Appendix

Search terms used

Pubmed

("hypertension" [MeSH Terms] OR "hyperten*" [Title/Abstract] OR "hypertension" [Title/Abstract] OR "hypertensive" [Title/Abstract] OR "high blood pressure" [Title/Abstract] OR "systolic blood pressure" [Title/Abstract] OR "diastolic blood pressure" [Title/Abstract] OR "raised blood pressure" [Title/Abstract]) AND ("frail elderly" [MeSH Terms] OR "frail*" [Title/Abstract] OR "frailty" [Title/Abstract])

Web of Science and Embase

("hyperten*" OR "hypertension" OR "hypertensive" OR "high blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR "raised blood pressure") AND ("frail*" OR "frailty")

First Author (year)	Study characteristics	n	Hypertension definition	Hypertension prevalence	Frailty definition	Frailty Incidence (longitudinal studies) or prevalence (cross- sectional studies)	% hypertension in frailty groups	Other results	NOS
LONGITUDIN	AL STUDIES								
Barzilay (2007)	Country: USA Name: Cardiovascular Health Study (CHS) Setting: community Age: ≥ 65 y	2826	BP ≥ 130/85 mm Hg or treated hypertension	37%	CHS criteria	Prefrail: 66% Frail: 8%	Robust=34% Prefrail=38% Frail=43%	Incident frailty (5 and 9 y follow-up) was not predicted by hypertension diagnosis or blood pressure levels. SBP at baseline was not independently associated with frailty: HR=0.96 (95% CI 0.89-1.04) for prefrailty and HR=1.01 (95% CI 0.88-1.17) for frailty.	7
Bouillon (2013)	Country: UK Name: Whitehall II Study Setting: community Age (range): 45-69 y	2707	BP ≥ 130/85 mm Hg or treated hypertension	40%	CHS criteria	Prefrail: 37% Frail: 3%	Robust=38% Prefrail/frail=43%	-	6
Castrejón- Pérez (2017)	Country: Mexico Name: Mexican Study of Nutritional and Psychosocial Markers of Frailty Setting: community Age (range): 70-95 y	237	Not defined	58%	CHS criteria	Frail=15%	Robust=55% Frail=74%	At univariate analysis hypertension was associated with incident frailty (HR=2.11, 95%CI 1.03-4.31), but this association was not confirmed in the multivariate analysis (HR=1.58, 95%CI 0.83-3.01)	6
Doba (2012)	Country: Japan Name: Japanese Health Research Volunteer Study	351	Not defined	28%	FI	Frail: 16%	Robust=28% Frail=29%	Baseline SBP was lower in persons who developed frailty vs non frail SBP=135±17 vs 140±21 (p=0.046) . In multivariate analyses, no	7

Table e1. Characteristics of the studies included in the systematic review.

	Setting: community							significant association between SBP and frailty was observed	
	Age (mean±SD): 78±4 y								
CROSS-SECTION	Country: Brazil	391	Self-reported	58%	CHS criteria	Prefrail: 60%	Robust=53%		5
Albuquerque Sousa (2012)	Name: Network of Studies on the Frailty of Elderly Brazilians	391	Sen-reported	3676		Frail: 17%	Prefrail=57% Frail=67%	-	5
	Setting: Community								
	Age (mean±SD): 74±7 y								
Ávila-Funes (2008)	Country: France Name: Three-City Study	6078	Self-reported or BP≥160/95 or treated hypertension	64%	CHS criteria	Prefrail: 48% Frail: 7%	Robust=64% Prefrail=63% Frail=71%	-	5
	Setting: community								
Basile (2017)	Age (mean±SD): 74±5 y Country: Italy	56	Treated	100%	FI	-	-	Participants with SBP≥140	5
	Setting: community		hypertension					mmHg had lower FI compared to those with SBP<140 mmHg (p=0.006)	
	Age (mean): 81±8 y								
Bastos- Barbosa (2012)	Country: Brazil Name: Research Network of Studies of Brazilian Elderly Individuals Setting: community	77	BP reported as a continuous measure	63%	CHS criteria	Prefrail: 40% Frail: 30%	Not reported	Ambulatory BP of frail group demonstrated significantly higher systolic and diastolic BP values over the 24 h (135/74 mm Hg) than nonfrail group (122/68 mm Hg).	5
	Age (mean±SD): 74±7 y								
Calado (2016)	Country: Brazil Setting: community	385	Self-reported	46%	CHS criteria	Prefrail: 50% Frail: 9%	Robust=44% Prefrail=48% Frail=49%	-	5

