applied sciences

MDPI

Article

The Influence of Exercise, Nutritional Status, and Disease on the Functional Ability to Undertake Activities of Daily Living and Instrumental Activities of Daily Living in Old Taiwanese People

Hui-Ting Lin [1], Fu-Kuei Chang [2] and Hsin-Jen Tsai [2,*]

[1] Department of Physical Therapy, I-Shou University, Kaohsiung 82445, Taiwan; huitinglin@isu.edu.tw
[2] Department of Health Management, I-Shou University, Kaohsiung 82445, Taiwan; fukuei@isu.edu.tw
* Correspondence: hsinjen@gmail.com; Tel.: +886-7615-1100 (ext. 7416)

Abstract: This study aimed to examine the influence of changes in exercise status, nutritional status, and a number of comorbidities on functional ability in Taiwanese community-dwelling older adults. Data were obtained from the Taiwan Longitudinal Study of Aging. The results revealed that current exercise and consistent exercise were negatively associated with subsequent 4- and 8-year activities of daily living (ADL) and instrumental ADL (IADL) decline (all $p < 0.05$). The Mini-Nutritional Assessment (MNA) score was negatively associated with subsequent 8-year IADL decline (all $p < 0.05$), while the number of diseases was positively associated with subsequent 4- and 8-year IADL decline (all $p < 0.05$). Current exercise and consistent exercises are beneficial for adults aged ≥65 years to maintain their functional ability in ADL and IADL and to prevent declines in functional ability. Consistency of exercise, MNA score, and the number of chronic diseases are good predictors of IADL decline.

Keywords: exercise; nutritional status; the number of diseases; ADL; IADL

Citation: Lin, H.-T.; Chang, F.-K.; Tsai, H.-J. The Influence of Exercise, Nutritional Status, and Disease on the Functional Ability to Undertake Activities of Daily Living and Instrumental Activities of Daily Living in Old Taiwanese People. *Appl. Sci.* **2022**, *12*, 4585. https://doi.org/10.3390/app12094585

Academic Editors: Fernando Ribeiro and Jesús García Pallarés

Received: 11 March 2022
Accepted: 28 April 2022
Published: 30 April 2022

1. Introduction

Increases in life expectancy in developed countries have led to a rapid increase in the elderly population, and as a result, many aging-related issues have become a public health concern. The annual incidence of chronic activities of daily living (ADL) disability is nearly 4% in community-dwelling people aged 65 years or older in northern Taiwan [1]. Functional ability deteriorates with age in older adults [2]. A decline in functional ability can adversely affect the quality of life of older adults and contribute to an increase in healthcare costs.

Some lifestyle factors are recognized as potentially modifiable behaviors that may influence the risk of decline in functional ability. For example, associations between physical activity and functional ability in older adults are reported [1,3,4]. Community-dwelling older adults with high levels of baseline physical activity are less likely to experience a decline in functional ability and disability than those with low levels of physical activity [3,4]. An exercise intervention study indicated that older adults aged more than 65 years who participated in a physical activity program maintained their functional ability in the intervention period without extra use of health care resources [5]. A meta-analysis of randomized controlled trials revealed the significant and beneficial effects of physical activity on the performance of activities of daily life in old age [6]. A cross-sectional study reported that practicing regular physical activities was associated with better functional performances in community-dwelling older adults and frail ones in day care centers [7].

Nutritional status is also a concern and essential for functional ability in older populations. The decline of functional ability in older adults impacts their nutritional status and

leads to a poor nutritional state [8–10]. Older adults at risk of malnutrition or malnourished were more likely to experience functional impairment later [11]. Nutritional status was reported to be associated with functional status in home-dwelling old adults receiving in-home care nursing services [12]. Being sarcopenia was reported to be associated with a high risk of functional disability in the oldest old people [13]. In contrast, obesity has essential impact on cardiovascular heart diseases. The elimination of modifiable risk factors, such as an unhealthy lifestyle, could help prevent 80% of acute coronary syndrome cases [14]. A higher BMI score was associated with a significantly lower risk of death in acute coronary syndrome [15]. All information indicates that it is extremely important and necessary to educate patients on diet prophylaxis and lifestyle changes [14,15].

