Accepted Article

Journal of Frailty, Sarcopenia and Falls

Original Article

Comparative Prognostic Value of Objectively Measured Standing Balance and Self-Reported Falls History for Mortality and Incident Disability in Older Indian Adults: A Prospective Analysis of the LASI-DAD Cohort

Bhrigu Jain[1], Aparajit Ballav Dey[1], Sharmistha Dey[2]

[1]Department of Geriatric Medicine, All India Institute of Medical Sciences, New Delhi, India
[2]Department of Biophysics, All India Institute of Medical Sciences, New Delhi, India

Abstract

Objectives: To test whether a brief objective standing-balance test predicts death and new disability in older Indians, and to compare it with self-reported falls history. **Methods**: Prospective analysis of 2,975 adults aged ≥60 years in the Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India (LASI-DAD). Standing balance (three timed stands, scored 1 to 4 and grouped as good, fair or poor) and self-reported falls were recorded. Outcomes were all-cause mortality and incident difficulty in basic activities of daily living. Models were adjusted for age, sex, education, body-mass index and, for mortality, baseline disability. **Results**: Over a median 4.25 years, 688 died. Poorer balance predicted death (adjusted hazard ratio 1.26 per standard deviation, 95% CI 1.18–1.34; poor versus good 2.30, 1.84–2.88) and new disability (odds ratio 1.25 per standard deviation, 1.07–1.46). Fall history predicted neither (mortality 1.02, 0.85–1.22; disability 1.25, 0.92–1.71). Balance improved discrimination for mortality (ΔC +0.012, 95% CI 0.005 to 0.021); fall history did not (−0.001, −0.001 to 0.001). **Conclusions**: A one-minute balance test carried prognostic information that the falls question did not. Balance testing and fall history are complementary and suit low-resource settings.

Keywords: Postural balance, Accidental falls, Mortality, Activities of daily living, Geriatric assessment

Introduction

India is ageing faster than almost any large country in recorded history. The number of Indians aged 60 years or older is projected to double from about 149 million in 2022 to 347 million by 2050, when roughly one in five Indians will be an older adult and older people will, for the first time, outnumber children[1]. Seven in ten older Indians live in rural areas and more than 40% belong to the poorest wealth quintile, often far from specialist geriatric services[1]. Against this backdrop, falls and the mobility decline that surrounds them are a major and growing source of injury, disability and death: about one in four older adults report a fall[2], and falls are among the leading contributors to fracture, hospitalisation, loss of independence and premature mortality in later life[3,4].

Identifying which older adults are on a trajectory toward decline, within the few minutes and minimal equipment available in a crowded clinic or a village health post, is a routine but consequential task of geriatric care. In practice, that assessment usually begins with a single question: has the person fallen recently? A history of falls is embedded in virtually every falls-risk pathway and guideline, including the World Falls Guidelines[5]. For its intended purpose,

The authors have no conflict of interest.

Corresponding author: *Dr Bhrigu Jain, Department of Geriatric Medicine, All India Institute of Medical Sciences, Sri Aurobindo Marg Ansari Nagar, Ansari Nagar East, New Delhi, Delhi, 110029, India*

E-mail: *bhrigujainaiims@gmail.com*

ORCID iD: *0000-0001-8785-3759*

Edited by: *Dawn Skelton*

Accepted *29 September 2026*

Published under the Creative Commons License CC BY-NC-SA 4.0 (Attribution-NonCommercial-ShareAlike 4.0).

identifying who is likely to fall again, it performs well: a previous fall is among the strongest predictors of a future fall[6,7]. Whether the same question identifies who will die or lose independence is a different matter, and as a marker of broader prognosis a self-reported fall has recognised weaknesses. Older adults recall falls imperfectly, and the non-injurious falls that make up the majority are especially likely to be forgotten[8,9]. Most of the evidence linking falls to hard outcomes also comes from high-income countries and may not transfer to the low- and middle-income settings where most of the world's older adults live and most fatal falls occur[4,10].

An attractive alternative is to measure what a fall only hints at: the body's capacity to remain upright. Standing-balance tests, in which the feet are held side by side, in semi-tandem and in full tandem for a set time, take about a minute, need no equipment beyond a timer, and depend on neither literacy nor recall. Similar stands form the balance component of the Short Physical Performance Battery (SPPB), and lower-extremity performance of this kind is among the most reproducible predictors of adverse outcomes in older adults, predicting death consistently across 17 pooled cohorts irrespective of region, age or follow-up length[11–13] and mortality, hospitalisation and incident disability in pooled analyses of tens of thousands of participants[14–17]. Balance is rarely isolated from these composite measures, however, and it has almost never been placed head-to-head against the falls question, the screen it would complement, in a large, nationally representative sample from a low- or middle-income country.

We therefore used the Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India (LASI-DAD) to ask two practical questions: whether a brief objective balance test predicts who will die and who will lose independence, and whether the information it carries is independent of, and additional to, the falls history that clinicians already elicit. We hypothesised that measured balance would predict both outcomes, that the falls question would carry little information about these outcomes, and that the two screens (the standing-balance test and the falls-history question) would therefore be complementary rather than interchangeable. We tested this directly, including whether balance stratifies risk within groups defined by fall history and whether it adds discrimination beyond the variables routinely available at the point of care.

Materials and Methods

Study design and data sources

LASI-DAD is a nationally representative cohort of Indians aged 60 years and older, assembled as an in-depth cognitive and biomarker sub-study of the Longitudinal Aging Study in India (LASI), the country's largest ageing survey[18,19]. Participants underwent a Harmonized Cognitive Assessment Protocol with informant interviews and, in a subset, venous-blood biomarker measurement; a second wave was completed between 2022 and 2024[20]. We used the Harmonized LASI (version A.3) and Harmonized LASI-DAD (version B.1) datasets of the Gateway to Global Aging Data programme[21–24], linking baseline physical and questionnaire measures from the LASI main wave, by individual identifier, to the LASI-DAD assessments (Waves 1 and 2) and to an informant-based end-of-life module recording deaths. Reporting follows the STROBE guidance[25].

Participants and analytic samples

Of the 4,096 LASI-DAD Wave 1 participants, 3,524 had a standing-balance score from the LASI physical-measures visit. The 572 without a score comprised 310 with no physical-measures record, 181 who were unable or unwilling to attempt the test because of a health condition, and 81 with no recorded summary score. Vital status could be confirmed for 3,008 of the 3,524 through a Wave 2 re-interview or a next-of-kin exit interview; the remaining 516 had neither, could not contribute follow-up, and were excluded from the primary analysis but examined in sensitivity analyses. After further exclusion of 5 participants with missing body-mass index, 8 with missing baseline activities-of-daily-living (ADL) items, 9 with no recorded date of death and 11 with a recorded date of death in or before the month of cohort entry, the mortality analytic sample comprised 2,975 participants (688 deaths). The flow of participants is shown in Supplementary Figure S1, and excluded participants are compared with those retained in Supplementary Table S1.

For incident disability, the sample was restricted to the 1,458 participants free of any ADL difficulty at Wave 1. Of these, 283 died before Wave 2, 34 were re-interviewed without completing the ADL items, and 1,141 were reassessed and formed the incident-disability sample, so that the outcome was incident by construction. Because a participant who died before Wave 2 could not be recorded as disabled, the 1,424 disability-free participants whose status at Wave 2 was known (died, alive with new disability, or alive without disability) formed a third sample.

Exposures

Standing balance was tested at the LASI physical-measures visit with the protocol used across the Health and Retirement Study family of surveys[23]. Participants first tried to stand for 10 seconds in semi-tandem (the heel of one foot beside the big toe of the other). Those who could not were asked to stand with their feet side by side for 10 seconds, and the test ended. Those who could were asked to stand in full tandem (one foot directly in front of the other) for 60 seconds if younger than 70 years or 30 seconds if 70 or older. The survey scores the result from 1 to 4: 4, semi-tandem and full tandem both held for the full time; 3, semi-tandem held but full tandem not held for

the full time; 2, only the side-by-side stand held; 1, neither stand held (Supplementary Table S2). We classified a score of 4 as Good balance, 3 as Fair and 1 or 2 as Poor, and also analysed the score continuously, per standard deviation (SD; 0.66 points in the mortality sample) of worse balance. Participants unable to attempt the test for health reasons had no score. Because the full-tandem target was longer than the 10 seconds used in the SPPB and differed by age, we repeated the analyses with two scorings that apply one standard to everyone: the SPPB balance score (0 to 4), recalculated from the recorded stance times, and the number of seconds the full tandem was held.

The comparator exposure was self-reported falls, ascertained at the same visit as (i) any fall in the previous two years, (ii) whether any such fall had resulted in an injury, and (iii) recurrent falling, defined as two or more falls, mirroring the way fall history is elicited in ordinary clinical practice.

Outcomes and timeline

Exposures and covariates were recorded at the LASI physical-measures visit; participants entered the cohort at the LASI-DAD Wave 1 assessment, a median of 8 months later (interquartile range 4–17; range 0–35). The first outcome was all-cause mortality. The end-of-life module recorded the month and year of death, and survival time ran from Wave 1 to death or to censoring at the Wave 2 assessment, with dates taken as mid-month (mid-year for the 12 deaths with no recorded month). Because cohort membership required survival to Wave 1, the interval before entry is immortal time and was not counted as time at risk[26]; a second analysis that took the balance assessment as time zero is described below. The second outcome was incident ADL disability, assessed with the LASI-DAD geriatric assessment, in which participants reported whether, because of a health or memory problem, they had any difficulty with six basic activities derived from the Katz index, namely dressing, bathing, eating, getting in or out of bed, walking across a room and using the toilet[27], excluding difficulties expected to last under three months (Supplementary Table S3). Incident disability was difficulty with one or more activities at Wave 2 among participants reporting none at Wave 1, using the same instrument at both waves. This instrument elicits difficulty more readily than the core LASI interview, so baseline prevalences are higher than in analyses of the core items.

Covariates

All models were adjusted for age, sex, educational attainment and measured body-mass index, variables routinely available at the point of care. Mortality models were additionally adjusted for baseline ADL difficulty, entered as the number of activities with difficulty (0 to 6); the incident-disability cohort was disability-free at baseline by design. A wider covariate set, described below, tested whether balance retained prognostic information beyond broader health status.