Age (mean): 74±6 y								
Country: Mexico Name: Mexican Health and Nutrition Survey Setting: community	7164	Not defined	38%	FI	Mean FI score=0.18	-	Multiple linear regression for FI for hypertension only (without diabetes) Beta: 0.31 (0.55-0.69)	5
Age (mean+SD): 71+8 v								
Country: Taiwan	234	Not defined	43%	CHS criteria	Frail: 39%	Robust=33%	Hypertension significantly	4
Setting: community						Frail=58%	associated with frailty OR=2.21 (1.16–4.21) in multivariate analysis.	
Age: ≥65 y								
Country: Taiwan Name: I-Lan Longitudinal Aging Study	962	Self-reported or BP≥140/90 or treated hypertension	37%	CHS criteria	Prefrail: 33% Frail: 3%	Robust=34% Prefrail=42% Frail=53%	-	6
Setting: community								
Country: Brazil Name: Research Network of Studies of Brazilian Elderly Individuals Setting: community	900	BP ≥ 140/90 mm Hg	52%	CHS criteria	Prefrail: 52% Frail: 8%	Not reported	Hypertension not associated with frailty OR=0.78 (0.60– 1.03) in univariate analysis.	7
Age: ≥65 y								
Country: Brazil Name: FRAgilidade em idosos com doenças CardiOvasculaRes	172	Not defined	84%	CHS criteria	Prefrail: 51% Frail: 38%	Robust=100% Prefrail=83% Frail=81%	-	4
	Name: Mexican Health and Nutrition Survey Setting: community Age (mean \pm SD): 71 \pm 8 y Country: Taiwan Setting: community Age: \geq 65 y Country: Taiwan Name: I-Lan Longitudinal Aging Study Setting: community Age (mean \pm SD): 62 \pm 9 y Country: Brazil Name: Research Network of Studies of Brazilian Elderly Individuals Setting: community Age: \geq 65 y Country: Brazil Name: FRAgilidade em idosos com doenças	Country: Mexico7164Name: Mexican Health and Nutrition SurveySetting: communityAge (mean \pm SD): 71 \pm 8 yCountry: Taiwan234Setting: communityAge: \geq 65 yCountry: Taiwan962Name: I-Lan Longitudinal Aging StudySetting: communityAge (mean \pm SD): 62 \pm 9 yCountry: Brazil900Name: Research Network of Studies of Brazilian Elderly IndividualsSetting: communityAge: \geq 65 yCountry: Brazil172Name: FRAgilidade em idosos com doenças CardiOvasculaRes	Country: Mexico7164Not definedName: Mexican Health and Nutrition SurveySetting: communityAge (mean \pm SD): 71 \pm 8 y.Country: Taiwan234Not definedSetting: communityAge: ≥ 65 y.Country: Taiwan962Self-reported or BP $\geq 140/90$ or treated hypertensionName: I-Lan Longitudinal Aging StudySetting: communityAge (mean \pm SD): 62 ± 9 y.Country: BrazilName: Research Network of Studies of Brazilian Elderly Individuals.Setting: communityAge: ≥ 65 y.Country: BrazilName: Research Network of Studies of Brazilian Elderly Individuals.Setting: communityAge: ≥ 65 y.Country: Brazil.Name: FRAgilidade em idosos com doenças CardiOvasculaRes.Name: FRAgilidade em idosos com doenças CardiOvasculaRes.	Country: Mexico7164Not defined38%Name: Mexican Health and Nutrition Survey38%38%Setting: community443%Age (mean \pm SD): 71 \pm 8 y43%Country: Taiwan234Not definedSetting: community443%Age: $\geq 65 \ y$ 7Country: Taiwan962Self-reported or BP $\geq 140/90 \ or$ treated hypertension37%Name: I-Lan Longitudinal Aging Study962Self-reported or BP $\geq 140/90 \ or$ treated hypertension37%Setting: community900BP $\geq 140/90 \ or$ mm Hg52%Name: Research Network of Studies of Brazilian Elderly Individuals900BP $\geq 140/90 \ or$ mm Hg52%Setting: community900BP $\geq 140/90 \ or$ mm Hg52%Name: Research Network of Studies of Brazilian Elderly Individuals172Not defined84%Name: FRAgilidade em idosos com doenças CardiOvasculaRes172Not defined84%	Country: Mexico7164Not defined38%FIName: Mexican Health and Nutrition Survey7164Not defined38%FISetting: communityAge (mean±SD): 71+8 yCountry: Taiwan234Not defined43%CHS criteriaSetting: communityAge: $\geq 65 \ y$ Country: Taiwan962Self-reported or BP $\geq 140/90 \ or$ treated hypertension37%CHS criteriaName: I-Lan Longitudinal Aging Study900BP $\geq 140/90 \ mm \ Hg$ Age (mean±SD): 62±9 yCountry: Brazil900BP $\geq 140/90 \ mm \ Hg$ 52%CHS criteriaName: Research Network of Studies of Brazilian Elderly Individuals172Not defined84%CHS criteriaSetting: community Age: $\geq 65 \ y$ 172Not defined84%CHS criteria	Country: Mexico 7164 Not defined 38% FI Mean FI score=0.18 Name: Mexican Health and Nutrition Survey Setting: community Age (mean±SD): 71±8 y	Country: Mexico 7164 Not defined 38% FI Mean FI score=0.18 - Name: Mexican Health and Nutrition Survey Setting: community Age (mean±SD): 71±8 y - - Country: Taiwan 234 Not defined 43% CHS criteria Frail: 39% Robust=33% Frail=58% Setting: community 962 Self-reported or BP≥140/90 or treated hypertension 37% CHS criteria Prefrail: 33% Frail=53% Robust=34% Prefrail=42% Setting: community 962 Self-reported or BP≥140/90 or treated hypertension 37% CHS criteria Prefrail: 33% Frail=53% Robust=34% Prefrail=53% Setting: community 900 BP ≥ 140/90 mm Hg 52% CHS criteria Prefrail: 52% Frail=53% Not reported Name: Research Network of Studies of Brazilian Elderly Individuals 900 BP ≥ 140/90 mm Hg 52% CHS criteria Prefrail: 52% Frail: 58% Not reported Setting: community 4 4 4 6 CHS criteria Prefrail: 51% Frail: 8% Robust=100% Prefrail=83% Frail=81%	Country: Mexico 7164 Not defined 38% FI Mean FI score=0.18 - Multiple linear regression for furthout diabetes) Beta: 0.31 (0.55-0.69) Name: Kexican Health and Nutrition Survey Setting: community - - Mean FI score=0.18 - - Multiple linear regression for furthout diabetes) Beta: 0.31 (0.55-0.69) Setting: community Age (meantSD): 71189 - - - Mean FI score=0.18 - - Multiple linear regression for furthout diabetes) Beta: 0.31 (0.55-0.69) Age (meantSD): 71189 - - - - Mean FI score=0.18 - - Mean FI score=0.18 - - Mean FI score=0.18 -