Old populations in different countries have heterogeneous characteristics and factors that affect their functional ability and decline in functional ability. Previous studies were limited in their examination of the longitudinal changes in lifestyle factors in the elderly population and their role in the transitional process of functional ability. Few studies have simultaneously investigated different factors, including exercise and nutritional status. In Taiwan, the old population is fast-growing, but few studies focused on the simultaneously and longitudinal impact of modified lifestyle factors, exercise, and nutritional status on the transitional process of functional ability. Therefore, this study aimed to examine the influence of changes in exercise status, nutritional status, and a number of comorbidities on functional ability in Taiwanese community-dwelling older adults.

2. Materials and Methods

2.1. Participants and Sampling

Data for this study were collected from a national cohort study called the Taiwan Longitudinal Study on Aging (TLSA). The TLSA was launched in 1989 and aimed to evaluate the health and well-being of elderly people in Taiwan. The study design and survey methods of the TLSA were fully documented previously [16]. The TLSA used a stratified multi-staged equal probability sampling design with townships as the primary sampling units. The TLSA recruited 4049 people aged $\geq$60 years in 1989 and further recruited 2462 and 1599 new participants aged 50–66 years in 1996 and 2003, respectively, to replenish the younger section of the cohort. Follow-up surveys were carried out every three to four years, and a total of six waves of the TLSA (1989, 1993, 1996, 1999, 2003, and 2007) were completed [17,18]. In each wave, some special variables were collected. The TLSA excluded Taiwanese aboriginals. The TLSA collected nutritional and dietary data from 1999. Therefore, the present study used data from the 1999 survey as a baseline dataset and data from the 2003 and 2007 surveys as the endpoints. Inclusion criteria in the present study were participants aged $\geq$65 years and those with a $0 \leq$ baseline ADL/IADL score < 18.

2.2. Exercise Status

Exercise habits were evaluated using the following question: "Do you usually exercise?" The response options were: "no;" "$\leq$2 times/week;" "3–5 times/week;" and "$\geq$6 times/week." Moreover, changes in exercise status were assessed. Subjects who did not exercise over 4/8 years periods (1999–2003 or 1999–2007) were classified as "not an exerciser." Those who exercised habitually in 1999 but not in 2003 or 2007 were classified as "past exercisers." Those who did not exercise habitually in 1999 but who were habitual exercisers at the time of the study were classified as "current exercisers," whereas those with exercise habits over 4/8 years (1999–2003 or 1999–2007) were classified as "consistent exercisers."

2.3. Comorbid Conditions

The presence of comorbid conditions was assessed using a disease list, and the total number of reported diagnosed diseases were calculated. Diagnosed diseases included hypertension, diabetes, heart disease, stroke, cancer, lung disease, arthritis/rheumatism,

gastric ulcer/gastric disease, liver/gallbladder disease, hip fracture, cataract, kidney disease, gout, and bone spurs.

2.4. Nutritional Status

Nutritional status was evaluated using the Mini-Nutritional Assessment (MNA)—Taiwan version II [19]. In clinical practice, two versions of the MNA questionnaire are used: a full and short-form [20–22]. A full form of MNA was used in the present study. The total MNA score was from 0 to 30 points. A high score indicated a good nutritional status. Normal nutritional status was 24–30 points, at risk of malnutrition 17–23.5 points, and malnourished fewer than 17 points.

2.5. Functional Ability

The functional ability of participants was evaluated using a six-item ADL questionnaire and a six-item instrumental activities of daily living (IADL) questionnaire in the TLSA. The six-item ADL questions assess whether respondents need help with bathing, dressing/undressing, eating, getting out of bed, sitting in a chair, standing up, moving around the house, and toileting [23]. The six-item IADL questions aimed to assess whether respondents needed help with shopping, finance, transportation, housework, cleaning the household, and calling out [24]. Participants self-reported their needs for activities of daily living. The responses for each item of ADL and IADL were rated on a 4-point scale ranging from "0" (no difficulty), "1" (need some help), "2" (need lots of help), and "3" (unable to do it). The total scores of ADL and IADL were calculated; values ranged from 0 to 18, with a high total score indicating poor functional status. The sum of ADL and IADL scores were calculated for each wave and were used to measure subsequent net changes during the 4-year and 8-year periods. A positive net change implied that participants needed more help when performing their daily living activities during the subsequent periods, while a negative change implied that participants needed less help when performing their daily living activities.

