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The Physical Activity and Nutritional INfluences in Ageing (PANINI) Toolkit: A Standardized Approach towards Physical Activity and Nutritional Assessment of Older Adults

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Abstract: Assessing multiple domains of health in older adults requires multidimensional and large datasets. Consensus on definitions, measurement protocols and outcome measures is a prerequisite. The Physical Activity and Nutritional INfluences In Ageing (PANINI) Toolkit aims to provide a standardized toolkit of best-practice measures for assessing health domains of older adults with an emphasis on nutrition and physical activity. The toolkit was drafted by consensus of multidisciplinary and pan-European experts on ageing to standardize research initiatives in diverse populations within the PANINI consortium. Domains within the PANINI Toolkit include socio-demographics, general health, nutrition, physical activity and physical performance and psychological and cognitive health. Implementation across various countries, settings and ageing populations has proven the feasibility of its use in research. This multidimensional and standardized approach supports interoperability and re-use of data, which is needed to optimize the coordination of research efforts, increase generalizability of findings and ultimately address the challenges of ageing.

Keywords: geriatric assessment; aged; nutrition; physical activity; standardization

1. Introduction

Ageing has a strong potential to influence and be influenced by multiple domains of health and lifestyle in older adults [1,2]. Focusing on nutrition and physical activity as lifestyle factors is important in research and clinical practice as they are modifiable and are both determinants of health outcomes [3–5]. The high prevalence of health conditions that cross-cut multiple domains, such as sarcopenia and frailty, requires an understanding of the interactions between physical activity and nutrition for prevention and treatment strategies [6–8].

Heterogeneous, multidimensional and therefore large datasets requiring cross-national research and data from different cohorts are important to compare and study the interactions between different health domains [9]. However, a lack of shared definitions, methodology and outcome measures across different settings and ageing populations makes it difficult to synthesize data, results and conclusions [10–12]. Further, fragmented assessment of individual lifestyle factors and health outcomes often overlooks the interaction between separate domains (e.g., the impact of nutrition on cognition). A multidimensional and standardized approach is required for data synthesis to understand the complexity of overlapping domains in the health of older adults.

The PANINI project is a European Commission Horizon 2020 Marie Curie-Skłodowska Innovative Training Network that aimed to: (1) develop a toolkit of best-practice measures for assessing the health domains of nutrition and physical activity, plus related key concepts, in older adults with a multidimensional design that deliberately accounts for potentially overlapping and interacting domains; (2) implement this toolkit for data collection across all new PANINI research projects; and (3) use the toolkit to create a shared dataset comprising standardized measures that spans across the various aspects involved in the health of older adults measured in different ageing populations. This article describes the development of the PANINI Toolkit, including its content and application within the PANINI consortium.

2. Materials and Methods

2.1. Design

The PANINI Toolkit was developed in 2016 in two consecutive consensus meetings of leading experts across Europe in the field of ageing, physical activity, and nutrition (including health scientists, biologists, geneticists, epidemiologists, computer scientists, clinicians, nutrition and exercise scientists, and psychologists) who formed the supervisory board of the PANINI consortium. Key areas of healthy ageing were defined as domains to develop the toolkit. The PANINI Toolkit focuses on two domains, nutrition and physical activity/physical performance, but also encompasses domains of socio-demographics,

general health, anthropometrics, and psychological and cognitive health. Domains were predefined by the consortium prior to tool and measure selection.

2.2. Tool and Measure Selection

Measures across all domains were collated based on current use, previous use (existing datasets) and expert opinion discussion of which measures should be used. Best-practice measures within these domains were ultimately chosen for inclusion in the toolkit based on validity, reliability and ease of use. Gold-standard measures (and measures that were correlated highly with their gold standard) were selected with preference for inclusion, as well as measures that were used broadly in large cohort studies or widely and internationally used in clinical practice. Consensus was reached through discussion, and any disagreements were resolved through evaluation of the aforementioned consideration factors, and similar tools/measures were included when the added value of including both could be justified and agreed upon. The customized PANINI Questionnaire was created to assess factors that were deemed important but not covered by other included tools. The customized PANINI Questionnaire, made up of 35 questions, is used to assess the domains of socio-demographics and general health, as well as the subdomains mobility and falls. Questions were designed based on consensus and with the specific intention of having broad applicability in diverse cohorts and to take into account population differences. All tools and measures were standardized into a protocol and a case report form.

3. Results

3.1. Measures by Domain

All screening tools and measures are listed by domain, and where appropriate, by subdomain, in Table 1. Where appropriate, articles describing validation are cited, and examples of which older populations the tools were validated in, as well as examples of comparator instruments used to assess concurrent validity, are presented.

3.1.1. Socio-Demographics

Socio-demographics are assessed using the PANINI Questionnaire and include age, ethnicity, nationality, language, education, and occupation as well as social aspects, including living situation and social circumstances.

