

Relationships between frailty, changes in frailty, and incidences of chronic lung disease: Findings from six population-based cohort studies

Supplementary Materials

Supplementary Table 1	Items used to construct the frailty index across the six studies	3
Supplementary Table 2	Numbers and rates of participants with missing covariates for the analyses of baseline frailty status across the six studies	7
Supplementary Table 3	Numbers and rates of participants with missing covariates for the analyses of changes in frailty status across the six studies	9
Supplementary Table 4	Characteristics of included participants for the analyses of changes in frailty status across the six studies	11
Supplementary Table 5	Characteristics of excluded participants from baseline to the second surveys across the six studies	13
Supplementary Table 6	Characteristics of included participants in the second survey and excluded participants from baseline to the second surveys across the six studies	15
Supplementary Table 7	Numbers of chronic lung disease and no chronic lung disease and follow-up time for baseline frailty status and changes in frailty status across the six studies	18
Supplementary Table 8	Numbers and percentages of participants for the analyses of changes in frailty status across the six studies	19
Supplementary Table 9	Association between baseline frailty status and risk of chronic lung disease by age	20
Supplementary Table 10	Association between baseline frailty status and risk of chronic lung disease by sex	22
Supplementary Table 11	Association between baseline frailty status and risk of chronic lung disease by educational attainment	24
Supplementary Table 12	Association between baseline frailty status and risk of chronic lung disease by total household income	26
Supplementary Table 13	Association between changes in frailty status and risk of chronic lung disease by age	29

Supplementary Table 14	Association between changes in frailty status and risk of chronic lung disease by sex	32
Supplementary Table 15	Association between changes in frailty status and risk of chronic lung disease by educational attainment	35
Supplementary Table 16	Association between changes in frailty status and risk of chronic lung disease by total household income	38
Supplementary Table 17	Association between baseline frailty status and risk of chronic lung disease across the six studies using accelerated failure time model	41
Supplementary Table 18	Association between changes in frailty status and risk of chronic lung disease across the six studies using accelerated failure time model	42
Supplementary Table 19	Association between baseline frailty status and risk of chronic lung disease across the six studies using competing risk model	44
Supplementary Table 20	Association between changes in frailty status and risk of chronic lung disease across the six studies using competing risk model	45
Supplementary Table 21	Association between baseline frailty status and risk of chronic lung disease across the six studies using frailty index cutoffs of 0.10 and 0.25	47
Supplementary Table 22	Association between changes in frailty status and risk of chronic lung disease across the six studies using frailty index cutoffs of 0.10 and 0.25	48
Supplementary Figure 1	The dynamic nature of frailty status	50

Supplementary Table 1 Items used to construct the frailty index across the six studies

Item	Description						Cut-off value
	HRS	ELSA	SHARE	CHARLS	KLoSA	MHAS	
1	Self-reported hypertension diagnosed by doctors						Yes=1, No=0
2	Self-reported diabetes diagnosed by doctors						Yes=1, No=0
3	Self-reported cancer diagnosed by doctors						Yes=1, No=0
4	Self-reported diagnosed heart disease by doctors						Yes=1, No=0
5	Self-reported diagnosed stroke by doctors						Yes=1, No=0
6	Self-reported arthritis diagnosed by doctors						Yes=1, No=0
7	Self-reported any emotional, nervous, or psychiatric problems diagnosed by doctors						-
8	Self-reported memory-related disease diagnosed by doctors, including Alzheimer's disease or dementia, organic brain senility, or other serious memory impairment						Yes=1, No=0
9	Self-reported eyesight		Self-reported eyesight for seeing thing up close		Self-reported eyesight		Blind or poor=1, fair=0.75, good=0.5, very good=0.25, excellent=0 (HRS, ELSA, SHARE, CHARLS, and MHAS); Blind, very poor or poor=1, fair=0.75, good=0.5, very good=0.25 (KLoSA)
10	Self-reported hearing (while using hearing aid if appropriate)						Deaf or poor=1, fair=0.75, good=0.5, very good=0.25, excellent=0 (HRS, ELSA, SHARE, CHARLS, and MHAS); Very poor or poor=1, fair=0.75, good=0.5, very good=0.25 (KLoSA)

11	Self-reported health status			Poor=1, fair=0.75, good=0.5, very good=0.25, excellent=0
12	ADL: Any difficulty in dressing	ADL: need help in dressing	ADL: Any difficulty in dressing	Yes=1, No=0
13	ADL: Any difficulty in bathing or showering	ADL: need help in bathing or showering	ADL: Any difficulty in bathing or showering	Yes=1, No=0
14	ADL: Any difficulty in eating	ADL: need help in eating	ADL: Any difficulty in eating	Yes=1, No=0
15	ADL: Any difficulty in getting in/out of bed	BADL: needs help in getting in/out bed	ADL: Any difficulty in getting in/out of bed	Yes=1, No=0
16	ADL: Any difficulty in using the toilet	ADL: need help in using the toilet	ADL: Any difficulty in using the toilet	Yes=1, No=0
17	IADL: Any difficulty in managing money	IADL: need help in managing money	IADL: Any difficulty in managing money	Yes=1, No=0
18	IADL: Any difficulty in taking medications	IADL: need help in taking medications	IADL: Any difficulty in taking medications	Yes=1, No=0
19	IADL: Any difficulty in shopping	IADL: need help in shopping	IADL: Any difficulty in shopping	Yes=1, No=0
20	IADL: Any difficulty in preparing meals	IADL: need help in preparing meals	IADL: Any difficulty in preparing meals	Yes=1, No=0
21	Mobility: Any difficulty in walking 100 yards or one block	-	Mobility: Any difficulty in walking 100 yards or one block	Yes=1, No=0
22	Mobility: Any difficulty in getting up from a chair after sitting for long periods	-	Mobility: Any difficulty in getting up from a chair after sitting for long periods	Yes=1, No=0

23	Mobility: difficulty in climbing several flights of stairs without resting	-			Mobility: difficulty in climbing several flights of stairs without resting	Yes=1, No=0
24	Mobility: Any difficulty in lifting or carrying weights over 10 pounds/jins	-			Mobility: Any difficulty in lifting or carrying weights over 10 pounds/jins	Yes=1, No=0
25	Mobility: Any difficulty in picking up a coin from the table	-			Mobility: Any difficulty in picking up a coin from the table	Yes=1, No=0
26	Mobility: Any difficulty in stooping, kneeling, or crouching	-			Mobility: Any difficulty in stooping, kneeling, or crouching	Yes=1, No=0
27	Mobility: Any difficulty in reaching arms above shoulder level	-			Mobility: Any difficulty in reaching arms above shoulder level	Yes=1, No=0
28	Depression: CESD-8 (range: 0 - 8)	Depression: EURO-D (range: 0 - 12)	Depression: CESD-10 (range: 0 - 30)	Depression: CESD-10A (range: 0 - 30) or taking an antidepressant	Depression: CESD-9 (range: 0 - 9)	(CESD-8 $\geq$ 4)=1, (CESD-8 < 4)=0 (HRS, ELSA); (EURO-D $\geq$ 4)=1, (EURO-D < 4)=0 (SHARE); (CESD-10 $\geq$ 10)=1, (CESD-10 < 10)=0 (CHARLS); (CESD-10A $\geq$ 10) or taking an antidepressant=1, (CESD-10A < 10) or not taking an antidepressant=0 (KLoSA); (CESD-9 $\geq$ 5)=1, (CESD-9 < 5)=0 (MHAS)

29 Cognition: (total score- (immediate and delayed word recall + date naming))/total score

Continuous variable,
range: 0 - 1

Cognitive tests consisted of three components: immediate word recall, delayed word recall, and date naming. For word recall tasks, participants were asked to memorize and recall 10 words in HRS, ELSA, SHARE, and CHARLS, 6 words in KLoSA, and 8 words in MHAS. Regarding date naming, participants were asked whether they could recall the current date. The specific elements varied across studies: HRS, ELSA, SHARE, and CHARLS assessed recall of the day of week, day of month, month, and year; KLoSA assessed recall of the month, date, year, and day of week; and MHAS assessed the day of month, month, and year. The cognitive score was calculated using the formula: (total score- (immediate and delayed word recall + date naming))/total score. The total score refers to the theoretical maximum achievable across all tests. Therefore, a higher cognitive score indicates lower cognitive function.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; ADL, activity of daily living; IADL, instrumental activities of daily living; CESD, Center for Epidemiologic Studies Depression Scale; EURO-D, European Depression Scale.

Supplementary Table 2 Numbers and rates of participants with missing covariates for the analyses of baseline frailty status across the six studies

Characteristics	HRS (n=15479)				ELSA (n=8312)				SHARE (n=42297)			
	Robust (n=2855) (n, %)	Pre-frail (n=8023) (n, %)	Frail (n=4601) (n, %)	Total (n=15479) (n, %)	Robust (n=2364) (n, %)	Pre-frail (n=4174) (n, %)	Frail (n=1774) (n, %)	Total (n=8312) (n, %)	Robust (n=10567) (n, %)	Pre-frail (n=22771) (n, %)	Frail (n=8959) (n, %)	Total (n=42297) (n, %)
Age (years)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Age group	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sex	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Marital status	0 (0)	1 (0.01)	2 (0.04)	3 (0.02)	0 (0)	1 (0.02)	0 (0)	1 (0.01)	7 (0.07)	5 (0.02)	6 (0.07)	18 (0.04)
Living region	7 (0.25)	38 (0.47)	17 (0.37)	62 (0.4)	-	-	-	-	521 (4.93)	958 (4.21)	441 (4.92)	1920 (4.54)
Labour force status	0 (0)	0 (0)	0 (0)	0 (0)	7 (0.3)	16 (0.38)	3 (0.17)	26 (0.31)	118 (1.12)	281 (1.23)	290 (3.24)	689 (1.63)
educational attainment	1 (0.04)	1 (0.01)	0 (0)	2 (0.01)	151 (6.39)	331 (7.93)	174 (9.81)	656 (7.89)	0 (0)	0 (0)	0 (0)	0 (0)
Total household income (tertiles)	0 (0)	0 (0)	0 (0)	0 (0)	45 (1.9)	62 (1.49)	29 (1.63)	136 (1.64)	1347 (12.75)	2354 (10.34)	766 (8.55)	4467 (10.56)
BMI (kg/m ²)	43 (1.51)	146 (1.82)	93 (2.02)	282 (1.82)	510 (21.57)	878 (21.03)	606 (34.16)	1994 (23.99)	130 (1.23)	450 (1.98)	379 (4.23)	959 (2.27)
BMI group	43 (1.51)	146 (1.82)	93 (2.02)	282 (1.82)	510 (21.57)	878 (21.03)	606 (34.16)	1994 (23.99)	130 (1.23)	450 (1.98)	379 (4.23)	959 (2.27)
Smoking status	13 (0.46)	35 (0.44)	31 (0.67)	79 (0.51)	0 (0)	0 (0)	0 (0)	0 (0)	26 (0.25)	91 (0.4)	94 (1.05)	211 (0.5)
Drinking status	0 (0)	0 (0)	0 (0)	0 (0)	124 (5.25)	286 (6.85)	237 (13.36)	647 (7.78)	554 (5.24)	2193 (9.63)	1604 (17.9)	4351 (10.29)
Physical activity	1 (0.04)	19 (0.24)	8 (0.17)	28 (0.18)	1 (0.04)	0 (0)	0 (0)	1 (0.01)	6 (0.06)	68 (0.3)	160 (1.79)	234 (0.55)

Supplementary Table 2 Continued Numbers and rates of participants with missing covariates for the analyses of baseline frailty status across the six studies

Characteristics	CHARLS (n=7950)				KLoSA (n=6866)				MHAS (n=9805)			
	Robust (n=1133) (n, %)	Pre-frail (n=5252) (n, %)	Frail (n=1565) (n, %)	Total (n=7950) (n, %)	Robust (n=649) (n, %)	Pre-frail (n=4983) (n, %)	Frail (n=1234) (n, %)	Total (n=6866) (n, %)	Robust (n=1385) (n, %)	Pre-frail (n=5514) (n, %)	Frail (n=2906) (n, %)	Total (n=9805) (n, %)
Age (years)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Age group	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sex	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Marital status	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Living region	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Labour force status	11 (0.97)	61 (1.16)	21 (1.34)	93 (1.17)	1 (0.15)	7 (0.14)	2 (0.16)	10 (0.15)	1 (0.07)	0 (0)	1 (0.03)	2 (0.02)
educational attainment	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.22)	28 (0.51)	6 (0.21)	37 (0.38)
Total household income (tertiles)	498 (43.95)	1824 (34.73)	407 (26.01)	2729 (34.33)	0 (0)	0 (0)	0 (0)	0 (0)	42 (3.03)	133 (2.41)	55 (1.89)	230 (2.35)
BMI (kg/m ²)	191 (16.86)	678 (12.91)	201 (12.84)	1070 (13.46)	8 (1.23)	102 (2.05)	50 (4.05)	160 (2.33)	75 (5.42)	540 (9.79)	410 (14.11)	1025 (10.45)
BMI group	191 (16.86)	678 (12.91)	201 (12.84)	1070 (13.46)	8 (1.23)	102 (2.05)	50 (4.05)	160 (2.33)	75 (5.42)	540 (9.79)	410 (14.11)	1025 (10.45)
Smoking status	0 (0)	1 (0.02)	0 (0)	1 (0.01)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.04)	0 (0)	2 (0.02)
Drinking status	0 (0)	3 (0.06)	0 (0)	3 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.04)	0 (0)	2 (0.02)
Physical activity	629 (55.52)	3017 (57.44)	881 (56.29)	4527 (56.94)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.02)	1 (0.03)	2 (0.02)

The covariate “living region” was not available in ELSA, so it was not excluded in the analysis.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; BMI, body mass index.