clinic								
Age (mean±SD):77±6 y								
Country: Switzerland Name: BusSante study Setting: community Age (mean): 60 y	2930	BP ≥ 140/90 mm Hg or treated hypertension	47%	Frailty scale based on 4 indicators (weakness, shrinking, exhaustion, and low activity)	1 indicator=29% ≥2 indicators=8%	0 indicators =42% 1 indicator =54% ≥2 indicators =65%	Hypertension significantly associated with frailty indicators in multivariate analyses. OR for 1 indicator (vs. 0 indicators) 1.40 (1.15-2.68)- OR for ≥2 indicators 1.88 (1.32- 2.68).	7
Country: Korea Name: Korea National Health and Nutrition Examination Survey Setting: community Age (mean±SD): 73±5 y	4352	BP ≥ 140/90 mm Hg or treated hypertension	62%	FI	Prefrail: 39% Frail: 44%	Robust=49% Prefrail=61% Frail=68%	-	6
Country: USA Name: Beaver Dam Eye Study Setting: community Age (range): 53-86 y	2515	BP ≥ 160/95 mm Hg or treated hypertension	47%	Frailty scale based on 5 indicators (gait speed, peak expiratory flow rate, hand grip strength, chair stand test and visual acuity)	Not reported	-	In multivariate analysis hypertension significantly associated with frailty scale in men OR for 1-point increment in scale =1.22 (1.00-1.49) and women OR=1.22 (1.02-1.46)	6
Country: The Netherlands Name: Rotterdam Study Setting: community	2833	BP ≥ 160/100 mm Hg or treated hypertension	75%	CHS criteria	Prefrail: 51% Frail: 6%	Robust=71% Prefrail=77% Frail=85%	-	6
	Age (mean±SD):77±6 yCountry: SwitzerlandName: BusSante' studySetting: communityAge (mean): 60 yCountry: KoreaName: Korea NationalHealth and NutritionExamination SurveySetting: communityAge (mean±SD): 73±5 yCountry: USAName: Beaver DamEye StudySetting: communityAge (range): 53-86 yCountry: TheNetherlandsName: RotterdamStudy	Age (mean±SD):77±6 yCountry: Switzerland2930Name: BusSante' study2930Setting: community4Age (mean): 60 y4352Country: Korea4352Name: Korea National Health and Nutrition Examination Survey4352Setting: community2515Name: Beaver Dam Eye Study2515Name: Beaver Dam Eye Study2515Setting: community2515Name: Beaver Dam Eye Study2515Name: Rotterdam Study2833	Age (mean±SD):77±6 yPCountry: Switzerland2930BP $\geq 140/90$ mm Hg or treated hypertensionName: BusSante' studyPSetting: communityAge (mean): 60 yBP $\geq 140/90$ mm Hg or treated hypertensionCountry: Korea4352BP $\geq 140/90$ mm Hg or treated hypertensionName: Korea National Health and Nutrition Examination SurveyBP $\geq 140/90$ mm Hg or treated hypertensionSetting: communityAge (mean±SD): 73±5 yBP $\geq 160/95$ mm Hg or treated hypertensionCountry: USA2515BP $\geq 160/95$ mm Hg or treated hypertensionName: Beaver Dam Eye Study2515BP $\geq 160/100$ mm Hg or treated hypertensionSetting: community Age (range): 53-86 y2833BP $\geq 160/100$ mm Hg or treated hypertensionCountry: The Netherlands Study2833BP $\geq 160/100$ mm Hg or treated hypertension	Age (mean \pm SD):77 \pm 6 yPCountry: Switzerland Name: BusSante' study Setting: community Age (mean): 60 y2930BP $\ge 140/90$ mm Hg or treated hypertension47%Country: Korea Name: Korea National Health and Nutrition Examination Survey4352BP $\ge 140/90$ mm Hg or treated hypertension62%Setting: community Age (mean \pm SD): 73 \pm 5 yBP $\ge 160/95$ mm Hg or treated hypertension47%Country: USA Setting: community Age (range): 53-86 y2515BP $\ge 160/100$ mm Hg or treated hypertension47%Country: The Netherlands Name: Rotterdam Study2833BP $\ge 160/100$ mm Hg or treated hypertension75%	Age (mean±SD):77±6 yParally scaleCountry: Switzerland2930BP ≥ 140/90 mm Hg or treated hypertension47%Frailty scale 	Age (mean \pm 5D): 77 \pm 6 yParticleParticleParticleCountry: Switzerland Name: BusSante' study2930BP $\geq 140/90$ mm Hg or treated hypertension47%Frailty scale based on 4 indicators (weakness, shrinking, exhaustion, and low activity)1 indicator=29% ≥ 2 indicator=29% indicators (weakness, shrinking, exhaustion, and low activity)Country: Korea Name: Korea National Health and Nutrition Examination Survey4352BP $\geq 140/90$ mm Hg or treated hypertension62%FiPrefrail: 39% Frail: 44%Country: Korea Name: Korea National Health and Nutrition Examination Survey4352BP $\geq 160/95$ mm Hg or treated hypertension47%Frailty scale based on 5 indicators (gait speed, peak expiratory flow rate, hand grip strength, chair stand test and visual acuity)Not reportedCountry: USA Setting: community Age (range): 53-86 yBP $\geq 160/100$ mm Hg or treated hypertension75%CHS criteriaPrefrail: 51% Frail: 51% Frail: 6%	Age (meantSD):7726 y Country: Switzerland Name: BusSante Study2930 2930BP ≥ 140/90 mm Hg or treated hypertension47% 47%Frailty scale based on 4 indicators (weakness, shrinking, exhaustion, and low activity)1 indicator = 54% ≥ 2 indicators = 8% ≥ 1 indicator = 54% ≥ 2 indicators = 65%Country: Korea Name: Korea National Health and Nutrition Examination Survey4352 SP ≥ 140/90 mm Hg or treated hypertensionBP ≥ 140/90 mm Hg or treated hypertension62% FIFIPrefrail: 39% Frail: 44%Robust=49% Prefrail: 51% Frail=68%Country: USA Name: Beaver Dam Eye Study2515 mm Hg or treated hypertension47% AffFrailty scale based on 5 indicators (gait speed, hand grip strength, chair stand test and visual acuity)Not reported-Country: The Netherlands Name: Rotterdam2833 BP ≥ 160/100 mm Hg or treated hypertension75% CHS criteriaCHS criteria Prefrail: 51% Frail: 6%Robust=71% Prefrail: 51% Frail: 6%	Age (meantSD):7716 y Country: Switzerland Name: BusSante' study2930 2930BP ≥ 140/90 mm Hg or treated hypertension47% 47% mm Hg or treated hypertensionFrailty scale based on 4 and low activity)1 indicator =24% 21 indicators =42% 21 indicators in multivariate analyses. OR for 1 indicator (weakness, shrinking, exhaustion, and low activity)1 indicator =42% 1 indicators =42% 21 indicators in multivariate analyses. OR for 1 indicator (weakness, shrinking, exhaustion, and low activity)1 indicator =42% 1 indicators =42% 2 indicators in multivariate analyses. OR for 1 indicator (s. 0 indicators indicator i