3.1.2. General Health

Intoxicants are self-reported and include alcohol, smoking and drug use (quantity and frequency) assessed by the PANINI Questionnaire. Medical history and medication use are also assessed by the PANINI Questionnaire and include self-reported past and current medical conditions and self-reported current medication use, respectively (medical records may be used to supplement self-reported information). Anthropometrics are objectively assessed using a calibrated height and weight measuring system, from which measures of height (cm) and weight (kg) can be obtained and body mass index (BMI) can be calculated (weight (kg)/[height (m)]^2). Dual-energy X-ray absorptiometry (DXA) [13–15] and Bioelectrical Impedance Analysis (BIA) [13,16,17] are included as tools for objective assessment of body composition from which measures of fat mass, lean soft-tissue mass (comprising muscle, inner organs and body water), and bone mineral content can be obtained (e.g., appendicular lean mass (ALM) and skeletal muscle index (SMI)).

3.1.3. Nutrition

Malnutrition is assessed by the Mini Nutritional Assessment (MNA) questionnaire, which is measured in points and stratifies risk of malnutrition as normal nutrition status, at risk of malnutrition and malnourished [18]. Dietary intake (quantity and frequency) is assessed by a food frequency questionnaire (FFQ) [19] to ascertain measures of macronutrient and micronutrient intake via self-report.

3.1.4. Physical Activity and Physical Performance

Physical activity is assessed by two self-reported assessment tools, the Modified Minnesota Leisure Time Activities (MLTA) Questionnaire [20,21] and the International Physical Activity Questionnaire Short Form (IPAQ-s) [22,23], to ascertain self-reported physical activity in kcals/week and hours/day, respectively. Accelerometry is included for objective assessment of physical activity and to obtain measures of physical activity level, energy expenditure and sedentary behavior. Mobility is captured by the PANINI Questionnaire, which includes questions pertaining to self-reported mobility. The Short Physical Performance Battery (SPPB), balance tests with eyes closed and handheld dynamometers are included as tools for the physical performance. The SPPB measures include gait speed (m/s) obtained from a four-meter walk test, time to complete 5 stands from a chair (s) from the chair stand test and ability to maintain balance for 10 s from side-by-side, tandem, and semi-tandem balance tests, as well as a composite score from these three individual tests [24]. Handgrip strength (kg) is assessed using a handheld dynamometer [25–28]. Frailty is assessed using the Fried Frailty Phenotype, which includes five tools for five criteria to ascertain frailty status: self-reported unintentional weight loss to assess shrinking; hand grip (kg) assessed using a handheld dynamometer to identify weakness; 4 m walk test to assess slowness using a cut-off for gait speed (m/s); Minnesota Leisure Time Physical Activity (MLTPA) questionnaire to assess low activity determined by kcal/week cut-off; and two questions from the Center for Epidemiological Studies depression (CES-D) scale to assess self-reported exhaustion indicating poor endurance and energy [29]. Falls are assessed using the Short Fall Efficacy Scale International (FES-I) to evaluate fear of falling and using the PANINI Questionnaire to assess fall history information in the past year [30]. Activities of daily living (ADLs) are assessed by the Katz Index of Independence in activities of daily living (ADL) and measures the ability to independently complete ADLs via self-report [31–33].

3.1.5. Psychological and Cognitive Health

Cognition is assessed through the Standardized Mini Mental State Examination (SMMSE), which is an interviewer-administered screening test for cognitive impairment covering a range of cognitive domains [34,35]. Depression is assessed by the Geriatric Depression Scale-15 (GDS-15), which screens for depression by identifying absence of depression, mild depression, moderate depression and severe depression [36–38].

3.1.6. The PANINI Toolkit Protocol and PANINI Case Report Form (CRF)

All tools and measures in the toolkit include standardized measurement schemes, definitions and scoring and are described in further detail in the PANINI Toolkit Protocol (Supplementary Material) and PANINI CRF (Supplementary Material).

3.2. Application of the PANINI Toolkit

The PANINI Toolkit was adapted and refined over several months and launched in October 2016 for implementation to aid in uniformity of new data collected across consortium-wide research projects. The PANINI Toolkit has been applied across data collection projects within the PANINI consortium (as appropriate based on study design) and aims to ultimately allow for comparability between different ageing populations and various pre- and post-physical activities and nutritional interventions by using the same protocol of measurements [39,40]. Data management for all projects adheres to the FAIR principles [41].

4. Discussion

The PANINI Toolkit is a set of tools and measures that provides a comprehensive and multidimensional assessment of health of older adults focusing on the domains of PA and nutrition. The toolkit brings together five domains representing different facets of health in older adults that contribute to overall health status and can interact with one

another. Subsequently, it provides a standardized and comprehensive approach towards assessment of health in older adults for research purposes that supports interoperability and re-use of data.