2.6. Analysis

Descriptive data were expressed as proportions or averages ± standard deviations. Multivariate linear regression analyses were performed to evaluate the associations of the frequency of exercise, change in exercise status, MNA scores, and the number of diseases with baseline ADL and IADL scores, as well as subsequent 4- and 8-year ADL and IADL scores, after adjusting for confounding variables. In the cross-sectional analysis, frequency of exercise (q 2, 3–5, ≥6/week) was compared with none of the exercises per week, a reference level. In the longitudinal analysis, being a past, current, or consistent exerciser was compared with being not an exerciser, a reference level. MNA scores were analyzed as a continuous variable. Multivariate logistic regression analyses were performed to evaluate the associations of changes in exercise status, MNA scores, and the number of diseases with 4- and 8-year ADL and IADL decline, adjusted for confounding variables. ADL and IADL decline was defined as subsequent 4- and 8-year positive net ADL/IADL changes scores (>0 points), which meant that participants had worse ADL/IADL functional ability over 4 and 8 years. Confounding factors included sex, age, years of education, and ADL scores at baseline. The beta (β) coefficients, adjusted odds ratios and 95% confidence intervals (AOR (95% CI)) were reported. The SAS software package (SAS Institute Inc., Cary, NC, USA) version 9.1 was used to perform all statistical analyses. Statistical significance was set at $p < 0.05$.

3. Results

Table 1 show the characteristics of the subjects in 1999. The study subjects had an average age of 75 years and had nearly two diseases each. The average and standard deviation of ADL, IADL, and MNA scores were 0.73 ± 2.61, 2.82 ± 4.70, and 25.64 ± 3.25, respectively. The proportion of study subjects who did not exercise, exercised ≤ 2 times/week,

exercised 3–5 times/week, and exercised ≥ 6 times/week were 38.42%, 5.77%, 10.20%, and 45.62%, respectively.

Table 1. Characteristics of study subjects in 1999 (n = 2932).

	Values %/Mean ± Std
Gender	
Men	54.74
Women	45.26
Age (y)	74.74 ± 6.13
Formal education (y)	4.78 ± 4.41
ADL score	0.73 ± 2.61
IADL score	2.82 ± 4.70
Frequency of exercise (times/week)	
None	38.42
≤2	5.77
3–5	10.20
≥6	45.62
MNA score	25.64 ± 3.25
Number of diseases	2.21 ± 1.75

Abbreviation: ADL: activity of daily living, IADL: independent activity of daily living, MNA: mini-nutritional assessment.

Table 2 show a multivariate regression analysis of the cross-sectional associations of frequency of exercise, MNA score, and a number of diseases with ADL and IADL scores in 1999. After adjusting for confounding factors, the frequency of exercise (≤2 times/week, 3–5 times/week, and ≥6 times/week) was negatively associated with baseline ADL (β = −0.7, −0.64, and −0.57, all $p < 0.05$) and IADL scores (β = −0.94, −1.05, and −1.34, all $p < 0.05$). The MNA score was negatively associated with the baseline ADL and IADL scores (β = −0.30 and −0.41, both $p < 0.05$). The number of diseases was positively associated with the baseline IADL score (β = 0.24, $p < 0.05$).

Table 2. Multivariate regression analysis of the cross-sectional associations * of frequency of exercise, MNA score and number of diseases with ADL and IADL scores in 1999.

