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ABSTRACT

Background: Participating in recommended levels of physical activity (PA) is critical for preventing functional decline, falls, and frailty, making it essential to identify older adults not meeting national PA guidelines. However, guidance on assessing older adult PA levels, particularly in clinical settings, is lacking. This paper presents an overview of clinically feasible PA assessment tools for older adults, identifies gaps in current tools, and provides recommendations on addressing these gaps.

Methods: We conducted a literature review on clinically feasible PA assessment tools, suggested modifications to an existing PA assessment for older adult patients, and highlighted opportunities for integrating the modified PA assessment tool in clinical settings.

Results: We identified 16 PA assessment tools used in clinical settings. The most widely used tool is the Physical Activity Vital Sign (PAVS), which has been successfully integrated into several electronic health records (EHR) and clinical practices. Most tools, including the PAVS, primarily focus on aerobic activities, with limited consideration for strength and balance. We recommend the use of a Modified PAVS for Older Adults that includes items on muscle-strengthening and balance activities to better align with national PA guidelines. We then identified several existing opportunities for broad implementation of the Modified PAVS for Older Adults within clinical settings.

Conclusions: Widespread integration of the Modified PAVS for Older Adults will better support healthcare providers in identifying individuals not meeting national PA recommendations, assisting them in prescribing tailored PA prescriptions and better connecting their patients to appropriate resources and professionals for further support.

Keywords: assessment; clinical settings; physical activity; older adults

Key points

- There is a lack of feasible and valid physical activity assessment tools for use with older adults in clinical settings.
- The Modified Physical Activity Vital Sign (PAVS) captures information on muscle-strengthening and balance activities in alignment with national PA guidelines.
- Multiple opportunities exist to integrate the Modified PAVS in U.S. healthcare systems.

Why does this paper matter?

Physical activity (PA) assessment is increasingly being integrated as a 'vital sign' in U.S. healthcare systems. However, there are few clinically feasible tools available for use with older adults and those that exist do not fully align with national PA guidelines for older adults. Our work, written by a team of experts in physical activity and the health of older adults, identifies clear gaps with existing tools. Our recommended 4-item tool aligns with national PA guidelines, can be easily administered by any member of the clinical team, and provides clinically relevant information in a matter of minutes to serve as a catalyst for further action (e.g., provision of a PA prescription, referral to evidence-based programs and professionals) by the healthcare team.

Physical Activity Guidelines and Older Adult Health

The importance of physical activity (PA) as a part of healthy aging is well documented for older adults.[1] PA is defined as any bodily movement produced by skeletal muscles that results in energy expenditure above resting levels. National guidelines have established adequate PA levels for adults to include at least 150 minutes of moderate-intensity (or 75 minutes of vigorous intensity) aerobic PA per week, as well as muscle-strengthening activities of moderate or greater intensity on two or more days per week.[2] The PA guidelines for older adults (see Table 1) are similar in terms of aerobic PA and muscle-strengthening activity, with the addition of conducting multicomponent PA that includes balance training. Despite this guidance, only 15.3% of men and 10.8% of women over the age of 65 meet current PA guidelines.[3] Inadequate PA leads to a cyclic relationship (see Figure 1), which increases risk of hospitalization, institutionalization, and death.[4–8] Thus, regular PA assessment of older adults is critical.

Aerobic Physical Activity

Despite increases over the past two decades,[9] the proportion of adults 65 years or older meeting aerobic PA guidelines (52.6%) remains suboptimal.[10] These proportions further decrease with increasing age, lower levels of education, and in Black and Hispanic populations.[9] Older adults with inadequate PA have increased difficulty performing household work, using public transportation, and performing activities of daily living.[11,12] The importance of aerobic activity is further highlighted when considering age-related changes to the cardiovascular system (e.g., stiffer, less compliant vascular tissues; reduced contractility of vascular walls), leading to increased systolic blood pressure and lower VO2 max, changes associated with increased prevalence of comorbidities and mortality.[13]

Muscular Strength

Similar to meeting aerobic PA guidelines, there has been a significant increase in the proportion of older adults meeting muscle-strengthening guidelines over the past two decades;[9] however, only 18.6% of adults ≥65 years of age meet national recommendations.[14] These proportions further decrease with increasing age, lower levels of education, and in Black and Hispanic populations.[9] The importance of muscle-strengthening is further emphasized when considering age-related progressive muscle loss of 1-8% per year starting between the ages of 30-50.[15] This progression leads to increased difficulty carrying groceries, climbing stairs, standing from a chair, frailty, falls, co-morbidities, and elevated all-cause mortality.[11,12,16–18]

Balance

While there is no formal national surveillance for balance in the U.S., in a sample of community-dwelling adults, less than half (41%) performed balance training 1 or more times per week.[19] The importance of performing balance activities is further highlighted by age-related changes that result in a reduction of motor neurons, impaired sensory systems, disruption in synaptic neuromuscular signaling, and impaired muscle recruitment and coordination.[20] These changes are associated with increased risk of falling that is more common (45% experience at least one fall per year) and detrimental among older adults.[21] This is particularly troubling as 27.7% of injury-related deaths among 70-79 years are attributable to falls.

The Power of Three: Assessing Aerobic Activity, Strength, and Balance

Due to age-related cardiovascular, muscular, and neuromuscular system changes, it is essential that older adults perform the recommended levels of aerobic, muscular strengthening, and

balance activities. The growing recognition of the importance of all three physical fitness components is evidenced in the inclusion of muscle-strengthening and balance in national and international recommendations.[22–24] The assessment of these activities is highlighted in a review by the American Heart Association on feasible, valid, and effective clinical PA screening tools.[25] However, this work did not examine potential adaptations to PA assessments across different patient populations, including older adults. Thus, in this manuscript we aim to: 1) discuss current opportunities for PA screening in clinical settings; 2) provide an overview of PA assessment tools developed and validated among older adults for use in clinical settings; 3) identify gaps across PA assessment tools; and 4) recommend adaptations to currently used tools to screen for older adult PA levels.

Opportunities for PA Assessment and Prescription for Older Adults in Clinical Settings

The catalyst for initiating PA counseling, an evidence-based approach to addressing inadequate PA levels,[26,27] is identifying current PA levels of patients.[28] In healthcare settings serving older adults, the largest drivers of assessing PA levels potentially involve healthcare policy and quality metrics, such as Pay-for-Performance and HEDIS measures.

Valued-Based Care (Pay-for-Performance)

Value-based care, also known as pay-for-performance, are payment models that attach financial incentives to health systems and healthcare teams for meeting metric-driven outcomes. Value-based care performance reviews highlight the importance of increased utilization of preventive care, enhanced outcomes, and improved patient satisfaction.[29] Successful value-based care focuses on sources of value and total cost-of-care savings, including reduction in functional

decline, falls, and frailty. Lin et al. (2022) demonstrated that individuals with higher levels of self-reported PA, identified via the Physical Activity Vital Sign (PAVS), had significantly lower rates of emergency department and primary care visits, as well as inpatient admissions.[30] Value-based care models present an opportunity for the widespread use of assessing and addressing older adults' inadequate PA levels.

Medicare Advantage Star Rating System

The Centers for Medicare & Medicaid Services (CMS) publishes annual star ratings that measure the quality of care received by Medicare Advantage and Prescription Drug Plans (PDPs or Part D plans) consumers.[31] Organizations receive an overall rating based on five categories, comprising 40 quality and performance measures.[32] The final score determines if they receive bonus payments and/or rebates for their enrollees. In 2023, Medicare Advantage quality bonus payments were anticipated to reach $12.8 billion to organizations averaging four stars or greater.[33] One of the five categories, broadly termed 'Staying Healthy', measures the receipt of preventive healthcare and includes 'monitoring of PA'. The average annual star rating for PA monitoring between 2021-24 is 3.0-3.2 (out of 5), which is on the lower side of performance measures and below levels for bonus payments. This suggests that improvements in this area can increase quality bonus payments to providers.[31]

HEDIS Measure – Physical Activity in Older Adults

Another existing, national initiative that more broadly impacts assessing and addressing inadequate PA is the Healthcare Effectiveness Data and Information Set (HEDIS), which is managed by the National Committee for Quality Assurance (NCQA). HEDIS measures serve as

performance improvement tools used by more than 90% of U.S. health plans, which collectively enroll >227 million people.[34] HEDIS scores measure performance on dimensions of care and service, serve as a proxy for quality-of-care that patients receive, and are used to produce an NCQA Health Plan Report Card. The HEDIS measures related to PA include: 1) weight assessment and counseling for nutrition and PA for children/adolescents, and 2) fall risk management (older adults). A third measure, titled 'Physical Activity in Older Adults', asks Medicare beneficiaries 65 and older who visited their doctor in the past 12 months if they: 1) spoke with a doctor or other health provider about their level of exercise or PA? and, 2) received advice to start, increase, or maintain their level of exercise or PA?[35] Since inception in 2004, national compliance with these measures has hovered slightly above the 50% mark.[35]

Addressing Gaps in Clinical Assessment of Physical Activity Levels

Through our work, we seek to identify strategies and resources to better integrate PA assessment and promotion in healthcare settings for older adult populations. This includes identifying and creating relevant materials for providers and their patients; advancing screening tools to ensure safety during exercise; promoting the use of evidence-based interventions in both healthcare and community settings; identifying outcomes and metrics for healthcare providers and older adult patients; and establishing meaningful relationships with other professional organizations seeking to promote health and wellness in older adult populations.

