

Supplemental Material

Data S1. Relationship between marginal prevalence of outcome and magnitude of prevalence ratios in dyadic studies.

Say $\Pr[W=1]$ is the marginal prevalence of hypertension among wives, and $\Pr[H=1]$ is the marginal prevalence of hypertension among husbands.

Assuming an unbiased estimation...

$$\Pr[W = 1] = \Pr[W=1,H=1] + \Pr[W=1, H =0]$$

$$\Pr[H = 1] = \Pr[W=1,H=1] + \Pr[W=0, H =1]$$

If marginal prevalence are similar, i.e.

$$\Pr[W = 1] \sim \Pr[H = 1],$$

$$\text{then } \Pr[W = 1, H = 0] \sim \Pr[W = 0, H = 1]$$

PR for Wife

$$= \Pr[W=1|H=1] \div \Pr[W=1|H=0]$$

$$= \Pr[W = 1,H = 1]/\Pr[H = 1] \div \Pr[W = 1, H = 0]/\Pr[H=0]$$

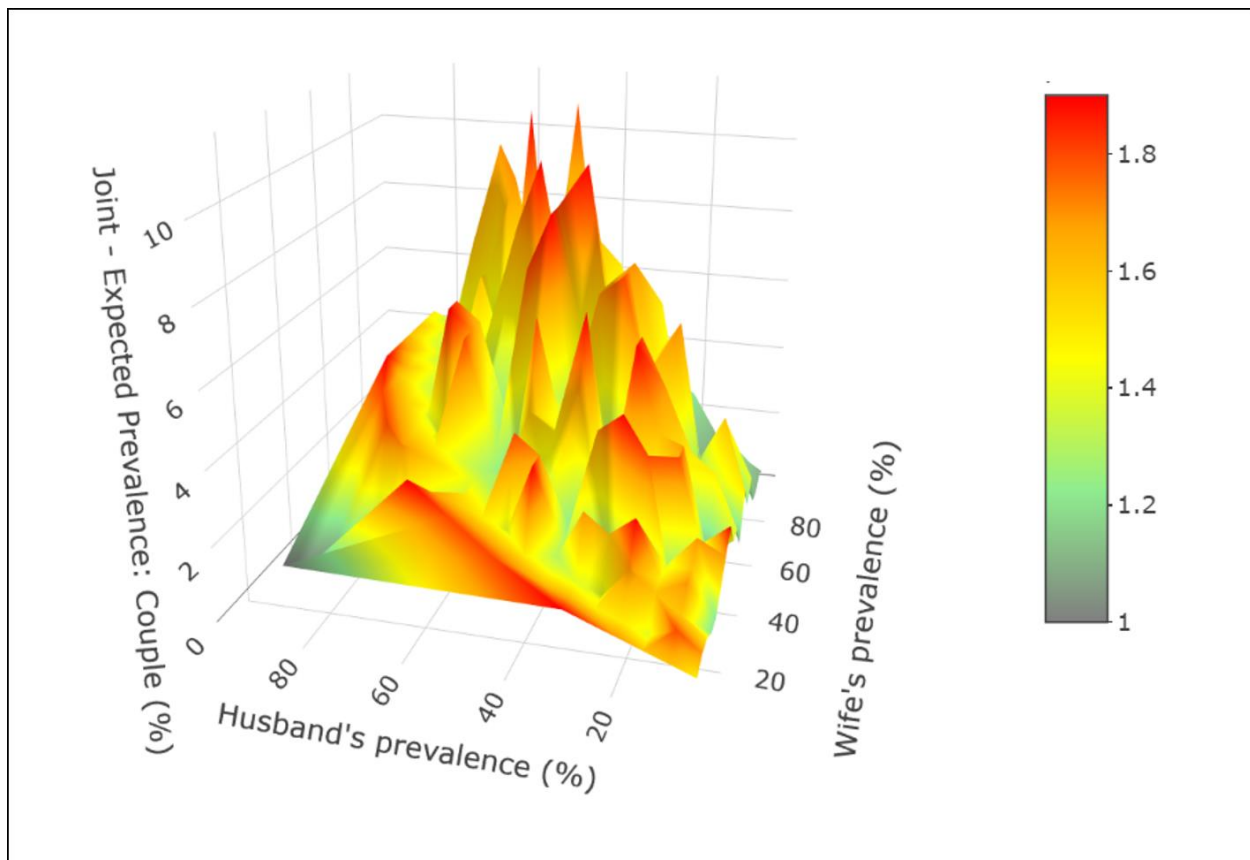
$$= \Pr[W=1, H = 1]/(\Pr[W=1,H=1] + \Pr[W=0, H =1]) \div \Pr[W = 1, H = 0]/(\Pr[W=1,H=0] + \Pr[W=0, H =0])$$