	ADL Score (n = 2790)		IADL Score (n = 2701)	
	β	p	β	p
Frequency of exercise (times/week)				
None	Reference **		Reference	
≤2	−0.70	0.0001	−0.94	0.0004
3–5	−0.64	<0.0001	−1.05	<0.0001
≥6	−0.57	<0.0001	−1.34	<0.0001
MNA score	−0.30	<0.0001	−0.41	<0.0001
Number of diseases	0.03	0.2830	0.24	<0.0001

Abbreviation: ADL: activity of daily living, IADL: independent activity of daily living, MNA: mini-nutritional assessment. * Adjusted for gender, age, years of formal education. ** A reference level.

Table 3 show the regression analysis of the associations of changes in exercise status over 4- and 8-year periods, MNA score, and the number of diseases with subsequent ADL and IADL scores. Past exercising was positively associated with ADL (β = 0.81, $p < 0.05$) and IADL score (β = 1.30, $p < 0.05$) over 8 years. Current exercise and consistent exercise were negatively associated with ADL (β range: –2.36 to –3.34, all $p < 0.05$) and IADL score (β range: –3.32 to –4.50, all $p < 0.05$) over 4 and 8 years. The MNA score and the number of diseases were associated with subsequent IADL scores over 4 and 8 years (for MNA, β = −0.19 and −0.16, both $p < 0.05$; for the number of diseases, β = 0.17 and 0.17, both $p < 0.05$).

Table 3. The regression analysis of the associations of change of exercise status over 4- and 8 years, MNA score and number of diseases with ADL and IADL scores in 2003 and 2007 *.

	ADL				IADL			
	2003 (n = 2148)		2007 (n = 1638)		2003 (n = 2109)		2007 (n = 1563)	
	β	p	β	p	β	p	β	p
Exercise status								
Not an exerciser	Reference **		Reference		Reference		Reference	
Past exercisers	−0.26	0.2907	0.81	0.0200	−0.39	0.2124	1.30	0.0009
Current exercisers	−2.36	<0.0001	−3.34	<0.0001	−3.32	<0.0001	−4.28	<0.0001
Consistent exercisers	−2.50	<0.0001	−3.27	<0.0001	−3.46	<0.0001	−4.50	<0.0001
MNA score	−0.02	0.4395	−0.05	0.2688	−0.19	<0.0001	−0.16	0.0030
Number of diseases	0.01	0.8295	0.11	0.1040	0.17	0.0034	0.17	0.0246

Abbreviation: ADL: activity of daily living, IADL: independent activity of daily living, MNA: mini-nutritional assessment. * Adjusted for gender, age, years of formal education, and baseline ADL score. ** A reference level.

Table 4 show the multivariate logistic regression analysis of the associations of changes in exercise status during the 4- and 8 years, MNA score, and the number of diseases with ADL and IADL decline over 4- and 8-year periods. Past exercising was positively associated with ADL decline over 8 years (AOR (95% CI) = 1.71 (1.23–2.38), $p < 0.05$) and IADL decline over 4 and 8 years (AOR (95% CI) = 1.36 (1.00–1.83) and 2.38 (1.61–3.51), both $p < 0.05$). Current and consistent exercise were negatively associated with ADL over 4- and 8- years periods (AOR range: 0.12 to 0.21, 95% CI range: 0.08 to 0.34, all $p < 0.05$) and IADL decline over 4- and 8- years periods (AOR range: 0.46 to 0.63, 95% CI range: 0.32 to 0.84), all $p < 0.05$). The MNA score was only negatively associated with subsequent IADL decline over 8 years (AOR (95% CI) = 0.95 (0.90–1.00), $p < 0.05$). The number of diseases was positively associated with IADL decline during the 4- and 8-year periods (AOR (95% CI) = 1.10 (1.04–1.17) and 1.09 (1.02–1.17), $p < 0.05$).

Table 4. Multivariate logistic regression analysis of the associations of change of exercise status during 4- and 8 years, MNA score and number of diseases with ADL and IADL decline over 4- and 8-year periods *.

