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Development and Validation of the Square Excursion Step Test (SEST) for Evaluating Postural Control in Older Adults: An Examination of Stepping Agility

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A B S T R A C T

Background: Postural control during multidirectional stepping is a fundamental component of functional independence and a critical factor in fall prevention among older adults. Despite the availability of various balance assessment tools, the need remains for a practical, cost-effective, and reliable instrument tailored to this population. The primary objective of this research was to develop and validate the Square Excursion Step Test (SEST) by assessing its reliability, validity, and usability in clinical and community-based settings.
Methods: A total of 88 older adults voluntarily participated in the study. The SEST involves stepping in four cardinal directions (forward, backward, left, and right) within a defined square, requiring precision, balance, and coordination.
Results: Face validity was confirmed by 10 sports science experts, yielding a Content Validity Ratio (CVR) of 0.80, surpassing the required threshold of 0.62, indicating strong consensus on its relevance. The Content Validity Index (CVI) averaged 0.90, reflecting high clarity and appropriateness of the test components. Concurrent validity was established through a significant correlation with the Timed Up and Go (TUG) test ($r = 0.81$; $p < 0.001$). Reliability assessments demonstrated an interrater reliability intraclass correlation coefficient (ICC) of 0.99 and an intrarater ICC of 0.90 across two assessments conducted ten days apart, confirming that SEST is a valid and reliable measure for evaluating balance in individuals with reduced physical fitness capabilities.
Conclusions: These findings validate SEST as a robust tool for measuring postural stability during multidirectional stepping in older adults.

K E Y W O R D S
Aging, Balance, Elderly, Fall, Gait

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INTRODUCTION

Functional mobility fundamental to preserving independence and quality of life in older adults[1]. Among the key determinants of mobility, gait stability is particularly critical, as it not only facilitates basic locomotion but also supports the performance of activities of daily living (ADLs) and engagement in social and community activities[2]. Aging is frequently accompanied by declines in musculoskeletal and neuromotor function[3], which undermine the ability to navigate various environments safely. These changes heighten the risk of falls, a leading cause of injury, disability, and mortality in older adults[4, 5]. The decline in agility, along with muscle strength and balance, is a key factor contributing to falls in older adults[6].Most falls among older adults living in the community happen while walking and are frequently caused by trips and slips. In these situations, postural disturbances often necessitate a change in support through stepping or grasping to prevent a fall[7].

In daily life, protective stepping can be initiated in two ways: voluntarily in anticipation of a balance disturbance or reactively in response to an unexpected perturbation. Volitional stepping, along with proactive gait adjustments, is commonly used to avoid fall hazards and relies on anticipatory postural adjustments (APAs) to optimize the center-of-mass position, stabilizing the single-leg stance phase. Conversely, reactive stepping occurs with minimal or no APAs, triggered by automatic reflexive responses when the sensory system detects a balance disruption, often serving as the final defense against falling[7].

The ability to execute multidirectional movements like stepping forward, backward, and laterally is a vital component of functional mobility. These movements are not only integral to navigating environmental complexities but are also essential for maintaining balance and preventing falls[8]. In daily life, older adults must frequently adjust their gait to negotiate uneven terrain, avoid obstacles, and respond to unexpected challenges. These tasks demand the integration of strength, coordination, and rapid decision-making, highlighting the importance of evaluating dynamic postural control. However, age-related declines in stepping speed, coordination, and stability compromise this ability, leaving older adults at greater risk of losing balance and falling [9].

Tasks that involve curved paths, rapid directional changes, or reactive stepping challenge balance to a greater extent than straight-line walking[10]. Compensatory stepping such as rapidly stepping in response to a trip or slip is a key mechanism for recovering balance [11]. The efficiency and accuracy of these steps are critical indicators of postural control and fall risk. Evidence indicates that older adults with reduced stepping speed and coordination are disproportionately at risk of falls[12, 13], particularly in environments that demand quick adjustments, such as crowded or uneven spaces. This underscores the need to assess not only static balance but also the dynamic capacities required to navigate real-world scenarios safely.