Review of the Literature

We completed a review of the literature using the six stage framework for scoping reviews recommended by Arksey and O'Malley.[36] In step one, we identified the research question: What

clinical PA assessment tools have been developed and validated among older adults? This led to the identification of key/MeSH terms, including PA, assessment, screening, and older adults. Because we were interested in tools that included aerobic, strength, and balance components, we included these words as key search terms. The second step, identifying relevant articles, was completed by entering these key terms into PubMed and Google Scholar. During the search, we identified three systematic and/or scoping reviews,[37–39] reviewing each of these publications for references to other PA assessment tools. We conducted a secondary search using the name of the identified PA assessments and the following key terms: psychometrics, clinometric, validity, and reliability. During the third step, we selected articles to review. Secondary to the need to map the evidence and cast a wide net, we decided against a detailed inclusion/exclusion criterion. Instead, we included all articles with older adults (aged 65 years and older) that used self-reported PA tools. The fourth step of the framework was to chart the data from the selected articles (see Supplemental File 1). Last, we summarized and reported our results, relying on the five co-authors not involved in the search to review our findings.

Physical Activity Assessment Tools Used with Older Adults in Clinical Settings

When identifying clinical methodologies for assessing older adult PA levels it is important to consider: 1) Does the tool align with PA guidelines for older adults?; 2) Is the tool validated for that population (e.g., older adults with or without cognitive impairments; primary language considerations)?; and 3) Is the tool feasible for clinic settings? In Supplemental Table 1, we provide a summary of 16 PA assessment tools used in clinical practice. Half focus on specific types of PA that can be classified as occupational, household, transportation, or leisure time activity. The other tools inquire about specific activities, making it difficult to determine if an

older adult is meeting recommended PA levels. For instance, the Community Healthy Activities Model Program for Seniors-Activities Questionnaire for Older Adults (CHAMPS) asks older adults if they participate in yoga; however, there is no additional information clarifying the type of yoga, which can range from chair yoga focusing on flexibility to power yoga focusing on strength.[40] The PA assessment tools that do not focus on specific types of activities primarily assess aerobic activity. Two commonly use PA assessment tools in clinical practice that have established reliability, validity, clinical feasibility, and align with national PA guidelines are:

The Rapid Assessment of Physical Activity (RAPA) is a nine-item questionnaire based on previous Centers for Disease Control and Prevention (CDC) guidelines of engaging in 30 minutes or more of moderate PA on most days of the week.[41] The questionnaire defines PA intensity levels (light, moderate, and vigorous), followed by 7 progressive options ranging from 'rarely or never engaging' to 'vigorous PA' for 20+ minutes for at least 3 days per week. The RAPA also includes a question about strength and flexibility. Based on individual responses, they are categorized as: 1) sedentary; 2) under-active; 3) under-active with regular light activities; 4) under-active with regular activities; and 5) active. Psychometric evaluation of the tool has identified good sensitivity (81%), positive predictive value (77%), and negative predictive value (75%).[41]

The Physical Activity Vital Sign (PAVS), also known as the Exercise Vital Sign (EVS), is used by multiple U.S. health systems.[42–44] The PAVS consists of two questions: 1) How many days during the past week have you performed PA where your heart beats faster and your breathing is harder than normal for 30 minutes or more? and 2) How many days in a typical week do you

perform activity such as this? The PAVS takes 30 seconds to complete, can be administered by any member of the clinic team (e.g., medical assistants, nurses), and can prompt providers to address inadequate PA.[45] The PAVS has demonstrated strong face and discriminant validity in identifying inactive individuals across gender, age groups, and disease conditions.[43] Significant associations exist between PA levels and cardiometabolic risk factors, body mass index (BMI), and patient disease burden,[46,47] while PAVS integration into electronic health records (EHR) leads to greater PA progress note documentation, PA counseling, and referral.[48] Despite PAVS integration in several U.S. health systems, there are no published studies examining its use in older adult populations.

Assessing Cardiorespiratory Fitness and Physical Function

Some healthcare providers and exercise professionals also advocate for the use of cardiorespiratory fitness testing in place of subjective PA assessments.[49,50] Studies suggest that cardiorespiratory fitness may be a stronger predictor of mortality than self-reported PA.[51] However, cardiorespiratory fitness testing, completed either at a sub-maximal or maximal level, is significantly more time intensive than using a self-reported questionnaire, and requires specialized equipment and trained personnel. Another measure suggested as a proxy for PA assessment is functional testing, such as 30-second sit-to-stand or gait speed assessments.[52] However, PA assessments have stronger associations with morbidity and mortality and are more sensitive identifying those at risk of developing limited physical fitness or functional limitations among inadequately active individuals. The results of cardiorespiratory and functional testing cannot be compared to PA guidelines[53] or easily completed in primary care settings. Thus, self-reported PA assessments have a greater likelihood of being implemented as a standard of care.

238

239 **Gaps in PA Assessment Tools for Older Adult Patients in Clinical Settings**

240 As demonstrated in the last column of Supplemental Table 1, currently available PA assessment
241 tools do not provide clinicians with insight into whether older adults are meeting all components
242 of the national PA guidelines. Most tools (85%; 35/41) focus on specific sub-categories of PA
243 (e.g., leisure time, recreational activity) and do not capture overall PA levels and may result in
244 missing other activities. For example, older adults residing in cooler climates may participate in
245 winter-based activities, which are not usually included in these tools. Further, these tools need
246 frequent updating as the activities older adults perform consistently change (e.g., the growing
247 current popularity of pickleball). Moreover, 78% of assessment tools contained >10 items,
248 limiting their clinical feasibility. Due to these limitations, there is a need to develop an
249 assessment tool whose outcomes are comparable to current national PA recommendations, is
250 validated among heterogeneous older adult populations (e.g., healthy older adults, older adults
251 with co-morbidities or mobility limitations), and can be feasibly implemented in any clinical
252 setting.

253

254 **Our Recommendations – The Modified PAVS for Older Adults**

255 Our work builds upon previous calls to update the PAVS for older adults[54] in recommending that
256 additional questions on muscle-strengthening and balance activities are included for use in
257 clinical settings. This recommendation is based on expansive literature describing the importance
258 of muscle-strengthening and balance training, a desire to align recommendations with national
259 PA guidelines, and the pragmatic realities of clinical settings (e.g., limited assessment time).

260

1. We compiled a list of muscle-strengthening questions used in clinical settings or for national surveillance (Table 2). In assessing muscle-strengthening activities, we recommend asking older adult patients about the average number of muscle-strengthening sessions completed per week. The best example for assessing general muscle-strengthening activities comes from the Physical Activity and Sedentary Behavior Questionnaire:[55]

   "In a typical week, how many times do you do muscle strengthening activities (such as resistance training or very heavy gardening)?"

2. Currently, there is no commonly used tool for assessing older adult balance training activities. Thus, to assess balance training activities, we recommend asking older adult patients about the average number of balance training activities completed each week following the example of Wingood et. al (2023)[56]:

   "How many days per week do you perform activities that challenge your balance, like standing with feet together or walking on trails?"

Implementing the Modified PAVS for Older Adults in Clinical Settings

Prior to widespread adoption, the Modified PAVS for Older Adults should be validated among diverse older adult populations, including healthy populations and those with multiple co-morbidities, frailty, and mild cognitive impairments. Once the modified version is validated, further research efforts should focus on real-world implementation through existing or emerging initiatives to integrate PA assessment in clinical settings to expand PA assessment, prescription,

and referral of older adult patients. Below, we discuss opportunities for the widespread integration of the Modified PAVS for Older Adults in clinical settings.