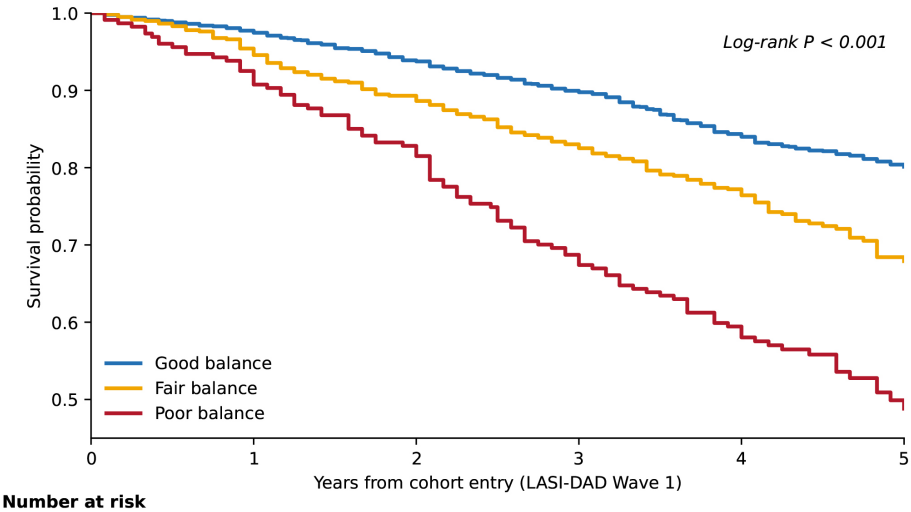
Statistical Analysis

Baseline characteristics were compared across balance categories by trend tests (linear or logistic regression on category rank; chi-squared tests for multi-level variables), and agreement between an abnormal balance test (Fair or Poor) and a reported fall was summarised with Cohen's κ and a bootstrap 95% confidence interval (CI). All-cause mortality was modelled with Cox regression, with balance entered continuously and categorically and crude rates per 100 person-years; proportional hazards were checked for every covariate with scaled Schoenfeld residuals, and a model stratifying the baseline hazard by age group (60 to 69, 70 to 79, 80 years or older) and sex checked the handling of age. Incident disability was modelled with logistic regression.

To address reverse causation, the analyses of balance and mortality (continuous and categorical) were repeated in landmark analyses excluding deaths within the first one and two years of baseline[28]; this reduces, but does not eliminate, the contribution of pre-existing disease. To address the interval before cohort entry, we also ran a delayed-entry analysis[26], taking the LASI balance assessment rather than LASI-DAD Wave 1 as time zero and counting each participant's risk time only from their Wave 1 date, and estimated the association separately for intervals of six months or less and longer.

Death before Wave 2 removes a participant from the disability analysis, so if poorer balance leads to earlier death, part of its effect on independence is hidden, because death acts as a competing outcome[29]. We therefore analysed the 1,424 participants of the third sample in two further ways: classifying each person's status at Wave 2 as alive without disability, alive with new disability or dead, and comparing the last two with the first by multinomial logistic regression; and counting death or new disability as a single outcome in a logistic model (Supplementary Table S4). Because disability was recorded only at Wave 2, a time-to-event competing-risks model was not possible.

To quantify the added value of each screen, we compared discrimination between a base model containing the routine covariates and models adding balance (continuous score; categorical as a secondary comparison) or the falls question, using Harrell's C for mortality and the area under the receiver-operating-characteristic curve (AUC) for disability[30,31]. Apparent values were corrected for optimism by bootstrap, and 95% CIs for each increment, and for the difference between the balance and fall-history increments, came from 1,000 paired bootstrap resamples with all models refitted on each; nested models were compared by likelihood-ratio test. Finally, we cross-classified participants by balance category and fall history and estimated the outcome within each stratum (Supplementary Table S5).



Number at risk

Good	2,159	2,104	2,024	1,930	1,615	575
Fair	589	557	522	486	388	132
Poor	227	206	185	153	123	45

Figure 1. Kaplan–Meier survival by standing-balance category. Good denotes a survey balance score of 4 (semi-tandem and full-tandem stands both held for the full time), Fair a score of 3 (semi-tandem held, full tandem not held for the full time) and Poor a score of 1 or 2 (semi-tandem not held for 10 seconds). Categories were compared by the log-rank test. Numbers at risk are shown beneath the curves. Curves are truncated at five years, when 45 participants in the Poor group remained at risk.

Three sets of sensitivity analyses were run. First, covariates were added in stages to the point-of-care model: socio-economic factors (marital status, rural residence, current work, scheduled caste or tribe, household assets), then health status (number of chronic conditions, stroke, self-rated health, depressive symptoms, Hindi Mental State Examination score), then physical function (grip strength, weekly vigorous activity, difficulty with instrumental activities of daily living [IADL]), all on participants with complete data for every covariate (Supplementary Table S6). Second, balance was rescored by SPPB rules and as full-tandem time, analysed within each age group, and extended to participants unable to attempt the test by counting them as Poor; models were also weighted to the national population (Supplementary Table S7, panels A and B). Third, for participants whose survival was unknown, we reran the analysis assuming all were alive, assuming all had died, and under the pattern of loss least favourable to our finding; and we filled in missing balance scores and covariates by multiple imputation[32], combining 10 imputations by Rubin's rules (Supplementary Table S7, panel C).

Analyses were performed in Python 3.12 (pandas, lifelines, statsmodels, scikit-learn) with a fixed random seed; tests were two-sided with alpha 0.05.

Results

Cohort characteristics and overlap between balance and fall history

The 2,975 participants had a mean age of 68.5 years, and 53.5% were women. Balance was Good (score 4) in 2,159 (72.6%), Fair (score 3) in 589 (19.8%) and Poor (score 1 or 2) in 227 (7.6%). Of the 589 participants with Fair balance, 428 held the full tandem for 10 seconds or more (full marks by SPPB rules) but not for the longer LASI target. A fall in the previous two years was reported by 22.3%, an injurious fall by 13.0% and recurrent falls by 10.4%. The two screens flagged largely different people: of the 663 participants who reported a fall, 438 (66%) had Good balance, and of the 816 with Fair or Poor balance, 591 (72%) reported no fall, so agreement between the two was close to chance (κ 0.08, 95% CI 0.04–0.12; Table 1). Worse balance was accompanied by graded increases in age, widowhood, multimorbidity, cognitive impairment, ADL and IADL limitation, poor self-rated health, weaker grip and adverse biomarkers, whereas reported falls rose only from 20.3% with Good balance to 27.5% with Fair and 27.8% with Poor balance. Participants excluded for lack of a balance score were older and frailer, whereas those with unconfirmed vital status were slightly better educated and

Table 1. Baseline characteristics and outcomes by standing-balance category.

Characteristic	Good (n = 2,159)	Fair (n = 589)	Poor (n = 227)	P for trend
Outcomes over follow-up				
Died, n (%)	411 (19.0)	165 (28.0)	112 (49.3)	<0.001
Mortality rate per 100 person-years	4.4	7.0	13.5	
Incident ADL disability, % (disability-free subsample)	34.2	49.7	52.6	<0.001
Demographic and socioeconomic characteristics				
Age, years, mean (SD)	67.7 (6.4)	69.7 (7.8)	73.9 (9.1)	<0.001
Female, %	49.4	62.1	69.6	<0.001
Education, %				
Below upper secondary	74.7	81.2	82.4	0.002
Upper secondary or vocational	22.0	15.6	15.9	
Tertiary	3.3	3.2	1.8	
Currently married or partnered, %	71.5	59.9	43.6	<0.001
Widowed, %	27.1	38.4	54.2	<0.001
Rural residence, %	65.6	63.0	62.1	0.147
Scheduled caste or tribe, %	25.5	24.4	22.0	0.250
Currently working, %	36.9	22.1	15.0	<0.001
Household size, persons, median (IQR)	5.0 (3.0–6.0)	5.0 (2.0–6.0)	5.0 (3.0–6.0)	0.309
Household assets, ₹ lakh, median (IQR)	11.6 (3.9–30.5)	11.0 (4.0–31.0)	14.5 (4.0–28.9)	0.613
Health behaviours				
Current smoker, %	18.2	12.1	9.3	<0.001
Ever consumed alcohol, %	16.6	13.8	7.5	<0.001
Vigorous physical activity at least once a week, %	29.7	14.4	7.5	<0.001
Self-reported diagnoses (ever), %				
Hypertension	35.4	43.5	47.6	<0.001
Diabetes	15.4	18.5	20.3	0.017
Heart disease	6.3	7.6	7.9	0.169
Stroke	1.7	3.6	6.2	<0.001
Chronic lung disease	3.1	3.2	4.4	0.337
Arthritis	18.0	18.3	25.1	0.033
Cancer	0.6	2.0	0.0	0.360
High cholesterol	3.7	5.9	5.3	0.035
Multimorbidity (≥ 2 conditions)	22.4	28.5	35.7	<0.001
Geriatric syndromes and function				
HMSE cognitive score (0–30), mean (SD)	23.1 (5.0)	22.6 (5.3)	20.6 (6.3)	<0.001
Depressive symptoms (CES-D ≥ 4), %	27.6	34.6	43.0	<0.001
Any ADL difficulty (LASI-DAD assessment, ≥ 1 of 6), %	47.8	54.8	70.9	<0.001
Any IADL difficulty (≥ 1 of 7), %	38.6	52.5	62.1	<0.001
Grip strength, kg, mean (SD)	21.7 (7.6)	18.7 (7.0)	14.9 (6.2)	<0.001
Difficulty walking across a room, %	3.4	7.0	13.7	<0.001
Frequent pain, %	39.1	44.1	42.7	0.047

Table 1. *(Cont. from previous page).*

Characteristic	Good (n = 2,159)	Fair (n = 589)	Poor (n = 227)	P for trend
Fair or poor self-rated health, %	47.6	58.6	66.5	<0.001
Body-mass index category, %				
Underweight (< 18.5 kg/m²)	22.5	21.6	23.3	
Normal (18.5–24.9 kg/m²)	51.5	47.0	47.1	0.101
Overweight or obese (≥ 25 kg/m²)	26.1	31.4	29.5	
Wears spectacles, %	38.6	44.3	38.8	0.168
Self-reported falls (comparator exposure)				
Any fall, previous 2 years, n (%)	438 (20.3)	162 (27.5)	63 (27.8)	<0.001
Injurious fall, %	12.0	15.3	16.7	0.008
Recurrent falls (≥ 2), %	8.9	14.1	14.1	<0.001
Blood biomarkers (venous subsample)				
Haemoglobin, g/dL, mean (SD)	12.8 (1.8)	12.6 (1.9)	12.2 (2.1)	<0.001
Anaemia, %	38.3	38.2	47.9	0.061
HbA1c, %, median (IQR)	5.9 (5.5–6.3)	5.9 (5.6–6.4)	5.9 (5.6–6.4)	0.315
Total cholesterol, mg/dL, mean (SD)	185 (43)	185 (40)	181 (45)	0.320
hs-CRP, mg/L, median (IQR)	1.6 (0.7–4.1)	2.0 (1.0–4.7)	2.3 (0.9–6.0)	0.064
Elevated CRP, %	33.4	38.3	42.7	0.005
Albumin, g/dL, mean (SD)	4.2 (0.3)	4.1 (0.3)	4.0 (0.4)	<0.001
Cystatin C, mg/L, median (IQR)	1.12 (0.96–1.31)	1.17 (1.01–1.43)	1.29 (1.09–1.57)	<0.001

Values are mean (standard deviation), median (interquartile range) or per cent unless stated. Balance category from the survey balance score: Good = score 4 (semi-tandem and full-tandem stands held for the target time); Fair = score 3 (semi-tandem held, full-tandem target not held); Poor = score 1 or 2 (semi-tandem stand not held for 10 seconds). P for trend across ordered categories from linear (continuous) or logistic (binary) regression on category rank; multi-level variables tested by chi-squared test. ADL difficulty at baseline is from the LASI-DAD geriatric assessment (six activities, any difficulty due to a health or memory problem; Supplementary Table S3), the instrument used to define the disability outcome; IADL difficulty is from the LASI core interview (seven activities). Agreement between Fair or Poor balance and any fall: κ 0.08 (95% CI 0.04 to 0.12). Biomarkers were measured in the venous-blood subsample (Good n = 1,556, Fair n = 422, Poor n = 169); incident ADL disability is shown for the disability-free subsample followed to Wave 2 (Good n = 918, Fair n = 185, Poor n = 38). ADL, activities of daily living; IADL, instrumental activities of daily living; BMI, body-mass index; CES-D, Center for Epidemiologic Studies Depression scale; HMSE, Hindi Mental State Examination; CRP, C-reactive protein; HbA1c, glycated haemoglobin.

cognitively better, and less often underweight or recurrent fallers (Supplementary Table S1).