Traditional balance assessment tools primarily focus on forward motion and static stability, each providing an aspect of functional mobility[14]. While they offer valuable insights into basic balance abilities, they fail to capture the agility to navigate in two-way movements in all key directions[6]. despite the critical role of multidirectional movements in preventing falls[15].. Most falls occur during dynamic activities, where individuals must rapidly adjust their posture to recover balance[14]. The ability to perform quick, corrective steps in multiple directions is an essential component of fall prevention[16]. Consequently, many older adults who perform well on these traditional tests may still face significant challenges in maintaining stability during dynamic activities.

Agility in athletes is traditionally defined as "a rapid whole-body movement involving changes in velocity or direction in response to a stimulus." [6]. However, in the context of older adults, agility encompasses the ability to perform quick, coordinated movements efficiently, particularly in response to daily mobility challenges. Given the age-related decline in neuromuscular function, maintaining agility is essential for fall prevention and functional independence. While balance contribute to agility, this test specifically evaluates multidirectional movement speed and adaptability, as the ability to step quickly in different directions is crucial for avoiding obstacles and maintaining stability in real-life scenarios. While muscle strength and balance contribute to agility, this test focuses specifically on agility as a critical factor. To ensure practicality, the test must be simple, brief, and executable without specialized equipment or large spaces. Furthermore, it is essential to establish the test's reliability and validity, along with normative values based on age and gender. The need for multidimensional assessment tools is particularly urgent given the multifactorial nature of balance and mobility. The purpose of this

study was to develop a step test that quantifies agility in forward, backward, and lateral movements in two-way directions and to evaluate its psychometric properties.

MATERIAL AND METHODS

Participants

This cross-sectional study used a convenience sampling method to recruit older adults from community centers and care facilities in Tehran. The sample size of 88 participants (48 men and 40 women) was determined to ensure sufficient statistical power, following guidelines for reliability and validity studies. A power analysis was conducted prior to the study using G Power software, aiming for a power of 0.80 (80%) with a significance level of $\alpha = 0.05$, which is commonly accepted in research for detecting significant correlations or differences while minimizing Type I and Type II errors. For assessing reliability, studies generally recommend at least 50 participants to estimate intra-class correlation coefficients (ICCs) accurately. Since the study assessed both interrater and intra rater reliability, the inclusion of 88 participants exceeded this minimum, providing additional confidence in the results. In terms of validity, the sample size was adequate for establishing strong statistical correlations with the Timed Up and Go (TUG) test. With an expected large effect size ($r > 0.5$), approximately 67 participants were required for sufficient power. Recruiting 88 participants allowed for potential attrition and variability, enhancing the reliability and validity of the analyses.[17, 18].

Inclusion and Exclusion Criteria

Participants were recruited in collaboration with community center management, who facilitated the identification and invitation of eligible individuals. Inclusion criteria required participants to be physically and cognitively able to perform the required tests, and provide informed consent. The informed consent process was conducted in accordance with ethical guidelines to ensure that participants fully understood the study's purpose, procedures, potential risks, and benefits before voluntarily agreeing to participate. Before enrollment, group meetings and individual consultations were held at the community centers where potential participants gathered. During these sessions, researchers provided a clear and comprehensive explanation of the study, including its objectives, methodology, duration, and expected participant involvement. A question-and-answer session followed to address any concerns. Participants who expressed interest in joining the study were given a written informed consent form, which included detailed information about the study. To ensure full comprehension, one-on-one discussions were held with each participant. Researchers explained key aspects in simple language and assessed whether participants understood the information provided. If needed, family members or caregivers were involved in the discussion.

Before signing the consent form, participants underwent an initial screening, including the Mini-Mental State Examination (MMSE) to ensure they had sufficient cognitive ability (score of 24 or higher) to make an informed decision[19]. Additionally, their physical capability to participate was assessed to confirm eligibility. After receiving all necessary explanations and addressing any remaining concerns, participants who agreed to take part in the study signed the informed consent form. Throughout the study, participants were reminded that their participation was voluntary, and they could withdraw at any stage without penalty or negative consequences. Any new risks or modifications to the study were promptly communicated, and participants were given the option to reaffirm or withdraw their consent.

Eligible participants were aged 60 years or older and able to walk independently, with or without a walking aid. They needed to perform basic movements such as standing, stepping, and changing directions without severe pain or discomfort. Participants were also required to have normal or near-normal neurophysiological function, meaning they did not exhibit severe sensory deficits (such as profound peripheral neuropathy or vestibular dysfunction) that could significantly impair balance and coordination.