Age-Friendly Health System

The Age-Friendly Health System is an evidence-based framework for evaluating and treating older adults who seek healthcare services[57] that prioritizes four essential elements, referred to as the 4Ms: 1) What Matters: align health care with the individual's goals and care preferences; 2) Mentation: prevent, identify, treat, and manage cognition and mental health; 3) Medications: minimize the use of potentially inappropriate medications and polypharmacy; and 4) Mobility: optimize safe physical function. Physical activity directly and indirectly impacts each of these 4Ms. Health outcomes associated with the 4Ms related to integrating PA assessment into healthcare include: increasing quality of life and symptom management (Matters), improving cognition, delirium, and anxiety (Mentation), decreasing the number and use of inappropriate medications (Medication), and enhancing gait, activities of daily living, and falls (Mobility).[56]

United States Core Data for Interoperability (V4) Efforts

Widespread implementation of the Modified PAVS for Older Adults must involve efforts to standardize and integrate PA into EHRs.[28] While initial efforts have successfully integrated the PAVS tool in a handful of academic health systems (e.g., Kaiser Permanente, Intermountain Health, Prisma Health), broad dissemination will require national efforts to facilitate seamless uptake across existing EHR systems. As a first step, PA assessment has been included as a Core Measure in the U.S. Core Data for Interoperability, Version 4 (USCDI v4).[58] The USCDI v4 focuses on improving equity by promoting the sharing of health information across information

systems. With this addition, EHR platforms in the U.S. will be required to include data elements to capture patient PA levels. The items in the data element mirror the original PAVS, plus an item on the frequency of muscle-strengthening activity (an item included in the Modified PAVS for Older Adults). Additionally, a new PA Implementation Guide[59] was published through Health Level 7 International (HL7), a not-for-profit organization dedicated to providing a comprehensive framework and standards for the exchange, integration, sharing and retrieval of electronic health information to support clinical practice.[60] The PA Implementation Guide standardizes the ability of software systems to exchange information involving measuring, reporting, and intervening to improve patient PA levels within EHRs and healthcare systems. Future versions of the PA Implementation Guide should include updates for using the Modified PAVS for Older Adults.

Medicare Wellness Visits

Medicare Wellness Visits were introduced in 2011 as an expansion of Medicare - Part B preventive services, focusing on health promotion and preventive care.[61] There are two types of Medicare Wellness Visits: the Initial Preventative Physical Exam (IPPE) and Annual Wellness Visits (AWV).[62] During the IPPE, covered once during the first 12 months of enrollment, clinicians are recommended to review patient medical and social history and collect information on diet and PA levels. Conducted annually, the AWV provides an opportunity to focus on preventive health and support healthy aging. Clinicians review patient medical and social history and risk factors for disease using a Health Risk Assessment (HRA) form.[63] The recommended HRA contains two questions on aerobic activity (similar to the original PAVS), but does not include questions on muscle-strengthening or balance activities. Based on the HRA, clinicians are recommended to provide health advice and referrals to community-based lifestyle

interventions. Uptake of AWVs has increased dramatically from 8.1% in 2011[64] to nearly 50% in 2020,[65] noteworthy given that AWVs are associated with increased utilization of preventive services.[65,66] The AWV addresses wellness more than problem-based visits and presents a prime opportunity to integrate the Modified PAVS for Older Adults.

U.S. Preventive Services Task Force (USPSTF) Falls Prevention Recommendations

The U.S. Preventive Services Task Force recently recommended exercise interventions for older adults at increased risk for falls.[67] The grade B recommendation suggests with high certainty that the net benefit is moderate to substantial, and that clinics and healthcare providers should offer or provide exercise interventions for older adults at risk for falls.[68] Additionally, the task force provided a grade C recommendation that clinicians should provide individualized decision-making to offer multifactorial interventions to prevent falls in older adults. The initial fall risk assessment should include a comprehensive geriatric assessment including balance, gait, vision, postural blood pressure, medication, environment, cognition, and psychological health. The Modified PAVS for Older Adults recommends assessing both muscle-strengthening and balance activities, two key fall risk factors aligned with the USPSTF fall prevention recommendations, providing greater insight into overall older adult PA levels, a critical step in connecting them to appropriate exercise interventions.

Conclusion

The recommendation for the development, validation, and utilization of the Modified PAVS for Older Adults expands on previous statements on PA assessment in general and clinical populations,[69] and robust history of literature demonstrating the validity and clinical utility of

PAVS utilization. Our recommended 4-item tool aligns with national PA guidelines, is easily administered by any member of the clinical team, and provides clinically relevant information in a matter of minutes. Healthcare teams can use the Modified PAVS for Older Adults to catalyze further action (e.g., provision of PA prescriptions, referral to evidence-based programs). Further, we identified several opportunities for dissemination and clinical utilization of the Modified PAVS for Older Adults.

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Author Contributions

Mark Stoutenberg and Mariana Wingood took the lead in conceptualizing ideas, developing the methodology, conducting the review, and developing the original draft. Michael Rogers, Paige Denison, Marcia Ory, Jeff Schlict, Garrett Kellar, Louisa Summers, and Kelsey Weitzel provided guidance in the conceptualization of ideas, assisting with the development of the original draft, and reviewing and editing the final draft.

Conflict of Interest Statement

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None.

REFERENCES

1. 2018 Physical Activity Guidelines Advisory Committee. *2018 Physical Activity Guidelines Advisory Committee Scientific Report*. U.S. Department of Health and Human Services:779.
2. U.S. Department of Health and Human Services. *Physical Activity Guidelines for Americans, 2nd Edition*. Department of Health and Human Services; 2018:118. Accessed December 21, 2021. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf.
3. Elgaddal N, Kramarow EA, Reuben C. *Physical Activity among Adults Aged 18 and over: United States, 2020*. National Center for Health Statistics (U.S.); 2022. doi:10.15620/cdc:120213.
4. Brunilda E, ErjonaAbazaj, Marsida K, et al. Prevention of frailty in the elderly through physical activity and nutrition. *J Geriatr Med Gerontol*. 2020;6(1). doi:10.23937/2469-5858/1510084.
5. Pérez-Ros P, Vila-Candel R, López-Hernández L, et al. Nutritional status and risk factors for frailty in community-dwelling older people: A cross-sectional study. *Nutrients*. 2020;12(4):1041. doi:10.3390/nu12041041.
6. McPhee JS, French DP, Jackson D, et al. Physical activity in older age: Perspectives for healthy ageing and frailty. *Biogerontology*. 2016;17(3):567-580. doi:10.1007/s10522-016-9641-0.
7. Subramaniam S, Faisal AI, Deen MJ. Wearable sensor systems for fall risk assessment: A review. *Front Digit Health*. 2022;4:921506. doi:10.3389/fdgth.2022.921506.
8. Landers MR, Jacobson KM, Matsunami NE, et al. A vicious cycle of fear of falling avoidance behavior in Parkinson's disease: A path analysis. *Clin Park Relat Disord*. 2021;4:100089. doi:10.1016/j.prdoa.2021.100089.
9. Hyde ET, Brown DR, Webber BJ, et al. Meeting the aerobic and muscle-strengthening physical activity guidelines among older US adults, National Health Interview Survey 1998-2018. *J Appl Gerontol*. Published online February 20, 2024:7334648241232930. doi:10.1177/07334648241232930.
10. Whitfield GP, Ussery EN, Saint-Maurice PF, et al. Trends in aerobic physical activity participation across multiple domains among US adults, National Health and Nutrition Examination Survey 2007/2008 to 2017/2018. *J Phys Act Health*. 2021;18(S1):S64-S73. doi:10.1123/jpah.2021-0173.
11. Jette AM, Branch LG. The Framingham Disability Study: II. Physical disability among the aging. *Am J Public Health*. 1981;71(11):1211-1216. doi:10.2105/ajph.71.11.1211.
12. Aniansson A, Sperling L, Rundgren A, et al. Muscle function in 75-year-old men and women. A longitudinal study. *Scand J Rehabil Med Suppl*. 1983;9:92-102.
13. Singam NSV, Fine C, Fleg JL. Cardiac changes associated with vascular aging. *Clin Cardiol*. 2020;43(2):92-98. doi:10.1002/clc.23313.
14. Hyde ET, Whitfield GP, Omura JD, et al. Trends in meeting the physical activity guidelines: Muscle-strengthening alone and combined with aerobic activity, United States, 1998-2018. *J Phys Act Health*. 2021;18(S1):S37-S44. doi:10.1123/jpah.2021-0077.
15. Cisterna B, Malatesta M. Molecular and structural alterations of skeletal muscle tissue nuclei during aging. *Int J Mol Sci*. 2024;25(3):1833. doi:10.3390/ijms25031833.