Supplementary Table 3 Numbers and rates of participants with missing covariates for the analyses of changes in frailty status across the six studies

Characteristics	HRS (n=12693)				ELSA (n=6904)				SHARE (n=27847)			
	Robust (n=2530) (n, %)	Pre-frail (n=6791) (n, %)	Frail (n=3372) (n, %)	Total (n=12693) (n, %)	Robust (n=1909) (n, %)	Pre-frail (n=3573) (n, %)	Frail (n=1422) (n, %)	Total (n=6904) (n, %)	Robust (n=7588) (n, %)	Pre-frail (n=15427) (n, %)	Frail (n=4832) (n, %)	Total (n=27847) (n, %)
Age (years)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Age group	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sex	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Marital status	0 (0)	1 (0.01)	1 (0.03)	2 (0.02)	1 (0.05)	0 (0)	0 (0)	1 (0.01)	4 (0.05)	3 (0.02)	5 (0.1)	12 (0.04)
Living region	6 (0.24)	30 (0.44)	7 (0.21)	43 (0.34)	-	-	-	-	372 (4.9)	618 (4.01)	193 (3.99)	1183 (4.25)
Labour force status	0 (0)	0 (0)	0 (0)	0 (0)	7 (0.37)	11 (0.31)	4 (0.28)	22 (0.32)	79 (1.04)	169 (1.1)	127 (2.63)	375 (1.35)
educational attainment	1 (0.04)	1 (0.01)	0 (0)	2 (0.02)	110 (5.76)	282 (7.89)	138 (9.7)	530 (7.68)	0 (0)	0 (0)	0 (0)	0 (0)
Total household income (tertiles)	0 (0)	0 (0)	0 (0)	0 (0)	37 (1.94)	45 (1.26)	20 (1.41)	102 (1.48)	959 (12.64)	1595 (10.34)	384 (7.95)	2938 (10.55)
BMI (kg/m ²)	36 (1.42)	118 (1.74)	57 (1.69)	211 (1.66)	345 (18.07)	528 (14.78)	287 (20.18)	1160 (16.8)	98 (1.29)	275 (1.78)	167 (3.46)	540 (1.94)
BMI group	36 (1.42)	118 (1.74)	57 (1.69)	211 (1.66)	345 (18.07)	528 (14.78)	287 (20.18)	1160 (16.8)	98 (1.29)	275 (1.78)	167 (3.46)	540 (1.94)
Smoking status	12 (0.47)	26 (0.38)	27 (0.8)	65 (0.51)	0 (0)	0 (0)	0 (0)	0 (0)	16 (0.21)	56 (0.36)	36 (0.75)	108 (0.39)
Drinking status	0 (0)	0 (0)	0 (0)	0 (0)	98 (5.13)	211 (5.91)	138 (9.7)	447 (6.47)	392 (5.17)	1412 (9.15)	806 (16.68)	2610 (9.37)
Physical activity	1 (0.04)	8 (0.12)	5 (0.15)	14 (0.11)	0 (0)	1 (0.03)	0 (0)	1 (0.01)	3 (0.04)	38 (0.25)	58 (1.2)	99 (0.36)

Supplementary Table 3 Continued Numbers and rates of participants with missing covariates for the analyses of changes in frailty status across the six studies

Characteristics	CHARLS (n=5604)				KLoSA (n=6053)				MHAS (n=6447)			
	Robust (n=841) (n, %)	Pre-frail (n=3759) (n, %)	Frail (n=1004) (n, %)	Total (n=5604) (n, %)	Robust (n=591) (n, %)	Pre-frail (n=4497) (n, %)	Frail (n=965) (n, %)	Total (n=6053) (n, %)	Robust (n=949) (n, %)	Pre-frail (n=3764) (n, %)	Frail (n=1734) (n, %)	Total (n=6447) (n, %)
Age (years)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Age group	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sex	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Marital status	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Living region	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Labour force status	6 (0.71)	40 (1.06)	13 (1.29)	59 (1.05)	1 (0.17)	7 (0.16)	2 (0.21)	10 (0.17)	0 (0)	0 (0)	1 (0.06)	1 (0.02)
educational attainment	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.11)	16 (0.43)	4 (0.23)	21 (0.33)
Total household income (tertiles)	342 (40.67)	1296 (34.48)	254 (25.3)	1892 (33.76)	0 (0)	0 (0)	0 (0)	0 (0)	22 (2.32)	74 (1.97)	25 (1.44)	121 (1.88)
BMI (kg/m ²)	110 (13.08)	429 (11.41)	118 (11.75)	657 (11.72)	7 (1.18)	90 (2)	40 (4.15)	137 (2.26)	57 (6.01)	345 (9.17)	231 (13.32)	633 (9.82)
BMI group	110 (13.08)	429 (11.41)	118 (11.75)	657 (11.72)	7 (1.18)	90 (2)	40 (4.15)	137 (2.26)	57 (6.01)	345 (9.17)	231 (13.32)	633 (9.82)
Smoking status	0 (0)	1 (0.03)	0 (0)	1 (0.02)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.05)	0 (0)	2 (0.03)
Drinking status	0 (0)	2 (0.05)	0 (0)	2 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.05)	0 (0)	2 (0.03)
Physical activity	458 (54.46)	2142 (56.98)	561 (55.88)	3161 (56.41)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.06)	1 (0.02)

The covariate “living region” was not available in ELSA, so it was not excluded in the analysis.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; BMI, body mass index.

Supplementary Table 4 Characteristics of included participants for the analyses of changes in frailty status across the six studies

Characteristics	HRS(n=12693)			ELSA (n=6904)			SHARE (n=27847)		
	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail
Age (years) (mean, SD)	59.3 (7.5)	64.5 (9.7)	66.9 (10.6)	62.2 (7.1)	66.6 (8.5)	69.9 (9.5)	61.2 (7.9)	65.8 (9.1)	70.8 (10.1)
Age group (n, %)									
50 - 64	1974 (78.0)	3633 (53.5)	1551 (46.0)	1418 (68.0)	1658 (46.5)	426 (33.9)	5226 (68.9)	7413 (48.1)	1427 (29.5)
65 - 74	439 (17.4)	1979 (29.1)	931 (27.6)	537 (25.8)	1214 (34.1)	415 (33.0)	1872 (24.7)	5136 (33.3)	1509 (31.2)
≥ 75	117 (4.6)	1179 (17.4)	890 (26.4)	130 (6.2)	690 (19.4)	416 (33.1)	490 (6.5)	2878 (18.7)	1896 (39.2)
Sex (n, %)									
Female	1390 (54.9)	3823 (56.3)	2230 (66.1)	1075 (51.6)	1975 (55.4)	815 (64.8)	3916 (51.6)	8736 (56.6)	3383 (70.0)
Male	1140 (45.1)	2968 (43.7)	1142 (33.9)	1010 (48.4)	1587 (44.6)	442 (35.2)	3672 (48.4)	6691 (43.4)	1449 (30.0)
Marital status (n, %)									
Unmarried	651 (25.7)	2112 (31.1)	1458 (43.2)	379 (18.2)	962 (27.0)	535 (42.6)	1596 (21.0)	3997 (25.9)	1836 (38.0)
Married	1879 (74.3)	4679 (68.9)	1914 (56.8)	1706 (81.8)	2600 (73.0)	722 (57.4)	5992 (79.0)	11430 (74.1)	2996 (62.0)
Living region (n, %)									
Rural	1965 (77.7)	4968 (73.2)	2336 (69.3)	-	-	-	4861 (64.1)	9961 (64.6)	3106 (64.3)
Urban	565 (22.3)	1823 (26.8)	1036 (30.7)	-	-	-	2727 (35.9)	5466 (35.4)	1726 (35.7)
Labour force status (n, %)									
Unemployed or unable to work	258 (10.2)	676 (10.0)	501 (14.9)	150 (7.2)	316 (8.9)	283 (22.5)	711 (9.4)	2156 (14.0)	1102 (22.8)
Employed or self-employed	1615 (63.8)	2789 (41.1)	596 (17.7)	1084 (52.0)	1135 (31.9)	115 (9.1)	3713 (48.9)	3958 (25.7)	367 (7.6)
Retired	657 (26.0)	3326 (49.0)	2275 (67.5)	851 (40.8)	2111 (59.3)	859 (68.3)	3164 (41.7)	9313 (60.4)	3363 (69.6)
educational attainment (n, %)									
Below high school	213 (8.4)	910 (13.4)	878 (26.0)	362 (17.4)	1038 (29.1)	595 (47.3)	1827 (24.1)	6035 (39.1)	2811 (58.2)
High school or above	2317 (91.6)	5881 (86.6)	2494 (74.0)	1723 (82.6)	2524 (70.9)	662 (52.7)	5761 (75.9)	9392 (60.9)	2021 (41.8)
Total household income (tertiles) (n, %)									
Low	383 (15.1)	1638 (24.1)	1563 (46.4)	408 (19.6)	1087 (30.5)	598 (47.6)	1252 (16.5)	4217 (27.3)	2087 (43.2)
Medium	680 (26.9)	2417 (35.6)	1179 (35.0)	632 (30.3)	1222 (34.3)	445 (35.4)	2167 (28.6)	5345 (34.6)	1785 (36.9)
High	1467 (58.0)	2736 (40.3)	630 (18.7)	1045 (50.1)	1253 (35.2)	214 (17.0)	4169 (54.9)	5865 (38.0)	960 (19.9)
BMI (kg/m ²) (mean, SD)	26.6 (4.5)	28.5 (5.4)	30.7 (6.9)	26.9 (4.3)	28.4 (5.0)	30.2 (5.9)	25.5 (3.9)	27.0 (4.5)	28.6 (5.5)
BMI group (n, %)									
< 18.5	22 (0.9)	61 (0.9)	32 (0.9)	17 (0.8)	33 (0.9)	5 (0.4)	77 (1.0)	152 (1.0)	55 (1.1)
18.5 - <25	915 (36.2)	1705 (25.1)	597 (17.7)	691 (33.1)	884 (24.8)	222 (17.7)	3627 (47.8)	5137 (33.3)	1227 (25.4)
25 - <30	1082 (42.8)	2683 (39.5)	1061 (31.5)	944 (45.3)	1527 (42.9)	459 (36.5)	3069 (40.4)	6749 (43.7)	1833 (37.9)
≥ 30	511 (20.2)	2342 (34.5)	1682 (49.9)	433 (20.8)	1118 (31.4)	571 (45.4)	815 (10.7)	3389 (22.0)	1717 (35.5)
Smoking status (n, %)									
Never	1327 (52.5)	3092 (45.5)	1438 (42.6)	936 (44.9)	1369 (38.4)	413 (32.9)	3940 (51.9)	8329 (54.0)	2963 (61.3)
Ever	1203 (47.5)	3699 (54.5)	1934 (57.4)	1149 (55.1)	2193 (61.6)	844 (67.1)	3648 (48.1)	7098 (46.0)	1869 (38.7)
Drinking status (n, %)									
Never	695 (27.5)	2413 (35.5)	1789 (53.1)	124 (5.9)	343 (9.6)	299 (23.8)	569 (7.5)	1488 (9.6)	904 (18.7)
Ever	1835 (72.5)	4378 (64.5)	1583 (46.9)	1961 (94.1)	3219 (90.4)	958 (76.2)	7019 (92.5)	13939 (90.4)	3928 (81.3)
Physical activity (n, %)									
Non-vigorous	1038 (41.0)	3961 (58.3)	2670 (79.2)	1084 (52.0)	2468 (69.3)	1129 (89.8)	2514 (33.1)	7436 (48.2)	3832 (79.3)
Vigorous	1492 (59.0)	2830 (41.7)	702 (20.8)	1001 (48.0)	1094 (30.7)	128 (10.2)	5074 (66.9)	7991 (51.8)	1000 (20.7)