Exclusion criteria included medical conditions that severely impaired mobility or balance, such as advanced Parkinson's disease, stroke with residual motor deficits, severe osteoarthritis, or lower limb amputation. Individuals with recent lower limb injuries or surgeries within the past six months, as well as those experiencing

conditions that interfered with balance and orientation (such as severe vestibular disorders or untreated inner ear dysfunction), were also excluded. Additionally, participants who required assistive devices beyond walking aids, such as wheelchairs, were not eligible.

Further exclusions were applied to individuals with diagnosed neurodegenerative conditions such as Alzheimer's disease or severe dementia, as well as psychiatric disorders like severe anxiety, depression, or schizophrenia, which could interfere with participation. Participants taking medications known to affect balance and motor coordination such as sedatives, high-dose muscle relaxants, strong antihypertensives causing postural hypotension, or neuroleptics were also excluded. Furthermore, individuals with uncontrolled hypertension, diabetes with severe peripheral neuropathy, or other conditions posing cardiovascular or metabolic risks during physical activity were deemed ineligible for the study.

score of 24 or higher, indicating no significant cognitive impairment. Participants were willing to engage in the study and provide informed consent. Those excluded were individuals diagnosed with conditions that significantly impaired mobility or balance, such as advanced Parkinson's disease, stroke with residual motor deficits, severe osteoarthritis, or lower limb amputation. Additionally, individuals with recent lower limb injuries or surgeries within the last six months, those experiencing conditions that interfered with balance and orientation, and those relying on assistive devices beyond walking aids, such as wheelchair-bound participants, were excluded., any diagnosed neurodegenerative condition such as Alzheimer's disease or severe dementia, as well as psychiatric disorders that could interfere with participation, such as severe anxiety or depression, led to exclusion. Furthermore, participants taking medications known to cause dizziness or impair motor coordination, like sedatives or high-dose muscle relaxants, and those with uncontrolled hypertension or diabetes that posed risks during physical activity were also not eligible for the study.

Square Excursion Step Test (SEST)

The Square Excursion Step Test (SEST) was designed and developed as a standardized and measurable protocol to assess multidirectional agility, dynamic postural control, and functional mobility in forward, backward, and lateral directions. Recognizing the importance of real-life stepping demands, researchers aimed to create a test that accurately evaluates movement efficiency while ensuring safety, precision, and replicability. A square-shaped stepping pattern was selected to incorporate movements in all cardinal directions, promoting a comprehensive assessment of balance, coordination, and agility. The test was refined through pilot testing, ensuring that its dimensions and stepping sequence were appropriately challenging yet feasible across different physical abilities. Special consideration was given to movement control, step length, and transition stability, preventing excessive difficulty while maintaining an adequate level of challenge. To enhance reliability and consistency, the timing mechanism, execution instructions, and scoring criteria underwent multiple iterations, incorporating participant feedback and expert review to improve clarity and standardization.

To ensure consistent administration, the SEST was conducted in a controlled environment with participants starting from the center of a clearly marked square on the floor, facing forward. Before beginning, the assessor explained the purpose of the SEST, emphasizing its focus on agility, balance, and postural control. The test area was prepared to ensure uniformity, and participants were given detailed verbal instructions and a visual demonstration of the stepping sequence by the assessor. The stepping sequence required individuals to move clockwise stepping forward, right, backward, and left before returning to the center. Participants were instructed to complete the sequence as quickly and safely as possible, ensuring both feet touched the ground at each position before moving to the next step. They were given one practice trial to familiarize themselves with the movement pattern. The timed trials began when the first foot lifted off the floor and ended when both feet returned to the center after completing the full sequence. To enhance test reliability, two timed trials were conducted, and the better time (in seconds) was recorded as the final score. Participants were instructed to maintain an upright, forward-facing posture, avoid stepping on boundary lines, and complete the sequence without hesitation. If a participant lost balance, stepped outside the designated area, or did not follow the correct sequence, the trial was stopped and repeated to ensure validity.

Several key considerations were taken into account to optimize test accuracy, safety, and inclusivity. The testing environment was free of obstacles and distractions, and participants wore comfortable, non-slip footwear to prevent accidental slips. The test surface was uniform across trials to reduce environmental bias. The SEST was designed to be inclusive of different functional abilities, allowing modifications for participants with mild mobility impairments. If necessary, the test could be conducted with a walking aid, but only if the participant could complete the sequence without external assistance. The use of assistive devices was recorded separately to distinguish performance variations among individuals. Rest breaks were provided if needed to prevent fatigue from influencing results. Finally, all assessments were conducted by trained evaluators, ensuring standardized administration and minimizing inter-rater variability.