PR for Husband

$$= \Pr[H=1|W=1] \div \Pr[H=1|W=0]$$

$$= \Pr[W = 1,H = 1]/\Pr[W = 1] \div \Pr[W = 0, H = 1]/\Pr[W=0]$$

$$= \Pr[W=1, H = 1]/(\Pr[W=1,H=1] + \Pr[W=1, H =0]) \div \Pr[W = 0, H = 1]/(\Pr[W=0,H=1] + \Pr[W=0, H =0])$$



As marginal prevalence among husbands and wives increases, a larger difference between joint ($\Pr[W=1, H=1]$) and expected prevalence ($\Pr[W=1] \times \Pr[H=1]$) is required for similar prevalence ratios.

$$PR_{\text{wife}} = \Pr[W=1, H=1] / \Pr[H=1] \div (\Pr[W=1] - \Pr[W=1, H=1]) / (1 - \Pr[H=1])$$

When $\Pr[W=1, H=1] / \Pr[H=1]$ increases (proportion of prevalence in husband explained by joint prevalence), assuming, $\Pr[H=1] \sim \Pr[W=1]$, PR_{wife} keeps increasing. The above figure has been truncated at PR of 2.0, and hence, larger values of Joint – Expected prevalence are not displayed.

Table S1. Study design and methodology to collect data

Country	United States	England	China	India
Cohort name	Health and Retirement study (HRS) ¹⁹	English Longitudinal Study on Ageing (ELSA) ¹⁸	China Health and Retirement Longitudinal Study (CHARLS) ¹⁷	Longitudinal Aging Study in India (LASI) ²⁰
When the cohort started	1992	2002	2011-12	2017-19
Main sampling and survey method	The HRS sample is based on a multi-stage area probability design involving geographical stratification and clustering and oversampling of certain demographic groups. The survey has been fielded every 2 years since 1992. HRS now employs a steady-state design, replenishing the sample every 6 years with younger cohorts not previously represented.	The sample was drawn from participants in the Health Survey for England (HSE), an annual cross-sectional survey that is designed to monitor the health of the general population. The survey has been fielded every 2 years. The sample was refreshed every three waves.	Samples were chosen through multistage probability sampling. Because no pre-existing sampling frame of residents existed, the CHARLS team conducted mapping and listing operations within each village-level unit to obtain the sampling frame. The study has been fielded every 2-3 years. The sample was refreshed at each wave.	The LASI sampling frame included only the household population; persons living in collective institutional living arrangements were excluded. Considering the longitudinal design and the geographical and socioeconomic disparities in India, LASI adopted a multistage stratified area probability cluster sampling design. Follow-up waves are planned every 2–3 years for the next 25 years.
Eligibility criteria of study participant recruitment	A primary respondent is randomly selected from all age-eligible (50 years old and over) household members and, if the selected person is coupled, their spouse or partner is also included in the sample, regardless of age.	Membership of a participating household from Health Survey for England (HSE) in which at least one person had agreed to follow-up. In addition to the target sample, partners who were aged <50 years and those who had joined the household since HSE were invited for interview.	In each randomly selected household, one individual aged 45 or older was invited to participate together with his or her spouse, if available.	The target population for LASI included all Indian adult men and women aged 45 and older and their spouses regardless of age, who reside in the same household.
Data accessibility	Publicly available	Publicly available	Publicly available	Publicly available
Which wave of the data was used in the current study	2016-17	2016-17	2015-16	2017-19