It was a prerequisite for the PANINI Toolkit to be applicable in existing and new datasets of diverse populations, which include (but are not limited to) frail inpatients, care home residents, older adults with a recent hip fracture, patients undergoing elective hip/knee surgery, acute hospital in-patients with a range of morbidities, menopausal women, older adults from ethnic minority groups and healthy community-dwelling older adults. Further, deliberation was conducted by experts across different biomedical fields and nationalities, who each had their own experiences and preferences in using various tools, which is reflected in the decision-making process and shaped its overall result as a multidisciplinary and cross-culturally representative toolkit. It is important to note that the toolkit is intended to provide a recommended framework for research and aid in data collection. Researchers apart of the PANINI consortium were encouraged to use the PANINI Toolkit as it fit with their study design, aims and objectives [39,40].

The PANINI Toolkit consists of validated measures with an emphasis on applicability in research and clinical practice. Despite the deliberate selection of measures in the present toolkit, it is important to acknowledge that there are a breadth of tools for assessing each of these domains [13,18,42–45]. The tools in the PANINI Toolkit were chosen with the requirement of having a wide bandwidth for use in different populations and settings. However, the use of tools that are intended to be applied generally can lead to floor effects (e.g., frail populations) and ceiling effects (e.g., very healthy populations) [46,47]. Self-reported measures were included in light of their practical benefits, but it is important to acknowledge that these assess perception rather than actual status [48,49].

The incorporation of a wide range of domains and clinically relevant tools aligns with that of other methods that support the concept that the health of older adults is multidimensional, such as the International Classification of Functioning, Disability and Health (ICF) [50] and comprehensive geriatric assessments (CGAs) [43,51]. The PANINI Toolkit focuses on modifiable lifestyle factors with nutrition and physical activity as the core domains, and it is intended to be used primarily for research purposes. This emphasis on nutrition and physical activity is appropriate for the purposes of the PANINI Toolkit and the objective of combining data from new and existing datasets across the PANINI consortium. The current focus of the PANINI Toolkit does not rule out any extension of included domains or incorporation of other domains, e.g., social and environmental domains as covered by the ICF.

The use of standardized tools is particularly important in the assessment of health outcomes within and between the included domains because it facilitates coordination and communication between researchers and clinicians from different fields. In addition, it allows for increased generalizability and aids in the synthesis of findings across different populations, interventions and research projects. The previous literature in the geriatric field has often cited the lack of shared methodology as a limitation and barrier to research [52–54]. It has been shown that the use of different screening tools for one clinical outcome (e.g., sarcopenia, malnutrition, frailty), in the same population can arrive at different estimates of prevalence [55,56]. Subsequently, this toolkit provides a method of fostering standardized datasets with shared definitions, methodology, scoring systems and outcome measures that can be used in coordination to address the challenges of ageing.

Table 1. Summary of the PANINI Toolkit tools and measures by domain.

Domain	Tool	Measure(s)	Examples of Validation in Older Adults		
Subdomain			Article	Population(s)	Comparator
(1) Socio-demographics					
Socio-demographic	PANINI Questionnaire	Age, nationality, language, education and occupation	n/a	n/a	n/a
Social	PANINI Questionnaire	Marital status, living situation and social circumstances	n/a	n/a	n/a
(2) General Health					
Intoxicants	PANINI Questionnaire	Alcohol, smoking and drug use	n/a	n/a	n/a
Medical history	PANINI Questionnaire	Past and current medical conditions	n/a	n/a	n/a
Medication use	PANINI Questionnaire	Current medication use	n/a	n/a	n/a
Anthropometrics	Calibrated height and weight measure	Height (cm) and weight (kg)	n/a	n/a	n/a
	Tape measure	Waist, hip, calf and mid-arm circumferences (cm)	n/a	n/a	n/a
Body composition	Dual-energy X-ray absorptiometry (DXA)	Fat mass, lean soft-tissue mass (comprising muscle, inner organs and body water) and bone mineral content (kg) (Same measures as DXA)	[13,16,57]	CD, H	4-C-model, CT, MRI
	Bioelectrical Impedance Analysis (BIA)		[17,58,59]	CD, H	TBW, 4-C model, CT, DXA
(3) Nutrition					
Malnutrition	Mini Nutritional Assessment (MNA)	Nutritional status (points) (normal nutritional status, at risk of malnutrition, malnourished)	[18,60,61]	CD, H, I, Frail, Healthy	Nutritional assessment by physician, comprehensive nutritional assessment (anthropometry, biochemistry and dietary intake) other malnutrition screening tools
Dietary intake	Food frequency questionnaire	Macronutrient and micronutrient intake (incl. fluid intake)	[19]	CD	24 h recalls
(4) Physical Activity and Physical Performance					
Physical activity	Modified Minnesota Leisure Time Activities (MLTPA) Questionnaire	Self-reported physical activity (kcal/week)	[20,21]	CD	Accelerometer
	International Physical Activity Questionnaire Short Form (IPAQ-s)	Self-reported physical activity (vigorous, moderate, walking, sitting) (hours/day)	[22,23]	CD	Accelerometer
	Accelerometer	Physical activity, energy expenditure and sedentary behavior	n/a	n/a	n/a
Mobility	PANINI Questionnaire	Self-reported mobility	n/a	n/a	n/a
Physical Performance	Short Physical Performance Battery (SPPB)	Composite physical performance score (points)	[24,62–65]	CD, H	Self-reported mobility limitations/disability
	4 m walk test	Gait speed (m/s)			
	Chair stand test	Time to complete 5 stands from a chair (s)			
	Balance tests	Ability to maintain balance for 10 s in side-by-side, tandem and semi-tandem positions (yes/no, points)			
	Balance tests with eyes closed	(Same as SPPB balance tests with eyes closed)			
	Handheld dynamometer	Hand grip strength (kg)	[25,26,28,65]	CD	Isometric muscle strength (knee extension, hip flexor, elbow flexion, trunk extension, pinch)
Frailty	Fried Frailty Phenotype Criteria	Frailty status (robust, pre-frail or frail) [a]	[29,66,67]	CD	Other frailty indices (e.g., Frailty Index)
	Shrinking: weight loss questions [b]	Shrinking: unintentional weight loss in past year [b] (yes/no)			
	Weakness: handheld dynamometer	Weakness: hand grip strength (kg)			
	Poor endurance: Depression Center for Epidemiologic Studies Depression Scale (CES-D) [c]	Poor endurance: depression score (points)			
	Slowness: 4 m walk test	Slowness: gait speed (m/s)			
	Low activity: MLTPA Questionnaire	Low Activity: physical activity (kcal/week)			