Lee (2011)	Country: China Setting: community Age (mean±SD): 72±5 y	4000	Medical records	43%	Composite frailty score (range 0-20)	Mean frailty score=12.2	-	In multivariate analysis hypertension not significantly associated with composite frailty score	5
Nadruz 2017)	Country: USA Name: Atherosclerosis Risk in Communities Study Setting: community	3991	BP ≥ 160/100 mm Hg or treated hypertension	82%	CHS criteria	Frail=5%	Robust=81% Frail=92%	-	6
Ng (2014)	Age (mean±SD): 76±5 y Country: Singapore Name: Singapore Longitudinal Ageing Studies I and II Setting: community Age (mean±SD): 67±8 y	1685	Not defined	62%	CHS criteria	Prefrail: 42% Frail: 5%	Robust=58% Prefrail=64% Frail=80%	Hypertension not associated with frailty in multivariate analysis (data not provided)	6
O'Connell (2015)	Country: Republic of Ireland Name: Irish Longitudinal Study on Aging Setting: community Age (mean±SD): 63±9 y	5692	BP reported as a continuous measure	-	CHS criteria & FI	CHS criteria Prefrail: 34% Frail: 4% Mean FI score=0.10	-	In adjusted linear regression analyses, frailty significantly associated with lower seated and standing SBP and DBP. Seated SBP -1.9 (-2.52to-1.27), standing SBP -1.79 (-2.46 to-1- 13), seated DBP -1.14 (-1.51to- 0.77), standing DBP -1.10 (- 1.48to-0.73).	7
Ramsay (2015)	Country: UK Name: British Regional Heart Study Setting: community Age (range): 71-92 y	1622	BP ≥ 160/90 mm Hg or treated hypertension	72%	CHS criteria	Prefrail: 54% Frail: 19%	Robust=65% Prefrail=74% Frail=78%	Hypertension associated with frailty age-adjusted OR=1.79 (1.27-2.54)	6