Table S2. Variable harmonization across four countries' datasets

Level	Variable	Harmonized variable name	Variable Type	HRS (Core, Rand, Gateway to aging)	ELSA (core, Gateway to Aging)	CHARLS (Core, Gateway to Aging)	LASI (Core, Gateway to Aging)
Survey	PSU (primary sampling unit)	psu		HHIDPN	r8clust	communityID	ssuid
Survey	Weight	sampleweight		RAESTRAT, RAEHSAMP, R13WTHH, R13WTRESP, S13WTRESP	r8cwtresp, s8cwtresp	R3WTRESP, S3WTRESP	r1wtresp, s1wtresp
Survey	Household ID	hhid		HHID	hh8hhid	householdID	hhid
Survey	Residence (Urban/Rural)	residence	Categorical			H3RURAL	hh1rural
Wife/Husband	Systolic BP	w_sbp, h_sbp	Continuous	R13BPSYS, S13BPSYS	r8systo, s8systo	R3SYSTO, S3SYSTO	r1systo, s1systo
Wife/Husband	Diastolic BP	w_dbp, h_dbp	Continuous	R13BPDIA, S13BPDIA	r8diasto, s8diasto	R3DIASTO, S3DIASTO	r1diasto, s1diasto
Wife/Husband	History of high BP	w_diagnosed_bp, h_diagnosed_bp	Categorical	R13HIBPE, S13HIBPE	r8hibpe, s8hibpe	R3HIBPE, S3HIBPE	r1hibpe, s1hibpe
Wife/Husband	Currently taking medication for high BP	w_medication_bp, h_medication_bp	Categorical	core HRS	r8rxhibp, s8rxhibp	R3RXHIBP, S3RXHIBP	r1rxhibp, s1rxhibp
Wife/Husband	Previously diagnosed with diabetes	w_diagnosed_dm, h_diagnosed_dm	Categorical	R13DIABE, S13DIABE,	r8diabe, s8diabe	R3DIABE, S3DIABE	r1diabe, s1diabe
Wife/Husband	Currently taking medication for diabetes	w_medication_dm, h_medication_dm	Categorical	core HRS	r8rxdiab, s8rxdiab	R3RXDIAB, S3RXDIAB	r1rxdiab, s1rxdiab
Wife/Husband	Weight (kg)	w_weight, h_weight	Continuous	R13WEIGHT, S13WEIGHT	r8mweight, s8mweight	R3MHEIGHT, S3MHEIGHT	r1mweight, s1mweight
Wife/Husband	Height (cm)	w_height, h_height	Continuous	R13HEIGHT, S13HEIGHT	r8mheight, s8mheight	R3MWEIGHT, S3MWEIGHT	r1mheight, s1mheight
Wife/Husband	BMI (kg/m ²)	w_bmi, h_bmi	Continuous	R13BMI, S13BMI	r8mbmi, s8mbmi	R3MBMI, S3MBMI	r1mbmi, s1mbmi
Wife/Husband	Waist circumference	w_waistcircumference, h_waistcircumference	Continuous	R13PMWAIST, S13PMWAIST	NA	R3MWAIST, S3MWAIST	r1mwaist, s1mwaist