Table 1. *Cont.*

Domain	Tool	Measure(s)	Examples of Validation in Older Adults		
Subdomain			Article	Population(s)	Comparator
Falls	Short Fall Efficacy Scale International (FES-I)	Fear of falling (points)	[30]	CD	FES-I (original)
	PANINI Questionnaire	Fall history information in past year			
Activities of daily living (ADLs)	Katz Index of Independence in Activities of daily living (ADL)	Ability to independently complete ADLs (yes/no, points)	[31–33]	CD	Self-reported mobility impairment/disability
(5) Psychological and Cognitive Health					
Cognition	Standardized Mini Mental State Examination (SMMSE)	Cognitive status (points)	[34,35,44]	I, H	MMSE
Psychological	Geriatric Depression Scale-15 (GDS-15)	Depression (normal, mild/moderate/ severe depression)	[36–38]	CD, H	Structured clinical interviews for DSM-IV and ICD-10 criteria

Bulleted items represent individual measures within a composite measure. Measures from the PANINI Questionnaire are assessed through customized questionnaire. m = meter, 4-c = 4-component, CT = computed tomography, MRI = magnetic resonance imaging, TBW = total body water, CD = community dwelling, H = hospitalized, I = institutionalized, incl. = including, n/a = not applicable. [a] All criteria of the Fried Frailty Phenotype are assessed as above or below a specified threshold cutoff (adjusted for BMI, age, height and/or sex as appropriate). [b] Unintentional weight loss is assessed by self-reported weight loss of $\geq$4.5kg in the year before the current evaluation, or unintentional weight loss of $\geq$5% of the previous year's body weight is used to assess the "shrinking" criteria of the Fried Frailty Phenotype. [c] The evaluation of two statements from the CES-D scale: (a) "I felt that everything I did was an effort" and (b) "I could not get going", is used to assess the "poor endurance" criteria of the Fried Frailty Phenotype.

Although this toolkit contains exclusively validated measures (with the exception of the PANINI Questionnaire), the toolkit as a whole has not yet been validated for use. Application in ongoing PANINI projects across Europe has shown the feasibility of its use within research endeavors; however, the feasibility of the PANINI Toolkit within a non-research or clinical framework has not yet been tested. Further research may be required to validate the toolkit as a whole, evaluate cost-effectiveness and demonstrate wide execution. To our knowledge, this is the first nutrition and physical activity toolkit for research purposes that has been applied simultaneously across European projects. Further research needs to be carried out in each of these domains individually, as well as for their interactions, and it would be beneficial to the research field if these studies were conducted using a standardized comprehensive approach as described in this article.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/healthcare10061017/s1, The PANINI Toolkit Protocol; The PANINI Toolkit Case Report Form (CRF).

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References

1. Rockwood, K.; Howlett, S.E. Age-related deficit accumulation and the diseases of ageing. *Mech. Ageing Dev.* **2019**, *180*, 107–116. [CrossRef] [PubMed]
2. Yarnall, A.J.; Sayer, A.A.; Clegg, A.; Rockwood, K.; Parker, S.; Hindle, J.V. New horizons in multimorbidity in older adults. *Age Ageing* **2017**, *46*, 882–888. [CrossRef] [PubMed]
3. Clark, P.G. The Study of Exercise and Nutrition in Older Rhode Islanders (SENIOR): Translating theory into research. *Health Educ. Res.* **2002**, *17*, 552–561. [CrossRef] [PubMed]
4. Clark, P.G.; Greene, G.W.; Blissmer, B.J.; Lees, F.D.; Riebe, D.A.; Stamm, K.E. Trajectories of Maintenance and Resilience in Healthful Eating and Exercise Behaviors in Older Adults. *J. Aging Health* **2019**, *31*, 861–882. [CrossRef] [PubMed]
5. McNaughton, S.A.; Crawford, D.; Ball, K.; Salmon, J. Understanding determinants of nutrition, physical activity and quality of life among older adults: The Wellbeing, Eating and Exercise for a Long Life (WELL) study. *Health Qual. Life Outcomes* **2012**, *10*, 109. [CrossRef] [PubMed]
6. Cesari, M.; Landi, F.; Vellas, B.; Bernabei, R.; Marzetti, E. Sarcopenia and physical frailty: Two sides of the same coin. *Front. Aging Neurosci.* **2014**, *6*, 192. [CrossRef]
7. Michel, J.-P.; Cruz-Jentoft, A.J.; Cederholm, T. Frailty, Exercise and Nutrition. *Clin. Geriatr. Med.* **2015**, *31*, 375–387. [CrossRef]

