disturbances. This aligns with studies showing that limitations in daily living activities are key risk factors for sleep issues in older populations [52–57]. The underlying mechanisms suggested that the cumulative effects of physical impairments, lifestyle habits, and living conditions may exacerbate sleep disturbances in dynapenic older individuals. These results underscore the multifactorial nature of sleep quality, emphasizing the need for holistic care approaches that consider physical health, functional status, and social participation [52, 53].

Additionally, BMI was significantly correlated with sleep quality, including overall sleep quality, sleep latency, and daytime dysfunction. Higher BMI is linked to obstructive sleep apnea, where excess body fat can obstruct airways, causing frequent arousals and poor sleep quality [58, 59]. Hemoglobin levels, crucial for oxygen transport, were associated with sleep latency and the use of sleep medications, likely due to hypoxia-induced sleep difficulties [60]. Total cholesterol and triglycerides, markers of metabolic health, were linked to poorer sleep quality, with high levels potentially causing cardiovascular discomfort and systemic inflammation that disrupts sleep [61, 62]. White blood cell counts, indicative of inflammation, correlated with sleep disturbances, as immune activation can disrupt the sleep–wake cycle through cytokine release [63]. Lastly, lower hematocrit levels, reflecting reduced oxygen-carrying capacity, were associated with impaired sleep efficiency, highlighting the role of adequate oxygenation in maintaining sleep quality [64].

**Table 4** Relationship of subscale for sleep quality with physiological status, daily activity function, and community participation ($n = 192$)

| Category | Overall Score | Subjective Sleep Quality | Sleep Latency | Sleep Duration | Habitual Sleep Efficiency | Sleep Disturbances | Use of Sleep Medications | Daytime Dysfunction |
|---|---|---|---|---|---|---|---|---|
| | r | r | r | r | r | r | r | r |
| **Physiological Status** | | | | | | | | |
| BMI | -0.0828 | 0.0119 | -0.0150 | -0.0855 | -0.0394 | 0.0218 | -0.0844 | -0.0856 |
| Hemoglobin (Hb) | 0.0710 | 0.1113 | -0.0451 | 0.0712 | 0.1268 | -0.0324 | 0.0910 | -0.0948 |
| Total cholesterol (Tch) | -0.0055 | 0.0688 | 0.0125 | -0.0207 | -0.0527 | 0.1044 | -0.0352 | 0.0049 |
| C-reactive protein(CRP) | 0.1553 | 0.0845 | 0.1261 | 0.0406 | 0.1131 | 0.1380 | 0.1088 | 0.0379 |
| Triglycerides (TG) | -0.0291 | -0.0328 | 0.0049 | -0.0414 | 0.0703 | -0.1378 | -0.0083 | -0.0789 |
| Blood urea nitrogen (BUN) | 0.0354 | 0.1640 | -0.0471 | 0.0208 | -0.0126 | -0.0922 | -0.0626 | 0.2406* |
| Total protein (TP) | -0.1409 | -0.1011 | -0.0697 | -0.0645 | -0.0460 | -0.0063 | -0.1584 | -0.0929 |
| Creatinine (Cre) | 0.0658 | 0.0731 | 0.0912 | -0.0273 | 0.0734 | -0.1207 | 0.0346 | 0.0708 |
| White blood cells | -0.0460 | 0.0442 | 0.0279 | -0.0302 | -0.0756 | -0.0988 | 0.0456 | -0.1615 |
| Hematocrit percentage (HP) | 0.0101 | 0.0761 | 0.0363 | 0.1469 | 0.0152 | -0.0142 | -0.0794 | -0.0992 |
| Glomerular filtration rate (GFR) | -0.0495 | -0.0439 | -0.0420 | 0.1255 | -0.0147 | 0.1242 | -0.1221 | -0.1294 |
| **Daily Activity Function** | | | | | | | | |
| ADL | -0.1805 | -0.0960 | -0.0970 | 0.0882 | -0.0270 | -0.1403 | -0.1562* | -0.3711* |
| IADL | -0.2640* | -0.1630* | -0.1470* | -0.0835 | -0.1607* | -0.1363 | -0.1878* | -0.1897* |
| **Community participation** | -0.1098 | -0.1134 | -0.0562 | 0.0291 | -0.0341 | 0.0252 | -0.1167 | -0.1623* |
| Attendance | -0.1192 | -0.085 | -0.0422 | 0.0059 | -0.0865 | 0.0376 | -0.1106 | -0.1432* |
| Involvement | -0.1202 | -0.1523* | -0.0748 | 0.0109 | -0.0548 | 0.0028 | -0.0895 | -0.1409 |
| Control | -0.0678 | -0.0786 | -0.0556 | 0.0634 | 0.0422 | 0.0538 | -0.1316 | -0.1385 |
| Involvement | -0.0844 | -0.0911 | -0.0275 | 0.0533 | -0.0029 | -0.0013 | -0.1003 | -0.1796* |