16. Li R, Xia J, Zhang XI, et al. Associations of muscle mass and strength with all-cause mortality among US older adults. *Med Sci Sports Exerc*. 2018;50(3):458-467. doi:10.1249/MSS.0000000000001448.
17. Li CI, Liu CS, Lin CH, et al. Independent and joint associations of skeletal muscle mass and physical performance with all-cause mortality among older adults: A 12-year prospective cohort study. *BMC Geriatr*. 2022;22(1):597. doi:10.1186/s12877-022-03292-0.
18. Cunningham C, O' Sullivan R, Caserotti P, et al. Consequences of physical inactivity in older adults: A systematic review of reviews and meta-analyses. *Scand J Med Sci Sports*. 2020;30(5):816-827. doi:10.1111/sms.13616.
19. Wingood M, Bonnell L, LaCroix AZ, et al. Community-dwelling older adults and physical activity recommendations: Patterns of aerobic, strengthening, and balance activities. *J Aging Phys Act*. 2022;30(4):653-665. doi:10.1123/japa.2021-0194.
20. Wu R, De Vito G, Delahunt E, et al. Age-related changes in motor function (I). Mechanical and neuromuscular factors. *Int J Sports Med*. 2020;41(11):709-719. doi:10.1055/a-1144-3408.
21. Gryfe CI, Amies A, Ashley MJ. A longitudinal study of falls in an elderly population: I. Incidence and morbidity. *Age Ageing*. 1977;6(4):201-210. doi:10.1093/ageing/6.4.201.
22. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-1462. doi:10.1136/bjsports-2020-102955.
23. Physical activity guidelines for older adults. UK National Health Service. Accessed March 20, 2024. https://www.nhs.uk/live-well/exercise/physical-activity-guidelines-older-adults.
24. Physical activity and exercise guidelines for older Australians (65 years and over). Australian Government - Department of Health and Aged Care. May 6, 2021. Accessed March 20, 2024. https://www.health.gov.au/topics/physical-activity-and-exercise/physical-activity-and-exercise-guidelines-for-all-australians/for-older-australians-65-years-and-over#how-much-physical-activity-you-should-do.
25. Lobelo F, Rohm Young D, Sallis R, et al. Routine assessment and promotion of physical activity in healthcare settings: A scientific statement from the American Heart Association. *Circulation*. 2018;137(18):e495-e522. doi:10.1161/CIR.0000000000000559.
26. Calfas KJ, Long BJ, Sallis JF, et al. A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med*. 1996;25(3):225-233. doi:10.1006/pmed.1996.0050.
27. Grandes G, Sanchez A, Montoya I, et al. Two-year longitudinal analysis of a cluster randomized trial of physical activity promotion by general practitioners. *PLoS One*. 2011;6(3):e18363. doi:10.1371/journal.pone.0018363.
28. Stoutenberg M, Shaya GE, Feldman DI, et al. Practical strategies for assessing patient physical activity levels in primary care. *Mayo Clin Proc Innov Qual Outcomes*. 2017;1(1):8-15. doi:10.1016/j.mayocpiqo.2017.04.006.
29. Abou-Atme Z, Alterman R, Khanna G, et al. Investing in the new era of value-based care. Accessed January 8, 2024. https://www.mckinsey.com/industries/healthcare/our-insights/investing-in-the-new-era-of-value-based-care.
30. Lin CY, Ball TJ, Gentile NL, et al. Associations between Physical Activity Vital Sign in patients and health care utilization in a health care system, 2018-2020. *J Phys Act Health*. 2023;20(1):28-34. doi:10.1123/jpah.2022-0266.

31. Centers for Medicare & Medicaid Services. *Fact Sheet - 2024 Medicare Advantage and Part D Star Ratings*. Department of Health & Human Services; 2023. Accessed April 4, 2024. https://www.cms.gov/files/document/101323-fact-sheet-2024-medicare-advantage-and-part-d-ratings.pdf.
32. What Are the Medicare Star Ratings? @NCOAging. Accessed April 4, 2024. https://www.ncoa.org/article/medicare-star-ratings.
33. Biniek JF, Damico A, Published TN. Spending on Medicare Advantage Quality Bonus Payments Will Reach at Least $12.8 Billion in 2023. KFF. August 9, 2023. Accessed April 4, 2024. https://www.kff.org/medicare/issue-brief/spending-on-medicare-advantage-quality-bonus-payments-will-reach-at-least-12-8-billion-in-2023.
34. National Committee for Quality Assurance. HEDIS Measures and Technical Resources. NCQA. Accessed February 15, 2023. https://www.ncqa.org/hedis/measures.
35. National Committee for Quality Assurance. Physical Activity in Older Adults. NCQA. Accessed February 15, 2023. https://www.ncqa.org/hedis/measures/physical-activity-in-older-adults.
36. Levac D, Colquhoun H, O'Brien KK. Scoping studies: Advancing the methodology. *Implementation Sci*. 2010;5(1):69. doi:10.1186/1748-5908-5-69.
37. Grogg KA, Giacobbi PR, Blair EK, et al. Physical activity assessment and promotion in clinical settings in the United States: A scoping review. *Am J Health Promot*. 2022;36(4):714-737. doi:10.1177/08901171211051840.
38. Sattler MC, Jaunig J, Tösch C, et al. Current evidence of measurement properties of physical activity questionnaires for older adults: An updated systematic review. *Sports Med*. 2020;50(7):1271-1315. doi:10.1007/s40279-020-01268-x.
39. Garnett A, Ploeg J, Markle-Reid M, et al. Self-report tools for assessing physical activity in community-living older adults with multiple chronic conditions: A systematic review of psychometric properties and feasibility. *Can J Aging*. 2020;39(1):12-30. doi:10.1017/S0714980819000357.
40. Stewart AL, Mills KM, King AC, et al. CHAMPS physical activity questionnaire for older adults: Outcomes for interventions. *Med Sci Sports Exerc*. 2001;33(7):1126-1141. doi:10.1097/00005768-200107000-00010.
41. Topolski TD, LoGerfo J, Patrick DL, et al. The Rapid Assessment of Physical Activity (RAPA) among older adults. *Prev Chronic Dis*. 2006;3(4):A118.
42. Greenwood JLJ, Joy EA, Stanford JB. The Physical Activity Vital Sign: A primary care tool to guide counseling for obesity. *J Phys Act Health*. 2010;7(5):571-576. doi:10.1123/jpah.7.5.571.
43. Coleman KJ, Ngor E, Reynolds K, et al. Initial validation of an exercise "vital sign" in electronic medical records. *Med Sci Sports Exerc*. 2012;44(11):2071-2076. doi:10.1249/MSS.0b013e3182630ec1.
44. Lin CY, Gentile NL, Bale L, et al. Implementation of a physical activity vital sign in primary care: Associations between physical activity, demographic characteristics, and chronic disease burden. *Prev Chronic Dis*. 2022;19:E33. doi:10.5888/pcd19.210457.
45. McCarthy MM, Fletcher J, Heffron S, et al. Implementing the physical activity vital sign in an academic preventive cardiology clinic. *Prev Med Rep*. 2021;23:101435. doi:10.1016/j.pmedr.2021.101435.