	ADL				IADL			
	1999–2003 (n = 2148)		1999–2007 (n = 1638)		1999–2003 (n = 2109)		1999–2007 (n = 1563)	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Exercise status								
Not an exerciser	Reference **		Reference		Reference		Reference	
Past exercisers	1.07 (0.78–1.47)	0.6877	1.71 (1.23–2.38)	0.0016	1.36 (1.00–1.83)	0.0482	2.38 (1.61–3.51)	<0.0001
Current exercisers	0.21 (0.13–0.34)	<0.0001	0.17 (0.10–0.29)	<0.0001	0.62 (0.46–0.84)	0.0021	0.46 (0.32–0.66)	<0.0001
Consistent exercisers	0.12 (0.08–0.17)	<0.0001	0.19 (0.13–0.27)	<0.0001	0.63 (0.49–0.80)	0.0002	0.51 (0.38–0.69)	<0.0001
MNA score	0.95 (0.90–1.00)	0.0400	0.96 (0.91–1.01)	0.1068	0.98 (0.94–1.02)	0.2473	0.95 (0.90–1.00)	0.0331
Number of diseases	1.07 (0.99–1.16)	0.0809	1.07 (0.99–1.16)	0.0720	1.10 (1.04–1.17)	0.0009	1.09 (1.02–1.17)	0.0119

Abbreviation: AOR (95% CI): adjusted odds ratio (95% confidence interval), ADL: activity of daily living, IADL: independent activity of daily living, MNA: mini-nutritional assessment. * Adjusted for gender, age, years of formal education, baseline ADL score. ** A reference level.

4. Discussion

4.1. Exercising Status

Our study revealed that the frequency of exercise was associated with ADL and IADL functional abilities. Longitudinal analysis demonstrated that older adults who discontinued exercise had a significantly increased risk of subsequent ADL and IADL decline. Older adults who currently or consistently exercised exhibited decreased risks of ADL and IADL decline. The longitudinal associations of change in exercise status with subsequent IADL decline were stronger than those with subsequent ADL decline. Physical activity was reported to be associated with ADL and IADL disability [1,3]. Older adults who undertook more physical activities had a decreased risk of reporting functional limitations

and disability and exhibited slower progression of ADL/IADL disability [3]. A meta-analysis for randomized controlled trials has indicated the significantly beneficial impacts of physical activity on ADL performance in old age [6]. Older adults who were aged more than 65 years and attended a physical activity program maintained their functional ability in the intervention period without extra use of health care resources [5]. A cross-sectional study reported that having regular physical activities was associated with better functional performances in community-dwelling older adults and frail ones in day care centers [7]. Consistent and routine exercise was associated with improved physical function, including ADL [1,4,25] and IADL [4]. Current or consistent exercise habits are essential to maintain the functional abilities of older adults, enabling them to lead independent daily lives. However, if older adults discontinue their exercise habits, this could be detrimental to maintaining their ADL and IADL functional abilities. A high frequency of exercise and consistent exercise can improve and maintain functional ability in IADL better than in ADL.

4.2. Nutritional Status

This study revealed that MNA scores were associated with ADL and IADL decline. Old adults who were well-nourished had a lower risk of functional ability decline. Poor MNA scores were associated with poor ADL status in community-dwelling and institutionalized elders [26–29]. A cross-sectional study in home-dwelling old adults receiving in-home care nursing services revealed that nutritional status was associated with ADL functional status [12]. An urban community study observed that older adults with sarcopenia aged 80 years or over had nearly double the risks of ADL disability than those without sarcopenia [13]. The older adults who were free of ADL or IADL dependency at baseline and were rated malnourished or at risk of malnutrition had significantly higher ADL and IADL scores 4 years later [11]. Taken together, nutritional status is an essential element to maintaining functional ability in the old population. Moreover, our study observed that the MNA appeared to predict IADL decline better than ADL. Our results further suggest that MNA is a good predictor of early functional decline in IADL.

4.3. The Number of Medical Conditions

This present observation showed that adults over the age of 65 years a high number of diseases had an essentially increased risk of IADL decline of 9–10% compared to those without diseases during the 4-and 8-year periods. The number of medical conditions was previously correlated with the functional ability of older adults in ADL [1,30–33]. Our study revealed that the number of diseases could predict subsequent IADL decline rather than ADL decline. The number of diseases affects older adults' ability to live independently, rather than their ability to undertake the basic activities of daily life.