Ravindrarajah (2017)	Country: UK Name: Clinical Practice Research Datalink Setting: community Age: ≥80 y	144403	SBP values classified as follows (mmHg): <110, 110-119, 120- 139, 140-159, ≥160	<110 =3% 110-119=7% 120-139=37% 140-159=41% ≥160=12%	FI	Mild frailty=40% Moderate frailty=21% Severe frailty=7% Any frailty=68%	Any frailty: <110 =78% 110-119=77% 120-139=72% 140-159=64% ≥160=58%	Frailty was associated with lower BP. In participants with SBP <110 mmHg, 22% were fit, 28% had moderate frailty, and 12% had severe frailty. In those with SBP ≥160 mm Hg, 42% were fit, 16% had moderate frailty, and 4% had severe frailty.	7
Ricci (2014)	Country: Brazil Name: Fragilidade em Idosos Brasileiros Network Study Setting: community Age (mean±SD): 72±6 y	761	Self-reported or BP≥140/90 or treated hypertension	84%	CHS criteria	Prefrail: 48% Frail: 10%	Robust=81% Prefrail=87% Frail=84%	-	5
Serra-Prat (2016)	Country: Spain, Setting: community Age (mean±SD): 80±3 y	324	Not defined	71%	CHS criteria	Prefrail: 54% Frail: 14%	Robust=66% Prefrail=70% Frail=82%	Hypertension associated with frailty OR=2.24 (1.00-4.99) at univariate analysis. Association not confirmed in multivariate analysis (data not provided).	5
Tavares (2016)	Country: Brazil Name: Study of Frailty in Elderly People Setting: hospital Age: ≥ 60 y	205	Self-reported	66%	CHS criteria	Prefrail: 52% Frail: 26%	Robust=62% Prefrail=62% Frail=76%	-	4
Vaingankar (2016)	Country: Singapore Name: Well-being of the Singapore Elderly study	2102	Not defined	59%	CHS criteria	Prefrail: 40% Frail: 6%	Robust=55% Prefrail=62% Frail=70%	Hypertension not associated with frailty in multivariate analysis (data not provided)	4
	Setting: community Age (mean): 69 y								