46. Ball TJ, Joy EA, Gren LH, et al. Predictive validity of an adult Physical Activity "Vital Sign" recorded in electronic health records. *J Phys Act Health*. 2016;13(4):403-408. doi:10.1123/jpah.2015-0210.
47. Young DR, Coleman KJ, Ngor E, et al. Associations between physical activity and cardiometabolic risk factors assessed in a Southern California health care system, 2010-2012. *Prev Chronic Dis*. 2014;11:E219. doi:10.5888/pcd11.140196.
48. Grant RW, Schmittdiel JA, Neugebauer RS, et al. Exercise as a vital sign: A quasi-experimental analysis of a health system intervention to collect patient-reported exercise levels. *J Gen Intern Med*. 2014;29(2):341-348. doi:10.1007/s11606-013-2693-9.
49. Ross R, Blair SN, Arena R, et al. Importance of assessing cardiorespiratory fitness in clinical practice: A case for fitness as a clinical vital sign: A scientific statement from the American Heart Association. *Circulation*. 2016;134(24):e653-e699. doi:10.1161/CIR.0000000000000461.
50. Harber MP, Myers J, Bonikowske AR, et al. Assessing cardiorespiratory fitness in clinical and community settings: Lessons and advancements in the 100th year anniversary of VO2max. *Prog Cardiovasc Dis*. 2024;83:36-42. doi:10.1016/j.pcad.2024.02.009.
51. Franklin BA, Wedig IJ, Sallis RE, et al. Physical activity and cardiorespiratory fitness as modulators of health outcomes: A compelling research-based case presented to the medical community. *Mayo Clin Proc*. 2023;98(2):316-331. doi:10.1016/j.mayocp.2022.09.011.
52. Wingood M, Gell NM, Vincenzo JL, et al. Exploring the implementation potential of physical activity assessment and prescription tools in physical therapy practice: A mixed-method study. *Physiother Theory Pract*. 2023;39(12):2676-2687. doi:10.1080/09593985.2022.2100849.
53. Chalé-Rush A, Guralnik JM, Walkup MP, et al. Relationship between physical functioning and physical activity in the lifestyle interventions and independence for elders pilot. *J Am Geriatr Soc*. 2010;58(10):1918-1924. doi:10.1111/j.1532-5415.2010.03008.x.
54. Schlict J, Wingood M, Heled Y, et al. The Physical Activity Vital Sign for Older Adults: Time for an update. 2024;25(8). doi:10.1016/j.jamda.2024.105020.
55. Fowles JR, O'Brien MW, Wojcik WR, et al. A pilot study: Validity and reliability of the CSEP-PATH PASB-Q and a new leisure time physical activity questionnaire to assess physical activity and sedentary behaviours. *Appl Physiol Nutr Metab*. 2017;42(6):677-680. doi:10.1139/apnm-2016-0412.
56. Wingood M, Bean JF, Linsky AM. Incorporating physical activity assessments and behavior change techniques into geriatrics. *Arch Rehabil Res Clin Transl*. 2023;5(4):100293. doi:10.1016/j.arrct.2023.100293.
57. Mate K, Fulmer T, Pelton L, et al. Evidence for the 4Ms: Interactions and outcomes across the care continuum. *J Aging Health*. 2021;33(7-8):469-481. doi:10.1177/0898264321991658.
58. ONC publishes new USCDI v4 standards. Healthcare IT News. July 21, 2023. Accessed June 16, 2024. https://www.healthcareitnews.com/news/onc-publishes-new-uscdi-v4-standards.
59. Physical Activity Implementation Guide. Accessed June 16, 2024. https://hl7.org/fhir/us/physical-activity/STU1.
60. Health Level Seven International - Homepage | HL7 International. Accessed June 16, 2024. https://www.hl7.org.

61. National Council on Aging. What Is a Medicare Annual Wellness Visit? Accessed June 16, 2024. https://www.ncoa.org/article/the-medicare-annual-wellness-visit-what-older-adults-should-know.
62. Centers for Medicare & Medicaid Services. Medicare Wellness Visits. Accessed June 16, 2024. https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/preventive-services/medicare-wellness-visits.html#IPPE.
63. Goetzel R, Staley P, Ogden L, et al. *A Framework for Patient-Centered Health Risk Assessments – Providing Health Promotion and Disease Prevention Services to Medicare Beneficiaries.* US Department of Health and Human Services, Centers for Disease Control and Prevention; 2011. Accessed May 15, 2024. http://www.cdc.gov/policy/opth/hra.
64. Lind KE, Hildreth KL, Perraillon MC. Persistent disparities in Medicare's Annual Wellness Visit utilization. *Med Care*. 2019;57(12):984-989. doi:10.1097/MLR.0000000000001229.
65. Park S, Nguyen AM. Determinants and effectiveness of annual wellness visits among Medicare beneficiaries in 2020. *Fam Pract*. 2024;41(2):203-206. doi:10.1093/fampra/cmad108.
66. McMurry TL, Lobo JM, Kang H, et al. Annual wellness visits are associated with increased use of preventive services in patients with diabetes living in the Diabetes Belt. *Diabet Epidemiol Manag*. 2022;7:100094. doi:10.1016/j.deman.2022.100094.
67. US Preventive Services Task Force, Nicholson WK, Silverstein M, et al. Interventions to prevent falls in community-dwelling older adults: US Preventive Services Task Force Recommendation Statement. *JAMA*. Published online June 4, 2024. doi:10.1001/jama.2024.8481.
68. Grade Definitions | United States Preventive Services Taskforce. Accessed June 16, 2024. https://www.uspreventiveservicestaskforce.org/uspstf/about-uspstf/methods-and-processes/grade-definitions.
69. Strath SJ, Kaminsky LA, Ainsworth BE, et al. Guide to the assessment of physical activity: Clinical and research applications: a scientific statement from the American Heart Association. *Circulation*. 2013;128(20):2259-2279. doi:10.1161/01.cir.0000435708.67487.da.
70. Increase the proportion of adults who do enough muscle-strengthening activity - Data Methodology and Measurement - Healthy People 2030 | health.gov. Accessed August 10, 2024. https://health.gov/healthypeople/objectives-and-data/browse-objectives/physical-activity/increase-proportion-adults-who-do-enough-muscle-strengthening-activity-pa-04/data-methodology.
71. Centers for Disease Control and Prevention (CDC). Trends in strength training--United States, 1998-2004. *MMWR Morb Mortal Wkly Rep*. 2006;55(28):769-772.
72. Washburn RA, Smith KW, Jette AM, Janney CA. The Physical Activity Scale for the Elderly (PASE): Development and evaluation. *J Clin Epidemiol*. 1993;46(2):153-162. doi:10.1016/0895-4356(93)90053-4.
73. Shakespear-Druery J, De Cocker K, Biddle SJH, et al. Muscle-Strengthening Exercise Questionnaire (MSEQ): An assessment of concurrent validity and test-retest reliability. *BMJ Open Sport Exerc Med*. 2022;8(1):e001225. doi:10.1136/bmjsem-2021-001225.

Figure 1. Impact of inadequate physical activity levels.
Adapted from previously published work.[4–8]

Supplemental Table 1. Physical activity assessment tools used in older adult populations.

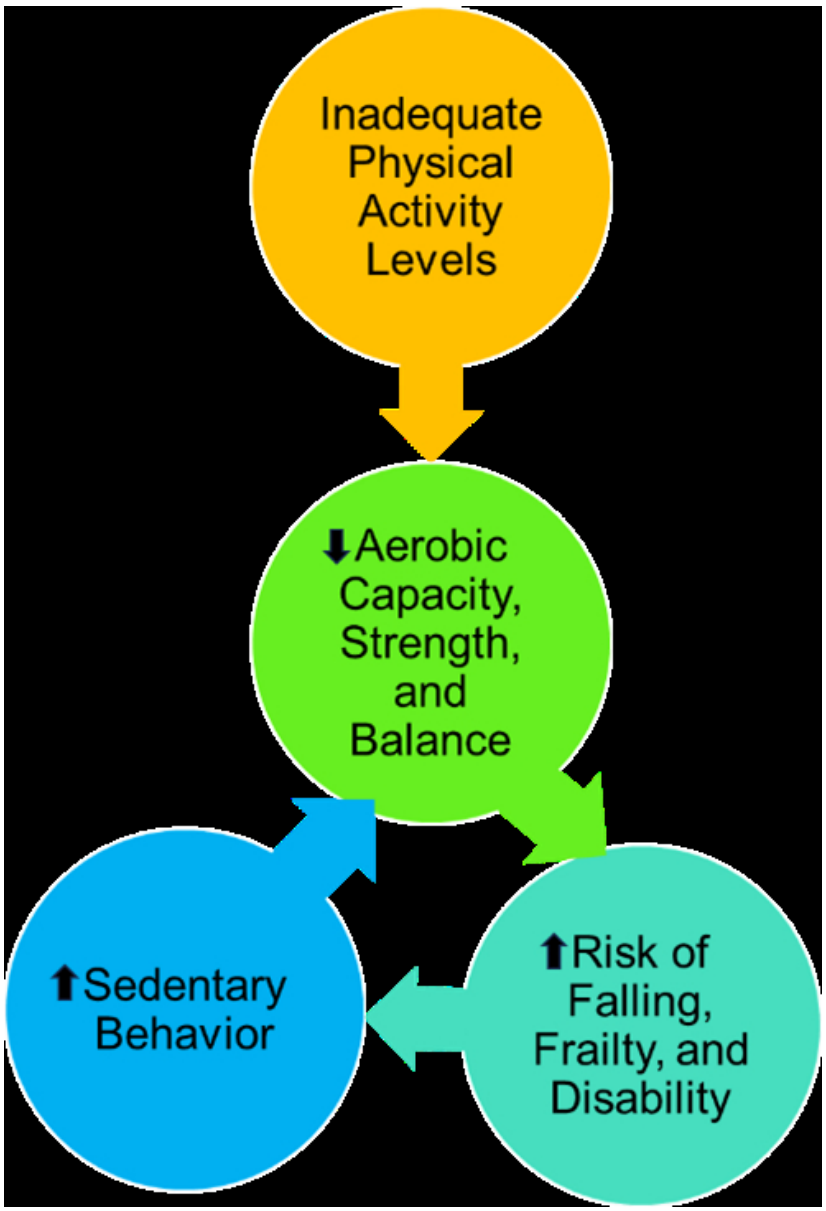
Table 1. U.S. Physical Activity Guidelines for Older Adults.