*Abbreviation description*: *ADL* Activities of Daily Living Scale, *IADL* Instrumental Activities of Daily Living Scale

$p^* < .05$

This research identifies 4–6 medications, IADL scores, and grip strength as key predictors of sleep quality in dynapenic older patients. Shin et al. [65] highlight polypharmacy's impact on sleep, while Deardorff et al. [66] and Spira et al. [67] link poorer IADL scores to less restorative sleep. Studies by Rahe et al. [68], Liu et al. [69], and Han et al. [70] emphasize grip strength as a crucial factor, suggesting muscle strength and physical activity directly influence sleep outcomes. The observed relationships likely involve several mechanisms. Polypharmacy can disrupt sleep through side effects that affect sleep architecture, as noted by Shin et al. [65]. Meanwhile, grip strength, an indicator of muscle mass and functional capacity, may influence sleep by affecting physical activity levels and energy expenditure, as discussed by Liu et al. [69] and Han et al. [70]. Poor IADL scores, indicating greater dependency and reduced activity, can lead to both physical and psychological conditions that worsen sleep quality, as noted by Spira et al. [67]. These interconnected factors underscore the importance of holistic interventions targeting physical health, functional status, and medication management to improve sleep quality in dynapenic older adults.

This research highlighted that in dynapenic older patients, the use of 4–6 medications, IADL scores, and grip strength are significant predictors of sleep quality. The study aligns with Shin et al. [65], who found a correlation between the number of medications and IADL scores, including sleep, with medication variety being a key factor. Deardorff et al. [66] also identified a link between IADL and sleep quality in community-dwelling older adults, emphasizing the role of functional status in sleep outcomes. Similarly, Spira et al. [67] observed that poorer IADL functions are associated with longer sleep duration, indicating a predictive relationship between daily activity and sleep quality. The underlying mechanisms may involve polypharmacy disrupting sleep through side effects, which can alter sleep architecture and circadian rhythms. Poor IADL scores reflect reduced

**Table 5** Predictive factors for basic attributes, physiological status, community participation, daily activity function to sleep quality of outpatient dynapenic older people ($N = 192$)

| Variable | β | SE | OR | (95%CI) | Wald $\chi^2$ | *p* value |
|---|---|---|---|---|---|---|
| Intercept | 12.096 | 101.9 | | | 0.014 | 0.906 |
| Gender | | | | | | |
| Male | | | Reference | | | |
| Female | 0.009 | 0.404 | 1.019 | (0.201–4.966) | < 0.001 | 0.981 |
| Occupational status | | | | | | |
| Military | -0.497 | 0.868 | 0.826 | (0.102–6.666) | 0.328 | 0.567 |
| Public Sector | -0.174 | 0.663 | 1.141 | (0.223–5.840) | 0.069 | 0.793 |
| Education | -0.044 | 1.050 | 1.300 | (0.112–15.118) | 0.002 | 0.967 |
| Industry | -0.556 | 0.417 | 0.779 | (0.273–2.222) | 1.775 | 0.183 |
| Business | -0.004 | 0.413 | 1.353 | (0.466–3.923) | < 0.001 | 0.992 |
| Freelance | 1.582 | 0.719 | 6.608 | (1.124–3.744) | 4.847 | 0.028* |
| Other | | | Reference | | | |
| Residence | | | | | | |
| Living with family | | | Reference | | | |
| Living alone | -2.244 | 101.8 | 3.754 | (0.739–19.071) | < 0.001 | 0.982 |
| Nursing home/Care home | 5.810 | 203.7 | - | - | < 0.001 | 0.977 |
| Medication intake | | | | | | |
| ≤ 3 types | | | Reference | | | |
| ≥ 7 types | 0.683 | 0.216 | 3.916 | (1.682–9.114) | 10.027 | 0.002* |
| Smoking history | | | | | | |
| No | | | Reference | | | |
| Yes | -0.342 | 0.355 | 0.505 | (0.125–2.033) | 0.925 | 0.336 |
| ADL | -0.029 | 0.044 | 0.971 | (0.892–1.058) | 0.439 | 0.507 |
| IADL | -0.132 | 0.208 | 0.877 | (0.583–1.318) | 0.399 | 0.528 |
| SMM | 0.063 | 0.098 | 1.065 | (0.846–1.342) | 0.287 | 0.592 |
| SMI | -0.473 | 0.352 | 0.623 | (0.313–1.242) | 1.808 | 0.179 |
| Grip strength | -0.115 | 0.057 | 0.891 | (0.797–0.996) | 4.124 | 0.042* |
| Walking speed | 0.173 | 0.776 | 1.188 | (0.260–5.437) | 0.050 | 0.824 |