Balance and mortality

Over a median of 4.25 years (12,442 person-years), 688 participants (23.1%) died. Mortality rose steadily across balance categories, from 4.4 per 100 person-years in the Good group to 7.0 in Fair and 13.5 in Poor (Figure 1). On the continuous scale, each SD decrement in balance carried a 26% higher hazard of death (adjusted hazard ratio [HR] 1.26, 95% CI 1.18–1.34); on the categorical scale, relative to Good balance, the adjusted HR was 1.51 (1.26–1.82) for Fair and 2.30 (1.84–2.88) for Poor balance (Table 2; Figure 2). Proportional hazards held for balance and every covariate (all $P \geq 0.08$), and stratifying the baseline hazard by age group and sex left the estimates unchanged (Supplementary Table S7, panel B). Excluding deaths within the first two years (n = 2,731; 444 deaths) gave an HR of 1.24 (1.14–1.34) per SD, 1.36 (1.08–1.72) for Fair and 2.27 (1.71–3.01) for Poor balance, with similar estimates for the one-year landmark (Table 3). Taking the balance assessment rather than Wave 1 as time zero, with risk time counted only from each participant's Wave 1 date, gave 1.26 (1.18–1.34) per SD, and the association was present whether the interval before entry was six months or less (1.34, 1.21–1.48) or longer (1.22, 1.12–1.32; Supplementary Table S7, panel B).

Predictor	All-cause mortality, HR (95% CI)	Incident ADL disability, OR (95% CI)	Death or incident ADL disability, OR (95% CI)
Measured standing balance			
Per SD (0.66 points) worse	1.26 (1.18–1.34)[c]	1.25 (1.07–1.46)[b]	1.38 (1.20–1.58)[c]
Fair vs Good (score 3 vs 4)	1.51 (1.26–1.82)[c]	1.62 (1.17–2.26)[b]	1.83 (1.37–2.44)[c]
Poor vs Good (score 1–2 vs 4)	2.30 (1.84–2.88)[c]	1.58 (0.80–3.13)	2.38 (1.34–4.22)[b]
Self-reported falls			
Any fall, previous 2 years	1.02 (0.85–1.22)	1.25 (0.92–1.71)	1.19 (0.91–1.57)
Injurious fall	0.88 (0.69–1.12)	1.15 (0.79–1.68)	1.06 (0.75–1.49)
Recurrent falls (≥2)	1.12 (0.88–1.41)	1.47 (0.95–2.28)	1.44 (0.98–2.13)

Cox proportional-hazards models (mortality) and logistic regression models (incident ADL disability; composite), each adjusted for age, sex, education and body-mass index; mortality models were additionally adjusted for the number of baseline ADL difficulties (0–6). Balance was standardised using the SD of the mortality analytic sample (0.66 points), higher values indicating worse performance, so that the per-SD unit is identical across outcomes; all estimates for an outcome are from the same sample. Mortality analysis: N = 2,975, 688 deaths, median follow-up 4.25 years. Incident ADL disability (disability-free at Wave 1, reassessed at Wave 2): N = 1,141, 426 incident cases. Composite (disability-free at Wave 1; death before Wave 2 or ADL difficulty at Wave 2): N = 1,424, 709 events; the corresponding multinomial estimates that separate death from disability are given in Supplementary Table S4. Statistical significance: [a] P<0.05; [b] P<0.01; [c] P<0.001. HR, hazard ratio; OR, odds ratio; CI, confidence interval; SD, standard deviation; ADL, activities of daily living.

Table 2. Adjusted associations of measured balance and self-reported falls with all-cause mortality, incident ADL disability, and the composite of death or incident ADL disability.

Falls and mortality

By contrast, self-reported falls showed no association with mortality: adjusted HR 1.02 (0.85–1.22) for any fall, 0.88 (0.69–1.12) for an injurious fall and 1.12 (0.88–1.41) for recurrent falls (Table 2; Figure 2). Fall history was similar in those who died and those who survived (Supplementary Table S8).

Balance, falls and incident disability

Among the 1,141 participants disability-free at baseline and reassessed at Wave 2, 426 (37.3%) developed new ADL difficulty. On the continuous scale, poorer balance predicted incident disability (adjusted odds ratio [OR] 1.25, 95% CI 1.07–1.46, per SD); on the categorical scale, Fair balance carried an OR of 1.62 (1.17–2.26), whereas the Poor-balance estimate was imprecise (OR 1.58, 0.80–3.13), reflecting the few participants with Poor balance who were disability-free at baseline and alive to be reassessed (38 participants, 20 cases). Neither any fall (OR 1.25, 0.92–1.71) nor an injurious fall (1.15, 0.79–1.68) was significantly associated with incident disability; recurrent falls showed a positive association of borderline significance (1.47, 0.95–2.28; Table 2; Figure 2).

Deaths explain the imprecise Poor-balance estimate. Of the 64 participants with Poor balance who were disability-free at Wave 1 and whose status at Wave 2 was known, 26 (41%) had died, against 17% of those with Good balance (Supplementary Table S4). Relative to remaining alive without disability, Poor balance carried a nearly four-fold risk of death (relative risk ratio 3.86, 95% CI 2.00–7.44) and a smaller, non-significant excess of new disability (1.61, 0.82–3.15). When death or new disability was counted as a single outcome (n = 1,424; 709 events), risk rose from Good to Fair (OR 1.83, 1.37–2.44) to Poor balance (2.38, 1.34–4.22), whereas fall history was not associated with it (Table 2).

Dissociation across strata and added discrimination

Cross-classification showed the same dissociation: within every balance category, participants who had and had not fallen had similar mortality (Good 4.5 versus 4.1; Fair 7.0 versus 7.1; Poor 13.6 versus 13.1 per 100 person-years), while mortality roughly tripled across balance categories regardless of fall history (Figure 3; adjusted estimates in Supplementary Table S5). The disability strata showed the same pattern with wider intervals; the two Poor-balance strata contained only 29 and 9 participants.

Adding balance (continuous) to the routine covariates improved optimism-corrected discrimination for mortality (Harrell's C 0.687 to 0.699; ΔC +0.012, 95% CI 0.005 to 0.021; likelihood-ratio $P < 0.001$), whereas the any-fall question did not (0.686; ΔC −0.001, −0.001 to 0.001; $P = 0.83$); the difference between the two increments was +0.012 (0.005 to 0.021). For incident disability the gains were small: the AUC rose from 0.629 to 0.635 with balance (ΔAUC +0.006, 0.000 to 0.021; $P = 0.005$) and

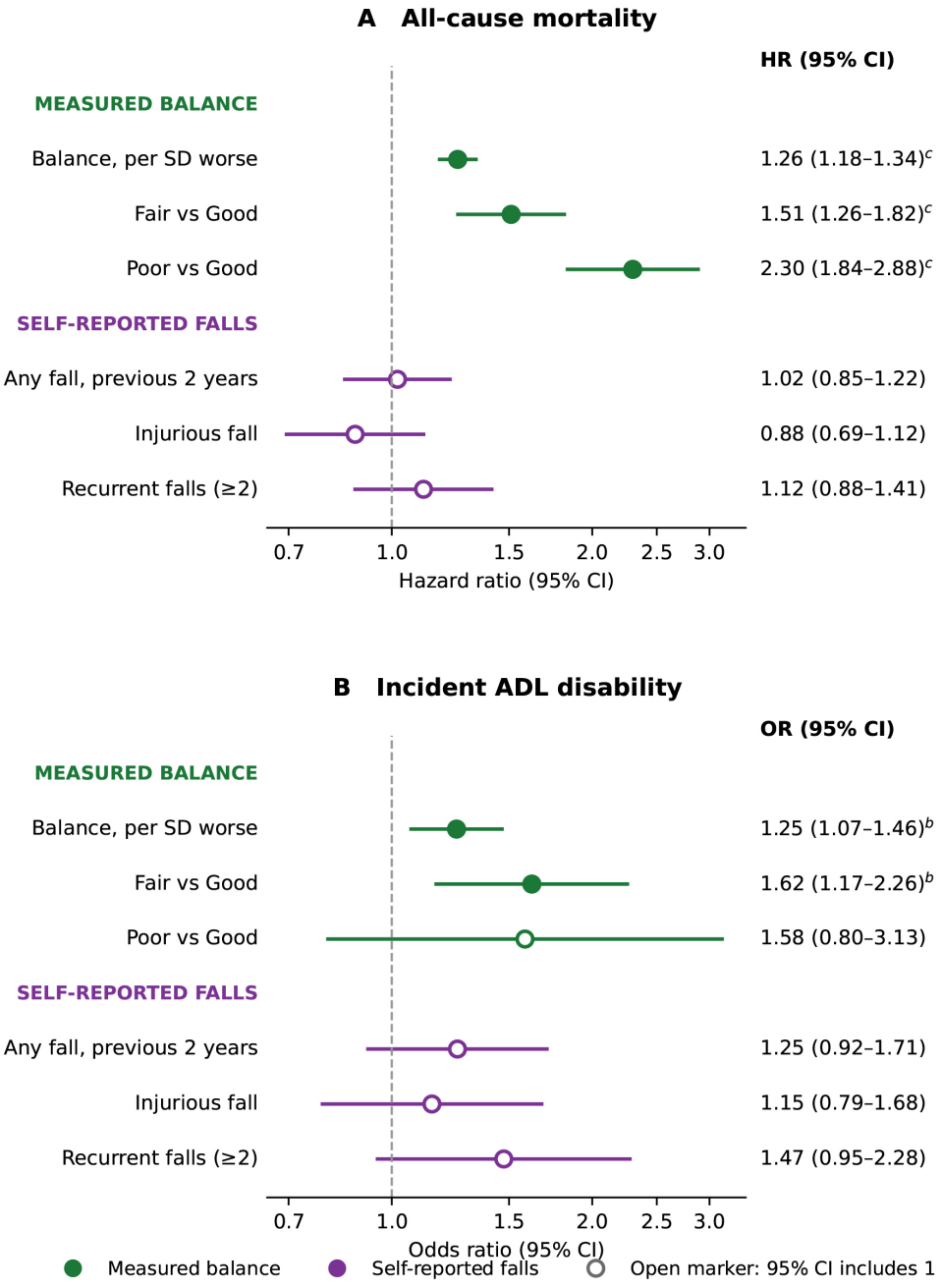


Figure 2. Adjusted associations of measured standing balance and self-reported falls with all-cause mortality (A, hazard ratios) and incident basic activity-of-daily-living disability (B, odds ratios). Balance is expressed per standard deviation (0.66 points) of worse performance and by category, with Good balance as the reference. Estimates are adjusted for age, sex, education and body-mass index, and mortality models additionally for the number of baseline ADL difficulties. Filled markers indicate a 95% confidence interval excluding 1 and open markers a non-significant estimate; superscripts denote [a] $P<0.05$, [b] $P<0.01$, [c] $P<0.001$. Both panels are drawn on a logarithmic scale. HR, hazard ratio; OR, odds ratio; CI, confidence interval; SD, standard deviation; ADL, activities of daily living.