- Aerobic physical activity that includes:
  - At least 150 minutes at moderate intensity
    OR 75 minutes at vigorous intensity
    OR an equivalent combination at moderate and vigorous intensity
- At least 2 days of activities that strengthen muscles
- Activities to improve balance

Table 2. Sample of Commonly Used Muscle-Strengthening Items.

Survey/Questionnaire	Muscle-Strengthening Question	Strengths	Weaknesses
Physical Activity and Sedentary Behavior Questionnaire (PASBQ)[55]	*In a typical week, how many times do you do muscle strengthening activities (such as resistance training or very heavy gardening)?*	• Maps to national PA guidelines • Includes activities other than resistance training	• Not validated in an older adult population • Not widely used
2019 BRFSS Questionnaire	*During the past month, how many times per week or per month did you do physical activities or exercises to strengthen your muscles?*	• Widely used in a national surveillance questionnaire • Asks more generally about muscle strengthening activities	• Potentially confusing to patients with mention of how many times per week or per month
NHIS (2019-present)[70]	*How often do you do LEISURE-TIME physical activities specifically designed to STRENGTHEN your muscles such as sit-ups, push-ups, or lifting weights?*	• Results are used to estimate proportion of individuals meeting national guidelines under Healthy People 2030	• Muscle-strengthening examples may not be relevant to older adult populations • No specified time period
CDC MMWR Question (1998-2004)[71]	*How often do you do physical activities designed to strengthen your muscles, such as lifting weights or doing calisthenics?*	• Asks more generally about muscle strengthening activities	• Muscle-strengthening examples may not be relevant to older adult populations • No specified time period
Physical Activity Scale for the Elderly (PASE)[72]	*Over the past 7 days, how often did you do any exercises specifically to increase muscle strength and endurance, such as lifting weights or pushups, etc.?*	• Well known and highly used instrument	• Categorical responses, rather than continuous • Scoring of question does not lead to determination of meeting national guidelines • Muscle-strengthening examples may not be relevant to older adult populations
Muscle-Strengthening Exercise Questionnaire (MSEQ-Short)[73]	*Brief 6-item instrument that assesses <u>any engagement in MSE</u> (yes/no), <u>usual weekly frequency</u> (number of days), <u>duration</u> (minutes spent), <u>intensity</u> (0-10), <u>type of muscle- strengthening exercise</u> (yes/no response to four types of MSE), and <u>muscle groups targeted</u> (yes/no response to seven muscle groups).*	• Strong test-retest reliability and validity • Maps to national PA guidelines	• Not validated in an older adult population • Numerous questions reduces clinical feasibility

BRFSS: Behavioral Risk Factor Surveillance System; CDC: Center for Disease Control and Prevention; MMWR: Morbidity and Mortality Weekly Report; MSE: muscle-strengthening exercise.



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Supplemental Table 1. Physical activity assessment tools used in older adult populations.

Assessment Tool	Description	Included Items	Psychometric Properties	Concerns Related with Use in Clinical Settings	Align with U.S. National PA Guidelines
7-Day Physical Activity Recall	Weekly time spent sleeping and doing moderate, hard, or very hard PA	▪ 3 items - moderate, hard, and very hard PA ▪ 1 item - comparing current PA to PA over prior 3 months ▪ 4 items - work schedule	▪ Cross-validation-diagnoses/languages[1–4] ▪ Reliable[5] ▪ Valid[6]	▪ Requires detailed recall of PA performed over past 7 days, including amount of moderate, hard, very hard PA performed in the morning, afternoon, and evening ▪ Administered via interview	Aerobic domain
Community Healthy Activities Model Program for Seniors-Activities Questionnaire for Older Adults	Weekly participation in 41 different types of activities	▪ 21 items - low intensity ▪ 20 items - moderate intensity PA	▪ Cross-validation-diagnoses/languages[7–10] ▪ Internal consistency[11] ▪ Reliable[9,11] ▪ Valid[7,11]	▪ Recall bias over past 4 weeks ▪ Only captures specific PA ▪ Difficult to score – use of metabolic equivalents ▪ 41 total items, with each having three sub-questions	No
General Practice Physical Activity Questionnaire	Weekly PA performed at work and about 5 types of aerobic activities	▪ 2 items - aerobic PA ▪ 1 item - occupational PA ▪ 2 items - housework, yardwork, and childcare PA	▪ Cross-validation-diagnoses/languages[12] ▪ Reliable[13–15] ▪ Valid[12–15]	▪ Recall bias over past 7 days ▪ The first 5 items are only related to work-related PA ▪ Requires walking pace, which may be difficult for patients to self-identify	Aerobic domain
Godin Leisure-Time Exercise Questionnaire	Open-ended questions about mild, moderate, and strenuous weekly PA	▪ 3 items - general PA	▪ Cross-validation-diagnoses/languages[16–18] ▪ Reliable[18,19] ▪ Valid[19]	▪ Recall bias over past 7 days in bouts of 15 minutes	Aerobic domain

				▪ Scoring is on a scale (0-24+) not comparable to PA recommendations	
International Physical Activity Questionnaire-Short Form	Weekly participation in strenuous and moderate intensity PA, walking, and sitting	▪ 4 items - general PA ▪ 2 items - walking ▪ 1 item - sitting	▪ Cross-validation-diagnoses/languages[20,21] ▪ Reliable[20,22] ▪ Valid[21–27]	▪ Recall bias over past 7 days ▪ Requires different levels of intensity (vigorous vs. moderate) and amount of time spent sitting	Aerobic domain
Modified Baecke Questionnaire for Older Adults	Weekly PA performed via work, recreations, and housework	▪ 8 items - recreational PA ▪ 8 items - occupational PA ▪ 8 items - housework PA	▪ Reliable[28–30] ▪ Valid[28,30,31]	▪ Focuses on recreational, occupational, and housework activities ▪ Only captures activity if type of PA is on list	No
Modifiable Activity Questionnaire	Weekly PA participation, watching television, using computer outside of work, and inactivity due to illness	▪ 1 item - PA ▪ 1 item - TV/computer use ▪ 1 item - inactivity due to illness	▪ Cross-validation-diagnoses/languages[32,33] ▪ Reliable[34] ▪ Valid[34]	▪ Recall bias - PA performed >10 times over past year ▪ Focuses on leisure time PA ▪ Scoring requires use of a formula with multiple calculations	No
Modified Leisure Time Physical Activity Questionnaire	Weekly PA performed at strenuous, moderate, and light intensity for ≥10 min	▪ 3 items - general PA	▪ Reliable[35] ▪ Valid[35]	▪ Recall bias over past 7 days ▪ Only captures PA >10 min bouts	Aerobic domain
Physical Activity Assessment Tool	Weekly PA performed at moderate and vigorous intensity	▪ 4 items - moderate/vigorous PA ▪ 1 item - comparing current PA to PA over prior 3 months	▪ Reliable[22] ▪ Valid[22]	▪ Recall bias over past 7 days ▪ Focuses on specific PA ▪ Only 1 validation study	Aerobic domain