Wife/Husband	Hip circumference	w_hipcircumference, h_hipcircumference	Continuous	NA	NA	NA	r1mhip, s1mhip
Wife/Husband	Age (years)	w_age, h_age	Continuous	R13AGEY_E, S13AGEY_E	r8agey, s8agey	R3AGEY, S3AGEY	r1agey, s1agey
Wife/Husband	Education level (harmonized)	w_education_h, h_education_h	Categorical	raeduc1	raeduc1, s8educ1	RAEDUCL	raeduc_1, s1educ_1
Wife/Husband	Employment status	w_employment, h_employment	Categorical	R13LBRF	r8work, s8work	R3WORK	r1work, s1work
Wife/Husband	Retirement status	w_retirement, h_retirement	Categorical	R13LBRF	r8retemp, s8retemp	R3RETEMP, S3RETEMP	r1sayret_1, s1sayret_1
Wife/Husband	Smoking ever	w_smokeever, h_smokeever	Categorical	R13SMOKEV, S13SMOKEV	r8smokev, s8smokev	R3SMOKEV, S3SMOKEV	r1smokev, s1smokev
Wife/Husband	Smoking current	w_smokecurr, h_smokecurr	Categorical	R13SMOKEN, S13SMOKEN	r8smoken, s8smoken	R3SMOKEN, S3SMOKEN	r1smoken, s1smoken
Wife/Husband	Alcohol in the past 3 months	w_alcohol, h_alcohol	Categorical	R13DRINK, S13DRINK	r8drink, s8drink	R3DRINKL, S3DRINKL	r1drink3m, s1drink3m
Wife/Husband	Moderate Physical activity (days)	w_moderate_pa, h_moderate_pa	Continuous	R13MDACTX, S13MDACTX	r8mdactx_e, s8mdactx_e	R3MDACTX_C, S3MDACTX_C	r1vgactx, s1vgactx
Wife/Husband	Vigorous Physical activity (days)	w_vigorous_pa, h_vigorous_pa	Continuous	R13VGACTX, S13VGACTX	r8vdactx_e, s8vdactx_e	R3VGACTX, S3VGACTX	r1mdactx, s1mdactx
household/couple	Number of children	hh_children	Count	H13CHILD	r8child, s8child	H3CHILD	r1child, s1child
household/couple	number of people living in the household	hh_size	Count	H13HHRES	hh8hhresp	H3HHRESP	
household/couple	income	hh_income	Continuous	H13ITOT	h8itot	H3ITOT	hh1earn
household/couple	wealth	hh_wealth	Continuous	H13ATOTB	h8atotb	H3ATOTB	hh1atotb
household/couple	length of current marriage (years)	hh_lengthmar	Continuous	R13MCURLN	r8mcurln, s8mcurln	R2MCURLN, S2MCURLN	r1mcurln, s1mcurln
Country-specific variables	Caste of head of household	hh_caste	Categorical				dm013

Country-specific variables	Religion of head of household	hh_religion	Categorical	RARELIG, S13RELIG			dm010
Country-specific variables	Race-ethnicity	w_race, h_race	Categorical	RARACEM, S13RACEM, RAHISPAN, S13HISPAN	raracem, s8racem		
Country-specific variables	Hukou status (household registration)	hh_hukou	Categorical			R3RURAL2, R3RURAL2	

Table S3. Comparison of questions ascertaining history of hypertension among participants by country