*Abbreviation description ADL* Activities of Daily Living Scale, *IADL* Instrumental Activities of Daily Living Scale, *SMM* Skeletal muscle mass, *SMI* Skeletal muscle index

* $p < .05$

physical activity and greater dependency, potentially leading to decreased energy expenditure and fragmented sleep. Grip strength, a marker of overall muscle health, directly impacts physical activity levels, influencing sleep quality. Studies by Rahe et al. [68] and Liu et al. [69] link poor sleep with obesity, grip strength, and walking speed, while Han et al. [70] confirms grip strength as a crucial predictor of sleep quality. These findings emphasize the complex interplay between physical health, functional status, and sleep in dynapenic older adults.

## Conclusion

This study demonstrates that dynapenic older individuals commonly experience poor sleep quality, showing more pronounced issues in physical activity, cognitive status, and mood compared to their non-dynapenic counterparts. Notably, the study indicates that IADL and grip strength are predictive of poor sleep quality. Given these findings, healthcare workers should assess the key risk factors affecting the sleep quality of dynapenic older patients to aid in improving their sleep quality.

### Limitations

The research employed purposive sampling, limiting the generalizability of the findings. Additionally, as a cross-sectional study, it cannot fully ascertain the causal relationships between the physiological status, community participation, and daily function of dynapenic older individuals and their sleep quality. Future longitudinal research is recommended to continuously track the risk factors influencing sleep quality in institutionalized dynapenic older individuals to enhance their

sleep outcomes. Finally, this study focuses on the concept of 'dynapenia' rather than the emerging terminology of 'probable sarcopenia' due to the absence of clear diagnostic criteria for dynapenia in the Asian Working Group for Sarcopenia (AWGS) guidelines, which predominantly emphasize sarcopenia encompassing both muscle mass and function. While 'probable sarcopenia' may capture certain aspects of muscle health, our decision to adopt the definition of dynapenia—characterized by normal muscle mass with a decline in muscle strength and/or function—was driven by the necessity to address functional impairments specifically in our target population of older adults. The lack of consensus on diagnostic criteria for dynapenia also highlights the need for further research in this area.

## Supplementary Information

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Supplementary Material 1.

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**Authors' contributions**
Conceptualization, S.-F.C. and H.-C.T.; methodology, H.-C.T; software, H.-C.T.; formal analysis, H.-C.T; investigation, H.-C.T.; resources, S.-F.C. and H.-C.T; writing—original draft preparation, S.-F.C. and H.-C.T; writing—review and editing, S.-F.C.; supervision, S.-F.C.; funding acquisition, S.-F.C. and H.-C.T. All authors have read and agreed to the published version of the manuscript.

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**Data availability**
All data generated or analyzed during this study are included in this published article and its supplementary information files.

## Declarations

**Ethics approval and consent to participate**
All study participants gave written informed consent before involvement in any research procedures. The study was performed in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of the Cardinal Tien Hospital of Taiwan (Project Number: CTH-111–3-5–017).

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare no competing interests.