				▪ Only captures PA >10 min bouts	
Physical Activity and Disability Scale	Weekly leisure-time and house/yard work PA	▪ 3 items - aerobic, muscle-strengthening, flexibility ▪ 2 items - leisure time ▪ 5 items - housework ▪ 2 items - indoor time	▪ Cross-validation-diagnoses/languages[36,37] ▪ Reliable[36] ▪ Valid[36]	▪ Recall bias over past 7 days	Aerobic and Strength domains
Phone-FITT	Weekly household and recreational activity, also asks how breathless the PA makes them	▪ 8 items - recreational PA ▪ 6 items - housework PA ▪ 2 items - seasonal PA ▪ 1 item - open ended PA	▪ Reliable[38] ▪ Valid[38]	▪ Recall bias for typical 7 days over past month ▪ Very detailed information on (e.g., frequency, duration) during activity ▪ Summary score requires multiple calculations ▪ Only one validation study ▪ 19 items with each having three sub-questions	No
Physical Activity and Sedentary Behavior Questionnaire	Weekly PA, perceived fitness, and sedentary behaviors	▪ 2 items - aerobic PA ▪ 1 item - muscle-strengthening ▪ 1 item - perceived fitness ▪ 3 items - sedentary behavior	▪ Reliable[35] ▪ Valid[35]	▪ Recall bias over typical week ▪ Has option to log PA for prospective 7 days	Aerobic and Strength domains
Physical Activity Scale for Elderly	Weekly participation in leisure, household, and work-related PA	▪ 3 items - light, moderate, and vigorous PA ▪ 1 item - walking ▪ 1 item - muscle-strengthening and endurance activity combined ▪ 2 items - household PA ▪ 1 item - volunteering	▪ Cross-validation-diagnoses/languages[39–46] ▪ Reliable[42,47,48] ▪ Valid[31,42,47,49]	▪ Recall bias over past 7 days ▪ Uses item weights to calculate score	No
Physical Activity Vital Sign	Weekly aerobic PA	▪ 2 items - aerobic PA	▪ Reliable[50,51] ▪ Valid[50,51]	▪ Recall bias over past 7 days	Aerobic domain

Quick Physical Activity Rating Scale	Weekly time spent sitting and performing PA at strenuous, moderate, and mild intensity	▪ 1 item - walking ▪ 1 item - muscle-strengthening ▪ 1 item - flexibility ▪ 3 items - housework PA ▪ 3 items - general PA ▪ 1 item - sitting	▪ Cross-validation-diagnoses/languages[52] ▪ Reliable[53] ▪ Valid[53]	▪ Recall bias - days and hours per week PA is performed	Aerobic and Strength domains
Rapid Assessment of Physical Activity	Weekly PA levels	▪ 7 items - aerobic PA ▪ 1 item - muscle-strengthening ▪ 1 item - flexibility	▪ Cross-validation-diagnoses/languages[54–59] ▪ Reliable[60] ▪ Valid[60]	▪ Recall bias over past 7 days	Aerobic and Strength domains

PA: physical activity

References for Supplemental Table 1

1. Zuazagoitia A, Montoya I, Grandes G, et al. Reliability and validity of the 7-day Physical Activity Recall interview in a Spanish population. *Eur J Sport Sci*. 2014;14 Suppl 1:S361-368. doi:10.1080/17461391.2012.705332.
2. Soundy A, Taylor A, Faulkner G, et al. Psychometric properties of the 7-Day Physical Activity Recall questionnaire in individuals with severe mental illness. *Arch Psychiatr Nurs*. 2007;21(6):309-316. doi:10.1016/j.apnu.2007.03.001.
3. Garfield BE, Canavan JL, Smith CJ, et al. Stanford Seven-Day Physical Activity Recall questionnaire in COPD. *Eur Respir J*. 2012;40(2):356-362. doi:10.1183/09031936.00113611.
4. Johnson-Kozlow M, Sallis JF, Gilpin EA, et al. Comparative validation of the IPAQ and the 7-Day PAR among women diagnosed with breast cancer. *Int J Behav Nutr Phys Act*. 2006;3:7. doi:10.1186/1479-5868-3-7.
5. Gross LD, Sallis JF, Buono MJ, et al. Reliability of interviewers using the Seven-Day Physical Activity Recall. *Res Q Exerc Sport*. 1990;61(4):321-325. doi:10.1080/02701367.1990.10607494.
6. Welk GJ, Thompson RW, Galper DI. A temporal validation of scoring algorithms for the 7-Day Physical Activity Recall. *Measurement in Physical Education and Exercise Science*. 2001;5(3):123-138. doi:10.1207/S15327841MPEE0503_1.
7. Colbert LH, Matthews CE, Havighurst TC, et al. Comparative validity of physical activity measures in older adults. *Med Sci Sports Exerc*. 2011;43(5):867-876. doi:10.1249/MSS.0b013e3181fc7162.
8. Feldman LS, Kaneva P, Demyttenaere S, et al. Validation of a physical activity questionnaire (CHAMPS) as an indicator of postoperative recovery after laparoscopic cholecystectomy. *Surgery*. 2009;146(1):31-39. doi:10.1016/j.surg.2009.02.019.
9. Mak S, Bourbeau J, Mayo NE, et al. Psychometric testing of the CHAMPS questionnaire in French Canadians with COPD. *Can Respir J*. 2019;2019:2185207. doi:10.1155/2019/2185207.
10. Zhao Y, Wang Q, Chung PK, et al. Cross-cultural modifications and measurement properties of the CHAMPS questionnaire among Chinese older adults. *J Exerc Sci Fit*. 2021;19(1):13-18. doi:10.1016/j.jesf.2020.07.002.
11. Hekler EB, Buman MP, Haskell WL, et al. Reliability and validity of CHAMPS self-reported sedentary-to-vigorous intensity physical activity in older adults. *J Phys Act Health*. 2012;9(2):225-236. doi:10.1123/jpah.9.2.225.
12. Wilkinson TJ, Palmer J, Gore EF, et al. The validity of the "General Practice Physical Activity Questionnaire" against accelerometery in patients with chronic kidney disease. *Physiother Theory Pract*. 2022;38(10):1528-1537. doi:10.1080/09593985.2020.1855684.
13. Smith TO, McKenna MC, Salter C, et al. A systematic review of the physical activity assessment tools used in primary care. *Fam Pract*. 2017;34(4):384-391. doi:10.1093/fampra/cmx011.
14. Dutton SN, Bauman A, Dennis SM, et al. Resourcing an evolution of roles in general-practice: A study to determine the validity and reliability of tools to assist nurses and patients to assess physical activity. *Aust J Prim Health*. 2016;22(6):505-509. doi:10.1071/PY15027.

15. Ahmad S, Harris T, Limb E, et al. Evaluation of reliability and validity of the General Practice Physical Activity Questionnaire (GPPAQ) in 60-74 year old primary care patients. *BMC Fam Pract*. 2015;16:113. doi:10.1186/s12875-015-0324-8.
16. Sari E, Erdoğan S. Adaptation of the Godin Leisure-Time Exercise Questionnaire into Turkish: The validity and reliability study. *Advances in Public Health*. 2016;2016(1):3756028. doi:10.1155/2016/3756028.
17. Sikes EM, Richardson EV, Cederberg KJ, et al. Use of the Godin leisure-time exercise questionnaire in multiple sclerosis research: A comprehensive narrative review. *Disabil Rehabil*. 2019;41(11):1243-1267. doi:10.1080/09638288.2018.1424956.
18. Amireault S, Godin G, Lacombe J, et al. The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: A systematic review. *BMC Med Res Methodol*. 2015;15:60. doi:10.1186/s12874-015-0045-7.
19. Amireault S, Godin G. The Godin-Shephard leisure-time physical activity questionnaire: Validity evidence supporting its use for classifying healthy adults into active and insufficiently active categories. *Percept Mot Skills*. 2015;120(2):604-622. doi:10.2466/03.27.PMS.120v19x7.
20. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381-1395. doi:10.1249/01.MSS.0000078924.61453.FB.
21. Hurtig-Wennlöf A, Hagströmer M, Olsson LA. The International Physical Activity Questionnaire modified for the elderly: Aspects of validity and feasibility. *Public Health Nutr*. 2010;13(11):1847-1854. doi:10.1017/S1368980010000157.
22. Meriwether RA, McMahon PM, Islam N, et al. Physical activity assessment: Validation of a clinical assessment tool. *Am J Prev Med*. 2006;31(6):484-491. doi:10.1016/j.amepre.2006.08.021.
23. Cleland C, Ferguson S, Ellis G, et al. 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(1):176. doi:10.1186/s12874-018-0642-3.
24. Grimm EK, Swartz AM, Hart T, et al. Comparison of the IPAQ-Short Form and accelerometry predictions of physical activity in older adults. *J Aging Phys Act*. 2012;20(1):64-79. doi:10.1123/japa.20.1.64.
25. Hagströmer M, Oja P, Sjöström M. The International Physical Activity Questionnaire (IPAQ): A study of concurrent and construct validity. *Public Health Nutr*. 2006;9(6):755-762. doi:10.1079/phn2005898.
26. Kim Y, Park I, Kang M. Convergent validity of the international physical activity questionnaire (IPAQ): Meta-analysis. *Public Health Nutr*. 2013;16(3):440-452. doi:10.1017/S1368980012002996.
27. Lee PH, Macfarlane DJ, Lam TH, et al. Validity of the International Physical Activity Questionnaire Short Form (IPAQ-SF): A systematic review. *Int J Behav Nutr Phys Act*. 2011;8:115. doi:10.1186/1479-5868-8-115.
28. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr*. 1982;36(5):936-942. doi:10.1093/ajcn/36.5.936.