Country	Self-reported Diagnosis	Self-reported Treatment
USA (HRS 2016-17)	Has a doctor ever told you that you have high blood pressure or hypertension? (Medical doctors include specialists such as Dermatologists, Psychiatrists, Ophthalmologists, Osteopaths, Cardiologists, as well as family doctors, internists and physicians' assistants. Also include diagnoses made by Nurses and Nurse Practitioners.)	In order to lower your blood pressure, are you now taking any medication?
England (ELSA 2016-17)	<p>Our records show that when we last interviewed [^you / [^name]] on [^date of last interview] [^you / he / she] said that [^you / he / she] had had (or had been told by a doctor [^you / he / she] had had) high blood pressure or hypertension. Our records also show that when we last interviewed [^you / [^name]] on [^date of last interview] [^you / he / she] said that [^you / he / she] had had (or had been told by a doctor [^you / he / she] had had)] high blood pressure or hypertension.</p> <p>[^Do you / Does [^name]] still have [^high blood pressure or hypertension?</p> <p>[^Has / Apart from what you have already told us, and thinking about what has happened since we last saw [^you / [^name]] on [^date of last interview] has] a doctor [^BLANK / ever] told [^you / [^name]] that [^you have / he has / she has] (or have had) any of the [^BLANK / other] conditions on this card?</p> <p>- 01 High blood pressure or hypertension</p>	<p>IF (type of cardiovascular disease condition = high blood pressure) OR (type of cardiovascular disease condition at last interview = high blood pressure AND reason for disputing high blood pressure <> Never had the condition, Misdiagnosed)</p> <p>Some doctors suggest that some patients take medication to lower their blood pressure. Did a doctor or nurse ever suggest that you take any medication to lower your blood pressure? 1 Yes 2 No</p>
China (CHARLS 2015-16)	Have you been diagnosed with Hypertension by a doctor?	Are you now taking any of the following treatments to treat or control your hypertension? Taking Chinese traditional medicine, taking Western modern medicine?
India (LASI 2017-19)	Has any health professional ever told you that you have hypertension or high blood pressure?	In order to control your blood pressure or hypertension, are you currently taking any medication?

Table S4. Number of missing observations by country

	USA		England		China		India	
Shared household characteristics	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands
Sample size (n)	3,989		1,086		6,514		22,389	
Residence (Rural, %)	54				770		0	
Wealth quintile of household	0				2324		14	
Length of current marriage (years)	349				1381		465	
Number of people in the same household	0				0		0	
Number of children	46				0		-	
Socio-demographic characteristics								
Age (years)	0	0	0	0	0	0	0	0
Education level	0	3	114	43	5	5	0	0
Employment status	26	30	0	1	107	83	0	1
Health behaviors and self-reported health outcomes								
Smoking	37	50	0	0	3	7	0	0
Heavy drinking (Yes, %)	37	48	87	108	17	25	22	59
Moderate Physical activity (days/week)	31	38	0	0	3335	3356	26	51
Vigorous Physical activity (days/week)	45	48	0	0	3332	3345	24	45
Self-reported diagnosis of hypertension (%)	31	41	0	0	1071	1069	0	0
Diagnosis of diabetes (%)	29	36	0	0	1115	1113	0	0
Clinical measures								
BMI (kg/m ²)	97	47	51	59	264	351	398	613
Waist circumference (cm)	1929	1904	-	-	254	324	397	619
Systolic blood pressure (mmHg)	0	0	86	93	259	306	302	415
Diastolic blood pressure (mmHg)	0	0	86	93	260	306	302	415
Hypertension ^b (%)								
Concordant Hypertension (%)	0		0		0		0	

Table S5. Associations of hypertension status between couples for wives and husbands across countries

	USA (n=3,989)	England (n=1,086)	China (n=6,514)	India (n=22,389)
<i>Equation 1a</i>				
Wife ^a	1.09 (1.01, 1.17)	1.09 (0.98, 1.21)	1.26 (1.17, 1.35)	1.19 (1.15, 1.24)
<i>Equation 1b</i>				
Husband ^a	1.06 (1.00, 1.13)	1.05 (0.96,1.16)	1.26 (1.18, 1.35)	1.20 (1.12, 1.28)
<i>Equation 2</i>				
Sex differences (Husband: Wife) ^b	0.92 (0.83, 1.02)	0.95 (0.82, 1.10)	0.94 (0.85, 1.04)	0.97 (0.92, 1.03)
<i>Equation 3a</i>				
Differences between countries among wives ^c	Ref (1.00)	0.97 (0.88, 1.11)	1.13 (1.01, 1.26)	1.19 (1.08, 1.31)
<i>Equation 3b</i>				
Differences between countries among husbands ^c	Ref (1.00)	0.98 (0.88, 1.11)	1.18 (1.07, 1.29)	1.20 (1.11, 1.30)