Supplementary Table 4 Continued Characteristics of included participants for the analyses of changes in frailty status across the six studies

Characteristics	CHARLS (n=5604)			KLoSA (n=6053)			MHAS (n=6447)		
	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail
Age (years) (mean, SD)	58.8 (6.7)	60.3 (7.0)	62.0 (7.3)	57.1 (6.4)	64.6 (9.3)	72.3 (8.4)	59.7 (7.1)	62.7 (8.1)	66.1 (8.7)
Age group (n, %)									
50 - 64	686 (81.6)	2821 (75.0)	667 (66.4)	514 (87.0)	2338 (52.0)	174 (18.0)	713 (75.1)	2348 (62.4)	798 (46.0)
65 - 74	129 (15.3)	778 (20.7)	283 (28.2)	68 (11.5)	1442 (32.1)	395 (40.9)	208 (21.9)	1058 (28.1)	629 (36.3)
≥ 75	26 (3.1)	160 (4.3)	54 (5.4)	9 (1.5)	717 (15.9)	396 (41.0)	28 (3.0)	358 (9.5)	307 (17.7)
Sex (n, %)									
Female	287 (34.1)	1741 (46.3)	621 (61.9)	264 (44.7)	2529 (56.2)	678 (70.3)	390 (41.1)	2098 (55.7)	1268 (73.1)
Male	554 (65.9)	2018 (53.7)	383 (38.1)	327 (55.3)	1968 (43.8)	287 (29.7)	559 (58.9)	1666 (44.3)	466 (26.9)
Marital status (n, %)									
Unmarried	71 (8.4)	397 (10.6)	144 (14.3)	44 (7.4)	886 (19.7)	373 (38.7)	221 (23.3)	985 (26.2)	610 (35.2)
Married	770 (91.6)	3362 (89.4)	860 (85.7)	547 (92.6)	3611 (80.3)	592 (61.3)	728 (76.7)	2779 (73.8)	1124 (64.8)
Living region (n, %)									
Rural	382 (45.4)	1577 (42.0)	348 (34.7)	479 (81.0)	3283 (73.0)	697 (72.2)	708 (74.6)	2722 (72.3)	1232 (71.0)
Urban	459 (54.6)	2182 (58.0)	656 (65.3)	112 (19.0)	1214 (27.0)	268 (27.8)	241 (25.4)	1042 (27.7)	502 (29.0)
Labour force status (n, %)									
Unemployed or unable to work	9 (1.1)	56 (1.5)	17 (1.7)	106 (17.9)	1354 (30.1)	433 (44.9)	270 (28.5)	1662 (44.2)	1171 (67.5)
Employed or self-employed	577 (68.6)	2485 (66.1)	563 (56.1)	414 (70.1)	2083 (46.3)	164 (17.0)	569 (60.0)	1613 (42.9)	395 (22.8)
Retired	255 (30.3)	1218 (32.4)	424 (42.2)	71 (12.0)	1060 (23.6)	368 (38.1)	110 (11.6)	489 (13.0)	168 (9.7)
educational attainment (n, %)									
Below high school	658 (78.2)	3273 (87.1)	946 (94.2)	196 (33.2)	2860 (63.6)	839 (86.9)	654 (68.9)	3240 (86.1)	1623 (93.6)
High school or above	183 (21.8)	486 (12.9)	58 (5.8)	395 (66.8)	1637 (36.4)	126 (13.1)	295 (31.1)	524 (13.9)	111 (6.4)
Total household income (tertiles) (n, %)									
Low	186 (22.1)	1031 (27.4)	373 (37.2)	243 (41.1)	1732 (38.5)	357 (37.0)	293 (30.9)	1221 (32.4)	606 (34.9)
Medium	251 (29.8)	1241 (33.0)	345 (34.4)	57 (9.6)	1249 (27.8)	437 (45.3)	204 (21.5)	1135 (30.2)	659 (38.0)
High	404 (48.0)	1487 (39.6)	286 (28.5)	291 (49.2)	1516 (33.7)	171 (17.7)	452 (47.6)	1408 (37.4)	469 (27.0)
BMI (kg/m ²) (mean, SD)	25.3 (57.0)	23.9 (14.5)	24.1 (4.1)	23.1 (2.2)	23.3 (2.7)	23.4 (3.2)	26.7 (3.9)	27.5 (4.6)	28.5 (5.4)
BMI group (n, %)									
< 18.5	44 (5.2)	199 (5.3)	53 (5.3)	5 (0.8)	151 (3.4)	47 (4.9)	4 (0.4)	32 (0.9)	28 (1.6)
18.5 - <25	569 (67.7)	2421 (64.4)	584 (58.2)	491 (83.1)	3290 (73.2)	645 (66.8)	336 (35.4)	1138 (30.2)	427 (24.6)
25 - <30	195 (23.2)	978 (26.0)	303 (30.2)	90 (15.2)	1005 (22.3)	245 (25.4)	434 (45.7)	1624 (43.1)	682 (39.3)
≥ 30	33 (3.9)	161 (4.3)	64 (6.4)	5 (0.8)	51 (1.1)	28 (2.9)	175 (18.4)	970 (25.8)	597 (34.4)
Smoking status (n, %)									
Never	434 (51.6)	2132 (56.7)	665 (66.2)	365 (61.8)	3081 (68.5)	720 (74.6)	551 (58.1)	2312 (61.4)	1194 (68.9)
Ever	407 (48.4)	1627 (43.3)	339 (33.8)	226 (38.2)	1416 (31.5)	245 (25.4)	398 (41.9)	1452 (38.6)	540 (31.1)
Drinking status (n, %)									
Never	465 (55.3)	2132 (56.7)	633 (63.0)	14 (2.4)	194 (4.3)	77 (8.0)	624 (65.8)	2726 (72.4)	1494 (86.2)
Ever	376 (44.7)	1627 (43.3)	371 (37.0)	577 (97.6)	4303 (95.7)	888 (92.0)	325 (34.2)	1038 (27.6)	240 (13.8)
Physical activity (n, %)									
Non-vigorous	528 (62.8)	2366 (62.9)	701 (69.8)	313 (53.0)	2907 (64.6)	732 (75.9)	460 (48.5)	2084 (55.4)	1173 (67.6)
Vigorous	313 (37.2)	1393 (37.1)	303 (30.2)	278 (47.0)	1590 (35.4)	233 (24.1)	489 (51.5)	1680 (44.6)	561 (32.4)

Unmarried status includes separated, divorced, widowed, and never married; married status includes married and partnered.

The covariate “living region” was not available in ELSA, so it was not excluded in the analysis.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; SD, standard deviation; BMI, body mass index.

Supplementary Table 5 Characteristics of excluded participants from baseline to the second surveys across the six studies

Characteristics	HRS (n=2786)			ELSA (n=1408)			SHARE (n=14450)		
	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail
Age (years) (mean, SD)	61.0 (9.6)	67.6 (11.3)	72.5 (11.9)	62.7 (8.0)	69.4 (10.3)	74.7 (10.6)	60.6 (8.0)	65.7 (9.6)	72.2 (11.0)
Age group (n, %)									
50 - 64	237 (72.9)	535 (43.4)	366 (29.8)	193 (69.2)	229 (37.4)	104 (20.1)	2202 (73.9)	3694 (50.3)	1151 (27.9)
65 - 74	50 (15.4)	315 (25.6)	292 (23.8)	56 (20.1)	179 (29.2)	130 (25.1)	585 (19.6)	2198 (29.9)	1098 (26.6)
≥ 75	38 (11.7)	382 (31.0)	571 (46.5)	30 (10.8)	204 (33.3)	283 (54.7)	192 (6.4)	1452 (19.8)	1878 (45.5)
Sex (n, %)									
Female	155 (47.7)	646 (52.4)	719 (58.5)	137 (49.1)	312 (51.0)	326 (63.1)	1448 (48.6)	3847 (52.4)	2691 (65.2)
Male	170 (52.3)	586 (47.6)	510 (41.5)	142 (50.9)	300 (49.0)	191 (36.9)	1531 (51.4)	3497 (47.6)	1436 (34.8)
Marital status (n, %)									
Unmarried	101 (31.1)	466 (37.8)	622 (50.6)	52 (18.6)	179 (29.2)	268 (51.8)	515 (17.3)	1809 (24.6)	1590 (38.5)
Married	224 (68.9)	766 (62.2)	607 (49.4)	227 (81.4)	433 (70.8)	249 (48.2)	2464 (82.7)	5535 (75.4)	2537 (61.5)
Living region (n, %)									
Rural	239 (73.5)	891 (72.3)	838 (68.2)	-	-	-	1926 (64.7)	4764 (64.9)	2612 (63.3)
Urban	86 (26.5)	341 (27.7)	391 (31.8)	-	-	-	1053 (35.3)	2580 (35.1)	1515 (36.7)
Labour force status (n, %)									
Unemployed or unable to work	29 (8.9)	139 (11.3)	170 (13.8)	11 (3.9)	55 (9.0)	94 (18.2)	340 (11.4)	1069 (14.6)	857 (20.8)
Employed or self-employed	202 (62.2)	389 (31.6)	97 (7.9)	151 (54.1)	176 (28.8)	26 (5.0)	1436 (48.2)	1763 (24.0)	211 (5.1)
Retired	94 (28.9)	704 (57.1)	962 (78.3)	117 (41.9)	381 (62.3)	397 (76.8)	1203 (40.4)	4512 (61.4)	3059 (74.1)
educational attainment (n, %)									
Below high school	31 (9.5)	247 (20.0)	363 (29.5)	61 (21.9)	251 (41.0)	302 (58.4)	860 (28.9)	3317 (45.2)	2569 (62.2)
High school or above	294 (90.5)	985 (80.0)	866 (70.5)	218 (78.1)	361 (59.0)	215 (41.6)	2119 (71.1)	4027 (54.8)	1558 (37.8)
Total household income (tertiles) (n, %)									
Low	69 (21.2)	386 (31.3)	681 (55.4)	53 (19.0)	214 (35.0)	276 (53.4)	840 (28.2)	3099 (42.2)	2397 (58.1)
Medium	97 (29.8)	442 (35.9)	389 (31.7)	94 (33.7)	222 (36.3)	175 (33.8)	854 (28.7)	2375 (32.3)	1205 (29.2)
High	159 (48.9)	404 (32.8)	159 (12.9)	132 (47.3)	176 (28.8)	66 (12.8)	1285 (43.1)	1870 (25.5)	525 (12.7)
BMI (kg/m ²) (mean, SD)	26.5 (4.5)	27.7 (5.4)	29.2 (7.2)	27.2 (4.3)	27.6 (5.2)	29.0 (6.0)	25.7 (4.0)	27.0 (4.4)	28.1 (5.6)
BMI group (n, %)									
< 18.5	116 (35.7)	391 (31.7)	336 (27.3)	3 (1.1)	9 (1.5)	9 (1.7)	32 (1.1)	87 (1.2)	84 (2.0)
18.5 - <25	140 (43.1)	468 (38.0)	420 (34.2)	91 (32.6)	189 (30.9)	129 (25.0)	1353 (45.4)	2462 (33.5)	1213 (29.4)
25 - <30	65 (20.0)	359 (29.1)	451 (36.7)	119 (42.7)	243 (39.7)	190 (36.8)	1219 (40.9)	3175 (43.2)	1518 (36.8)
≥ 30	116 (35.7)	391 (31.7)	336 (27.3)	66 (23.7)	171 (27.9)	189 (36.6)	375 (12.6)	1620 (22.1)	1312 (31.8)
Smoking status (n, %)									
Never	166 (51.1)	507 (41.2)	488 (39.7)	139 (49.8)	205 (33.5)	173 (33.5)	1497 (50.3)	3811 (51.9)	2491 (60.4)
Ever	159 (48.9)	725 (58.8)	741 (60.3)	140 (50.2)	407 (66.5)	344 (66.5)	1482 (49.7)	3533 (48.1)	1636 (39.6)
Drinking status (n, %)									
Never	110 (33.8)	538 (43.7)	770 (62.7)	22 (7.9)	69 (11.3)	154 (29.8)	313 (10.5)	1019 (13.9)	888 (21.5)
Ever	215 (66.2)	694 (56.3)	459 (37.3)	257 (92.1)	543 (88.7)	363 (70.2)	2666 (89.5)	6325 (86.1)	3239 (78.5)
Physical activity (n, %)									
Non-vigorous	136 (41.8)	776 (63.0)	1050 (85.4)	163 (58.4)	466 (76.1)	501 (96.9)	1007 (33.8)	3884 (52.9)	3495 (84.7)
Vigorous	189 (58.2)	456 (37.0)	179 (14.6)	116 (41.6)	146 (23.9)	16 (3.1)	1972 (66.2)	3460 (47.1)	632 (15.3)