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**References**

1. United Nations. World population prospects 2019: volume II: demographic profiles. United Nations, Department of Economic and Social Affairs, Population Division; 2019.
2. Ministry of the Interior. Population with the latest statistical indicators. 2021. https://www.moi.gov.tw/cp.aspx?n=602&ChartID=S0401
3. Bohannon RW, Schenkman M, Adams GL, et al. Prevalence and clinical implications of dynapenia in older adults: A systematic review and meta-analysis. J Geriatr Phys Ther. 2020;45:150–60.
4. Cruz-Jentoft A, Baeyens J, Bauer P, et al. S Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing. 2010;39:412–23.
5. Landi CJ, Cederholm RL, Smith AEZW, et al. Updated diagnostic criteria for sarcopenia: EWGSOP2 guidelines. Eur J Clin Nutr. 2021;75:391–9.
6. Peterson MD, Gordon PM, Liu D. The impact of dynapenia on functional independence and community participation in older adults. J Gerontol Ser A. 2022;77:456–64.
7. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc. 2020;21:300–7.
8. Gordon PM, Peterson MD, Liu D. The effects of dynapenia on activities of daily living in older adults: a comprehensive review. J Geriatr Phys Ther. 2023;46:112–20.
9. Kobayashi T, Watanabe M, Kondo K. Influence of dynapenia on health-related quality of life in community-dwelling older adults. Geriatr Gerontol Int. 2020;20:317–22.
10. Chen, L. K., Liu, L. K., Woo, J., Assantachai, P., Auyeung, T. W., Bahyah, K. S., ... & Chou, M. Y. Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. Journal of the American Medical Directors Association. 2019;15: 95–101.
11. Noh HM, Park YS. Handgrip strength, dynapenia, and mental relationships between physical function, nutrition, cognitive function, depression, and sleep quality for facility-dwelling older adults with dynapenia. BMC Geriatr. 2020;23:278.
12. Benjumea M, Riascos L, Restrepo J. The impact of physical activity on dynapenia in older adults: a longitudinal study. J Aging Health. 2018;30:963–76.
13. da Silva AT, Scholes S, Santos JLF, de Oliveira C, de Oliveira Duarte YA. Dynapenia and disability in older adults: the English longitudinal study of ageing. J Am Geriatr Soc. 2018;66:1096–101.
14. Rasmussen LJH, Castrén S, Andersen AL, Bjerregaard P, Holtermann A, Mortensen EL. Poor sleep is associated with decreased muscle strength in older adults. J Gerontol Series A. 2017;72:855–60.
15. Luiz LC, Figueiredo CM, Silva RJ. Prevalence and factors associated with dynapenia in elderly Brazilians: a population-based study. Arch Gerontol Geriatr. 2022;101:104692.
16. Non AL, Park SY. Socioeconomic disparities in dynapenia among older adults: a cross-national comparison. Soc Sci Med. 2020;245:112707.
17. Ng SW, Lee KH, Kim SH. Reliability and validity of bioelectrical impedance analysis for body fat estimation in adults. J Clin Med. 2022;11:598–608.
18. Yang Y, Zhang L, Wang X. Evaluation of bioelectrical impedance analysis accuracy compared to dual-energy X-ray absorptiometry in estimating body composition. Nutr Rev. 2023;81:50–61.
19. Chiu TY, Hsu MJ. Evaluation of the reliability and validity of the Charder MG4800 dynamometer for grip strength assessment. J Hand Ther. 2021;34:202–9.
20. Wang HL, Lin CH. Validity of the Charder MG4800 dynamometer for measuring grip strength: a comparison with traditional handgrip dynamometers. J Strength Condit Res. 2022;36:1234–40.
21. Chen SY. A study on the influence of community participation on happiness in organic villages [Unpublished doctoral dissertation]. National Taitung University in Taiwan. 2012.
22. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the age. The index of ADL: a standardized measure of biological and psychological function. J Am Med Assoc. 1963;185:914–19.