All values are survey-weighted prevalence ratios with 95% robust confidence intervals, after adjusting for individual characteristics and household characteristics. Estimates of association may be numerically, but not statistically, different between models used (e.g. between survey-weighted Poisson regression of analysis separately by cohort and in pooled cohorts) due to differences in estimation method (maximum likelihood with survey design vs generalized estimating equations), confounding adjustment etc.

a. Prevalence ratio from survey-weighted regression models accounting for survey design

b. Ratio of prevalence ratio of husbands to wives from generalized estimating equations of pooled dataset

c. Ratio of prevalence ratio of country, relative to USA, from survey-weighted regression models with normalized weights in pooled dataset.

Table S6. Associations of hypertension status between the couple for wives and husbands across countries before and after adjusting for individual, spousal and household characteristics

	USA (n=3,989)		England (n=1,086)		China (n=6,514)		India (n=22,389)	
	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Unadjusted for individual, spousal and household characteristics	1.25 (1.16, 1.35)	1.18 (1.12, 1.25)	1.15 (1.07, 1.23)	1.10 (1.03, 1.17)	1.41 (1.31, 1.52)	1.39 (1.30, 1.48)	1.39 (1.33, 1.45)	1.35 (1.30, 1.41)
Adjusted for individual characteristics	1.10 (1.02, 1.18)	1.07 (1.01, 1.14)	1.11 (1.01, 1.21)	1.06 (0.99, 1.15)	1.27 (1.18, 1.36)	1.27 (1.18, 1.36)	1.23 (1.17, 1.28)	1.21 (1.17, 1.26)
Adjusted for individual, spousal and household characteristics	1.08 (1.00, 1.16)	1.06 (1.00, 1.12)	1.10 (0.99, 1.23)	1.06 (0.96, 1.17)	1.25 (1.16, 1.35)	1.25 (1.17, 1.35)	1.21 (1.16, 1.26)	1.19 (1.15, 1.24)

Reported associations are prevalence ratios (95%CI) without adjustment and after adjusting for individual (BMI, age, education, wage employment, smoking, heavy drinking, moderate physical activity, vigorous physical activity), spousal (BMI, age, education, wage employment, smoking, heavy drinking, moderate physical activity, vigorous physical activity), and household characteristics (wealth, number of residents, rural/urban residence, length of marriage).

Table S7. Associations of hypertension status between the couple for wives and husbands across countries stratified by residence, wealth, length of marriage, age groups, and education