Supplementary Table 5 Continued Characteristics of excluded participants from baseline to the second surveys across the six studies

Characteristics	CHARLS (n=2346)			KLoSA (n=813)			MHAS (n=3358)		
	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail	Robust	Pre-frail	Frail
Age (years) (mean, SD)	58.7 (7.0)	61.8 (8.3)	64.4 (8.8)	55.4 (5.2)	67.2 (11.3)	76.7 (9.4)	59.7 (7.7)	64.8 (9.2)	70.2 (10.2)
Age group (n, %)									
50 - 64	244 (83.6)	1016 (68.1)	314 (56.0)	54 (93.1)	212 (43.6)	26 (9.7)	335 (76.8)	923 (52.7)	372 (31.7)
65 - 74	34 (11.6)	332 (22.2)	163 (29.1)	4 (6.9)	137 (28.2)	83 (30.9)	77 (17.7)	531 (30.3)	395 (33.7)
≥ 75	14 (4.8)	145 (9.7)	84 (15.0)	0 (0.0)	137 (28.2)	160 (59.5)	24 (5.5)	296 (16.9)	405 (34.6)
Sex (n, %)									
Female	114 (39.0)	751 (50.3)	369 (65.8)	24 (41.4)	258 (53.1)	173 (64.3)	172 (39.4)	919 (52.5)	806 (68.8)
Male	178 (61.0)	742 (49.7)	192 (34.2)	34 (58.6)	228 (46.9)	96 (35.7)	264 (60.6)	831 (47.5)	366 (31.2)
Marital status (n, %)									
Unmarried	23 (7.9)	212 (14.2)	131 (23.4)	5 (8.6)	126 (25.9)	152 (56.5)	97 (22.2)	516 (29.5)	494 (42.2)
Married	269 (92.1)	1281 (85.8)	430 (76.6)	53 (91.4)	360 (74.1)	117 (43.5)	339 (77.8)	1234 (70.5)	678 (57.8)
Living region (n, %)									
Rural	159 (54.5)	645 (43.2)	188 (33.5)	48 (82.8)	368 (75.7)	196 (72.9)	351 (80.5)	1255 (71.7)	800 (68.3)
Urban	133 (45.5)	848 (56.8)	373 (66.5)	10 (17.2)	118 (24.3)	73 (27.1)	85 (19.5)	495 (28.3)	372 (31.7)
Labour force status (n, %)									
Unemployed or unable to work	7 (2.4)	43 (2.9)	19 (3.4)	16 (27.6)	152 (31.3)	132 (49.1)	127 (29.1)	790 (45.1)	836 (71.3)
Employed or self-employed	190 (65.1)	873 (58.5)	258 (46.0)	39 (67.2)	194 (39.9)	17 (6.3)	241 (55.3)	705 (40.3)	185 (15.8)
Retired	95 (32.5)	577 (38.6)	284 (50.6)	3 (5.2)	140 (28.8)	120 (44.6)	68 (15.6)	255 (14.6)	151 (12.9)
educational attainment (n, %)									
Below high school	226 (77.4)	1324 (88.7)	537 (95.7)	17 (29.3)	314 (64.6)	212 (78.8)	268 (61.5)	1486 (84.9)	1094 (93.3)
High school or above	66 (22.6)	169 (11.3)	24 (4.3)	41 (70.7)	172 (35.4)	57 (21.2)	168 (38.5)	264 (15.1)	78 (6.7)
Total household income (tertiles) (n, %)									
Low	64 (21.9)	470 (31.5)	216 (38.5)	23 (39.7)	193 (39.7)	114 (42.4)	147 (33.7)	514 (29.4)	411 (35.1)
Medium	76 (26.0)	483 (32.4)	205 (36.5)	3 (5.2)	131 (27.0)	110 (40.9)	89 (20.4)	587 (33.5)	485 (41.4)
High	152 (52.1)	540 (36.2)	140 (25.0)	32 (55.2)	162 (33.3)	45 (16.7)	200 (45.9)	649 (37.1)	276 (23.5)
BMI (kg/m ²) (mean, SD)	23.2 (3.1)	23.7 (16.2)	23.5 (4.0)	23.0 (2.3)	23.2 (2.9)	22.3 (3.4)	26.9 (4.2)	27.3 (4.8)	28.0 (5.9)
BMI group (n, %)									
< 18.5	15 (5.1)	105 (7.0)	45 (8.0)	1 (1.7)	29 (6.0)	34 (12.6)	2 (0.5)	26 (1.5)	25 (2.1)
18.5 - <25	198 (67.8)	992 (66.4)	345 (61.5)	46 (79.3)	345 (71.0)	182 (67.7)	156 (35.8)	561 (32.1)	365 (31.1)
25 - <30	70 (24.0)	339 (22.7)	132 (23.5)	11 (19.0)	105 (21.6)	47 (17.5)	201 (46.1)	748 (42.7)	426 (36.3)
≥ 30	9 (3.1)	57 (3.8)	39 (7.0)	0 (0.0)	7 (1.4)	6 (2.2)	77 (17.7)	415 (23.7)	356 (30.4)
Smoking status (n, %)									
Never	157 (53.8)	869 (58.2)	380 (67.7)	31 (53.4)	319 (65.6)	195 (72.5)	248 (56.9)	1057 (60.4)	771 (65.8)
Ever	135 (46.2)	624 (41.8)	181 (32.3)	27 (46.6)	167 (34.4)	74 (27.5)	188 (43.1)	693 (39.6)	401 (34.2)
Drinking status (n, %)									
Never	161 (55.1)	916 (61.4)	372 (66.3)	1 (1.7)	29 (6.0)	18 (6.7)	288 (66.1)	1298 (74.2)	994 (84.8)
Ever	131 (44.9)	577 (38.6)	189 (33.7)	57 (98.3)	457 (94.0)	251 (93.3)	148 (33.9)	452 (25.8)	178 (15.2)
Physical activity (n, %)									
Non-vigorous	189 (64.7)	947 (63.4)	433 (77.2)	28 (48.3)	338 (69.5)	220 (81.8)	238 (54.6)	1026 (58.6)	887 (75.7)
Vigorous	103 (35.3)	546 (36.6)	128 (22.8)	30 (51.7)	148 (30.5)	49 (18.2)	198 (45.4)	724 (41.4)	285 (24.3)

Unmarried status includes separated, divorced, widowed, and never married; married status includes married and partnered.

The covariate “living region” was not available in ELSA, so it was not excluded in the analysis.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; SD, standard deviation; BMI, body mass index.

Supplementary Table 6 Characteristics of included participants in the second survey and excluded participants from baseline to the second surveys across the six studies

Characteristics	HRS (n=12693)		ELSA (n=6904)		SHARE (n=27847)	
	Included	Excluded	Included	Excluded	Included	Excluded
Age (years) (mean, SD)	69.0 (12.0)	64.1 (9.94)	70.0 (10.9)	65.9 (8.69)	66.5 (10.6)	65.4 (9.50)
Age group (n, %)						
50 - 64	1138 (40.8)	7158 (56.4)	526 (37.4)	3502 (50.7)	7047 (48.8)	14066 (50.5)
65 - 74	657 (23.6)	3349 (26.4)	365 (25.9)	2166 (31.4)	3881 (26.9)	8517 (30.6)
≥ 75	991 (35.6)	2186 (17.2)	517 (36.7)	1236 (17.9)	3522 (24.4)	5264 (18.9)
Sex (n, %)						
Female	1520 (54.6)	7443 (58.6)	775 (55.0)	3865 (56.0)	7986 (55.3)	16035 (57.6)
Male	1266 (45.4)	5250 (41.4)	633 (45.0)	3039 (44.0)	6464 (44.7)	11812 (42.4)
Marital status (n, %)						
Unmarried	1189 (42.7)	4221 (33.3)	499 (35.4)	1876 (27.2)	3914 (27.1)	7429 (26.7)
Married	1597 (57.3)	8472 (66.7)	909 (64.6)	5028 (72.8)	10536 (72.9)	20418 (73.3)
Living region (n, %)						
Rural	1968 (70.6)	9269 (73.0)	-	-	9302 (64.4)	17928 (64.4)
Urban	818 (29.4)	3424 (27.0)	-	-	5148 (35.6)	9919 (35.6)
Labour force status (n, %)						
Unemployed or unable to work	338 (12.1)	1435 (11.3)	160 (11.4)	749 (10.8)	2266 (15.7)	3969 (14.3)
Employed or self-employed	688 (24.7)	5000 (39.4)	353 (25.1)	2334 (33.8)	3410 (23.6)	8038 (28.9)
Retired	1760 (63.2)	6258 (49.3)	895 (63.6)	3821 (55.3)	8774 (60.7)	15840 (56.9)
educational attainment (n, %)						
Below high school	641 (23.0)	2001 (15.8)	614 (43.6)	1995 (28.9)	6746 (46.7)	10673 (38.3)
High school or above	2145 (77.0)	10692 (84.2)	794 (56.4)	4909 (71.1)	7704 (53.3)	17174 (61.7)
Total household income (tertiles) (n, %)						
Low	1136 (40.8)	3584 (28.2)	543 (38.6)	2093 (30.3)	6336 (43.8)	7556 (27.1)
Medium	928 (33.3)	4276 (33.7)	491 (34.9)	2299 (33.3)	4434 (30.7)	9297 (33.4)
High	722 (25.9)	4833 (38.1)	374 (26.6)	2512 (36.4)	3680 (25.5)	10994 (39.5)
BMI (kg/m ²) (mean, SD)	28.2 (6.27)	28.7 (5.86)	28.0 (5.37)	28.3 (5.12)	27.0 (4.79)	26.9 (4.64)
BMI group (n, %)						
< 18.5	40 (1.44)	115 (0.91)	21 (1.49)	55 (0.80)	203 (1.40)	284 (1.02)
18.5 - <25	843 (30.3)	3217 (25.3)	409 (29.0)	1797 (26.0)	5028 (34.8)	9991 (35.9)
25 - <30	1028 (36.9)	4826 (38.0)	552 (39.2)	2930 (42.4)	5912 (40.9)	11651 (41.8)
≥ 30	875 (31.4)	4535 (35.7)	426 (30.3)	2122 (30.7)		
Smoking status (n, %)						
Never	1161 (41.7)	5857 (46.1)	517 (36.7)	2718 (39.4)	7799 (54.0)	15232 (54.7)
Ever	1625 (58.3)	6836 (53.9)	891 (63.3)	4186 (60.6)	6651 (46.0)	12615 (45.3)
Drinking status (n, %)						
Never	1418 (50.9)	4897 (38.6)	245 (17.4)	766 (11.1)	2220 (15.4)	2961 (10.6)
Ever	1368 (49.1)	7796 (61.4)	1163 (82.6)	6138 (88.9)	12230 (84.6)	24886 (89.4)
Physical activity (n, %)						
Non-vigorous	1962 (70.4)	7669 (60.4)	1130 (80.3)	4681 (67.8)	8386 (58.0)	13782 (49.5)
Vigorous	824 (29.6)	5024 (39.6)	278 (19.7)	2223 (32.2)	6064 (42.0)	14065 (50.5)

Supplementary Table 6 Continued Characteristics of included participants in second survey and excluded participants from baseline to the second surveys across the six studies