Landmark analysis	N / deaths	Per SD worse, HR (95% CI)	Fair vs Good, HR (95% CI)	Poor vs Good, HR (95% CI)
A. Landmark analyses of the balance–mortality association				
Full cohort	2,975 / 688	1.26 (1.18–1.34)[c]	1.51 (1.26–1.82)[c]	2.30 (1.84–2.88)[c]
Excluding deaths within 1 year	2,867 / 580	1.24 (1.16–1.33)[c]	1.42 (1.16–1.74)[c]	2.24 (1.75–2.87)[c]
Excluding deaths within 2 years	2,731 / 444	1.24 (1.14–1.34)[c]	1.36 (1.08–1.72)[b]	2.27 (1.71–3.01)[c]
Landmark analyses re-estimate the balance–mortality association after excluding participants who died within one and within two years of baseline, addressing reverse causation; models are adjusted for age, sex, education, body-mass index and the number of baseline ADL difficulties. Statistical significance: [a] P<0.05; [b] P<0.01; [c] P<0.001.				
Discrimination		**Base + balance (continuous)**	**Base + any fall**	**Balance increment minus fall increment (95% CI)**
B. Added discrimination (optimism-corrected; change from the base model with 95% bootstrap CI and likelihood-ratio P)				
Mortality: Harrell's C (base 0.687)		0.699 (Δ +0.012; 0.005 to 0.021); *P* < 0.001	0.686 (Δ −0.001; −0.001 to 0.001); *P* = 0.83	+0.012 (0.005 to 0.021)
Incident ADL disability: AUC (base 0.629)		0.635 (Δ +0.006; 0.000 to 0.021); *P* = 0.005	0.630 (Δ +0.001; −0.001 to 0.013); *P* = 0.15	+0.005 (−0.008 to 0.018)
Harrell's C-statistic (mortality) and the area under the receiver-operating-characteristic curve (incident ADL disability) for a covariate-only base model versus models adding balance (continuous score) or the any-fall question, corrected for optimism by bootstrap; 95% confidence intervals for each increment and for the difference between increments are from 1,000 paired bootstrap resamples, and P values from likelihood-ratio tests of nested models. Categorical balance and recurrent falls: Supplementary Table S7, panel D. HR, hazard ratio; CI, confidence interval; SD, standard deviation; AUC, area under the curve; ADL, activities of daily living.				

Table 3. Landmark sensitivity analyses and added discrimination.

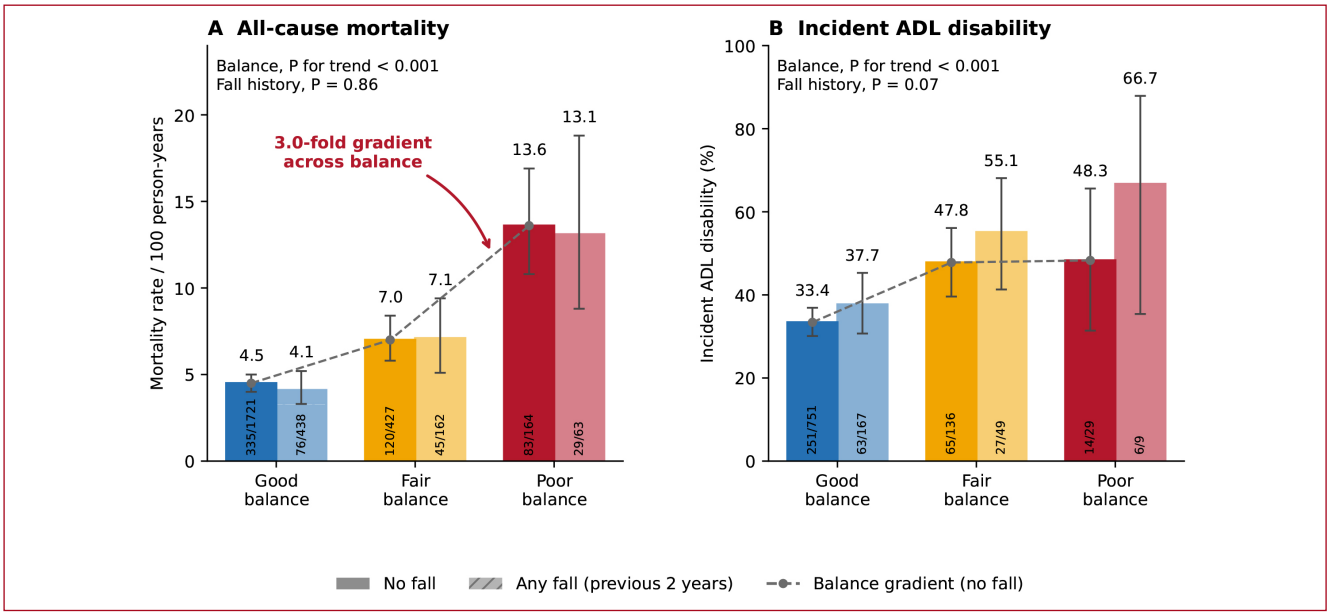


Figure 3. All-cause mortality rate (A) and incident basic activity-of-daily-living disability (B) by standing-balance category, with participants in each category further divided according to whether they reported a fall in the previous two years. Bars show crude estimates with 95% confidence intervals; the value above each bar is the point estimate and the label at the base of each bar gives the number of events over the number of participants in that stratum. The dashed line traces the balance gradient among participants who had not fallen, and the annotation in panel A gives the fold difference in mortality rate between the Good and Poor categories in that group. *P* values are unadjusted: *P* for trend across balance categories is from Cox (A) or logistic (B) regression on category rank, and P for fall history is from the corresponding model for any fall. Adjusted estimates for each stratum are given in Supplementary Table S5. ADL, activities of daily living.

to 0.630 with the falls question (ΔAUC +0.001, −0.001 to 0.013; P = 0.15), and the difference between them (+0.005, −0.008 to 0.018) did not exclude zero (Table 3; further comparisons in Supplementary Table S7, panel D).

Sensitivity analyses

Adjusting additionally for socio-economic, health and functional factors, including cognition, multimorbidity, depressive symptoms, self-rated health, grip strength, physical activity and IADL difficulty, weakened but did not remove the association (HR 1.18, 95% CI 1.10–1.26, per SD; Poor versus Good 1.82, 1.43–2.32); for incident disability the per-SD OR fell to 1.18, 1.00–1.40 (Supplementary Table S6).

The result did not depend on how balance was scored (Supplementary Table S7, panel A). Rescored by SPPB rules, each point lower carried a 26% higher hazard of death (HR 1.26, 95% CI 1.18–1.35), and each 10 seconds less in full tandem a 32% higher hazard (1.32, 1.23–1.41); the gradient from Good to Poor balance was present both below and above 70 years. Counting participants unable to attempt the test as Poor, and weighting to the national population, left the estimates unchanged (panels A and B).

Participants with unknown survival status did not explain the result (Supplementary Table S7, panel C). Assuming all of them survived gave an HR of 1.23 (1.16–1.31) per SD, and assuming all died gave 1.18 (1.12–1.24). The association disappeared only if every one of them with Good balance had died and every one with Fair or Poor balance had survived, which would mean 100% mortality in a group whose analysed counterparts had 19%. Filling in missing balance scores and covariates by multiple imputation gave 1.25 (1.18–1.32) per SD.

Discussion

In a nationally representative cohort of nearly 3,000 older Indians followed for a median of more than four years, a standing-balance test taking about a minute predicted both death and the loss of independence, while the question that dominates falls screening in everyday practice, “have you fallen?”, predicted neither. Poor balance more than doubled the adjusted hazard of death and tripled the crude mortality rate; within every stratum of fall history, balance separated higher- from lower-risk participants while fall history did not; and adding balance to routine covariates improved discrimination for mortality whereas adding fall history did not. Among participants independent at baseline, the proportion still alive and independent at follow-up fell from 55% with Good balance to 28% with Poor balance, and in the Poor group death was commoner than new disability, so the imprecise disability estimate for Poor balance reflects these deaths rather than an absence of risk. Balance and fall history flagged largely different people and carried different prognostic information. To our knowledge, this is the first head-to-head comparison of objective balance and the self-reported-falls question against mortality and prospectively ascertained incident disability in a large, nationally representative sample from a low- or middle-income country.

Several features of a self-reported fall limit its value as a marker of subsequent death and disability, whatever its value as a marker of future falls. Recall is unreliable: older adults, especially those with cognitive impairment, under-report falls, and the non-injurious majority are the most likely to be forgotten, biasing any association between falls and outcomes toward the null[8,9]. More fundamentally, a fall is an event rather than a trait. Whether a given degree of instability produces a fall depends on the environment and on chance: two people with the same underlying vulnerability may accumulate different fall histories depending on their exposure to hazards, and a chance fall in a robust person is recorded in the same way as a fall that results from frailty. Fall history is therefore a noisy readout of the reserve that determines longer-term outcomes. Consistent with this, the one fall variable that approached an association with disability was recurrent falling, which begins to index a stable propensity rather than a single accident; the World Falls Guidelines draw the same distinction in singling out recurrent falls as a trigger for comprehensive assessment[5]. Self-reported falls may also index anxiety and fear of falling as much as physical decline[33], weakening their relation to physical outcomes while leaving intact their value for identifying people who need falls-specific attention.