	USA (n=3,989)		England (n=1,086)		China (n=6,514)		India (n=22,389)	
	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
Shared household characteristics								
Residence								
Urban	0.84 (0.62, 1.16)	0.94 (0.71, 1.26)	-	-	1.25 (0.89, 1.75)	1.20 (0.88, 1.64)	1.14 (1.07, 1.22)	1.11 (1.05, 1.17)
Rural	0.98 (0.85, 1.13)	1.01 (0.88, 1.16)	-	-	1.26 (1.06, 1.48)	1.23 (1.06, 1.44)	1.24 (1.18, 1.31)	1.25 (1.19, 1.32)
Wealth quintile of household								
Lowest	1.06 (0.91, 1.23)	1.08 (0.95, 1.22)	1.22 (0.85, 1.73)	1.19 (0.95, 1.50)	1.30 (1.18, 1.42)	1.32 (1.21, 1.44)	1.16 (1.06, 1.28)	1.15 (1.06, 1.26)
Low	1.12 (0.97, 1.31)	1.08 (0.95, 1.23)	0.99 (0.73, 1.36)	0.94 (0.73, 1.20)	1.13 (0.95, 1.36)	1.17 (0.98, 1.39)	1.32 (1.20, 1.44)	1.34 (1.23, 1.46)
Mid	1.03 (0.84, 1.27)	1.05 (0.90, 1.23)	1.18 (0.95, 1.48)	1.06 (0.81, 1.38)	1.25 (1.03, 1.52)	1.20 (1.00, 1.43)	1.26 (1.15, 1.38)	1.25 (1.15, 1.36)
High	1.11 (0.94, 1.32)	1.03 (0.91, 1.18)	0.93 (0.72, 1.20)	0.97 (0.75, 1.24)	1.21 (0.96, 1.53)	1.22 (1.00, 1.49)	1.16 (1.06, 1.26)	1.17 (1.08, 1.27)
Highest	1.11 (0.89, 1.40)	1.07 (0.92, 1.24)	1.23 (1.09, 1.39)	1.18 (1.06, 1.31)	1.32 (1.00, 1.74)	1.23 (0.91, 1.65)	1.14 (1.06, 1.24)	1.09 (1.01, 1.17)
Length of marriage								
<10	1.29 (0.97, 1.71)	1.22 (1.02, 1.47)	-	-			1.69 (0.64, 4.43)	1.32 (0.69, 2.53)
≥10	1.06 (0.98, 1.14)	1.04 (0.97, 1.11)	-	-			1.21 (1.16, 1.26)	1.19 (1.15, 1.24)
Individual level characteristics								
Age groups								
Age < 65	1.10 (0.99, 1.23)	1.14 (1.04, 1.26)	0.95 (0.48, 1.90)	0.86 (0.51, 1.47)	1.34 (1.22, 1.47)	1.33 (1.21, 1.47)	1.24 (1.18, 1.29)	1.22 (1.16, 1.28)
Age ≥ 65	1.06 (0.97, 1.17)	1.00 (0.93, 1.08)	1.11 (1.01, 1.21)	1.07 (0.96, 1.18)	1.12 (1.02, 1.23)	1.16 (1.06, 1.27)	1.12 (1.04, 1.21)	1.16 (1.10, 1.22)
Education levels								
Less than lower secondary	1.00 (0.81, 1.22)	0.99 (0.85, 1.16)	1.28 (1.14, 1.43)	1.03 (0.84, 1.26)	1.27 (1.18, 1.37)	1.24 (1.15, 1.34)	1.22 (1.17, 1.28)	1.23 (1.17, 1.30)
Upper secondary and vocational training	1.05 (0.95, 1.16)	1.04 (0.96, 1.13)	0.99 (0.81, 1.21)	1.11 (0.98, 1.25)	1.35 (1.02, 1.80)	1.41 (1.16, 1.73)	1.16 (1.06, 1.28)	1.17 (1.10, 1.24)
Tertiary	1.22 (1.02, 1.46)	1.13 (1.02, 1.25)	0.87 (0.73, 1.05)	0.94 (0.79, 1.12)	0.39 (0.15, 1.02)	1.22 (0.88, 1.69)	1.05 (0.84, 1.32)	1.06 (0.95, 1.17)