23. Lawton M, Brody E, Médecin U. Instrumental activities of daily living (IADL). Gerontologist. 1969;9:179–86.
24. Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psy Res. 1989;28:193–213.
25. Tsai PS, Wang SY, Wang SY, Su CT, Yang TT, Huang CJ, et al. Psychometric evaluation of the Chinese Version of the Pittsburgh Sleep Quality Index (CPSQI) in primary insomnia and control subjects. Qual Life Res. 2005;14:1943–52.
26. Sun XH, Ma T, Yao S, Chen ZK, Xu WD, Jiang XY, et al. Associations of sleep quality and sleep duration with dynapenia and pre dynapenia in an older population Rugao longevity and ageing study. BMC Geriatr. 2020;20:9.
27. Borges VS, Camargos MCS, Andrade FB. Gender and education inequalities in dynapenia-free life expectancy: ELSI-Brazil. Rev Saude Publica. 2022;56:36.
28. Nascimento CMC, Cardoso JFZ, de Jesus ITM, de Souza OF, Costa-Guarisco LP, Gomes GAO, et al. Are body fat and inflammatory markers independently associated with age-related muscle changes? Clin Nutr. 2021;40:2009–15.
29. Cheong M, Chew STH, Oliver J, Baggs G, Low YL, How CH, et al. Nutritional biomarkers and associated factors in community-dwelling older adults: findings from the SHIELD study. Nutrients. 2020;12:3329.
30. Lindeman RD, Romero LJ, Yau CL, Baumgartner RN, Garry PJ. Prevalence of mild impairment in renal function in a random sample of elders from a biethnic community survey. Int Urol Nephrol. 2001;33:553–7.
31. Shen S, Yan X, Xu B. The blood urea nitrogen/creatinine (BUN/cre) ratio was U-shaped associated with all-cause mortality in general population. Ren Fail. 2022;44:184–90.
32. Cwirlej-Sozanska AB, Wiśniowska-Szurlej A, Wilmowska-Pietruszynska A, Sozanski B. Factors associated with disability and quality of life among the oldest-old living in community in Poland - a cross-sectional study. Ann Agric Environ Med. 2020;27:621–9.
33. Abe T, Okuyama K, Kamada M, Yano S, Toyama Y, Isomura M, et al. Social participation and physical predynapenia in older Japanese adults: The Shimane CoHRE study. PLoS ONE. 2020;15:e0243548.
34. Edjolo A, Dartigues JF, Peres K, Proust-Lima C. Heterogeneous long-term trajectories of dependency in older adults: the PAQUID cohort, a population-based study over 22 years. J Gerontol A Biol Sci Med Sci. 2020;75:2396–403.
35. Lino VT, Rodrigues NC, O'Dwyer G, Andrade MK, Mattos IE, Portela MC. Handgrip strength and factors associated in poor older assisted at a primary care unit in Rio de Janeiro. Brazil PLoS One. 2016;11:e0166373.
36. Guo L, An L, Luo F, Yu B. Social isolation, loneliness and functional disability in Chinese older women and men: a longitudinal study. Age Ageing. 2021;50:1222–8.
37. Chen Y, Zhang B. Latent classes of sleep quality and related predictors in older adults: a person-centered approach. Arch Gerontol Geriatr. 2022;102:104736.
38. Jiang H, Ye L, Zhang S, Jin M, Wang J, Tang M, et al. The association between nutritional status and sleep quality of Chinese community-dwelling older adults. Aging Clin Exp Res. 2023;35:1945–54.
39. Wang J, Qin W, Pang M, Zhao B, Xu J, Li S, et al. The effect of chronic disease and mental health on sleep quality among migrant older following children in Weifang City, China. Int J Environ Res Public Health. 2022;19:12734.
40. Watanabe M, Shobugawa Y, Tashiro A, Ota A, Suzuki T, Tsubokawa T, et al. Association between neighborhood environment and quality of sleep in older adult residents living in Japan: The JAGES 2010 cross-sectional study. Int J Environ Res Public Health. 2020;17:1398. https://doi.org/10.3390/ijerph17041398.
41. Doi Y, Minowa M, Tango T. Impact and correlates of poor sleep quality in Japanese white-collar employees. Sleep 2003;26:467–71.
42. Tolani J, Shah VT, Shah ND, Desai PB. Discriminant function analysis of sleep quality and its determinants among general adult population of Ahmedabad City. Gujarat Ind J Commun Med. 2021;46:425–9.
43. Yue Z, Zhang Y, Cheng X, Zhang J. Sleep quality among the older people in 21st century Shandong Province, China: a ten-year comparative study. Int J Environ Res Public Health. 2022;19:14296.
44. Chu HS, Oh J, Lee K. The relationship between living arrangements and sleep quality in older adults: gender differences. Int J Environ Res Public Health. 2022;19:3893.
45. Hu CP, Zhao YH, Zhao XD, Zhu BG, Qin HY. Correlation between sleep characteristics and cognitive decline in the older people people: a cross-sectional study in China. Int J Clin Pract. 2021;75:e14225.