Balance, by contrast, is a trait. Remaining upright continuously integrates lower-limb strength, proprioception, vestibular input and vision, reweighted moment to moment by the central nervous system[34,35], and ageing degrades each channel; a graded balance score is therefore a compact readout of physiological reserve, capturing the vulnerability that a fall reveals only intermittently. This is why balance behaves like the other objective performance measures (gait speed, grip strength and the chair rise) that are among the most durable predictors of mortality, hospitalisation and disability[11–17,36]. Hazard ratios for slow gait and weak grip in pooled analyses and large cohorts are of similar magnitude to ours[14,15,37], and inability to hold a brief one-legged stance predicts survival elsewhere[38]. Our per-SD hazard of 1.26 and the 2.3-fold hazard in the poorest group are in keeping with this evidence, now shown in an Indian population. The LASI protocol requires a longer full-tandem hold than the SPPB, so the Fair category includes many participants who would score full marks on the SPPB; the association was present under either scoring, and its graded relation with full-tandem time suggests that the longer hold carries prognostic information of its own.

A natural objection is that poor balance simply marks people already dying of something else. Excluding deaths in the first two years left the association essentially unchanged, so balance predicted deaths occurring years later, and taking the balance assessment itself as time

zero, with risk time counted from LASI-DAD Wave 1, gave the same estimate as the primary analysis. Landmark analyses reduce the contribution of occult terminal illness but cannot exclude it, and they do not address confounding by conditions that both impair balance and shorten life. Adjustment for cognition, multimorbidity, depressive symptoms, self-rated health, grip strength, physical activity and IADL difficulty attenuated the per-SD hazard ratio from 1.26 to 1.18 and the Poor-versus-Good hazard ratio from 2.30 to 1.82. Part of the association therefore reflects the broader health status that poor balance summarises, as expected of a measure of reserve, and residual confounding by unmeasured conditions cannot be excluded. The survivor requirement at cohort entry removes deaths in the median eight months between measurement and entry; the direction of any resulting bias cannot be determined from these data.

These findings extend a large high-income-country evidence base to a setting where it cannot be assumed to hold. In India's largest ageing cohort, a balance test of the kind embedded in performance batteries carried the prognostic weight it does in Western populations, while the self-reported-falls question did not predict death or disability. This does not diminish the question's role in falls prevention: a previous fall is among the strongest single predictors of a future fall[6,7], although screening tools built on it discriminate only moderately even for falls[39]. The results complement recent Indian work in which composite intrinsic capacity tracks survival[40] by showing that a single balance test captures much of that signal without a multi-domain assessment[41], and add a prospective comparison against hard outcomes to earlier Indian work linking frailty cross-sectionally to falls[42].

The practical implication is that the two screens should be used together, because they answer different questions. India's public programmes for older adults are delivered largely by frontline and community health workers with minimal equipment[43], and the World Health Organization's Integrated Care for Older People (ICOPE) framework already asks primary care to screen locomotor capacity with brief performance tests[44,45]. Locomotor impairment is common among older Indians seeking care, affecting 48% of those screened across the ICOPE domains in a tertiary hospital outpatient clinic in New Delhi[46], and a standing-balance test fits that setting. The falls question retains its established role: a recent or recurrent fall triggers the multifactorial assessment and the strength-and-balance and home-safety interventions recommended by the World Falls Guidelines[5], and nothing in our data argues against it. What our data add is that a person who reports no falls but cannot hold a tandem stand carries a graded risk of death and disability that the falls question alone would miss. A pragmatic pathway would administer both: the falls history to identify who needs falls-specific prevention, and the balance test to identify who carries the vulnerability that predicts broader decline. A positive balance screen would prompt the ICOPE actions for impaired locomotion (assessment of causes, review of medication and vision, and referral to strength-and-balance exercise) together with closer monitoring of function.

The balance categories used here need a simple, field-ready cut-point validated prospectively when administered by community health workers rather than survey teams, against both mortality and independent-living outcomes and in light of the measurement properties established for physical-performance tests[47]. The small gain in discrimination for incident disability, not distinguishable from that of fall history, indicates that neither screen predicts individual disability trajectories well; both identify groups at higher risk. Because balance is modifiable, the more important test is whether acting on a positive balance screen, with the strength-and-balance exercise shown to improve lower-extremity performance and reduce falls, alters the trajectory it predicts[5,13].

Strengths include a large, nationally representative cohort with informant-verified mortality, a prospective incident-disability design with death handled as a competing outcome, a direct comparison of the two screens against hard outcomes, landmark and delayed-entry analyses, formal bootstrap comparison of discrimination and sensitivity analyses addressing missing follow-up. There are limitations. Our analysis was restricted to participants with a balance score and known survival status (2,975 of 4,096). Those without a balance score were older and frailer, so the findings describe people able to attempt the test; imputing their missing scores, or counting those unable to attempt it as Poor, gave the same estimates. Those whose survival status was unknown were slightly healthier at baseline, and only an implausible pattern of loss, in which every such participant with good balance died and every one with poor balance survived, would account for the association (Supplementary Table S7). The survey's full-tandem target differs by age, so Good balance is defined more stringently below 70 years; rescoring by SPPB rules, which apply a common 10-second standard, gave the same conclusions. Balance was assessed once, so change over time could not be examined. The LASI-DAD ADL instrument elicits difficulty readily, so the disability outcome captures mild as well as severe limitation, and the poorest-balance stratum contributed few disability events, so those estimates are imprecise. Comorbidities were self-reported. Analyses were unweighted, so prevalences describe the analytic sample, although weighted mortality estimates were unchanged. Residual confounding cannot be excluded. We had no validated fear-of-falling instrument and therefore did not analyse fear of falling as a predictor[33]. Finally, although LASI-DAD is nationally representative of India, the findings may not transfer wholesale to other low- and middle-income settings.

In conclusion, in older Indians a standing-balance test

taking about a minute predicted death and incident disability, which the standard self-reported-falls question did not, and it stratified risk within groups defined by fall history. The two screens are complementary: the falls history identifies who has been falling and needs falls-specific prevention, and the balance test identifies who carries the underlying vulnerability that predicts broader decline. Needing only a timer and no literacy, objective balance assessment suits risk screening in low-resource geriatric care alongside the falls question; whether coupling it to a strength-and-balance intervention can alter the trajectory it predicts is the natural next step.

Ethics approval

LASI-DAD was approved by the Indian Council of Medical Research (2202-16741/F1) and the ethics committees of the University of Southern California (UP-15-00684) and the All India Institute of Medical Sciences, New Delhi (IEC-284/06.05.2016, RP-33/2016). This secondary analysis of de-identified data required no additional ethical approval.

Consent to participate

All participants legally authorized representatives gave written informed consent.

Authors' contributions

BJ conceived the analysis, curated and linked the data, performed the statistical analyses, produced the figures and tables, and drafted the manuscript. ABD contributed to the study concept, the interpretation of the clinical findings and the framing of the screening implications. SD contributed to the interpretation of the biomarker and cognitive data and to critical revision of the manuscript. All authors critically revised the manuscript for important intellectual content, approved the final version and agree to be accountable for all aspects of the work.

Funding

This secondary analysis received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. LASI-DAD is funded by the U.S. National Institute on Aging (RO1 AG051125, U01 AG064948) and the Ministry of Health and Family Welfare, Government of India.

Acknowledgements

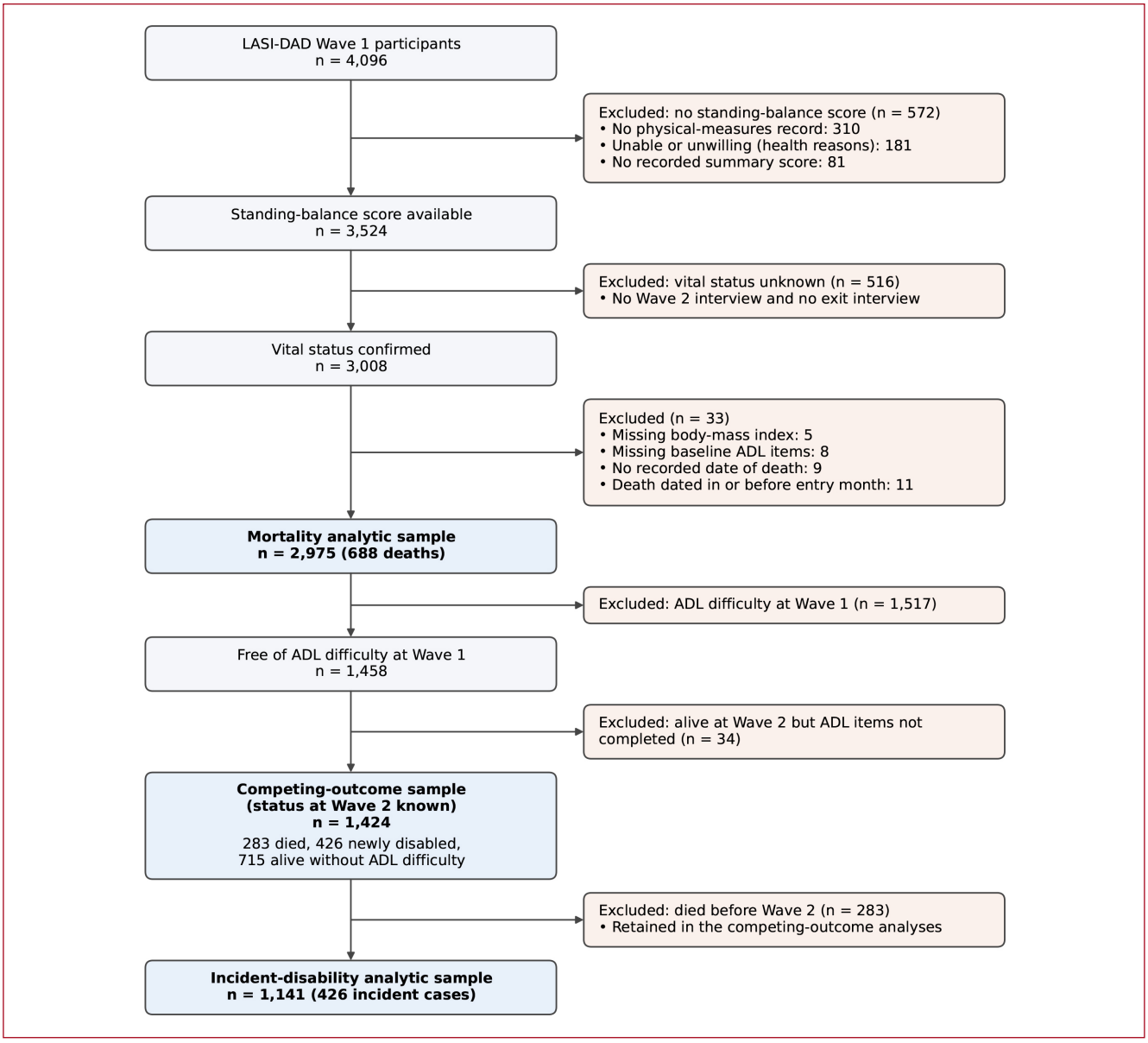
The authors thank the participants of LASI-DAD and their family informants, whose time made this work possible, and the LASI-DAD field investigators and interviewers, who collected the physical-performance, cognitive and end-of-life data analysed here. We also thank the Gateway to Global Aging Data programme for preparing and maintaining the harmonized datasets used in this analysis.