Characteristics	CHARLS (n=5604)		KLoSA (n=6053)		MHAS (n=6447)	
	Included	Excluded	Included	Excluded	Included	Excluded
Age (years) (mean, SD)	62.0 (8.43)	60.4 (7.09)	69.5 (11.9)	65.1 (9.72)	66.0 (10.0)	63.2 (8.40)
Age group (n, %)						
50 - 64	1574 (67.1)	4174 (74.5)	292 (35.9)	3026 (50.0)	1630 (48.5)	3859 (59.9)
65 - 74	529 (22.5)	1190 (21.2)	224 (27.6)	1905 (31.5)	1003 (29.9)	1895 (29.4)
≥ 75	243 (10.4)	240 (4.28)	297 (36.5)	1122 (18.5)	725 (21.6)	693 (10.7)
Sex (n, %)						
Female	1234 (52.6)	2649 (47.3)	455 (56.0)	3471 (57.3)	1897 (56.5)	3756 (58.3)
Male	1112 (47.4)	2955 (52.7)	358 (44.0)	2582 (42.7)	1461 (43.5)	2691 (41.7)
Marital status (n, %)						
Unmarried	366 (15.6)	612 (10.9)	283 (34.8)	1303 (21.5)	1107 (33.0)	1816 (28.2)
Married	1980 (84.4)	4992 (89.1)	530 (65.2)	4750 (78.5)	2251 (67.0)	4631 (71.8)
Living region (n, %)						
Rural	992 (42.3)	2307 (41.2)	612 (75.3)	4459 (73.7)	2406 (71.6)	4662 (72.3)
Urban	1354 (57.7)	3297 (58.8)	201 (24.7)	1594 (26.3)	952 (28.4)	1785 (27.7)
Labour force status (n, %)						
Unemployed or unable to work	69 (2.94)	82 (1.46)	300 (36.9)	1893 (31.3)	1753 (52.2)	3103 (48.1)
Employed or self-employed	1321 (56.3)	3625 (64.7)	250 (30.8)	2661 (44.0)	1131 (33.7)	2577 (40.0)
Retired	956 (40.8)	1897 (33.9)	263 (32.3)	1499 (24.8)	474 (14.1)	767 (11.9)
educational attainment (n, %)						
Below high school	2087 (89.0)	4877 (87.0)	543 (66.8)	3895 (64.3)	2848 (84.8)	5517 (85.6)
High school or above	259 (11.0)	727 (13.0)	270 (33.2)	2158 (35.7)	510 (15.2)	930 (14.4)
Total household income (tertiles) (n, %)						
Low	750 (32.0)	1590 (28.4)	330 (40.6)	2332 (38.5)	1072 (31.9)	2120 (32.9)
Medium	764 (32.6)	1837 (32.8)	244 (30.0)	1743 (28.8)	1161 (34.6)	1998 (31.0)
High	832 (35.5)	2177 (38.8)	239 (29.4)	1978 (32.7)	1125 (33.5)	2329 (36.1)
BMI (kg/m ²) (mean, SD)	23.6 (13.1)	24.2 (25.1)	22.9 (3.03)	23.3 (2.74)	27.5 (5.16)	27.7 (4.77)
BMI group (n, %)						
< 18.5	165 (7.03)	296 (5.28)	64 (7.87)	203 (3.35)	53 (1.58)	64 (0.99)
18.5 - <25	1535 (65.4)	3574 (63.8)	573 (70.5)	4426 (73.1)	1082 (32.2)	1901 (29.5)
25 - <30	541 (23.1)	1476 (26.3)	163 (20.0)	1340 (22.1)	1375 (40.9)	2740 (42.5)
≥ 30	105 (4.48)	258 (4.60)	13 (1.60)	84 (1.39)	848 (25.3)	1742 (27.0)
Smoking status (n, %)						
Never	1406 (59.9)	3231 (57.7)	545 (67.0)	4166 (68.8)	2076 (61.8)	4057 (62.9)
Ever	940 (40.1)	2373 (42.3)	268 (33.0)	1887 (31.2)	1282 (38.2)	2390 (37.1)
Drinking status (n, %)						
Never	1449 (61.8)	3230 (57.6)	48 (5.90)	285 (4.71)	2580 (76.8)	4844 (75.1)
Ever	897 (38.2)	2374 (42.4)	765 (94.1)	5768 (95.3)	778 (23.2)	1603 (24.9)
Physical activity (n, %)						
Non-vigorous	1569 (66.9)	3595 (64.2)	586 (72.1)	3952 (65.3)	2151 (64.1)	3717 (57.7)
Vigorous	777 (33.1)	2009 (35.8)	227 (27.9)	2101 (34.7)	1207 (35.9)	2730 (42.3)

Unmarried status includes separated, divorced, widowed, and never married; married status includes married and partnered.
The covariate "living region" was not available in ELSA, so it was not excluded in the analysis.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; BMI, body mass index.

Supplementary Table 7 Numbers of chronic lung disease and no chronic lung disease and follow-up time for baseline frailty status and changes in frailty status across the six studies

Study	Baseline frailty status				Changes in frailty status			
	CLD (n, %)	No CLD (n, %)	Total (n)	Follow-up time (median [IQR], years)	CLD (n, %)	No CLD (n, %)	Total (n)	Follow-up time (median [IQR], years)
HRS	1053 (6.80)	14426 (93.20)	15479	9.3 (6.3-9.9)	699 (5.51)	11994 (94.49)	12693	7.8 (5.9-8.1)
ELSA	309 (3.72)	8003 (96.28)	8312	7.9 (5.7-8.1)	210 (3.04)	6694 (96.96)	6904	6.1 (5.7-6.2)
SHARE	2732 (6.46)	39565 (93.54)	42297	6.3 (4.2-8.5)	1347 (4.84)	26500 (95.16)	27847	6.3 (4.0-6.7)
CHARLS	1225 (15.41)	6725 (84.59)	7950	9.0 (7.0-9.0)	794 (14.17)	4810 (85.83)	5604	7.0 (6.8-7.0)
KLoSA	107 (1.56)	6759 (98.44)	6866	9.9 (8.2-10.0)	63 (1.04)	5990 (98.96)	6053	8.0 (7.8-8.0)
MHAS	495 (5.05)	9310 (94.95)	9805	6.1 (6.0-6.1)	155 (2.40)	6292 (67.60)	6447	3.1 (3.0-3.1)

Baseline frailty status: frailty status at the first survey, Changes in frailty status: frailty status changes from the first to second surveys.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease, IQR, interquartile range.

Supplementary Table 8 Numbers and percentages of participants for the analyses of changes in frailty status across the six studies

Changes in frailty status	HRS (n, %)	ELSA (n, %)	SHARE (n, %)	CHARLS (n, %)	KLoSA (n, %)	MHAS (n, %)
Stable robust	1802 (14.20)	1514 (21.90)	4848 (17.40)	424 (7.57)	98 (1.62)	461 (7.15)
Robust to pre-frail	705 (5.55)	559 (8.10)	2635 (9.46)	408 (7.28)	126 (2.08)	464 (7.20)
Robust to frail	23 (0.18)	12 (0.17)	105 (0.38)	9 (0.16)	367 (6.06)	24 (0.37)
Stable pre-frail	5473 (43.10)	2753 (39.90)	11591 (41.60)	2854 (50.90)	909 (15.00)	2742 (42.50)
Pre-frail to robust	410 (3.23)	393 (5.69)	1519 (5.45)	348 (6.21)	52 (0.86)	210 (3.26)
Pre-frail to frail	908 (7.15)	416 (6.03)	2317 (8.32)	557 (9.94)	3536 (58.40)	812 (12.60)
Stable frail	2806 (22.10)	994 (14.40)	3640 (13.10)	574 (10.20)	949 (15.7)	1317 (20.40)
Frail to robust	2 (0.02)	2 (0.03)	18 (0.06)	7 (0.13)	-	5 (0.08)
Frail to pre-frail	564 (4.44)	261 (3.78)	1174 (4.22)	423 (7.55)	16 (0.26)	412 (6.39)

No participants were classified in the group of “Frail to robust” in KLoSA.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study.

Supplementary Table 9 Association between baseline frailty status and risk of chronic lung disease by age

Age (years)	HRS (n=15479)		ELSA (n=8312)		SHARE (n=42297)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
50 - 64						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	3.96 (1.56-10.10)	3.15 (1.23-8.03)	3.49 (2.11-5.77)	2.95 (1.77-4.92)	2.53 (1.70-3.76)	2.24 (1.50-3.35)
Frail	17.9 (7.21-44.40)	9.66 (3.75-24.90)	6.32 (3.61-11.00)	3.85 (2.05-7.25)	4.70 (2.98-7.41)	3.60 (2.27-5.72)
65 - 74						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.14 (1.28-3.57)	1.95 (1.16-3.28)	1.54 (0.85-2.80)	1.32 (0.72-2.43)	1.82 (1.56-2.11)	1.50 (1.28-1.75)
Frail	4.59 (2.74-7.69)	3.70 (2.16-6.34)	4.96 (2.75-8.95)	3.72 (1.96-7.05)	3.14 (2.63-3.74)	2.10 (1.72-2.56)
≥ 75						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.05 (0.57-1.95)	1.06 (0.57-1.99)	0.81 (0.38-1.76)	0.82 (0.37-1.80)	1.08 (0.78-1.48)	1.08 (0.78-1.49)
Frail	1.48 (0.79-2.74)	1.46 (0.77-2.78)	0.77 (0.34-1.76)	0.86 (0.35-2.07)	1.65 (1.20-2.26)	1.71 (1.22-2.40)

Supplementary Table 9 Continued Association between baseline frailty status and risk of chronic lung disease by age

Age (years)	CHARLS (n=7950)		KLoSA (n=6866)		MHAS (n=9805)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
50 - 64						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.92 (1.50-2.45)	1.97 (1.54-2.52)	2.33 (0.55-9.95)	2.08 (0.48-9.09)	1.34 (0.90-2.01)	1.30 (0.86-1.96)
Frail	3.33 (2.56-4.35)	3.53 (2.69-4.64)	7.81 (1.51-40.3)	6.09 (1.08-34.4)	2.55 (1.67-3.90)	2.26 (1.44-3.55)
65 - 74						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.62 (1.00-2.63)	1.79 (1.10-2.92)	1.40 (0.19-10.3)	1.46 (0.20-10.9)	3.28 (1.20-8.97)	2.96 (1.07-8.19)
Frail	2.46 (1.49-4.06)	2.94 (1.76-4.90)	1.87 (0.24-14.50)	2.40 (0.30-19.2)	6.47 (2.37-17.6)	5.54 (1.98-15.5)
≥ 75						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.03 (0.63-6.58)	2.02 (0.62-6.58)	0.26 (0.03-1.92)	0.33 (0.04-2.62)	0.79 (0.28-2.20)	1.48 (1.04-2.11)
Frail	3.26 (0.99-10.7)	3.99 (1.19-13.40)	0.39 (0.05-2.91)	0.59 (0.07-4.82)	1.17 (0.43-3.23)	2.68 (1.86-3.87)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 10 Association between baseline frailty status and risk of chronic lung disease by sex

Sex	HRS (n=15479)		ELSA (n=8312)		SHARE (n=42297)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Female						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.25 (1.64-3.10)	1.82 (1.31-2.52)	2.50 (1.50-4.16)	1.94 (1.14-3.29)	2.58 (1.65-4.04)	2.30 (1.47-3.62)
Frail	4.88 (3.56-6.69)	3.13 (2.23-4.41)	4.29 (2.53-7.28)	2.80 (1.55-5.07)	5.42 (3.44-8.54)	4.34 (2.72-6.92)
Male						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.04 (1.44-2.89)	1.63 (1.14-2.33)	2.26 (1.42-3.60)	1.86 (1.15-3.00)	1.82 (1.56-2.11)	1.50 (1.28-1.75)
Frail	5.22 (3.68-7.41)	3.28 (2.23-4.81)	5.51 (3.36-9.04)	3.44 (1.97-6.00)	3.14 (2.63-3.74)	2.10 (1.72-2.56)

Supplementary Table 10 Continued Association between baseline frailty status and risk of chronic lung disease by sex

Sex	CHARLS (n=7950)		KLoSA (n=6866)		MHAS (n=9805)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Female						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.13 (1.39-3.25)	2.16 (1.41-3.31)	2.69 (0.37-19.90)	1.77 (0.23-13.50)	1.34 (0.83-2.17)	1.28 (0.79-2.09)
Frail	3.93 (2.55-6.05)	3.87 (2.50-6.00)	8.88 (1.19-66.10)	4.37 (0.53-35.80)	2.54 (1.58-4.08)	2.22 (1.35-3.65)
Male						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.97 (1.53-2.53)	1.90 (1.47-2.44)	2.66 (0.83-8.56)	1.57 (0.47-5.24)	1.82 (1.10-3.01)	1.58 (0.95-2.64)
Frail	3.57 (2.70-4.74)	3.20 (2.40-4.28)	4.78 (1.33-17.10)	2.29 (0.59-8.85)	3.68 (2.17-6.25)	2.86 (1.62-5.04)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 11 Association between baseline frailty status and risk of chronic lung disease by educational attainment