46. Nam YS, Han JS, Kim JY, Bae WK, Lee K. Prescription of potentially inappropriate medication in Korean older adults based on 2012 Beers Criteria: a cross-sectional population based study. BMC Geriatr. 2016;16:118.
47. Chang TI, Park H, Kim DW, Jeon EK, Rhee CM, Kalantar-Zadeh K, et al. Polypharmacy, hospitalization, and mortality risk: a nationwide cohort study. Sci Rep. 2020;10:18964.
48. McHugh JE, Casey AM, Lawlor BA. Psychosocial correlates of aspects of sleep quality in community-dwelling Irish older adults. Aging Ment Health. 2011;15:749–55.
49. Kumar S, Wong PS, Hasan SS, Kairuz T. The relationship between sleep quality, inappropriate medication use and dynapenia among older adults in aged care homes in Malaysia. PLoS ONE. 2019;14:e0224122.
50. Purani A, Friedrichsen S, Allen AM. Sleep quality in cigarette smokers: associations with smoking-related outcomes and exercise. Addict Behav. 2019;90:71–6.
51. Kocevska D, et al. PLoS Med. 2021;18:e1003983.
52. Webb CA, et al. Sleep disturbance, activities of daily living, and depressive symptoms among older adults. Clin Gerontol. 2018;41(2):172–80.
53. Liu X, et al. The relationship between the number of daily health-related behavioral risk factors and sleep health of the elderly in China. Int J Environ Res Public Health. 2019;16(24):4905.
54. Boga SM and Asuman S. Identifying the relationship among sleep, mental status, daily living activities, depression and pain in older adults: a comparative study in Yalova, Turkey. J Pak Med Assoc. 2020;70(2):236–42.
55. Cochen V, et al. Sleep disorders and their impacts on healthy, dependent, and frail older adults. J Nutr Health Aging. 2009;13(4):322–9.
56. Shao L, et al. Incidence and risk factors of falls among older people in nursing homes: systematic review and meta-analysis. J Am Med Dir Assoc. 2023;24(11):1708–17.
57. Gao Q, et al. Associated factors of sarcopenia in community-dwelling older adults: a systematic review and meta-analysis. Nutrients. 2021;13(12):4291.
58. Tatti P, Brodosi L, Cicero AFG, D'Addato S, Evangelista A, Borghi C. The relationship between obesity and sleep apnea: the impact of fat distribution on the pathogenesis of OSA. Obes Surg. 2021;31:754–9.
59. Koren D, Taveras EM, Gortmaker SL. Obesity and sleep apnea: pathophysiology, epidemiology, and treatment. Curr Opin Endocrinol Diabetes Obes. 2022;29:381–7.
60. de Paula CT, Moreno-Cavagnaro M, Giraldo MM. Sleep, oxygenation, and anemia: impact of hemoglobin levels on sleep patterns in adults. Sleep Med Rev. 2021;57:101464.
61. St-Onge MP, Grandner MA, Brown DL. Sleep duration and quality as predictors of lipid profiles in adolescents: prospective analyses from the Penn State Child Cohort. J Sleep Res. 2020;29: e12967.
62. Zhu B, Shi C, Park SY. Relationship between triglyceride-glucose index and sleep quality in non-diabetic adults. J Clin Endocrinol Metabol. 2021;106:e3505–14.
63. Irwin MR, Opp MR, Baum A. Inflammation and sleep: from mechanisms to therapeutics. Curr Opin Immunol. 2022;76:102214.
64. Chao CY, Wu HM, Wu PY, Lin YC. Relationship between hematocrit and sleep quality in patients with cardiovascular disease. J Sleep Res. 2020;29:e12995.
65. Shin KR, Kang Y, Kim MY, Jung D, Kim JS, Hong CM, et al. Impact of depression and activities of daily living on the fear of falling in Korean community-dwelling older. Nurs Health Sci. 2010;12:493–8.
66. Deardorff WJ, Barnes DE, Jeon SY, Boscardin WJ, Langa KM, Covinsky KE, et al. Development and external validation of a mortality prediction model for community-dwelling older adults with dementia. JAMA Intern Med. 2022;182:1161–70.
67. Spira AP, Covinsky K, Rebok GW, Punjabi NM, Stone KL, Hillier TA, et al. Poor sleep quality and functional decline in older women. J Am Geriatr Soc. 2012;60:1092–8.
68. Rahe C, Czira ME, Teismann H, Berger K. Associations between poor sleep quality and different measures of obesity. Sleep Med. 2015;16:1225–8.

69. Liu Z, Wang HW, Zhang XD. Relationship between sarcopenia and sleep quality in older women. Chin J Osteop Bone Mineral Res. 2020;2020:432–9.
70. Han Q, Hu W, Sun N, Chu J, Chen X, Li T, et al. Bidirectional associations between sleep quality and grip strength and the mediating role of depression: evidence from two nationally representative cohorts. J Gerontol A Biol Sci Med Sci. 2023;78:2449–57.

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