The Harmonized LASI and LASI-DAD datasets are available to researchers on application through the Gateway to Global Aging Data programme and the International Institute for Population Sciences. The analysis code is available from the corresponding author on request.

References

1. International Institute for Population Sciences, United Nations Population Fund. India Ageing Report 2023. Caring for our elders: institutional responses. New Delhi: United Nations Population Fund; 2023.
2. Salari N, Darvishi N, Ahmadipanah M, Shohaimi S, Mohammadi M. Global prevalence of falls in the older adults: a comprehensive systematic review and meta-analysis. J Orthop Surg Res 2022;17:334.
3. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006;35(Suppl 2):ii37-41.
4. World Health Organization. Falls [fact sheet]. Geneva: World Health Organization; 26 April 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/falls (accessed 22 September 2026).
5. Montero-Odasso M, van der Velde N, Martin FC, Petrovic M, Tan MP, Ryg J, et al. World guidelines for falls prevention and management for older adults: a global initiative. Age Ageing 2022;51:afac205.
6. Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? JAMA 2007;297:77-86.
7 Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk factors for falls in community-dwelling older people: a systematic review and meta-analysis. Epidemiology 2010;21:658-68.
8. Ganz DA, Higashi T, Rubenstein LZ. Monitoring falls in cohort studies of community-dwelling older people: effect of the recall interval. J Am Geriatr Soc 2005;53:2190-4.
9. Hannan MT, Gagnon MM, Aneja J, Jones RN, Cupples LA, Lipsitz LA, et al. Optimizing the tracking of falls in studies of older participants: comparison of quarterly telephone recall with monthly falls calendars in the MOBILIZE Boston Study. Am J Epidemiol 2010;171:1031-6.
10. Stewart Williams J, Kowal P, Hestekin H, O'Driscoll T, Peltzer K, Yawson A, et al. Prevalence, risk factors and disability associated with fall-related injury in older adults in low- and middle-income countries: results from the WHO Study on global AGEing and adult health (SAGE). BMC Med 2015;13:147.
11. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85-94.
12. Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med 1995;332:556-61.
13. Pavasini R, Guralnik J, Brown JC, di Bari M, Cesari M, Landi F, et al. Short Physical Performance Battery and all-cause mortality: systematic review and meta-analysis. BMC Med 2016;14:215.
14. Cooper R, Kuh D, Hardy R; Mortality Review Group; FALCon and HALCyon Study Teams. Objectively measured physical capability levels and mortality: systematic review and meta-analysis. BMJ 2010;341:c4467.
15. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, et

al. Gait speed and survival in older adults. JAMA 2011;305:50-8.
16. Penninx BW, Ferrucci L, Leveille SG, Rantanen T, Pahor M, Guralnik JM. Lower extremity performance in nondisabled older persons as a predictor of subsequent hospitalization. J Gerontol A Biol Sci Med Sci 2000;55:M691-7.
17. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci 2000;55:M221-31.
18. Lee J, Khobragade PY, Banerjee J, Chien S, Angrisani M, Perianayagam A, et al. Design and methodology of the Longitudinal Aging Study in India-Diagnostic Assessment of Dementia (LASI-DAD). J Am Geriatr Soc 2020;68(Suppl 3):S5-10.
19. Perianayagam A, Bloom D, Lee J, Parasuraman S, Sekher TV, Mohanty SK, et al. Cohort profile: the Longitudinal Ageing Study in India (LASI). Int J Epidemiol 2022;51:e167-76.
20. Khobragade PY, Petrosyan S, Dey S, Dey AB, Lee J. Design and methodology of the Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India: Wave 2. J Am Geriatr Soc 2025;73:685-96.
21. Lee J, Banerjee J, Khobragade PY, Angrisani M, Dey AB. LASI-DAD study: a protocol for a prospective cohort study of late-life cognition and dementia in India. BMJ Open 2019;9:e030300.
22. Banerjee J, Jain U, Khobragade P, Weerman B, Hu P, Chien S, et al. Methodological considerations in designing and implementing the Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India (LASI-DAD). Biodemography Soc Biol 2020;65:189-213.
23. Chien S, Young C, Phillips D, Wilkens J, Wang Y, Gross A, et al. Harmonized LASI, version A.3 [data set and documentation]. Los Angeles: Gateway to Global Aging Data; 2023. https://doi.org/10.25549/h-lasi.
24. Lee J, Dey AB, Petrosyan S, Khobragade P, Weerman A, Chien S, et al. Harmonized Diagnostic Assessment of Dementia for the Longitudinal Aging Study in India (LASI-DAD), version B.1 [data set]. Los Angeles: University of Southern California; 2025. https://doi.org/10.25549/h5wx-ay45.
25. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet 2007;370:1453-7.
26. Lévesque LE, Hanley JA, Kezouh A, Suissa S. Problem of immortal time bias in cohort studies: example using statins for preventing progression of diabetes. BMJ 2010;340:b5087.
27. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963;185:914-9.
28. Dafni U. Landmark analysis at the 25-year landmark point. Circ Cardiovasc Qual Outcomes 2011;4:363-71.
29. Berry SD, Ngo L, Samelson EJ, Kiel DP. Competing risk of death: an important consideration in studies of older adults. J Am Geriatr Soc 2010;58:783-7.
30. Harrell FE Jr, Lee KL, Mark DB. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. Stat Med 1996;15:361-87.
31. Steyerberg EW, Vickers AJ, Cook NR, Gerds T, Gonen M, Obuchowski N, et al. Assessing the performance of prediction models: a framework for traditional and novel measures. Epidemiology 2010;21:128-38.
32. White IR, Royston P, Wood AM. Multiple imputation using chained equations: issues and guidance for practice. Stat Med 2011;30:377-99.
33. MacKay S, Ebert P, Harbidge C, Hogan DB. Fear of falling in older adults: a scoping review of recent literature. Can Geriatr J 2021;24:379-94.
34. Anson E, Bigelow RT, Swenor B, Deshpande N, Studenski S, Jeka JJ, et al. Loss of peripheral sensory function explains much of the increase in postural sway in healthy older adults. Front Aging Neurosci 2017;9:202.
35. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age Ageing 2006;35(Suppl 2):ii7-11.
36. Cooper R, Strand BH, Hardy R, Patel KV, Kuh D. Physical capability in mid-life and survival over 13 years of follow-up: British birth cohort study. BMJ 2014;348:g2219.
37. Leong DP, Teo KK, Rangarajan S, Lopez-Jaramillo P, Avezum A Jr, Orlandini A, et al. Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. Lancet 2015;386:266-73.
38. Araujo CG, de Souza e Silva CG, Laukkanen JA, Fiatarone Singh M, Kunutsor SK, Myers J, et al. Successful 10-second one-legged stance performance predicts survival in middle-aged and older individuals. Br J Sports Med 2022;56:975-80.
39. Lin CC, Meardon S, O'Brien K. The predictive validity and clinical application of Stopping Elderly Accidents, Deaths & Injuries (STEADI) for fall risk screening. Adv Geriatr Med Res 2022;4:e220008.
40. Rao AR, Bhagwasia M, Rao A, Waris M, Kiruthika S, George S, et al. Intrinsic capacity and survival among older adults in India: LASI-DAD study (wave 1 and wave 2). Lancet Reg Health Southeast Asia 2026;49:100775.
41. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001;56:M146-56.
42. Thakkar S, Muhammad T, Srivastava S. Cross-sectional associations of physical frailty with fall, multiple falls and fall-injury among older Indian adults: findings from LASI, 2018. PLoS One 2022;17:e0272669.
43. Dumka N, Mangat S, Ahmed T, Hannah E, Kotwal A. Adding health to years: a review of the National Programme for Health Care of the Elderly (NPHCE) in India. J Family Med Prim Care 2022;11:6654-9.
44. World Health Organization. Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. Geneva: World Health Organization; 2019.
45. Leung AYM, Su JJ, Lee ESH, Fung JTS, Molassiotis A. Intrinsic capacity of older people in the community using WHO Integrated Care for Older People (ICOPE) framework: a cross-sectional study. BMC Geriatr 2022;22:304.
46. Jain B, Chakrawarty A, Chatterjee P, Dey AB, Vikram NK, Jaiswal A, et al. Observations on intrinsic capacity and sarcopenia in healthcare-seeking older adults. Cureus 2026;18:e100595.
47. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc 2006;54:743-9.



Supplementary Figure S1. Participant flow. Of 4,096 LASI-DAD Wave 1 participants, 2,975 entered the mortality analysis and 1,141 the incident-disability analysis; 1,424 participants free of ADL difficulty at Wave 1 with known status at Wave 2 (dead, disabled or disability-free) entered the competing-outcome analyses. ADL, activities of daily living.

Characteristic	Included (n = 2,975)	No balance score (n = 572)	P value	Vital status unconfirmed (n = 516)	P value
Age, years	68.5 (7.1)	72.2 (9.2)	<0.001	68.0 (7.1)	0.132
Female, %	53.5	54.9	0.564	56.0	0.310
Education below upper secondary, %	76.5	73.3	0.103	70.3	0.003
Body-mass index, kg/m^2	22.4 (4.8)	23.2 (5.9)	0.048	23.0 (4.8)	0.005
Underweight (BMI < 18.5), %	22.4	23.8	0.677	16.1	0.002
Any ADL difficulty (LASI-DAD assessment, ≥ 1 of 6), %	51.0	64.1	<0.001	47.5	0.164
Any IADL difficulty (≥ 1 of 7), %	43.1	60.1	<0.001	42.8	0.945
Difficulty walking across a room, %	4.9	23.0	<0.001	5.2	0.840
HMSE score (0–30)	22.8 (5.2)	20.8 (6.6)	<0.001	23.4 (5.4)	0.027
Depressive symptoms (CES-D ≥ 4), %	30.2	34.5	0.068	29.4	0.751
Fair/poor self-rated health, %	51.2	59.6	<0.001	47.9	0.176
Multimorbidity (≥ 2 conditions), %	24.6	33.1	<0.001	26.4	0.429
Grip strength, kg	20.6 (7.6)	16.1 (7.7)	<0.001	20.9 (7.8)	0.400
Any fall, previous 2 years, %	22.3	29.4	<0.001	19.4	0.155
Recurrent falls (≥ 2), %	10.4	13.4	0.043	5.8	0.002
Died during follow-up (where known), %	23.1	39.2	<0.001	—	—

Values are mean (standard deviation) or per cent. Each excluded group is compared with the included group by Welch's t test or the chi-squared test. 'No balance score' comprises 310 participants with no physical-measures record, 181 judged unable or unwilling to attempt the test because of a health condition and 81 who attempted it without a recorded summary score; 'vital status unconfirmed' denotes participants with a balance score but neither a Wave 2 interview nor an exit interview, for whom death during follow-up cannot be determined. A further 33 participants were excluded for missing covariates or an unusable date of death (Supplementary Figure S1). ADL difficulty is from the LASI-DAD geriatric assessment; IADL difficulty from the LASI core interview; HMSE, Hindi Mental State Examination; CES-D, Center for Epidemiologic Studies Depression scale.