Educational attainment	HRS (n=15479)		ELSA (n=8312)		SHARE (n=42297)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Below high school						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.70 (0.91-3.20)	1.44 (0.76-2.75)	1.38 (0.80-2.39)	1.33 (0.75-2.34)	1.58 (1.30-1.92)	1.50 (1.23-1.83)
Frail	3.97 (2.16-7.30)	2.92 (1.53-5.57)	2.30 (1.32-4.02)	2.22 (1.20-4.09)	2.54 (2.08-3.09)	2.32 (1.87-2.87)
High school or above						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	3.57 (1.63-7.82)	-	2.75 (1.77-4.27)	2.37 (1.51-3.72)	1.66 (1.45-1.90)	1.47 (1.28-1.70)
Frail	11.60 (5.31-25.20)	3.13 (2.37-4.13)	5.41 (3.35-8.74)	4.11 (2.41-7.02)	3.14 (2.69-3.68)	2.49 (2.08-2.97)

Supplementary Table 11 Continued Association between baseline frailty status and risk of chronic lung disease by educational attainment

Educational attainment	CHARLS (n=7950)		KLoSA (n=6866)		MHAS (n=9805)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Below high school						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.85 (1.46-2.35)	1.90 (1.50-2.41)	1.76 (0.43-7.25)	1.45 (0.35-6.09)	1.74 (1.13-2.67)	1.54 (1.00-2.38)
Frail	3.16 (2.46-4.05)	3.41 (2.64-4.41)	3.52 (0.84-14.80)	2.70 (0.61-12.00)	3.41 (2.22-5.24)	2.69 (1.72-4.20)
High school or above						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.10 (1.27-3.48)	2.05 (1.23-3.43)	2.70 (0.63-11.5)	1.81 (0.41-8.05)	1.36 (0.73-2.56)	1.23 (0.65-2.32)
Frail	3.13 (1.61-6.07)	2.82 (1.41-5.66)	7.49 (1.45-38.70)	3.18 (0.54-18.70)	2.51 (1.18-5.33)	1.82 (0.80-4.15)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 12 Association between baseline frailty status and risk of chronic lung disease by total household income

Total household income	HRS (n=15479)		ELSA (n=8312)		SHARE (n=42297)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Low						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.18 (0.80-1.74)	1.14 (0.77-1.69)	1.75 (1.02-3.00)	1.52 (0.87-2.66)	1.53 (1.23-1.91)	1.42 (1.13-1.78)
Frail	2.36 (1.63-3.42)	2.20 (1.48-3.27)	2.35 (1.34-4.10)	1.89 (1.03-3.48)	2.33 (1.86-2.91)	2.03 (1.59-2.60)
Medium						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.63 (1.66-4.18)	2.25 (1.41-3.60)	2.55 (1.29-5.05)	2.37 (1.18-4.75)	1.73 (1.42-2.09)	1.55 (1.27-1.89)
Frail	4.87 (3.06-7.75)	3.86 (2.37-6.30)	5.20 (2.57-10.50)	4.70 (2.17-10.20)	3.30 (2.69-4.05)	2.68 (2.14-3.36)
High						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	8.44 (2.09-34.20)	1.82 (1.21-2.73)	2.21 (1.22-4.02)	2.03 (1.10-3.75)	1.65 (1.39-1.97)	1.40 (1.17-1.68)
Frail	-	3.41 (2.13-5.46)	6.13 (3.11-12.10)	5.12 (2.41-10.90)	3.73 (3.01-4.62)	2.64 (2.07-3.35)

Supplementary Table 12 Continued Association between baseline frailty status and risk of chronic lung disease by total household income

Total household income	CHARLS (n=7950)		KLoSA (n=6866)		MHAS (n=9805)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Low						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	2.33 (1.44-3.76)	2.72 (1.68-4.42)	1.99 (0.47-8.34)	1.39 (0.32-6.13)	1.49 (0.79-2.82)	1.38 (0.72-2.65)
Frail	3.59 (2.19-5.87)	4.53 (2.74-7.50)	4.09 (0.91-18.50)	2.62 (0.51-13.40)	3.37 (1.79-6.32)	2.98 (1.53-5.80)
Medium						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.78 (1.22-2.59)	1.76 (1.21-2.57)	1.22 (0.17-8.99)	1.27 (0.17-9.53)	2.64 (1.15-6.02)	2.41 (1.04-5.55)
Frail	3.43 (2.31-5.08)	3.63 (2.42-5.45)	1.84 (0.24-14.00)	2.16 (0.27-17.30)	4.66 (2.04-10.60)	3.81 (1.62-8.94)
High						
Robust	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail	1.75 (1.28-2.40)	1.74 (1.27-2.40)	3.22 (0.43-24.3)	2.21 (0.28-17.40)	1.21 (0.74-1.99)	1.12 (0.67-1.86)
Frail	2.66 (1.85-3.83)	2.58 (1.77-3.76)	-	5.21 (0.54-49.80)	2.01 (1.18-3.43)	1.64 (0.92-2.93)

FI cutoffs: robust (FI ≤ 0.08), pre-frail (0.08 < FI < 0.25), and frail (FI ≥ 0.25).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), BMI (< 18.5, 18.5 - < 25, 25 - < 30, ≥ 30; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and

Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 13 Association between changes in frailty status and risk of chronic lung disease by age

Age (years)	HRS (n=12693)		ELSA (n=6904)		SHARE (n=27847)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
50 - 64						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	2.37 (1.31-4.28)	1.90 (1.02-3.53)	-	-	2.31 (1.63-3.26)	2.07 (1.45-2.97)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.16 (0.00-16.8)	0.18 (0.00-18.30)	0.62 (0.22-1.75)	0.66 (0.23-1.86)	0.58 (0.39-0.85)	0.62 (0.42-0.93)
Pre-frail to frail	11.00 (4.03-30.30)	8.52 (3.10-23.40)	3.46 (1.82-6.55)	3.28 (1.69-6.34)	1.49 (1.09-2.04)	1.35 (0.98-1.86)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.56 (0.35-0.89)	0.61 (0.37-0.98)	0.13 (0.02-0.96)	0.14 (0.02-1.04)	0.49 (0.32-0.75)	0.50 (0.32-0.78)
65 - 74						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.30 (0.41-4.10)	1.71 (0.49-5.97)	1.00 (0.30-3.31)	1.46 (0.41-5.22)	1.33 (0.85-2.09)	1.28 (0.81-2.03)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.23 (0.03-1.63)	0.23 (0.03-1.67)	1.02 (0.31-3.42)	1.04 (0.31-3.52)	0.59 (0.32-1.08)	0.62 (0.34-1.14)
Pre-frail to frail	1.83 (1.17-2.85)	1.86 (1.19-2.92)	1.66 (0.63-4.37)	1.40 (0.51-3.81)	1.95 (1.48-2.57)	1.94 (1.46-2.59)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	0.88 (0.40-1.91)	0.92 (0.41-2.05)	0.80 (0.53-1.21)	0.77 (0.51-1.17)
≥ 75						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.28 (0.03-2.29)	0.06 (0.01-0.42)	1.22 (0.19-7.85)	11.80 (1.55-90.30)	-	-
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	1.54 (0.48-4.89)	1.01 (0.57-1.81)	1.02 (0.13-7.80)	1.00 (0.13-7.84)	0.24 (0.03-1.69)	0.24 (0.03-1.69)
Pre-frail to frail	1.74 (0.53-5.65)	1.06 (0.59-1.91)	1.98 (0.80-4.91)	2.08 (0.76-5.68)	1.98 (1.38-2.84)	1.98 (1.38-2.84)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.66 (0.28-1.54)	0.11 (0.00-3.51)	2.17 (0.65-7.22)	2.35 (0.66-8.44)	1.02 (0.65-1.61)	0.99 (0.62-1.57)

Supplementary Table 13 Continued Association between changes in frailty status and risk of chronic lung disease by age

Age (years)	CHARLS (n=5604)		KLoSA (n=6053)		MHAS (n=6447)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
50 - 64						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.73 (0.41-1.33)	0.77 (0.42-1.42)	-	-	3.05 (0.51-18.20)	2.83 (0.29-28.00)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.61 (0.40-0.92)	0.60 (0.40-0.92)	-	-	0.79 (0.19-3.32)	0.80 (0.19-3.44)
Pre-frail to frail	1.54 (1.19-1.98)	1.64 (1.27-2.13)	0.90 (0.29-2.83)	0.65 (0.20-2.11)	1.76 (0.86-3.58)	1.63 (0.78-3.43)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.78 (0.56-1.08)	0.81 (0.58-1.13)	-	-	0.48 (0.16-1.40)	0.41 (0.14-1.23)
65 - 74						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	-	-	-	-	0.64 (0.04-10.30)	-
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.54 (0.22-1.32)	0.51 (0.21-1.27)	-	-	-	-
Pre-frail to frail	0.82 (0.49-1.38)	1.00 (0.59-1.71)	3.17 (0.42-24.00)	2.77 (0.36-21.50)	1.11 (0.47-2.61)	1.18 (0.48-2.87)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.78 (0.44-1.37)	0.71 (0.38-1.31)	-	-	0.54 (0.16-1.79)	0.66 (0.19-2.24)
≥ 75						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.64 (0.04-10.2)	0.59 (0.04-9.60)	-	-	-	-
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	1.28 (0.17-9.62)	0.82 (0.10-6.87)	-	-	-	-
Pre-frail to frail	0.75 (0.22-2.56)	0.84 (0.23-3.05)	1.24 (0.15-9.88)	1.23 (0.14-10.40)	0.88 (0.27-2.94)	1.55 (0.39-6.12)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.80 (0.27-2.35)	0.51 (0.11-2.39)	-	-	-	-

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational

attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) (“living region” was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 14 Association between changes in frailty status and risk of chronic lung disease by sex

Sex	HRS (n=12693)		ELSA (n=6904)		SHARE (n=27847)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
Female						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.83 (0.94-3.58)	1.54 (0.76-3.12)	-	3.57 (1.13-11.3)	2.21 (1.52-3.21)	2.02 (1.37-2.99)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.48 (0.21-1.07)	0.56 (0.25-1.27)	0.95 (0.37-2.44)	1.04 (0.40-2.69)	0.47 (0.28-0.78)	0.51 (0.31-0.85)
Pre-frail to frail	1.79 (1.28-2.49)	1.63 (1.16-2.30)	2.73 (1.49-4.98)	2.32 (1.23-4.37)	1.77 (1.40-2.24)	1.62 (1.27-2.07)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.63 (0.41-0.97)	0.75 (0.48-1.18)	0.71 (0.30-1.71)	0.69 (0.28-1.70)	0.64 (0.46-0.88)	0.61 (0.44-0.86)
Male						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.67 (0.79-3.54)	1.51 (0.69-3.31)	1.28 (0.45-3.64)	1.23 (0.41-3.63)	1.92 (1.33-2.76)	1.59 (1.09-2.33)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	-	-	0.61 (0.19-1.98)	0.53 (0.16-1.73)	0.6 (0.40-0.91)	0.68 (0.45-1.04)
Pre-frail to frail	2.29 (1.53-3.44)	2.01 (1.34-3.03)	2.48 (1.20-5.14)	2.12 (0.99-4.54)	1.98 (1.53-2.57)	1.81 (1.38-2.37)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	0.70 (0.31-1.58)	0.81 (0.34-1.91)	0.81 (0.55-1.20)	0.84 (0.56-1.25)

Supplementary Table 14 Continued Association between changes in frailty status and risk of chronic lung disease by sex