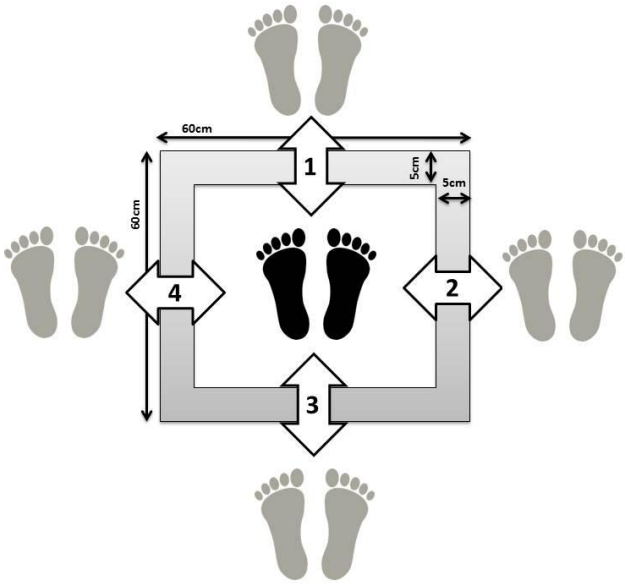

Figure (1). Square Excursion Step Test

Time Up & Go (TUG) Test

The Timed Up and Go (TUG) test was conducted to assess participants' functional mobility[15]. Participants began seated in a standard chair with their back against the chair, arms resting on the armrests, and feet flat on the floor. They were instructed to stand up upon a verbal cue, walk a distance of 3 meters at a comfortable and safe pace, turn around, walk back to the chair, and sit down. The test was demonstrated by the assessor before participants performed one practice trial to ensure understanding. Two timed trials were subsequently conducted, with the faster time (in seconds) recorded as the final score. Timing started when the participant's back left the chair and ended when they returned to a seated position with their back against the chair. Trials were repeated if the participant failed to complete the task as instructed, such as by losing balance, deviating significantly from the path, or requiring assistance.

Data analysis

The Kolmogorov-Smirnov test was used to assess the normality of the data distribution. Logical validity of the SEST was evaluated through both face validity and statistical validity. Face validity was confirmed by expert review using the Content Validity Ratio (CVR) and Content Validity Index (CVI), while statistical validity was established by comparing the SEST to the Timed Up and Go (TUG) test, a widely accepted measure of functional

mobility. Pearson's correlation coefficient was used to assess the relationship between the SEST and TUG. All statistical analyses were conducted at a significance level of $p < 0.05$, ensuring robust and reliable results. The analyses were performed using SPSS software (version 27), which provided the necessary tools for comprehensive data processing and interpretation.

RESULTS

Descriptive statistics of participants and variables are presented in Table 1. Normality assessment using the Kolmogorov-Smirnov test confirms normal distribution, with significance values above 0.05 for SEST: 0.31, and TUG: 0.23). These findings suggest that the data is suitable for parametric statistical analyses.

Table 1. Descriptive Statistics of Participants and Variables

Variable	Mean ± Standard Deviation
Age(years)	70.82 ± 5.52
Height(cm)	162.49 ± 4.90
Weight(kg)	68.98 ± 7.14
SEST - Rater 1 (First Time) (s)	8.98 ± 1.12
SEST - Rater 1 (Second Time) (s)	8.96 ± 1.08
SEST - Rater 2 (First Time) (s)	8.99 ± 1.12
TUG - Rater 1 (s)	9.44 ± 1.10