8. Verlaan, S.; Ligthart-Melis, G.C.; Wijers, S.L.J.; Cederholm, T.; Maier, A.B.; de van der Schueren, M.A.E. High Prevalence of Physical Frailty Among Community-Dwelling Malnourished Older Adults–A Systematic Review and Meta-Analysis. *J. Am. Med. Dir. Assoc.* **2017**, *18*, 374–382. [CrossRef]
9. Veron, J.; Council, N.R. Preparing for an Aging World: The Case for Cross-National Research. *Population* **2001**, *56*, 885. [CrossRef]
10. Fuchs, J.; Scheidt-Nave, C.; Hinrichs, T.; Mergenthaler, A.; Stein, J.; Riedel-Heller, S.G.; Grill, E. Indicators for healthy ageing—A debate. *Int. J. Environ. Res. Public Health* **2013**, *10*, 6630–6644. [CrossRef]
11. Peel, N.; Bartlett, H.; McClure, R. Healthy ageing: How is it defined and measured? *Australas. J. Ageing* **2004**, *23*, 115–119. [CrossRef]
12. Phelan, E.A.; Larson, E.B. "Successful Aging"—Where Next? *J. Am. Geriatr. Soc.* **2002**, *50*, 1306–1308. [CrossRef] [PubMed]
13. Mijnarends, D.M.; Meijers, J.M.; Halfens, R.J.; ter Borg, S.; Luiking, Y.C.; Verlaan, S.; Schoberer, D.; Cruz-Jentoft, A.J.; van Loon, L.J.; Schols, J.M. Validity and Reliability of Tools to Measure Muscle Mass, Strength, and Physical Performance in Community-Dwelling Older People: A Systematic Review. *J. Am. Med. Dir. Assoc.* **2013**, *14*, 170–178. [CrossRef] [PubMed]
14. Salamone, L.M.; Fuerst, T.; Visser, M.; Kern, M.; Lang, T.; Dockrell, M.; Cauley, J.A.; Nevitt, M.; Tylavsky, F.; Lohman, T.G. Measurement of fat mass using DEXA: A validation study in elderly adults. *J. Appl. Physiol.* **2000**, *89*, 345–352. [CrossRef]
15. Visser, M.; Fuerst, T.; Lang, T.; Salamone, L.; Harris, T.B. Validity of fan-beam dual-energy X-ray absorptiometry for measuring fat-free mass and leg muscle mass. *J. Appl. Physiol.* **1999**, *87*, 1513–1520. [CrossRef]
16. Bosaeus, I.; Wilcox, G.; Rothenberg, E.; Strauss, B.J. Skeletal muscle mass in hospitalized elderly patients: Comparison of measurements by single-frequency BIA and DXA. *Clin. Nutr.* **2014**, *33*, 426–431. [CrossRef]
17. Ling, C.H.Y.; de Craen, A.J.M.; Slagboom, P.E.; Gunn, D.A.; Stokkel, M.P.M.; Westendorp, R.G.J.; Maier, A.B. Accuracy of direct segmental multi-frequency bioimpedance analysis in the assessment of total body and segmental body composition in middle-aged adult population. *Clin. Nutr.* **2011**, *30*, 610–615. [CrossRef]
18. Isautier, J.M.J.; Bosnić, M.; Yeung, S.S.Y.; Trappenburg, M.C.; Meskers, C.G.M.; Whittaker, A.C.; Maier, A.B. Validity of Nutritional Screening Tools for Community-Dwelling Older Adults: A Systematic Review and Meta-Analysis. *J. Am. Med. Dir. Assoc.* **2019**, *20*, 1351.e13–1351.e25. [CrossRef]
19. Ocke, M. The Dutch EPIC food frequency questionnaire. I. Description of the questionnaire, and relative validity and reproducibility for food groups. *Int. J. Epidemiol.* **1997**, *26* (Suppl. 1), S37–S48. [CrossRef]
20. Richardson, M.T.; Leon, A.S.; Jacobs, D.R.; Ainsworth, B.E.; Serfass, R. Comprehensive evaluation of the Minnesota leisure time physical activity questionnaire. *J. Clin. Epidemiol.* **1994**, *47*, 271–281. [CrossRef]