4.4. Strengths and Limitations

The national scope of the TLSA study strengthened the generalizability of the ADL and IADL status and healthy/risky behavior findings. The longitudinal and prospective design of the TLSA strengthened the effect of behavior changes with time, making it possible to evaluate the effects of behavioral changes on ADL and IADL decline with confidence.

The limitations of this study should be considered when interpreting its results. The observed effects may be the result of physically active participants being generally healthier. Participants who were lost to follow-up were more likely to be functionally impaired, institutionalized, or in poor health, and their exclusion from the analysis may have underestimated the reported associations. This study was a secondary data analysis. In the TLSA, the data on participants' chronic diseases, physical functions, physical activity, and nutritional assessment was based on the subjects' self-reports. The accuracy of self-reported data varies from person to person, as well as the conditions being reported. The assessment of the participant's physical activity was highly subjective as quantitative measures of activity, duration, and intensity were not available, and the instruments used in the TLSA were not measured objectively. In the TLSA, general disease terms were used in

the disease list. Data on individual diseases, including specific pathology and severity, were not collected. The severity of specific diseases and diseases affects the participants' functional status. However, we used the total number of diseases as an ordinal scale to evaluate multimorbidity effects without considering the different effects of specific diseases, severity, and combinations of diseases on physical functioning. Confounding effects should be considered in the analysis.

5. Conclusions

The frequency of exercise, consistency of exercise, nutritional status, and the number of diseases are cross-sectionally and longitudinally associated with functional ability in ADL and IADL in old Taiwanese people. Current and consistent exercises are beneficial for adults aged ≥65 years to maintain their functional ability in ADL and IADL and prevent a decline in functional ability, while discontinuation of exercise is harmful. Consistency of exercise, MNA score, and the number of chronic diseases are good predictors of subsequent IADL and IADL decline. The influences of consistency of exercise, nutritional status, and the number of diseases with IADL were stronger than those on ADL.

Author Contributions: Conceptualization, H.-J.T., H.-T.L. and F.-K.C.; Methodology, H.-J.T.; Software, H.-J.T. and F.-K.C.; Validation, H.-J.T., H.-T.L. and F.-K.C.; Formal Analysis, H.-J.T. and F.-K.C.; Investigation, H.-J.T.; Resources, H.-J.T.; Data Curation, H.-J.T.; Writing—Original Draft Preparation, H.-J.T.; Writing—Review and Editing, H.-J.T., H.-T.L. and F.-K.C.; Supervision, H.-J.T.; Project Administration, H.-J.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of I-Shou University, Taiwan.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the TLSA.

Data Availability Statement: Data sharing was not applicable.

Acknowledgments: This study used data from the TLSA, provided by the Bureau of Health Promotion, Department of Health, Taiwan. The conclusions expressed here do not represent those of the Bureau.

Conflicts of Interest: The authors declare that they do not have any conflicts of interest.