Supplementary Table S1. Baseline characteristics of participants included in the mortality analysis and of those excluded because no balance score was recorded or because vital status could not be confirmed.

What the participant managed	LASI score (1 to 4)	Category in this study	Score by SPPB rules (0 to 4)	Participants (n = 2,975)
Neither the semi-tandem nor the side-by-side stand held for 10 s	1	Poor	0	38
Side-by-side stand held; semi-tandem not held	2	Poor	1	189
Semi-tandem held; full tandem held under 3 s	3	Fair	2	32
Semi-tandem held; full tandem held 3 to 9.9 s	3	Fair	3	129
Semi-tandem held; full tandem held 10 s or more but short of the age-specific target	3	Fair	4	428
Semi-tandem held; full tandem held for the age-specific target (60 s if under 70 years, 30 s if 70 or older)	4	Good	4	2,159

Protocol: semi-tandem stand for 10 s first; if not held, side-by-side stand for 10 s and the test ends; if held, full-tandem stand for an age-specific target of 60 s (under 70 years) or 30 s (70 years or older). SPPB rules score the side-by-side and semi-tandem stands 1 point each if held for 10 s and the full tandem 2 points if held for 10 s or more, 1 point if held for 3 to 9.9 s and 0 points if held for under 3 s; the side-by-side stand was taken as held when the semi-tandem stand was held. Participants judged unable, or unwilling, to attempt the test because of a health condition received no score and are not included. SPPB, Short Physical Performance Battery.

Supplementary Table S2. Standing-balance protocol and scoring: the LASI summary score, the categories used in this study, and the equivalent score by Short Physical Performance Battery (SPPB) rules.

Item	Activity	Coding
GA201	Dressing, including putting on chappals or shoes	0 = no difficulty; 1 = some difficulty
GA202	Walking across a room	0 = no difficulty; 1 = some difficulty
GA203	Bathing	0 = no difficulty; 1 = some difficulty
GA204	Eating, including breaking chapatti or mixing rice	0 = no difficulty; 1 = some difficulty
GA205	Getting in or out of bed	0 = no difficulty; 1 = some difficulty
GA206	Using the toilet, including getting up and down	0 = no difficulty; 1 = some difficulty

Participants were asked whether, because of a health or memory problem, they had any difficulty with each activity, and were instructed to exclude difficulties expected to last less than three months; the same six items were administered at Wave 1 (2017–2020) and Wave 2 (2022–2024). The six activities correspond to those of the Katz index. Harmonized LASI-DAD version B.1 variable names: r1hdressa, r1hwalkra, r1hbatha, r1heata, r1hbeda and r1htoilta at Wave 1 and the corresponding r2h variables at Wave 2; the count of activities with difficulty (0 to 6) is r1hadltot6 and the any-difficulty indicator r1hadltot6a. The LASI core interview asks about the same six activities with a different question stem and yields a lower prevalence of difficulty (20.4% versus 51.0% in the analytic sample); the LASI-DAD instrument was used throughout because it was administered at both waves of the LASI-DAD assessment.

Supplementary Table S3. Activities-of-daily-living items of the LASI-DAD geriatric assessment used to define baseline ADL difficulty and incident ADL disability.

	Total	Alive, no ADL difficulty	Alive, ADL difficulty	Died before Wave 2
A. Status at Wave 2 among participants free of ADL difficulty at Wave 1, n (row %)				
Good balance	1,104	604 (54.7)	314 (28.4)	186 (16.8)
Fair balance	256	93 (36.3)	92 (35.9)	71 (27.7)
Poor balance	64	18 (28.1)	20 (31.2)	26 (40.6)
B. Multinomial logistic regression, relative risk ratio (95% CI) versus survival free of disability				
Balance, per SD worse	—	1 (reference)	1.26 (1.08–1.47)[b]	1.56 (1.32–1.85)[c]
Fair vs Good	—	1 (reference)	1.63 (1.17–2.26)[b]	2.14 (1.47–3.10)[c]
Poor vs Good	—	1 (reference)	1.61 (0.82–3.15)	3.86 (2.00–7.44)[c]
Any fall, previous 2 years	—	1 (reference)	1.24 (0.91–1.68)	1.10 (0.75–1.61)
Recurrent falls (≥2)	—	1 (reference)	1.43 (0.93–2.21)	1.44 (0.85–2.46)

Multinomial models adjusted for age, sex, education and body-mass index; 34 participants alive at Wave 2 without completed ADL items are excluded. The composite death-or-disability estimates from the same sample are in Table 2. Statistical significance: [a] P<0.05; [b] P<0.01; [c] P<0.001. CI, confidence interval; SD, standard deviation; ADL, activities of daily living.

Supplementary Table S4. Death treated as a competing outcome for incident ADL disability (participants free of ADL difficulty at Wave 1 with known status at Wave 2, n = 1,424).

Stratum	Participants	Events	Person-years	Crude rate per 100 person-years (95% CI) / incidence, % (95% CI)	Adjusted HR / OR (95% CI) vs Good balance, no fall
A. All-cause mortality					
Good balance, no fall	1,721	335	7,423	4.5 (4.0–5.0)	1 (reference)
Good balance, any fall	438	76	1,833	4.1 (3.3–5.2)	0.92 (0.71–1.18)
Fair balance, no fall	427	120	1,717	7.0 (5.8–8.4)	1.45 (1.17–1.79)
Fair balance, any fall	162	45	638	7.1 (5.1–9.4)	1.59 (1.16–2.17)
Poor balance, no fall	164	83	610	13.6 (10.8–16.9)	2.18 (1.68–2.81)
Poor balance, any fall	63	29	222	13.1 (8.8–18.8)	2.54 (1.72–3.75)
B. Incident ADL disability					
Good balance, no fall	751	251	—	33.4 (30.1–36.9)	1 (reference)
Good balance, any fall	167	63	—	37.7 (30.7–45.3)	1.14 (0.79–1.63)
Fair balance, no fall	136	65	—	47.8 (39.6–56.1)	1.52 (1.04–2.23)
Fair balance, any fall	49	27	—	55.1 (41.3–68.1)	2.13 (1.16–3.90)
Poor balance, no fall	29	14	—	48.3 (31.4–65.6)	1.35 (0.62–2.95)
Poor balance, any fall	9	6	—	66.7 (35.4–87.9)	2.93 (0.70–12.29)

Rates carry exact Poisson 95% confidence intervals and proportions Wilson intervals. Adjusted estimates are from a single Cox (A) or logistic (B) model containing the six strata as indicator variables with Good balance and no fall as reference, adjusted for age, sex, education, body-mass index and (A) the number of baseline ADL difficulties. Crude P for trend across balance categories: < 0.001 (A), < 0.001 (B); crude P for any fall: 0.86 (A), 0.07 (B). HR, hazard ratio; OR, odds ratio; CI, confidence interval; ADL, activities of daily living.

Supplementary Table S5. All-cause mortality and incident ADL disability by standing-balance category and fall history (the six strata shown in Figure 3).

Model	Per SD (0.66 points) worse	Fair vs Good	Poor vs Good
A. All-cause mortality, HR (95% CI) — common sample n = 2,878			
Model 1: age, sex, education, body-mass index, baseline ADL count	1.25 (1.17–1.34)[c]	1.51 (1.25–1.82)[c]	2.23 (1.76–2.83)[c]
Model 2: + marital status, rural residence, current work, scheduled caste/tribe, household assets	1.24 (1.16–1.32)[c]	1.44 (1.20–1.74)[c]	2.16 (1.70–2.73)[c]
Model 3: + number of chronic conditions, stroke, self-rated health, depressive symptoms, HMSE score	1.21 (1.13–1.29)[c]	1.43 (1.19–1.73)[c]	1.97 (1.55–2.50)[c]
Model 4: + grip strength, weekly vigorous activity, IADL difficulty	1.18 (1.10–1.26)[c]	1.37 (1.13–1.65)[b]	1.82 (1.43–2.32)[c]
B. Incident ADL disability, OR (95% CI) — common sample n = 1,099 (baseline ADL count omitted; all disability-free)			
Model 1: age, sex, education, body-mass index	1.23 (1.04–1.45)[a]	1.60 (1.14–2.23)[b]	1.48 (0.71–3.10)
Model 2: + marital status, rural residence, current work, scheduled caste/tribe, household assets	1.24 (1.05–1.46)[a]	1.61 (1.15–2.26)[b]	1.50 (0.71–3.14)
Model 3: + number of chronic conditions, stroke, self-rated health, depressive symptoms, HMSE score	1.20 (1.02–1.42)[a]	1.54 (1.09–2.17)[a]	1.38 (0.65–2.91)
Model 4: + grip strength, weekly vigorous activity, IADL difficulty	1.18 (1.00–1.40)	1.49 (1.06–2.10)[a]	1.32 (0.63–2.78)

All models within a panel are fitted on the same participants (those with complete data for every covariate in Model 4), so that changes across models reflect adjustment rather than sample. Model 1 on the full analytic sample gives the primary estimates in Table 2. Household assets entered as log(1 + assets in lakh rupees); HMSE and grip strength standardised. Statistical significance: [a] P<0.05; [b] P<0.01; [c] P<0.001. HR, hazard ratio; OR, odds ratio; CI, confidence interval; SD, standard deviation; ADL, activities of daily living; IADL, instrumental ADL; HMSE, Hindi Mental State Examination.

Supplementary Table S6. Sequential adjustment of the associations of standing balance with all-cause mortality and incident ADL disability.

Supplementary Table S7. Sensitivity analyses of the balance–mortality association: exposure definition, model specification, missing data and additional discrimination comparisons.