Sex	CHARLS (n=5604)		KLoSA (n=6053)		MHAS (n=6447)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
Female						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.56 (0.21-1.51)	0.62 (0.20-1.96)	-	-	2.61 (0.27-25.1)	2.17 (0.23-20.9)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.27 (0.10-0.72)	0.25 (0.09-0.67)	-	-	0.54 (0.07-3.94)	0.6 (0.08-4.48)
Pre-frail to frail	1.44 (1.05-1.97)	1.49 (1.09-2.05)	1.28 (0.28-5.76)	1.03 (0.22-4.81)	1.58 (0.86-2.89)	1.4 (0.75-2.61)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.76 (0.53-1.09)	0.84 (0.57-1.21)	-	-	0.32 (0.12-0.90)	0.35 (0.12-0.99)
Male						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	7.32 (0.87-61.7)	7.46 (0.88-63.4)	-	-	3.21 (0.33-30.8)	2.76 (0.28-27.2)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.70 (0.47-1.05)	0.72 (0.48-1.08)	3.77 (0.42-33.7)	2.87 (0.28-29.1)	0.42 (0.06-3.08)	0.44 (0.06-3.32)
Pre-frail to frail	1.39 (0.99-1.94)	1.36 (0.97-1.91)	1.74 (0.60-5.04)	1.39 (0.48-4.09)	1.08 (0.41-2.81)	0.92 (0.34-2.49)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.78 (0.52-1.18)	0.77 (0.50-1.17)	-	-	0.44 (0.13-1.50)	0.47 (0.13-1.70)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work,

employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) (“living region” was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 15 Association between changes in frailty status and risk of chronic lung disease by educational attainment

Educational attainment	HRS (n=12693)		ELSA (n=6904)		SHARE (n=27847)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
Below high school						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	2.68 (0.76-9.52)	4.79 (1.30-17.7)	1.68 (0.51-5.51)	2.85 (0.71-11.4)	1.37 (0.84-2.24)	1.26 (0.76-2.09)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	-	-	0.54 (0.13-2.27)	0.52 (0.12-2.26)	0.63 (0.36-1.10)	0.65 (0.37-1.14)
Pre-frail to frail	1.84 (1.03-3.31)	1.77 (0.95-3.28)	1.79 (0.86-3.71)	1.68 (0.78-3.62)	1.55 (1.20-1.99)	1.5 (1.15-1.95)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.76 (0.42-1.39)	0.87 (0.47-1.61)	0.47 (0.17-1.31)	0.51 (0.18-1.44)	0.72 (0.51-1.00)	0.051 (0.48-0.97)
High school or above						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.55 (0.89-2.70)	1.32 (0.74-2.34)	1.98 (0.81-4.84)	2.00 (0.80-5.00)	2.33 (1.71-3.16)	2.03 (1.48-2.78)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.35 (0.16-0.79)	0.39 (0.17-0.87)	0.89 (0.38-2.09)	0.87 (0.37-2.06)	0.53 (0.36-0.79)	0.57 (0.38-0.85)
Pre-frail to frail	1.97 (1.48-2.63)	1.72 (1.29-2.31)	2.84 (1.58-5.09)	2.93 (1.59-5.38)	2.01 (1.58-2.56)	1.94 (1.51-2.50)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	1.06 (0.50-2.27)	1.08 (0.49-2.38)	0.71 (0.49-1.02)	0.7 (0.48, 1.02)

Supplementary Table 15 Continued Association between changes in frailty status and risk of chronic lung disease by educational attainment

Educational attainment	CHARLS (n=5604)		KLoSA (n=6053)		MHAS (n=6447)	
	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Below high school						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.74 (0.42-1.33)	0.80 (0.44-1.47)	-	-	1.98 (0.38-10.2)	1.87 (0.36-9.70)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.64 (0.43-0.95)	0.61 (0.41-0.91)	-	-	0.36 (0.05-2.59)	0.42 (0.06-3.11)
Pre-frail to frail	1.31 (1.03-1.65)	1.45 (1.14-1.85)	1.93 (0.59-6.38)	1.92 (0.58-6.40)	1.58 (0.94-2.68)	1.40 (0.81-2.40)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.83 (0.63-1.10)	0.84 (0.63-1.11)	-	-	0.36 (0.16-0.83)	0.38 (0.16-0.90)
High school or above						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	-	0.49 (0.15-1.61)	-	-	-	-
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.42 (0.15-1.16)	0.44 (0.15-1.23)	4.27 (0.44-41.1)	4.32 (0.44-42.0)	0.57 (0.07-4.36)	0.67 (0.08-5.74)
Pre-frail to frail	1.26 (0.57-2.79)	1.11 (0.47-2.59)	0.83 (0.21-3.20)	0.73 (0.19-2.85)	0.63 (0.08-4.88)	0.40 (0.05-3.25)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	-	-	0.48 (0.05-4.59)	0.42 (0.02-7.17)

FI cutoffs: robust (FI ≤ 0.08), pre-frail (0.08 < FI < 0.25), and frail (FI ≥ 0.25).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75; years), sex (female, male), marital status (unmarried [including

separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 16 Association between changes in frailty status and risk of chronic lung disease by total household income

Total household income	HRS (n=12693)		ELSA (n=6904)		SHARE (n=27847)	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)	(unadjusted)	(adjusted)
Low						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	2.16 (0.93-5.07)	2.86 (1.14-7.13)	0.82 (0.23-3.00)	1.03 (0.26-4.04)	1.35 (0.72-2.53)	1.13 (0.59-2.16)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.22 (0.03-1.57)	0.22 (0.03-1.57)	0.80 (0.24-2.62)	0.85 (0.26-2.84)	0.80 (0.43-1.48)	0.84 (0.45-1.57)
Pre-frail to frail	1.80 (1.18-2.75)	1.96 (1.27-3.03)	2.32 (1.23-4.40)	2.13 (1.08-4.23)	1.91 (1.43-2.56)	1.88 (1.39-2.55)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.92 (0.57-1.46)	0.97 (0.60-1.57)	0.47 (0.17-1.34)	0.46 (0.16-1.31)	0.70 (0.46-1.06)	0.67 (0.44-1.02)
Medium						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.84 (0.27-2.61)	0.78 (0.24-2.60)	-	-	2.32 (1.47-3.68)	2.22 (1.37-3.58)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	2.06 (0.12-35.0)	2.38 (0.14-40.4)	0.98 (0.29-3.28)	0.87 (0.26-2.93)	0.50 (0.28-0.89)	0.52 (0.29-0.93)
Pre-frail to frail	8.75 (2.83-27.0)	9.12 (2.95-28.2)	2.03 (0.87-4.75)	2.39 (1.00-5.75)	1.55 (1.16-2.08)	1.55 (1.15-2.10)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	0.7 (0.24-2.04)	0.70 (0.24-2.04)	0.65 (0.44-0.95)	0.61 (0.41-0.90)
High						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.60 (0.71-3.58)	1.68 (0.73-3.83)	3.20 (0.93-11.0)	3.42 (0.94-12.5)	4.30 (1.47-12.60)	3.61 (1.23-10.6)
Stable pre-frail	Reference	Reference			Reference	Reference
Pre-frail to robust	0.33 (0.08-1.33)	0.42 (0.10-1.71)	0.61 (0.14-2.59)	0.74 (0.17-3.22)	0.50 (0.30-0.82)	0.58 (0.35-0.96)
Pre-frail to frail	2.70 (1.61-4.54)	2.05 (1.20-3.48)	2.47 (0.84-7.25)	3.11 (1.00-9.62)	1.94 (1.38-2.72)	1.85 (1.30-2.62)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.49 (0.20-1.16)	0.48 (0.20-1.17)	1.37 (0.47-4.04)	1.26 (0.38-4.20)	0.86 (0.51-1.47)	1.02 (0.58-1.78)

Supplementary Table 16 Continued Association between changes in frailty status and risk of chronic lung disease by total household income

	CHARLS (n=5604)		KLoSA (n=6053)		MHAS (n=6447)	
Total household income	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
Low						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	2.16 (0.93-5.07)	2.86 (1.14-7.13)	-	-	1.35 (0.72-2.53)	1.13 (0.59-2.16)
Stable pre-frail	Reference	Reference			Reference	Reference
Pre-frail to robust	0.22 (0.03-1.57)	0.22 (0.03-1.57)	-	-	0.8 (0.43-1.48)	0.84 (0.45-1.57)
Pre-frail to frail	1.80 (1.18-2.75)	1.96 (1.27-3.03)	1.69 (0.38-7.47)	1.59 (0.34-7.34)	1.91 (1.43-2.56)	1.88 (1.39-2.55)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.92 (0.57-1.46)	0.97 (0.60-1.57)	-	-	0.70 (0.46-1.06)	0.67 (0.44-1.02)
Medium						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.84 (0.27-2.61)	0.78 (0.24-2.60)	-	-	2.32 (1.47-3.68)	2.22 (1.37-3.58)
Stable pre-frail	Reference	Reference			Reference	Reference
Pre-frail to robust	2.06 (0.12-35.0)	2.38 (0.14-40.4)	-	-	0.5 (0.28-0.89)	0.52 (0.29-0.93)
Pre-frail to frail	8.75 (2.83-27.0)	9.12 (2.95-28.2)	2.84 (0.38-21.5)	3.04 (0.40-23.3)	1.55 (1.16-2.08)	1.55 (1.15-2.10)
Stable frail	-	-	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	-	-	-	-	0.65 (0.44-0.95)	0.61 (0.41-0.90)
High						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.60 (0.71-3.58)	1.68 (0.73-3.83)	-	-	4.30 (1.47-12.6)	3.61 (1.23-10.6)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.33 (0.08-1.33)	0.42 (0.10-1.71)	5.01 (0.52-48.3)	14.3 (1.17-174)	0.50 (0.30-0.82)	0.58 (0.35-0.96)
Pre-frail to frail	2.70 (1.61-4.54)	2.05 (1.20-3.48)	0.65 (0.16-2.61)	0.49 (0.11-2.06)	1.94 (1.38-2.72)	1.85 (1.30-2.62)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.49 (0.20-1.16)	0.48 (0.20-1.17)	-	-	0.86 (0.51-1.47)	1.02 (0.58-1.78)

FI cutoffs: robust (FI ≤ 0.08), pre-frail (0.08 < FI < 0.25), and frail (FI ≥ 0.25).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never

married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) (“living region” was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 17 Association between baseline frailty status and risk of chronic lung disease across the six studies using accelerated failure time model

Study	Robust	Pre-frail		Frail	
		TR (95% CI) (unadjusted)	TR (95% CI) (adjusted)	TR (95% CI) (unadjusted)	TR (95% CI) (adjusted)
HRS (n=15479)	Reference	0.61 (0.52-0.71)	0.70 (0.60-0.82)	0.35 (0.30-0.41)	0.48 (0.40-0.56)
ELSA (n=8312)	Reference	0.60 (0.49-0.74)	0.67 (0.55-0.83)	0.40 (0.32-0.50)	0.50 (0.39-0.63)
SHARE (n=42297)	Reference	0.71 (0.66-0.76)	0.78 (0.72-0.83)	0.48 (0.45-0.52)	0.57 (0.52-0.62)
CHARLS (n=7950)	Reference	0.77 (0.70-0.84)	0.76 (0.69-0.83)	0.61 (0.55-0.67)	0.60 (0.54-0.66)
KLoSA (n=6866)	Reference	0.48 (0.20-1.12)	0.66 (0.29-1.51)	0.24 (0.10-0.59)	0.39 (0.16-0.97)
MHAS (n=9805)	Reference	0.84 (0.74-0.96)	0.88 (0.77-1.00)	0.66 (0.57-0.75)	0.72 (0.63-0.83)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

TR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; TR, time ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 18 Association between changes in frailty status and risk of chronic lung disease across the six studies using accelerated failure time model

	HRS (n=12693)	ELSA (n=6904)	SHARE (n=27847)	CHARLS (n=5604)	KLoSA (n=6053)	MHAS (n=6447)
Changes in frailty status	TR (95% CI)	TR (95% CI)	TR (95% CI)	TR (95% CI)	TR (95% CI)	TR (95% CI)
Unadjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.77 (0.61-0.98)	0.69 (0.46-1.03)	0.69 (0.61-0.80)	1.18 (0.93-1.49)	-	0.99 (0.96-1.01)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	1.94 (1.23-3.05)	1.14 (0.81-1.61)	1.40 (1.17-1.68)	1.28 (1.06-1.54)	0.50 (0.12-2.01)	1.00 (0.99-1.01)
Pre-frail to frail	0.68 (0.58-0.78)	0.65 (0.52-0.82)	0.71 (0.64-0.79)	0.88 (0.78-0.98)	0.76 (0.43-1.35)	0.94 (0.94-0.95)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	1.29 (1.07-1.55)	1.18 (0.88-1.58)	1.21 (1.06-1.38)	1.14 (0.99-1.31)	-	1.07 (1.06-1.08)
Adjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	0.84 (0.66-1.06)	0.70 (0.47-1.05)	0.74 (0.65-0.85)	1.12 (0.88-1.43)	-	0.98 (0.98-0.98)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	1.79 (1.15-2.78)	1.12 (0.80-1.57)	1.34 (1.12-1.61)	1.30 (1.08-1.56)	0.58 (0.14-2.34)	1.02 (1.01-1.02)
Pre-frail to frail	0.73 (0.63-0.84)	0.68 (0.54-0.86)	0.73 (0.66-0.81)	0.84 (0.75-0.94)	0.83 (0.47-1.45)	0.96 (0.96-0.96)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	1.22 (1.01-1.48)	-	1.23 (1.07-1.41)	1.13 (0.98-1.31)	-	1.04 (1.03-1.04)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