Validity

The face validity of the Square Excursion Step Test (SEST) was rigorously evaluated by a panel of 10 experts in sports sciences, who reviewed the test design and the researcher's explanations regarding its applicability for assessing sitting balance and multidirectional agility. Using the Content Validity Ratio (CVR), expert agreement was quantified based on the Lawshe method, with each expert rating the necessity of the SEST for its intended purpose. The resulting CVR of 0.80 exceeded the minimum threshold of 0.62 for 10 experts, indicating strong consensus on the relevance and appropriateness of the SEST for assessing balance and agility. Additionally, the Content Validity Index (CVI) was calculated to evaluate the clarity and relevance of each component of the SEST. Experts rated each aspect of the test on a 4-point Likert scale, and the average CVI score of 0.90 reflected high overall validity, demonstrating that the SEST is both clear and well-suited for its intended purpose. To further establish its validity, the concurrent validity of the SEST was assessed by comparing it with the Timed Up and Go (TUG) test, a widely recognized and validated measure of functional mobility. Pearson's correlation coefficient revealed a strong positive correlation between the SEST and TUG, with $r = 0.81$ ($df = 87$, $p = 0.001$), confirming that the SEST effectively measures balance and mobility in alignment with the established TUG test. These findings collectively underscore the SEST's strong face validity, content validity, and concurrent validity, making it a robust and reliable tool for assessing multidirectional agility, postural control, and functional mobility in both clinical and research settings.

Reliability

The Square Excursion Step Test (SEST) was rigorously evaluated for both interrater and intrarater reliability to ensure its consistency and reproducibility as a tool for assessing multidirectional agility and postural control. For interrater reliability, two raters independently and simultaneously recorded the evaluation results for the same set of participants. Statistical analysis using the intraclass correlation coefficient (ICC) revealed exceptionally high interrater reliability, with an ICC of .99 ($df=87$, $p=.001$), indicating near-perfect agreement between the raters.

This high level of consistency underscores the clarity of the SEST protocol and scoring criteria, minimizing variability in results due to differences in rater interpretation. For intrarater reliability, a test-retest method was employed, with participants assessed at two separate time points spaced 10 days apart to reduce the influence of memory or practice effects. The results recorded by the first rater were used for analysis, and the ICC analysis demonstrated high intrarater reliability, with an ICC of .90 (df=87, p=.001), reflecting strong consistency in the rater's evaluations over time. These findings confirm that the SEST is a highly reliable tool for both single and multiple raters, making it suitable for use in clinical and research settings where consistent and accurate measurement of agility and postural control is essential. The high ICC values for both interrater and intrarater reliability further validate the SEST as a robust and dependable assessment method.

DISCUSSION

Agile stepping is a fundamental component of functional capacity in older adults, underscoring the necessity for precise and reliable measurement tools to evaluate this critical ability. The accurate identification of older individuals at risk for mobility limitations and falls is essential for implementing timely interventions that mitigate fall risk and associated morbidities. Developing practical, reliable, and accessible assessment tools that can be seamlessly integrated into clinical and community settings is a priority in geriatric healthcare and research. The Square Excursion Step Test (SEST) addresses this need by providing a comprehensive and ecologically valid measure of dynamic balance and agility, which are key predictors of fall risk and functional independence in older adults.

The SEST demonstrated a strong correlation with the Timed Up and Go (TUG) test ($r = 0.81$), providing robust evidence of its concurrent validity. This significant relationship highlights the SEST's capacity to effectively evaluate dynamic balance, offering a performance measure comparable to the widely recognized TUG test. However, unlike the TUG, which primarily focuses on forward motion and basic mobility, the SEST expands the scope of balance assessment by incorporating multidirectional movements, including forward, backward, and lateral stepping bilaterally. This multidirectional approach better reflects the complex movement patterns required in daily life, such as navigating obstacles, changing direction, or recovering from a loss of balance, thereby enhancing the ecological validity of the test.

In addition to its strong concurrent validity, the SEST exhibited excellent reliability, with intra-rater reliability ($\alpha = 0.90$) and inter-rater reliability ($\alpha = 0.99$). These high reliability coefficients ensure consistency and reproducibility across evaluators and repeated assessments, making the SEST a dependable tool for both clinical and research applications. The test's structured protocol, which includes clear instructions, practice trials, and the option to repeat attempts in cases of errors or instability, further enhances its feasibility and safety for use with older adults, including those with mild physical or cognitive impairments.