Analysis	N / deaths	Per SD worse (or per unit stated), HR (95% CI)	Fair vs Good, HR (95% CI)	Poor vs Good, HR (95% CI)
A. Exposure definition (all-cause mortality; adjustment as in Table 2)				
Survey score per 1-point decrement (primary continuous scale is per 0.66-point SD)	2,975 / 688	1.41 (1.29–1.55)[c]		
Rescored by SPPB rules (0 to 4): distribution 0/1/2/3/4 = 38/189/32/129/2,587; per 1-point decrement	2,975 / 688	1.26 (1.18–1.35)[c]		
Rescored by SPPB rules, categories			Score 3 vs 4: 1.78 (1.30–2.44)[c]	Score ≤2 vs 4: 2.14 (1.74–2.64)[c]
Full-tandem time censored at 30 s, per 10 s shorter (semi-tandem failure = 0 s)	2,975 / 688	1.32 (1.23–1.41)[c]		
Survey categories, participants < 70 years (full-tandem target 60 s)	1,851 / 294		1.44 (1.09–1.92)[a]	2.70 (1.79–4.07)[c]
Survey categories, participants ≥ 70 years (full-tandem target 30 s)	1,124 / 394		1.58 (1.24–2.01)[c]	2.13 (1.62–2.80)[c]
Participants unable to attempt the test for health reasons added to Poor (n = 109, 51 deaths)	3,084 / 739	1.26 (1.19–1.34)[c]	1.51 (1.25–1.81)[c]	2.21 (1.81–2.70)[c]
B. Model specification				
Proportional-hazards tests (scaled Schoenfeld residuals): smallest P across balance and covariates, continuous model 0.09; categorical model 0.08				
Baseline hazard stratified by age group (60–69, 70–79, ≥80) × sex	2,975 / 688	1.25 (1.17–1.33)[c]	1.50 (1.25–1.81)[c]	2.27 (1.81–2.84)[c]
Delayed-entry Cox model, time origin at the LASI physical-measures visit	2,975 / 688	1.26 (1.18–1.34)[c]	1.49 (1.24–1.79)[c]	2.31 (1.84–2.89)[c]
Interval to cohort entry ≤ 6 months	1,253 / 280	1.34 (1.21–1.48)[c]	1.65 (1.22–2.22)[b]	2.78 (1.97–3.93)[c]
Interval to cohort entry > 6 months	1,722 / 408	1.22 (1.12–1.32)[c]	1.45 (1.15–1.84)[b]	2.04 (1.51–2.75)[c]
Survey-weighted (LASI-DAD Wave 1 analysis weights, robust variance)	2,975 / 688	1.25 (1.17–1.34)[c]	1.50 (1.24–1.81)[c]	2.25 (1.77–2.84)[c]
C. Missing follow-up and missing balance scores				
Unconfirmed vital status: all assumed alive until the state's median Wave 2 date (n added = 504)	3,479 / 688	1.23 (1.16–1.31)	1.44 (1.20–1.73)	2.17 (1.73–2.72)
Unconfirmed vital status: all assumed to have died at the interval midpoint	3,479 / 1192	1.18 (1.12–1.24)	1.36 (1.18–1.56)	1.77 (1.47–2.13)
Worst case for the finding: unconfirmed with Good balance all dead, with Fair or Poor all alive	3,479 / 1046	0.97 (0.91–1.03)	0.71 (0.60–0.85)	1.16 (0.94–1.44)
Opposite case: unconfirmed with Fair or Poor balance all dead, with Good all alive	3,479 / 834	1.45 (1.37–1.52)	2.78 (2.38–3.25)	3.43 (2.80–4.21)
Multiple imputation of balance score and covariates in the vital-status-confirmed cohort (10 imputations, Rubin's rules)	3,479 / 913	1.25 (1.18–1.32)	1.63 (1.38–1.91)	2.15 (1.74–2.66)

Supplementary Table S7. *(Cont. from previous page).*

Analysis	N / deaths	Per SD worse (or per unit stated), HR (95% CI)	Fair vs Good, HR (95% CI)	Poor vs Good, HR (95% CI)
D. Discrimination, additional comparisons (optimism-corrected; Δ from base with 95% bootstrap CI; likelihood-ratio P)				
Mortality — base + balance (categorical) (C)		0.699 (Δ +0.012; 0.006 to 0.022); *P* < 0.001		
Mortality — base + recurrent falls (C)		0.686 (Δ −0.001; −0.001 to 0.001); *P* = 0.37		
Mortality — base + balance (continuous) + any fall (C)		0.698 (Δ +0.011; 0.005 to 0.021); *P* < 0.001		
Disability — base + balance (categorical) (AUC)		0.633 (Δ +0.004; 0.001 to 0.021); *P* = 0.010		
Disability — base + recurrent falls (AUC)		0.630 (Δ +0.002; −0.001 to 0.017); *P* = 0.08		
Disability — base + balance (continuous) + any fall (AUC)		0.634 (Δ +0.006; 0.001 to 0.024); *P* = 0.009		
Balance increment minus recurrent-falls increment: mortality +0.012 (0.005 to 0.021); disability +0.004 (−0.010 to 0.017)				

All models adjusted for age, sex, education, body-mass index and the number of baseline ADL difficulties unless stated. Balance standardised with the mortality-sample SD (0.66 points) in every analysis, including those with added participants. Numbers reconcile with the participant flow as follows: of the 516 participants with unconfirmed vital status, 504 had complete covariates and could be analysed; of the 181 unable to attempt the test, 109 had confirmed vital status and complete covariates; the imputation cohort comprises all 3,479 participants with confirmed vital status and usable follow-up, including those without a balance score. Imputation model (chained equations with Bayesian ridge regression, posterior sampling): balance score, age, sex, education, body-mass index, ADL and IADL difficulty, grip strength, walking speed, HMSE score, self-rated health, difficulty walking across a room, depressive symptoms, number of chronic conditions, any fall, death, log follow-up time and an indicator of inability to attempt the balance test. Statistical significance: [a] P<0.05; [b] P<0.01; [c] P<0.001. HR, hazard ratio; CI, confidence interval; SD, standard deviation; SPPB, Short Physical Performance Battery; ADL, activities of daily living.

Supplementary Table S8. Baseline characteristics by vital status (mortality analytic sample, N = 2,975; 688 deaths).

Characteristic	All (n = 2,975)	Alive (n = 2,287)	Died (n = 688)	P value
Demographic and socioeconomic characteristics				
Age, years, mean (SD)	68.5 (7.1)	67.4 (6.3)	72.4 (8.4)	<0.001
Female, %	53.5	56.6	43.2	<0.001
Education, %				
Below upper secondary	76.5	75.4	80.2	
Upper secondary or vocational	20.3	21.1	17.6	0.105
Tertiary	3.2	3.5	2.2	
Currently married or partnered, %	67.1	69.2	59.9	<0.001
Widowed, %	31.4	29.6	37.5	<0.001
Rural residence, %	64.8	65.5	62.8	0.215
Scheduled caste or tribe, %	25.0	24.3	27.3	0.119
Currently working, %	32.3	34.7	24.3	<0.001
Household size, persons, median (IQR)	5.0 (3.0–6.0)	5.0 (3.0–6.0)	5.0 (3.0–6.0)	0.566
Household assets, ₹ lakh, median (IQR)	11.7 (4.0–30.5)	11.2 (3.9–30.6)	12.6 (4.1–30.2)	0.549
Health behaviours				
Current smoker, %	16.3	15.0	20.5	<0.001
Ever consumed alcohol, %	15.4	14.3	18.8	0.006
Vigorous physical activity at least once a week, %	25.0	27.5	16.7	<0.001
Self-reported diagnoses (ever), %				
Hypertension	37.9	37.4	39.8	0.264
Diabetes	16.4	14.8	21.7	<0.001
Heart disease	6.7	6.2	8.1	0.091
Stroke	2.4	1.8	4.2	<0.001
Chronic lung disease	3.2	3.1	3.6	0.533
Arthritis	18.6	18.8	17.9	0.614
Cancer	0.9	0.7	1.5	0.104
High cholesterol	4.3	4.5	3.6	0.404
Multimorbidity (≥ 2 conditions)	24.6	23.5	28.3	0.011
Geriatric syndromes and function				
HMSE cognitive score (0–30), mean (SD)	22.8 (5.2)	23.3 (4.9)	21.3 (5.9)	<0.001
Depressive symptoms (CES-D ≥ 4), %	30.2	28.5	35.8	<0.001
Any ADL difficulty (LASI-DAD assessment, ≥ 1 of 6), %	51.0	48.6	58.9	<0.001
Any IADL difficulty (≥ 1 of 7), %	43.1	40.2	52.9	<0.001
Grip strength, kg, mean (SD)	20.6 (7.6)	21.0 (7.6)	19.1 (7.5)	<0.001
Difficulty walking across a room, %	4.9	4.0	8.0	<0.001
Frequent pain, %	40.4	40.7	39.2	0.518
Fair or poor self-rated health, %	51.2	49.2	57.8	<0.001
Body-mass index category, %				
Underweight (< 18.5 kg/m²)	22.4	20.4	28.9	
Normal (18.5–24.9 kg/m²)	50.3	50.2	50.4	<0.001
Overweight or obese (≥ 25 kg/m²)	27.4	29.4	20.6	
Wears spectacles, %	39.7	39.5	40.6	0.644

Supplementary Table S8. *(Cont. from previous page).*

Characteristic	All (n = 2,975)	Alive (n = 2,287)	Died (n = 688)	P value
Self-reported falls (comparator exposure), %				
Any fall, previous 2 years	22.3	22.4	21.8	0.764
Injurious fall	13.0	13.5	11.3	0.154
Recurrent falls (≥ 2)	10.4	10.1	11.3	0.376
Blood biomarkers (venous subsample)				
Haemoglobin, g/dL, mean (SD)	12.7 (1.9)	12.8 (1.8)	12.4 (2.2)	<0.001
Anaemia, %	39.0	36.3	48.2	<0.001
HbA1c, %, median (IQR)	5.9 (5.5–6.4)	5.9 (5.5–6.3)	5.9 (5.6–6.6)	0.002
Total cholesterol, mg/dL, mean (SD)	185 (43)	187 (42)	176 (44)	<0.001
hs-CRP, mg/L, median (IQR)	1.7 (0.8–4.4)	1.6 (0.7–3.8)	2.5 (0.9–6.8)	<0.001
Elevated CRP, %	35.1	32.3	44.6	<0.001
Albumin, g/dL, mean (SD)	4.1 (0.3)	4.2 (0.3)	4.0 (0.4)	<0.001
Cystatin C, mg/L, median (IQR)	1.14 (0.98–1.35)	1.11 (0.96–1.29)	1.31 (1.09–1.59)	<0.001

Values are mean (standard deviation), median (interquartile range) or per cent unless stated. P values from Welch's t test (continuous) or the chi-squared test (categorical) comparing participants who died with those alive at Wave 2. ADL difficulty is from the LASI-DAD geriatric assessment (six activities; Supplementary Table S3); IADL difficulty from the LASI core interview (seven activities). Biomarkers were measured in the venous-blood subsample (alive n = 1,655, died n = 492). Self-reported fall history did not differ appreciably by vital status, whereas balance, cognition, function and biomarkers all did. Abbreviations as in Table 1.