TR was adjusted for age (50 - 64, 65 - 74, $\geq$ 75; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, TRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; TR, time ratio; ; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 19 Association between baseline frailty status and risk of chronic lung disease across the six studies using competing risk model

Study	Robust	Pre-frail		Frail	
		HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
HRS (n=15479)	Reference	2.02 (1.60-2.55)	1.71 (1.34-2.18)	3.93 (3.11-4.95)	2.74 (2.11-3.56)
ELSA (n=8312)	Reference	2.33 (1.65-3.28)	1.94 (1.35-2.80)	4.29 (2.99-6.16)	3.07 (2.01-4.68)
SHARE (n=42297)	Reference	1.61 (1.44-1.80)	1.46 (1.30-1.63)	2.45 (2.18-2.75)	2.10 (1.82-2.41)
CHARLS (n=7950)	Reference	1.84 (1.48-2.27)	1.88 (1.51-2.33)	2.94 (2.34-3.69)	3.14 (2.49-3.97)
KLoSA (n=6866)	Reference	2.31 (0.85-6.32)	1.70 (0.59-4.89)	4.26 (1.51-12.0)	2.62 (0.82-8.41)
MHAS (n=9805)	Reference	1.55 (1.10-2.20)	1.41 (0.99-2.01)	2.74 (1.93-3.87)	2.25 (1.55-3.29)

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 20 Association between changes in frailty status and risk of chronic lung disease across the six studies using competing risk model

	HRS (n=12693)	ELSA (n=6904)	SHARE (n=27847)	CHARLS (n=5604)	KLoSA (n=6053)	MHAS (n=6447)
Changes in frailty status	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Unadjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.70 (1.03-2.81)	-	1.98 (1.53-2.57)	0.71 (0.43-1.18)	-	2.43 (0.62-9.55)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.32 (0.14-0.72)	-	0.57 (0.41-0.78)	0.61 (0.42-0.89)	2.92 (0.36-23.7)	0.48 (0.12-1.95)
Pre-frail to frail	1.79 (1.39-2.32)	-	1.58 (1.33-1.89)	1.27 (1.02-1.58)	1.45 (0.61-3.44)	1.33 (0.81-2.19)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.75 (0.54-1.04)	-	0.81 (0.64-1.04)	0.82 (0.63-1.08)	-	0.40 (0.18-0.86)
Adjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.43 (0.86-2.39)	-	1.76 (1.34-2.31)	0.79 (0.46-1.34)	-	1.23 (0.25-6.11)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.35 (0.16-0.79)	-	0.60 (0.43-0.82)	0.59 (0.41-0.86)	2.46 (0.24-24.9)	0.52 (0.13-2.10)
Pre-frail to frail	1.60 (1.22-2.11)	-	1.53 (1.28-1.84)	1.36 (1.09-1.71)	1.33 (0.56-3.15)	1.21 (0.72-2.01)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.79 (0.56-1.11)	-	0.75 (0.58-0.96)	0.81 (0.62-1.07)	-	-

FI cutoffs: robust ($FI \leq 0.08$), pre-frail ($0.08 < FI < 0.25$), and frail ($FI \geq 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including

separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

As mortality data for ELSA was unavailable from Wave 7, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 21 Association between baseline frailty status and risk of chronic lung disease across the six studies using frailty index cutoffs of 0.10 and 0.25

Study	Robust	Pre-frail		Frail	
		HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)	HR (95% CI) (unadjusted)	HR (95% CI) (adjusted)
HRS (n=15479)	Reference	4.03 (2.16-7.53)	3.12 (1.66-5.89)	11.20 (6.06-20.50)	6.65 (3.50-12.70)
ELSA (n=8312)	Reference	2.21 (1.64-2.97)	1.86 (1.37-2.54)	3.94 (2.89-5.37)	2.91 (2.04-4.15)
SHARE (n=42297)	Reference	2.03 (1.57-2.63)	1.47 (1.32-1.62)	3.67 (2.80-4.82)	2.28 (2.02-2.57)
CHARLS (n=7950)	Reference	1.79 (1.52-2.10)	1.86 (1.58-2.19)	2.84 (2.38-3.39)	3.07 (2.55-3.70)
KLoSA (n=6866)	Reference	1.69 (0.95-3.02)	1.25 (0.68-2.31)	3.58 (1.91-6.71)	2.29 (1.12-4.68)
MHAS (n=9805)	Reference	1.73 (1.29-2.31)	1.54 (1.15-2.08)	3.17 (2.37-4.24)	2.56 (1.87-3.50)

FI cutoffs: robust ($FI \leq 0.10$), pre-frail ($0.10 < FI \leq 0.25$), and frail ($FI > 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.

Supplementary Table 22 Association between changes in frailty status and risk of chronic lung disease across the six studies using frailty index cutoffs of 0.10 and 0.25

	HRS (n=12693)	ELSA (n=6904)	SHARE (n=27847)	CHARLS (n=5604)	KLoSA (n=6053)	MHAS (n=6447)
Changes in frailty status	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Unadjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	5.00 (1.29-19.4)	1.39 (0.73-2.64)	2.21 (1.78-2.74)	1.31 (0.92-1.86)	1.78 (0.23-14.1)	3.43 (1.20-9.82)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.13 (0.01-1.10)	0.70 (0.34-1.48)	0.74 (0.57-0.96)	0.79 (0.59-1.06)	-	0.79 (0.31-1.98)
Pre-frail to frail	4.09 (2.01-8.33)	2.33 (1.45-3.74)	1.63 (1.36-1.96)	1.30 (1.03-1.64)	1.58 (0.56-4.50)	1.17 (0.69-2.01)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.08 (0.02-0.33)	0.73 (0.40-1.33)	0.71 (0.56-0.91)	0.78 (0.60-1.03)	-	0.37 (0.17-0.80)
Adjusted						
Stable robust	Reference	Reference	Reference	Reference	Reference	Reference
Robust to pre-frail/frail	1.26 (0.80-1.98)	1.35 (0.70-2.61)	1.96 (1.56-2.45)	1.40 (0.98-2.01)	1.81 (0.23-14.3)	3.03 (0.98-9.42)
Stable pre-frail	Reference	Reference	Reference	Reference	Reference	Reference
Pre-frail to robust	0.14 (0.02-1.22)	0.72 (0.34-1.52)	0.80 (0.61-1.04)	0.75 (0.56-1.01)	-	0.87 (0.34-2.20)
Pre-frail to frail	4.06 (1.98-8.33)	2.25 (1.37-3.68)	1.59 (1.31-1.92)	1.40 (1.11-1.78)	1.46 (0.51-4.19)	1.06 (0.61-1.84)
Stable frail	Reference	Reference	Reference	Reference	Reference	Reference
Frail to robust/pre-frail	0.10 (0.03-0.40)	0.71 (0.38-1.30)	0.69 (0.53-0.89)	0.78 (0.59-1.03)	-	0.40 (0.18-0.88)

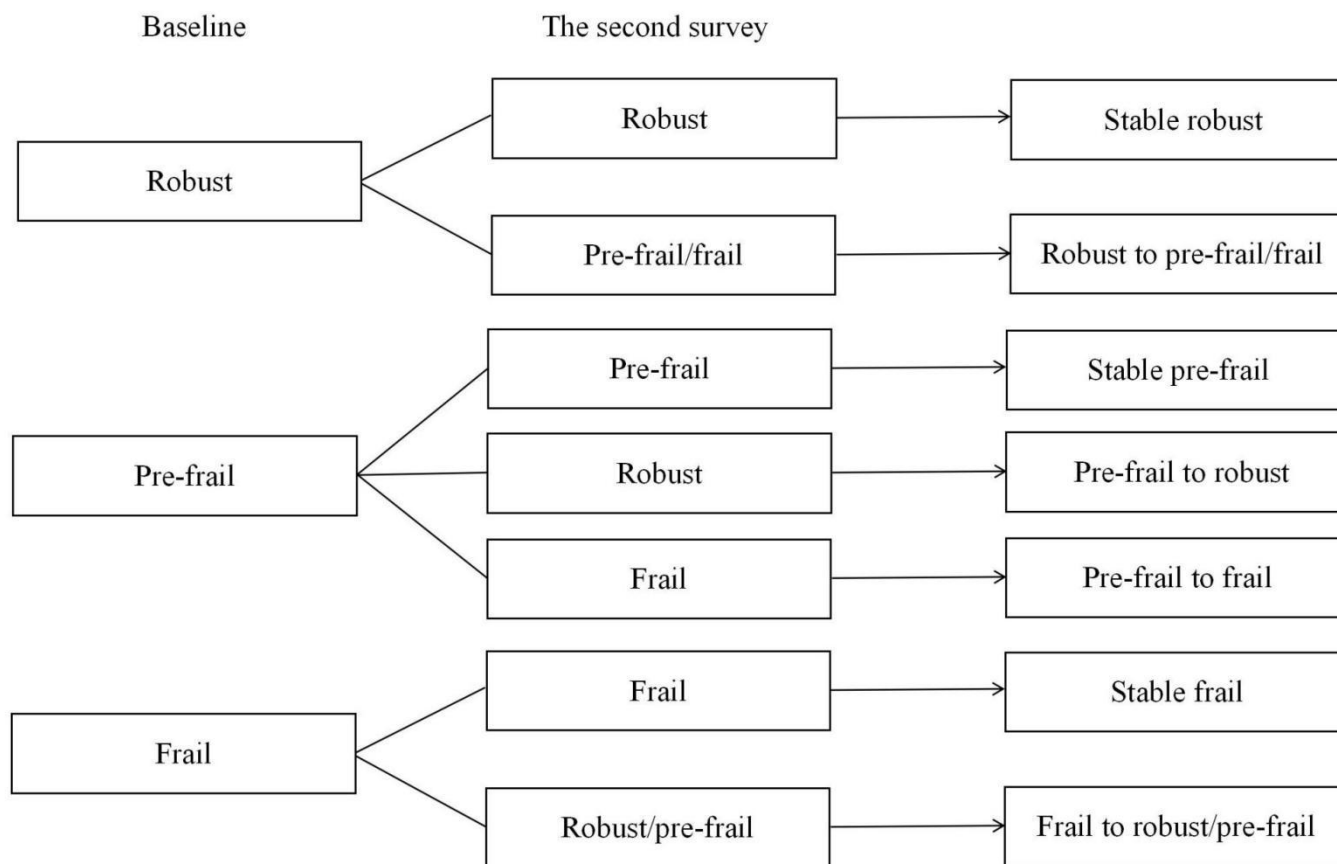
FI cutoffs: robust ($FI \leq 0.10$), pre-frail ($0.10 < FI \leq 0.25$), and frail ($FI > 0.25$).

HR was adjusted for age (50 - 64, 65 - 74, ≥ 75 ; years), sex (female, male), marital status (unmarried [including

separated/divorced/widowed/never married], married [including married/partnered]), living region (rural, urban), labor force status (unemployed/unable to work, employed/self-employed, retired), educational attainment (below high school, high school or above), total household income (low, medium, and high), BMI (< 18.5 , $18.5 - < 25$, $25 - < 30$, ≥ 30 ; kg/m²), smoking status (never, ever), drinking status (never, ever), and physical activity (non-vigorous, vigorous) ("living region" was removed in ELSA).

Due to insufficient event numbers or an inadequate sample size, HRs were not able to be calculated.

HRS, Health and Retirement Study; ELSA, English Longitudinal Study of Ageing; SHARE, Survey of Health, Ageing and Retirement in Europe; CHARLS, China Health and Retirement Longitudinal Study; KLoSA, Korean Longitudinal Study of Aging; MHAS, Mexican Health and Aging Study; CLD, chronic lung disease; HR, hazard ratio; CI, confidence interval; BMI, body mass index; FI, frailty index.



Supplementary Figure 1 The dynamic nature of frailty status