Watanabe (2017)	Country: Japan Name: Obu Study of Health Promotion for the Elderly Setting: community Age (mean): 71 y	4720	Self reported	46%	CHS criteria	Prefrail: 57% Frail: 11%	Robust=39% Prefrail=47% Frail=55%	Hypertension significantly associated with frailty in multivariate analysis (OR 1.43, 95% CI = 1.14–1.78)	4
Wong (2010)	Country: Canada, Name: Montreal Unmet Needs Study Setting: community Age (mean±SD): 80±4 y	740	Self-reported	52.3%	CHS criteria	Prefrail: 50% Frail: 7%	Robust=47% Prefrail=55% Frail=60%	-	5
Wu (2009)	Country: Taiwan Setting: community and hospital Age (mean±SD): 77±6 y	90	Not defined	58%	CHS criteria	Prefrail: 62% Frail: 23%	Robust=69% Prefrail=48% Frail=76%	No significant association between frailty and hypertension at univariate analysis, OR=1.23 (0.76–1.98)	4
Yanagita (2017)	Country: Japan Setting: hospital Age (mean±SD): 78±8 y	132	BP reported as a continuous measure	-	Clinical Frailty Scale	Frail=42%	-	Frail participants had lower SBP values. In multivariate analyses frailty associated with significantly lower SBP values.	4

NOS = Newcastle-Ottawa Scale; CHS = Cardiovascular Health Study; OR = Odds Ratio; FI = Frailty Index; BP=Blood Pressure; SBP=Systolic Blood Pressure; DBP=Diastolic Blood Pressure