29. Moore DS, Ellis R, Allen PD, et al. Construct validation of physical activity surveys in culturally diverse older adults: A comparison of four commonly used questionnaires. *Res Q Exerc Sport*. 2008;79(1):42-50. doi:10.1080/02701367.2008.10599459.
30. Pols MA, Peeters PH, Bueno-De-Mesquita HB, et al. Validity and repeatability of a modified Baecke questionnaire on physical activity. *Int J Epidemiol*. 1995;24(2):381-388. doi:10.1093/ije/24.2.381.
31. Hertogh EM, Monninkhof EM, Schouten EG, et al. Validity of the modified Baecke questionnaire: Comparison with energy expenditure according to the doubly labeled water method. *Int J Behav Nutr Phys Act*. 2008;5:30. doi:10.1186/1479-5868-5-30.
32. Momenan AA, Delshad M, Sarbazi N, et al. Reliability and validity of the Modifiable Activity Questionnaire (MAQ) in an Iranian urban adult population. *Arch Iran Med*. 2012;15(5):279-282.
33. Tonoli C, Heyman E, Roelands B, et al. Validation and reliability of the Dutch language version of the Modifiable Activity Questionnaire in healthy subjects. *Sport Sci Health*. 2013;9(3):139-144. doi:10.1007/s11332-013-0160-y.
34. Pettee Gabriel K, McClain JJ, Schmid KK, et al. Reliability and convergent validity of the past-week Modifiable Activity Questionnaire. *Public Health Nutr*. 2011;14(3):435-442. doi:10.1017/S1368980010002612.
35. Fowles JR, O'Brien MW, Wojcik WR, et al. A pilot study: Validity and reliability of the CSEP-PATH PASB-Q and a new leisure time physical activity questionnaire to assess physical activity and sedentary behaviours. *Appl Physiol Nutr Metab*. 2017;42(6):677-680. doi:10.1139/apnm-2016-0412.
36. Kayes NM, McPherson KM, Taylor D, et al. The Physical Activity and Disability Survey (PADS): Reliability, validity and acceptability in people with multiple sclerosis. *Clin Rehabil*. 2007;21(7):628-639. doi:10.1177/0269215507075516.
37. Kayes NM, Schluter PJ, McPherson KM, et al. The Physical Activity and Disability Survey -- Revised (PADS-R): An evaluation of a measure of physical activity in people with chronic neurological conditions. *Clin Rehabil*. 2009;23(6):534-543. doi:10.1177/0269215508101750.
38. Gill DP, Jones GR, Zou GY, et al. The Phone-FITT: A brief physical activity interview for older adults. *J Aging Phys Act*. 2008;16(3):292-315. doi:10.1123/japa.16.3.292.
39. Ngai SPC, Cheung RTH, Lam PL, et al. Validation and reliability of the Physical Activity Scale for the Elderly in Chinese population. *J Rehabil Med*. 2012;44(5):462-465. doi:10.2340/16501977-0953.
40. Vaughan K, Miller WC. Validity and reliability of the Chinese translation of the Physical Activity Scale for the Elderly (PASE). *Disabil Rehabil*. 2013;35(3):191-197. doi:10.3109/09638288.2012.690498.
41. Covotta A, Gagliardi M, Berardi A, et al. Physical Activity Scale for the Elderly: Translation, cultural adaptation, and validation of the Italian version. *Curr Gerontol Geriatr Res*. 2018;2018:8294568. doi:10.1155/2018/8294568.
42. Casartelli NC, Bolszak S, Impellizzeri FM, et al. Reproducibility and validity of the physical activity scale for the elderly (PASE) questionnaire in patients after total hip arthroplasty. *Phys Ther*. 2015;95(1):86-94. doi:10.2522/ptj.20130557.
43. Granger CL, Parry SM, Denehy L. The self-reported Physical Activity Scale for the Elderly (PASE) is a valid and clinically applicable measure in lung cancer. *Support Care Cancer*. 2015;23(11):3211-3218. doi:10.1007/s00520-015-2707-8.

44. Hagiwara A, Ito N, Sawai K, et al. Validity and reliability of the Physical Activity Scale for the Elderly (PASE) in Japanese elderly people. *Geriatr Gerontol Int*. 2008;8(3):143-151. doi:10.1111/j.1447-0594.2008.00463.x.
45. Martin KA, Rejeski WJ, Miller ME, et al. Validation of the PASE in older adults with knee pain and physical disability. *Med Sci Sports Exerc*. 1999;31(5):627-633. doi:10.1097/00005768-199905000-00001.
46. Svege I, Kolle E, Risberg MA. Reliability and validity of the Physical Activity Scale for the Elderly (PASE) in patients with hip osteoarthritis. *BMC Musculoskelet Disord*. 2012;13:26. doi:10.1186/1471-2474-13-26.
47. Dinger MK, Oman RF, Taylor EL, et al. Stability and convergent validity of the Physical Activity Scale for the Elderly (PASE). *J Sports Med Phys Fitness*. 2004;44(2):186-192.
48. Washburn RA, Smith KW, Jette AM, et al. The Physical Activity Scale for the Elderly (PASE): Development and evaluation. *J Clin Epidemiol*. 1993;46(2):153-162. doi:10.1016/0895-4356(93)90053-4.
49. Cavanaugh JT, Crawford K. Life-Space Assessment and Physical Activity Scale for the Elderly: Validity of proxy informant responses. *Arch Phys Med Rehabil*. 2014;95(8):1527-1532. doi:10.1016/j.apmr.2014.03.027.
50. Ball TJ, Joy EA, Goh TL, et al. Validity of two brief primary care physical activity questionnaires with accelerometry in clinic staff. *Prim Health Care Res Dev*. 2015;16(1):100-108. doi:10.1017/S1463423613000479.
51. Ball TJ, Joy EA, Gren LH, et al. Concurrent validity of a self-reported Physical Activity "Vital Sign" questionnaire with adult primary care patients. *Prev Chronic Dis*. 2016;13:E16. doi:10.5888/pcd13.150228.
52. de Souto Barreto P. Construct and convergent validity and repeatability of the Questionnaire d'Activité Physique pour les Personnes Âgées (QAPPA), a physical activity questionnaire for the elderly. *Public Health*. 2013;127(9):844-853. doi:10.1016/j.puhe.2012.10.018.
53. Galvin JE, Tolea MI, Rosenfeld A, et al. The Quick Physical Activity Rating (QPAR) scale: A brief assessment of physical activity in older adults with and without cognitive impairment. *PLoS One*. 2020;15(10):e0241641. doi:10.1371/journal.pone.0241641.
54. Silva AG, Queirós A, Alvarelhão J, et al. Validity and reliability of the Portuguese version of the Rapid Assessment of Physical Activity questionnaire. *Intl J Therapy Rehab*. 2014;21(10):469-474. doi:10.12968/ijtr.2014.21.10.469.
55. Alqahtani BA, Alenazi AM. Cross-cultural adaptation and psychometric properties of the Arabic version of the Rapid Assessment of Physical Activity. *Oman Med J*. 2020;2020(5):e170. doi:10.5001/omj.2020.112.
56. Angosta AD, Serafica R. Assessing physical activity levels in Filipino Americans with hypertension using the Rapid Assessment of Physical Activity Questionnaire. *Home Health Care Management & Practice*. 2017;29(2):91-95. doi:10.1177/1084822316685517.
57. Çekok FK, Kahraman T, Kalkışım M, et al. Cross-cultural adaptation and psychometric study of the Turkish version of the Rapid Assessment of Physical Activity. *Geriatr Gerontol Int*. 2017;17(11):1837-1842. doi:10.1111/ggi.12970.
58. Miszory EV, Makai A, Pakai A, et al. Cross-cultural adaptation and validation of the rapid assessment of physical activity questionnaire (RAPA) in Hungarian elderly over 50 years. *BMC Sports Sci Med Rehabil*. 2022;14(1):131. doi:10.1186/s13102-022-00512-3.

59. Noguchi KS, O'Brien KK, Aubry RL, et al. Construct validity and responsiveness of the Rapid Assessment of Physical Activity in adults living with HIV. *Arch Rehabil Res Clin Transl*. 2021;3(4):100164. doi:10.1016/j.arrct.2021.100164.
60. Topolski TD, LoGerfo J, Patrick DL, et al. The Rapid Assessment of Physical Activity (RAPA) among older adults. *Prev Chronic Dis*. 2006;3(4):A118.