Measures of balance, gait, and mobility including timed tandem stance[20], tandem walk, timed unipedal stance, timed up and go[21], performance oriented mobility assessment [22], and 6-minute walk[23]; measures of leg strength (peak knee and ankle torque and power at slow and fast speeds); self-report measures of frequent falls (>2 per 12 months), and confidence to avoid falls (Activity-specific Balance Confidence (ABC) Scale)[24-26] have advanced the field but remain limited in scope. Existing tools that address stepping performance, such as the Step Test and the Four-Square Step Test (FSST)[8, 27], The Step Test focuses on forward stepping speed and coordination, correlating with lower-limb strength and walking performance. However, it does not evaluate lateral or backward stepping, which are equally critical for real-world mobility. The FSST, by incorporating multidirectional movements, addresses this limitation to some extent. It assesses the ability to step forward, backward, and sideways in a set sequence, challenging cognitive and physical capabilities. While the FSST has demonstrated utility in identifying fall risk, However, it does not evaluate each direction in a two way movement.

A notable advantage of the SEST lies in its ability to address critical gaps in traditional balance assessment tools. Conventional measures, such as the Berg Balance Scale (BBS) and the TUG test, primarily emphasize static balance and unidirectional movements, limiting their applicability to the complex dynamics of real-world mobility. The SEST's multidirectional approach is particularly relevant for older adults, as tasks in daily life often require stepping in various directions, such as maneuvering through crowded spaces, avoiding obstacles, or adjusting to uneven surfaces. These tasks demand advanced motor planning, postural control, and coordination—abilities that the SEST is uniquely designed to evaluate. By mimicking these real-life challenges, the SEST provides a more comprehensive assessment of functional mobility, enabling the identification of specific deficits in dynamic balance that may otherwise go undetected.

In addition to balance, the SEST effectively evaluates agility, coordination, spatial orientation, proprioception, and quickness. The test's requirement for rapid and precise stepping in multiple directions challenges the participant's ability to quickly adapt to changing spatial demands, thereby enhancing its relevance to real-world scenarios. Agility and coordination are critical for executing controlled and efficient movements, while spatial orientation and proprioception ensure accurate foot placement and body awareness during the test. The emphasis on quickness not only reflects the speed component of dynamic balance but also highlights the individual's capacity to respond swiftly to environmental demands, a key factor in fall prevention. By integrating these elements, the SEST offers a holistic evaluation of functional mobility that extends beyond traditional balance measures.

In summary, the SEST offers a novel and comprehensive approach to balance assessment that aligns with the multidirectional demands of everyday mobility. Its demonstrated validity, reliability, and practicality establish it as an essential tool in geriatric healthcare and fall prevention research. By addressing the limitations of traditional assessment tools and providing a detailed evaluation of dynamic balance, agility, and coordination, the SEST represents a significant advancement in the field, ultimately supporting the independence and well-being of older adults.

Limitations of the Study

While the Square Excursion Step Test (SEST) showed high validity and reliability, this study has limitations. The sample was limited to older adults in Tehran care centers, reducing generalizability due to unaddressed cultural and environmental differences. Its cross-sectional design prevents establishing causality between SEST performance and fall risk or mobility outcomes. The study excluded individuals with severe cognitive or physical impairments, limiting its applicability to more disabled populations. Lastly, SEST validity was assessed only against the Timed Up and Go (TUG) test, restricting evaluation across broader balance measures.

Conclusion

The Square Excursion Step Test (SEST) is a highly practical and valid assessment tool designed to evaluate dynamic balance, coordination, and agility, particularly in older adults. By engaging multiple components of postural control such as motor planning, reaction time, and stepping precision the SEST addresses critical factors necessary for maintaining functional independence and preventing falls in aging populations. Its structured protocol, which involves sequential multi-directional stepping in a controlled and repeatable pattern, provides a comprehensive evaluation of an individual's ability to execute complex motor tasks under time constraints. The SEST's ecological validity is particularly noteworthy, as it simulates functional movement patterns commonly encountered in daily life, such as navigating confined spaces or adjusting steps to avoid obstacles, making it highly relevant for assessing real-world physical performance. Furthermore, the test's emphasis on safety through clear instructions, practice trials, and the option to repeat attempts in cases of errors or instability ensures its feasibility for use with older adults, including those with mild physical or cognitive impairments. The timed outcomes provide a quantifiable and objective measure of performance, enabling clinicians and researchers to monitor physical function over time and develop targeted interventions to enhance mobility, reduce fall risk, and improve overall quality of life in aging populations.