21. Taylor, H.L.; Jacobs, D.R.; Schucker, B.; Knudsen, J.; Leon, A.S.; Debacker, G. A questionnaire for the assessment of leisure time physical activities. *J. Chronic Dis.* **1978**, *31*, 741–755. [CrossRef]
22. Cleland, C.; Ferguson, S.; Ellis, G.; Hunter, R.F. Validity of the International Physical Activity Questionnaire (IPAQ) for assessing moderate-to-vigorous physical activity and sedentary behaviour of older adults in the United Kingdom. *BMC Med. Res. Methodol.* **2018**, *18*, 176. [CrossRef] [PubMed]
23. Tomioka, K.; Iwamoto, J.; Saeki, K.; Okamoto, N. Reliability and Validity of the International Physical Activity Questionnaire (IPAQ) in Elderly Adults: The Fujiwara-kyo Study. *J. Epidemiol.* **2011**, *21*, 459–465. [CrossRef] [PubMed]
24. Guralnik, J.M.; Simonsick, E.M.; Ferrucci, L.; Glynn, R.J.; Berkman, L.F.; Blazer, D.G.; Scherr, P.A.; Wallace, R.B. A Short Physical Performance Battery Assessing Lower Extremity Function: Association with Self-Reported Disability and Prediction of Mortality and Nursing Home Admission. *J. Gerontol.* **1994**, *49*, M85–M94. [CrossRef] [PubMed]
25. Abizanda, P.; Navarro, J.L.; García-Tomás, M.I.; López-Jiménez, E.; Martínez-Sánchez, E.; Paterna, G. Validity and usefulness of hand-held dynamometry for measuring muscle strength in community-dwelling older persons. *Arch. Gerontol. Geriatr.* **2012**, *54*, 21–27. [CrossRef]
26. Bohannon, R.W. Test-Retest Reliability of Measurements of Hand-Grip Strength Obtained by Dynamometry from Older Adults: A Systematic Review of Research in the PubMed Database. *J. Frailty Aging* **2017**, *6*, 83–87. [CrossRef]
27. Reijnierse, E.M.; De Jong, N.; Trappenburg, M.C.; Blauw, G.J.; Butler-Browne, G.; Gapeyeva, H.; Hogrel, J.-Y.; McPhee, J.; Narici, M.V.; Sipila, S.; et al. Assessment of maximal handgrip strength: How many attempts are needed? *J. Cachexia Sarcopenia Muscle* **2017**, *8*, 466–474. [CrossRef]
28. Sallinen, J.; Stenholm, S.; Rantanen, T.; Heliövaara, M.; Sainio, P.; Koskinen, S. Hand-Grip Strength Cut Points to Screen Older Persons at Risk for Mobility Limitation. *J. Am. Geriatr. Soc.* **2010**, *58*, 1721–1726. [CrossRef]
29. Fried, L.P.; Tangen, C.M.; Walston, J.; Newman, A.B.; Hirsch, C.; Gottdiener, J.; Seeman, T.; Tracy, R.; Kop, W.J.; Burke, G.; et al. Frailty in Older Adults: Evidence for a Phenotype. *J. Gerontol. Ser. A Biol. Sci. Med. Sci.* **2001**, *56*, M146–M157. [CrossRef]
30. Kempen, G.I.J.M.; Yardley, L.; Van Haastregt, J.C.M.; Zijlstra, G.A.R.; Beyer, N.; Hauer, K.; Todd, C. The Short FES-I: A shortened version of the falls efficacy scale-international to assess fear of falling. *Age Ageing* **2007**, *37*, 45–50. [CrossRef]
31. Brorsson, B.; Asberg, K.H. Katz index of independence in ADL. Reliability and validity in short-term care. *Scand. J. Rehabil. Med.* **1984**, *16*, 125–132. Available online: http://www.ncbi.nlm.nih.gov/pubmed/6494836 (accessed on 1 September 2019). [PubMed]
32. Katz, S.; Downs, T.D.; Cash, H.R.; Grotz, R.C. Progress in Development of the Index of ADL. *Gerontologist* **1970**, *10*, 20–30. [CrossRef]
33. Liebzeit, D.; King, B.; Bratzke, L. Measurement of function in older adults transitioning from hospital to home: An integrative review. *Geriatr. Nurs.* **2018**, *39*, 336–343. [CrossRef] [PubMed]