References

1. Wu, S.C.; Leu, S.Y.; Li, C.Y. Incidence of and predictors for chronic disability in activities of daily living among older people in Taiwan. *J. Am. Geriatr. Soc.* **1999**, *47*, 1082–1086. [CrossRef] [PubMed]
2. Holstein, B.E.; Due, P.; Almind, G.; Avlund, K. Eight-year change in functional ability among 70- to 95-year-olds. *Scand. J. Public Health* **2007**, *35*, 243–249. [CrossRef] [PubMed]
3. Miller, M.E.; Rejeski, J.; Reboussin, B.A.; Have, T.R.T.; Ettinger, W.H. Physical activity, functional limitations, and disability in older adults. *J. Am. Geriatr. Soc.* **2000**, *48*, 1264–1272. [CrossRef] [PubMed]
4. Lee, Y.; Kim, J.; Back, J.H.; Kim, S.; Ryu, M. Changes in combined lifestyle risks and disability transition in older adults: Korean Longitudinal Study of Aging, 2006–2008. *Prev. Med.* **2013**, *56*, 124–129. [CrossRef]
5. Vestergaard, S.; Kronborg Andersen, C.; Korsholm, L.; Puggaard, L. Exercise intervention of 65+-year-old men and women: Functional ability and health care costs. *Aging Clin. Exp. Res.* **2006**, *18*, 227–234. [CrossRef]
6. Roberts, C.E.; Phillips, L.H.; Cooper, C.L.; Gray, S.; Allan, J.L. Effect of different types of physical activity on activities of daily living in older adults: Systematic review and meta-Analysis. *J. Aging Phys. Act.* **2017**, *25*, 653–670. [CrossRef]
7. Cheng, I.F.; Kuo, L.C.; Tsai, Y.J.; Su, F.C. The Comparisons of physical functional performances between older adults with and without regular physical activity in two different living settings. *Int. J. Environ. Res. Public Health* **2021**, *18*, 3561. [CrossRef]
8. Rodríguez-Tadeo, A.; Wall-Medrano, A.; Gaytan-Vidaña, M.E.; Campos, A.; Ornelas-Contreras, M.; Novelo-Huerta, H.I. Malnutrition risk factors among the elderly from the US-Mexico border: The "one thousand" study. *J. Nutr. Health Aging* **2012**, *6*, 426–431. [CrossRef]
9. Schrader, E.; Grosch, E.; Bertsch, T.; Sieber, C.C.; Volkert, D. Nutritional and functional Status in geriatric day hospital patients—MNA short form versus full MNA. *J. Nutr. Health Aging* **2016**, *20*, 918–926. [CrossRef]