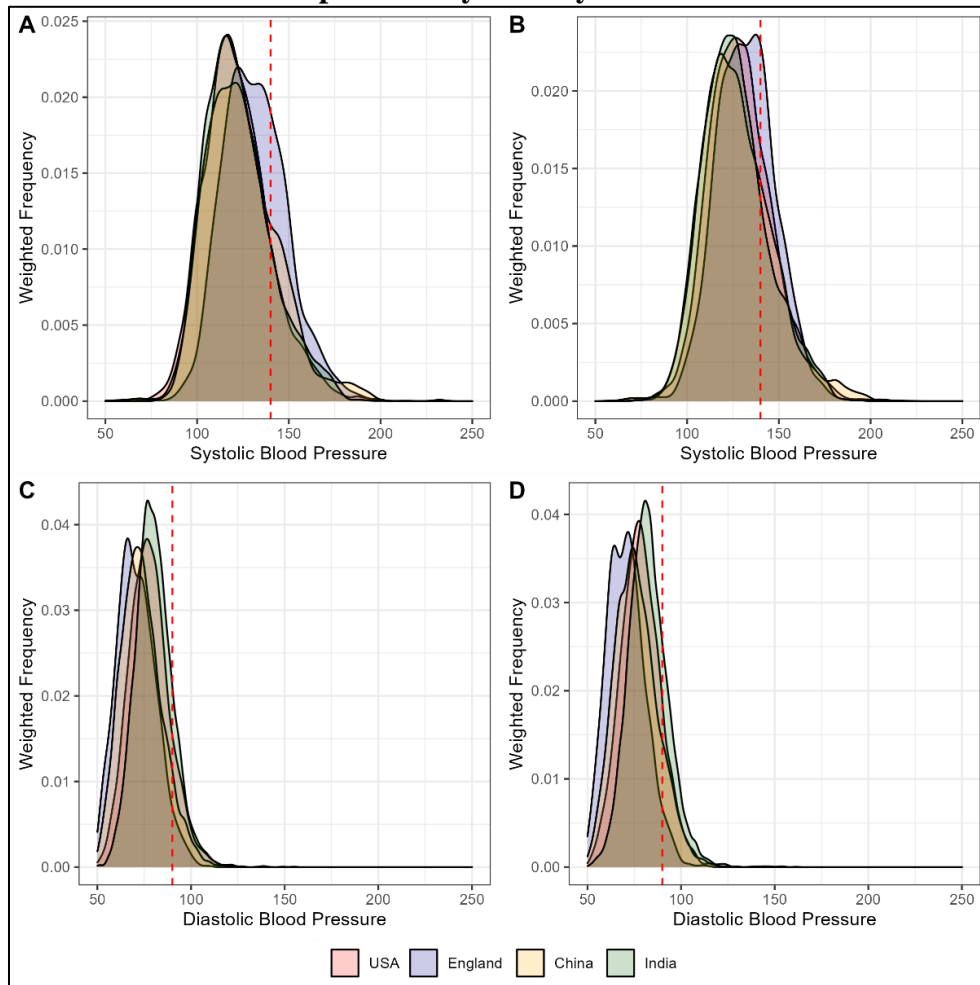
All values are survey weighted prevalence ratios with 95% robust confidence intervals.

Table S8. Marginal associations of hypertension status of spouse with hypertension status of an individual using pooled data of four countries (n=33,978 couples)

Cohort	Wives PR (95% CI)	Husbands PR (95% CI)
USA	1.14 (1.05, 1.24)	1.09 (1.02, 1.17)
England	1.11 (0.99, 1.24)	1.07 (0.97, 1.18)
China	1.29 (1.19, 1.39)	1.29 (1.20, 1.38)
India	1.36 (1.30, 1.42)	1.31 (1.26, 1.37)
England:USA (exp[Interaction])	0.97 (0.88, 1.11)	0.98 (0.88, 1.11)
China:USA (exp[Interaction])	1.13 (1.01, 1.26)	1.18 (1.07, 1.29)
India:USA (exp[Interaction])	1.19 (1.08, 1.31)	1.20 (1.11, 1.30)

Reported associations are prevalence ratios (95%CI) based on Equation 3a-b after adjusting for individual (BMI, age, education, wage employment, smoking, heavy drinking, moderate physical activity, vigorous physical activity) and household characteristics (wealth, number of residents, rural/urban residence, length of marriage).

Figure S1. Distribution of blood pressure by country for wives and husbands.



Distributions are density plots weighted using normalized survey weights that account for differences in sample sizes between countries.

A: Systolic BP among wives, B: Systolic BP among husbands; C: Diastolic BP among wives; D: Diastolic BP among husbands