34. Molloy, D.W.; Standish, T.I.M. A Guide to the Standardized Mini-Mental State Examination. *Int. Psychogeriatr.* **1997**, *9* (Suppl. 1), 87–94. [CrossRef] [PubMed]
35. Vertesi, A.; Lever, J.A.; Molloy, D.W.; Sanderson, B.; Tuttle, I.; Pokoradi, L.; Principi, E. Standardized Mini-Mental State Examination. Use and interpretation. *Can. Fam. Physician Med. Fam. Can.* **2001**, *47*, 2018–2023. Available online: http://www.ncbi.nlm.nih.gov/pubmed/11723596 (accessed on 1 September 2019).
36. Almeida, O.P.; Almeida, S.A. Short versions of the Geriatric Depression Scale: A study of their validity for the diagnosis of a major depressive episode according to ICD-10 and DSM-IV. *Int. J. Geriatr. Psychiatry* **1999**, *14*, 858–865. [CrossRef]
37. Nyunt, M.S.Z.; Fones, C.; Niti, M.; Ng, T.-P. Criterion-based validity and reliability of the Geriatric Depression Screening Scale (GDS-15) in a large validation sample of community-living Asian older adults. *Aging Ment. Health* **2009**, *13*, 376–382. [CrossRef]
38. Yesavage, J.A.; Sheikh, J.I. 9/Geriatric Depression Scale (GDS). *Clin. Gerontol.* **1986**, *5*, 165–173. [CrossRef]
39. Whittaker, A.C.; Delledonne, M.; Finni, T.; Garagnani, P.; Greig, C.; Kallen, V.; Kokko, K.; Lord, J.; Maier, A.B.; Meskers, C.G.M.; et al. Physical Activity and Nutrition INfluences In ageing (PANINI): Consortium mission statement. *Aging Clin. Exp. Res.* **2018**, *30*, 685–692. [CrossRef]
40. Whittaker, A.C.; Asamane, E.A.; Aunger, J.A.; Bondarev, D.; Cabbia, A.; Doody, P.D.; Yeung, S.S. Physical Activity and Nutrition INfluences in Ageing: Current Findings from the PANINI Project. *Adv. Geriatr. Med. Res.* **2019**, *1*, e190005. [CrossRef]
41. Wilkinson, M.D.; Dumontier, M.; Aalbersberg, I.J.; Appleton, G.; Axton, M.; Baak, A.; Blomberg, N.; Boiten, J.W.; da Silva Santos, L.B.; Bourne, P.E.; et al. The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* **2016**, *3*, 160018. [CrossRef] [PubMed]
42. Bonnefoy, M.; Normand, S.; Pachiaudi, C.; Lacour, J.R.; Laville, M.; Kostka, T. Simultaneous Validation of Ten Physical Activity Questionnaires in Older Men: A Doubly Labeled Water Study. *J. Am. Geriatr. Soc.* **2001**, *49*, 28–35. [CrossRef] [PubMed]
43. Jiang, S.; Li, P. Current Development in Elderly Comprehensive Assessment and Research Methods. *BioMed Res. Int.* **2016**, *2016*, 1–10. [CrossRef]
44. Lin, J.S.; O'Connor, E.; Rossom, R.C.; Perdue, L.A.; Eckstrom, E. Screening for Cognitive Impairment in Older Adults: A Systematic Review for the U.S. Preventive Services Task Force. *Ann. Intern. Med.* **2013**, *159*, 601–612. [CrossRef]
45. van Bokhorst-de van der Schueren, M.A.E.; Guaitoli, P.R.; Jansma, E.P.; de Vet, H.C.W. Nutrition screening tools: Does one size fit all? A systematic review of screening tools for the hospital setting. *Clin. Nutr.* **2014**, *33*, 39–58. [CrossRef] [PubMed]
46. Fries, J.F.; Lingala, B.; Siemons, L.; Glas, C.A.W.; Cella, D.; Hussain, Y.N.; Bruce, B.; Krishnan, E. Extending the floor and the ceiling for assessment of physical function. *Arthritis Rheumatol.* **2014**, *66*, 1378–1387. [CrossRef]
47. Tangen, G.G.; Robinson, H.S. Measuring physical performance in highly active older adults: Associations with age and gender? *Aging Clin. Exp. Res.* **2020**, *32*, 229–237. [CrossRef]
48. Ryan, D.J.; Wullems, J.A.; Stebbings, G.K.; Morse, C.I.; Stewart, C.E.; Onambele-Pearson, G.L. Reliability and validity of the international physical activity questionnaire compared to calibrated accelerometer cut-off points in the quantification of sedentary behaviour and physical activity in older adults. *PLoS ONE* **2018**, *13*, e0195712. [CrossRef]
49. Waller, K.; Vähä-Ypyä, H.; Lindgren, N.; Kaprio, J.; Sievänen, H.; Kujala, U.M. Self-Reported Fitness and Objectively Measured Physical Activity among Older Adults. *Med. Sci. Sports Exerc.* **2017**, *49*, 648. [CrossRef]
50. Spoorenberg, S.L.W.; Reijneveld, S.A.; Middel, B.; Uittenbroek, R.J.; Kremer, H.P.H.; Wynia, K. The Geriatric ICF Core Set reflecting health-related problems in community-living older adults aged 75 years and older without dementia: Development and validation. *Disabil. Rehabil.* **2015**, *37*, 2337–2343. [CrossRef]
51. Parker, S.G.; McCue, P.; Phelps, K.; McCleod, A.; Arora, S.; Nockels, K.; Kennedy, S.; Roberts, H.; Conroy, S. What is Comprehensive Geriatric Assessment (CGA)? An umbrella review. *Age Ageing* **2018**, *47*, 149–155. [CrossRef] [PubMed]
52. Bijlsma, A.Y.; Meskers, C.; Ling, C.H.Y.; Narici, M.; Kurrle, S.E.; Cameron, I.D.; Westendorp, R.G.J.; Maier, A.B. Defining sarcopenia: The impact of different diagnostic criteria on the prevalence of sarcopenia in a large middle aged cohort. *Age* **2013**, *35*, 871–881. [CrossRef] [PubMed]
53. Bongue, B.; Buisson, A.; Dupre, C.; Beland, F.; Gonthier, R.; Crawford-Achour, É. Predictive performance of four frailty screening tools in community-dwelling elderly. *BMC Geriatr.* **2017**, *17*, 262. [CrossRef]
54. Velasco, C.; García, E.; Rodriguez, V.; Frias, L.; Garriga, R.; Alvarez, J.; García-Peris, P.; Leon, M. Comparison of four nutritional screening tools to detect nutritional risk in hospitalized patients: A multicentre study. *Eur. J. Clin. Nutr.* **2011**, *65*, 269–274. [CrossRef] [PubMed]
55. Reijnierse, E.M.; Trappenburg, M.C.; Leter, M.J.; Blauw, G.J.; Sipila, S.; Sillanpää, E.; Narici, M.V.; Hogrel, J.-Y.; Butler-Browne, G.; McPhee, J.; et al. The Impact of Different Diagnostic Criteria on the Prevalence of Sarcopenia in Healthy Elderly Participants and Geriatric Outpatients. *Gerontology* **2015**, *61*, 491–496. [CrossRef] [PubMed]
56. Reijnierse, E.M.; Buljan, A.; Tuttle, C.S.L.; van Ancum, J.; Verlaan, S.; Meskers, C.G.M.; Maier, A.B. Prevalence of sarcopenia in inpatients 70 years and older using different diagnostic criteria. *Nurs. Open* **2019**, *6*, 377–383. [CrossRef]
57. Abe, T.; Thiebaud, R.S.; Loenneke, J.P.; Young, K.C. Prediction and validation of DXA-derived appendicular lean soft tissue mass by ultrasound in older adults. *AGE* **2015**, *37*, 114. [CrossRef]
58. Janssen, I.; Heymsfield, S.B.; Baumgartner, R.N.; Ross, R. Estimation of skeletal muscle mass by bioelectrical impedance analysis. *J. Appl. Physiol.* **2000**, *89*, 465–471. [CrossRef]