10. Kurkcu, M.; Meijer, R.I.; Lonterman, S.; Muller, M.; de van der Schueren, M.A.E. The association between nutritional status and frailty characteristics among geriatric outpatients. *Clin. Nutr. ESPEN* **2018**, *23*, 112–116. [CrossRef]
11. Lee, L.C.; Tsai, A.C. Mini-Nutritional assessment predicts functional decline of elderly Taiwanese: Results of a population-representative sample. *Br. J. Nutr.* **2012**, *107*, 1707–1713. [CrossRef]
12. Leão, L.L.; Engedal, K.; Monteiro-Junior, R.S.; Tangen, G.G.; Krogseth, M. Malnutrition is associated with impaired functional status in older people receiving home care nursing service. *Front. Nutr.* **2021**, *8*, 684438. [CrossRef]
13. Xu, W.; Chen, T.; Cai, Y.; Hu, Y.; Fan, L.; Wu, C. Sarcopenia in community-dwelling oldest old is associated with disability and poor physical function. *J. Nutr. Health Aging* **2020**, *24*, 339–345. [CrossRef]
14. Jørgensen, T.; Jacobsen, R.K.; Toft, U.; Aadahl, M.; Glümer, C.; Pisinger, C. Effect of screening and lifestyle counselling on incidence of ischaemic heart disease in general population: Inter99 randomised trial. *BMJ* **2014**, *348*, g3617. [CrossRef]
15. Czapla, M.; Karniej, P.; Juárez-Vela, R.; Łokieć, K. The Association between Nutritional Status and In-Hospital Mortality among Patients with Acute Coronary Syndrome-A Result of the Retrospective Nutritional Status Heart Study (NSHS). *Nutrients* **2020**, *12*, 3091. [CrossRef]
16. Hermalin, A.L.; Liang, J.; Chang, M.C. *1989 Survey of the Health and Living Status of the Elderly in Taiwan: Questionnaire and Survey Design*; Comparative study of the elderly in Asia research report 89-1; PSC Publications, University of Michigan: Ann Arbor, MI, USA, 1989.
17. Zimmer, Z.; Liu, X.; Hermalin, A.; Chuang, Y.L. Educational Attainment and transitions in functional status among older Taiwanese. *Demography* **1998**, *35*, 361–375. [CrossRef]
18. Zimmer, Z.; Martin, L.G.; Chang, M.C. Changes in functional limitation and survival among older Taiwanese, 1993, 1996 and 1999. *Popul. Stud.* **2002**, *56*, 265–276. [CrossRef]
19. Tsai, A.C.; Ku, P.Y.; Tsai, J.D. Population-specific anthropometric cutoff standards improve the functionality of the mini nutritional assessment without BMI in institutionalized elderly in Taiwan. *J. Nutr. Health Aging* **2008**, *12*, 696–700.
20. Guigoz, Y.; Vellas, B.; Garry, P.J. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr. Rev.* **1996**, *54*, S59–S65. [CrossRef]
21. Vellas, B.; Villars, H.; Abellan, G.; Soto, M.E.; Rolland, Y.; Guigoz, Y.; Morley, J.E.; Chumlea, W.; Salva, A.; Rubenstein, L.Z.; et al. Overview of the MNA—Its history and challenges. *J. Nutr. Health Aging* **2006**, *10*, 456–463.
22. Rubenstein, L.Z.; Harker, J.O.; Salva, A.; Guigoz, Y.; Vellas, B. Screening for undernutrition in geriatric practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF). *J. Geront.* **2001**, *56*, M366–M377. [CrossRef]
23. Katz, S.; Ford, A.B.; Moskowitz, R.W.; Jackson, B.A.; Jaffe, M.W. Studies of illness in the age. The index of ADL: A standardized measurement of biological and psychological function. *J. Am. Med. Assoc.* **1963**, *185*, 914–919. [CrossRef]
24. Lawton, M.P.; Brody, E.M. Assessment of older people: Self-maintaining and instrumental activities of daily living. *Gerontologist* **1969**, *9*, 179–186. [CrossRef]
25. Mosallanezhad, Z.; Salavati, M.; Sotoudeh, G.R.; Wikmar, L.N.; Frändin, K. Walking habits and health-related factors in 75-year-old Iranian women and men. *Arch. Gerontol. Geriatr.* **2014**, *58*, 320–326. [CrossRef]
26. Saka, B.; Kaya, O.; Ozturk, G.B.; Erten, N.; Karan, M.A. Malnutrition in the elderly and its relationship with other geriatric syndromes. *Clin. Nutr.* **2010**, *29*, 745–748. [CrossRef]
27. Ahmed, T.; Haboubi, N. Assessment and management of nutrition in older people and its importance to health. *Clin. Interv. Aging* **2010**, *5*, 207–216.
28. Suominen, M.; Murrinen, S.; Routasalo, P.; Soini, H.; Suur-Uski, I.; Peiponen, A.; Finne-Soveri, H.; Pitkala, K.H. Malnutrition and associated factors among aged residents in all nursing homes in Helsinki. *Eur. J. Clin. Nutr.* **2005**, *59*, 578–583. [CrossRef] [PubMed]
29. Ferdous, T.; Cederholm, T.; Razzaque, A.; Wahlin, A.; Nahar Kabir, Z. Nutritional status and self-reported and performance-based evaluation of physical function of elderly persons in rural Bangladesh. *Scand. J. Public Health* **2009**, *37*, 518–524. [CrossRef] [PubMed]
30. Okochi, J. Increase of mild disability in Japanese elders: A seven year follow-up cohort study. *BMC Public Health* **2005**, *5*, 55. [CrossRef] [PubMed]
31. Wolff, J.L.; Boult, C.; Boyd, C.; Anderson, G. Newly reported chronic conditions and onset of functional dependency. *J. Am. Geriatr. Soc.* **2005**, *53*, 851–855. [CrossRef] [PubMed]
32. Kriegsman, D.M.W.; Deeg, D.J.H.; Stalman, W.A.B. Comorbidity of somatic chronic diseases and decline in physical functioning: The Longitudinal Aging study Amsterdam. *J. Clin. Epidemiol.* **2004**, *57*, 55–65. [CrossRef]
33. Marengoni, A.; von Strauss, E.; Rizzuto, D.; Winblad, B.; Fratiglioni, L. The impact of chronic multimorbidity and disability on functional decline and survival in elderly persons. A community-based, longitudinal study. *J. Intern. Med.* **2009**, *265*, 288–295. [CrossRef]