The findings from the SEST have significant implications for the broader field of geriatrics, rehabilitation, and fall prevention. By offering a reliable and valid measure of dynamic balance and agility, the SEST fills a critical gap in the assessment of functional mobility, particularly for older adults who are at higher risk of falls and mobility-related disabilities. The test's ability to simulate real-world movement challenges makes it a valuable tool for identifying individuals at risk of falls and designing personalized intervention programs. For example, poor performance on the SEST could prompt targeted exercises to improve stepping precision, reaction time, or multi-directional coordination, thereby reducing fall risk and enhancing independence. Additionally, the SEST's high inter-rater and test-retest reliability, along with its strong concurrent validity when compared to established measures like the Timed Up and Go (TUG) test, underscores its potential for widespread adoption in clinical and research settings. Future studies could explore the use of the SEST in diverse populations, such as individuals with neurological conditions or post-surgical patients, to further validate its applicability and expand its utility. By contributing to the development of more effective assessment and intervention strategies, the SEST has the potential to significantly impact the field of aging research and improve outcomes for older adults worldwide.

Ethical Considerations:

Compliance with ethical guidelines

This study complied with the Declaration of Helsinki. Informed consent was obtained from all subjects involved in the study.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript

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Author Contributions: Conceptualization, HA and ZP; Methodology, HA, ZP, and HM; Investigation, all authors; Writing – Original Draft, all HA and ZP; Writing – Review & Editing, all authors; Funding Acquisition, HA and ZP; Resources, HA and ZP; Supervision, HA and HM. All authors have read and agreed to the published version of the manuscript.

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توسعه و اعتبارسنجی آزمون گام‌برداری چهارجهته برای ارزیابی کنترل پاسچرال در سالمندان: بررسی چابکی گام‌برداری

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چکیده

هدف: کنترل پاسچرال حین گام‌برداری چندجهته یکی از مؤلفه‌های اساسی استقلال عملکردی و عاملی کلیدی در پیشگیری از سقوط سالمندان است. با وجود ابزارهای متعدد ارزیابی تعادل، همچنان نیاز به آزمونی عملی، کم‌هزینه و قابل اطمینان برای این جمعیت وجود دارد. هدف اصلی این پژوهش، توسعه و اعتبارسنجی آزمون گام‌برداری چهارجهته (SEST) از طریق بررسی پایایی، روایی و کاربرد آن در محیط‌های بالینی و اجتماعی بود.

روش شناسی: در این مطالعه، ۸۸ سالمند به‌صورت داوطلبانه شرکت کردند. آزمون گام‌برداری چهارجهته شامل گام‌برداری در چهار جهت اصلی (جلو، عقب، چپ و راست) در یک مربع مشخص‌شده است که نیاز به دقت، تعادل و هماهنگی دارد.

نتایج: روایی صوری آزمون توسط ۱۰ متخصص علوم ورزشی تأیید شد و نسبت روایی محتوایی (CVR) برابر با ۰/۸۰ به‌دست آمد که از حد آستانه ۰/۶۲ فراتر بود و بر اجماع قوی متخصصان در مورد ارتباط آزمون دلالت داشت. شاخص روایی محتوایی (CVI) به‌طور میانگین ۰/۹۰ محاسبه شد که نشان‌دهنده وضوح و تناسب بالای مؤلفه‌های آزمون است. روایی همزمان نیز از طریق همبستگی معنی‌دار با آزمون برخاستن و راه رفتن زمان‌بندی‌شده تأیید شد($r=۰/۸۱$، $p=۰/۰۰۱$). ارزیابی‌های پایایی نشان داد که همبستگی درون‌رده‌ای (ICC) برای پایایی بین ارزیابان برابر با ۰/۹۹و برای پایایی درون‌ارزیابان در دو ارزیابی با فاصله ده روز، ۰/۹۰ بود. این نتایج نشان می‌دهد که آزمون گام‌برداری چهارجهته(یک ابزار معتبر و پایا برای ارزیابی تعادل در افراد با توانایی‌های فیزیکی کاهش‌یافته است.

نتیجه گیری: یافته‌های این پژوهش اعتبار آزمون گام‌برداری چهارجهته را به‌عنوان ابزاری مناسب برای سنجش ثبات پاسچرال حین گام‌برداری چندجهته در سالمندان تأیید می‌کند.

واژه‌های کلیدی
پیری، تعادل، سالمندان، سقوط، راه رفتن

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