59. Sergi, G.; De Rui, M.; Veronese, N.; Bolzetta, F.; Berton, L.; Carraro, S.; Bano, G.; Coin, A.; Manzato, E.; Perissinotto, E. Assessing appendicular skeletal muscle mass with bioelectrical impedance analysis in free-living Caucasian older adults. *Clin. Nutr.* **2015**, *34*, 667–673. [CrossRef]
60. 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.* **2009**, *54*, S59–S65. [CrossRef]
61. Vellas, B.; Guigoz, Y.; Garry, P.J.; Nourhashemi, F.; Bennahum, D.; Lauque, S.; Albarede, J.-L. The mini nutritional assessment (MNA) and its use in grading the nutritional state of elderly patients. *Nutrition* **1999**, *15*, 116–122. [CrossRef]
62. Corsonello, A.; Lattanzio, F.; Pedone, C.; Garasto, S.; Laino, I.; Bustacchini, S.; Pranno, L.; Mazzei, B.; Passarino, G. Prognostic significance of the short physical performance battery in older patients discharged from acute care hospitals. *Rejuvenation Res.* **2012**, *15*, 41–48. [CrossRef]
63. Fisher, S.; Ottenbacher, K.J.; Goodwin, J.S.; Graham, J.E.; Ostir, G.V. Short physical performance battery in hospitalized older adults. *Aging Clin. Exp. Res.* **2009**, *21*, 445–452. [CrossRef] [PubMed]
64. Westman, A.W.; Combs-Miller, S.; Moore, J.; Ehrlich-Jones, L. Measurement Characteristics and Clinical Utility of the Short Physical Performance Battery Among Community-Dwelling Older Adults. *Arch. Phys. Med. Rehabil.* **2019**, *100*, 185–187. [CrossRef]
65. Bohannon, R.W. Hand-Grip Dynamometry Predicts Future Outcomes in Aging Adults. *J. Geriatr. Phys. Ther.* **2008**, *31*, 3–10. [CrossRef] [PubMed]
66. Bouillon, K.; Kivimaki, M.; Hamer, M.; Sabia, S.; Fransson, E.I.; Singh-Manoux, A.; Gale, C.R.; Batty, G.D. Measures of frailty in population-based studies: An overview. *BMC Geriatr.* **2013**, *13*, 64. [CrossRef] [PubMed]
67. Chang, S.-F.; Lin, P.-L. Frail phenotype and mortality prediction: A systematic review and meta-analysis of prospective cohort studies. *Int. J. Nurs. Stud.* **2015**, *52*, 1362–1374. [CrossRef]