



No	3732	738	Ref		Ref		Ref	
Yes	307	113	1.11(1.07–1.15)	<0.001	1.09(1.05–1.13)	<0.001	1.06(1.01–1.11)	0.017
Waist pain								
No	3318	646	Ref		Ref		Ref	
Yes	721	205	1.06(1.03–1.09)	<0.001	1.07(1.04–1.10)	<0.001	1.04(1.00–1.08)	0.011
Buttocks pain								
No	3929	812	Ref		Ref		Ref	
Yes	110	39	1.09(1.03–1.16)	0.004	1.08(1.01–1.15)	0.018	1.03(0.95–1.10)	0.496
Leg pain								
No	3444	657	Ref		Ref		Ref	
Yes	595	194	1.09(1.06–1.12)	<0.001	1.09(1.06–1.12)	<0.001	1.04(1.01–1.08)	0.023
Knees pain								
No	3566	691	Ref		Ref		Ref	
Yes	473	160	1.09(1.06–1.13)	<0.001	1.09(1.06–1.13)	<0.001	1.07(1.03–1.11)	<0.001
Ankle pain								
No	3844	780	Ref		Ref		Ref	
Yes	195	71	1.10(1.05–1.16)	<0.001	1.09(1.04–1.14)	<0.001	1.04(0.99–1.10)	0.122
Toes pain								
No	3922	811	Ref		Ref		Ref	
Yes	117	40	1.09(1.02–1.15)	0.007	1.06(1.00–1.13)	0.046	0.99(0.93–1.07)	0.870
Neck pain								
No	3857	762	Ref		Ref		Ref	
Yes	182	89	1.18(1.12–1.23)	<0.001	1.15(1.09–1.20)	<0.001	1.10(1.04–1.16)	<0.001
Pain_level								
0None	2338	384	Ref		Ref		Ref	
1A Little	789	180	1.05(1.02–1.07)	0.002	1.05(1.02–1.08)	<0.001	1.03(0.99–1.06)	0.128
2Some	434	115	1.07(1.03–1.11)	<0.001	1.08(1.05–1.12)	<0.001	1.06(1.02–1.10)	0.005
3Quite ABit	317	104	1.11(1.07–1.16)	<0.001	1.12(1.08–1.17)	<0.001	1.10(1.05–1.15)	<0.001
4A Lot	161	68	1.17(1.11–1.23)	<0.001	1.20(1.14–1.26)	<0.001	1.15(1.08–1.22)	<0.001
Pain_number			1.02(1.01–1.02)	<0.001	1.02(1.01–1.02)	<0.001	1.01(1.00–1.02)	<0.001

Supplementary Table S2 Odds ratios and 95% confidence intervals for CVD by persistent chronic pain in the longitudinal analysis.

	CVD		Model 1	P-value	Model 2	P-value	Model 3	P-value
	No	Yes						
Chronic Pain								
No	2165	347	Ref		Ref		Ref	
Yes	1443	337	1.05(1.03–1.07)	<0.001	1.04(1.02–1.07)	<0.001	1.02(0.99–1.05)	0.282
P-Chronic Pain								
No	2729	447	Ref		Ref		Ref	
Yes	879	237	1.08(1.05–1.11)	<0.001	1.07(1.04–1.10)	<0.001	1.05(1.00–1.08)	0.012
P-Head pain								
No	3357	613						
Yes	192	62	1.09(1.04–1.15)	<0.001	1.09(1.04–1.15)	<0.001	1.05(0.99–1.12)	0.098
P-Shoulder pain								
No	3369	621	Ref		Ref		Ref	
Yes	185	55	1.09(1.03–1.15)	0.002	1.08(1.02–1.14)	0.006	1.03(0.96–1.10)	0.454
P-Arm pain								
No	3456	639	Ref		Ref		Ref	
Yes	111	39	1.09(1.02–1.17)	0.012	1.09(1.02–1.17)	0.016	1.05(0.97–1.14)	0.226
P-Wrist pain								
No	3528	665	Ref		Ref		Ref	
Yes	67	19	1.03(0.94–1.13)	0.495	1.00(0.91–1.10)	0.975	0.98(0.88–1.10)	0.772
P-Fingers pain								
No	3500	654	Ref		Ref		Ref	
Yes	87	23	1.04(0.96–1.13)	0.299	1.03(0.95–1.12)	0.425	0.97(0.87–1.07)	0.525
P-Chest pain								
No	3559	660	Ref		Ref		Ref	
Yes	39	18	1.15(1.04–1.28)	0.006	1.13(1.02–1.25)	0.022	1.10(0.96–1.25)	0.168

P-Stomach pain								
No	3496	653	Ref		Ref		Ref	
Yes	86	26	1.05(1.97–1.13)	0.236	1.07(0.98–1.15)	0.114	1.06(0.96–1.6)	0.274
P-Back pain								
No	3465	634	Ref		Ref		Ref	
Yes	105	40	1.09(1.02–1.17)	0.010	1.07(1.00–1.15)	0.045	1.04(0.96–1.13)	0.300
P-Waist pain								
No	3103	542	Ref		Ref		Ref	
Yes	396	123	1.10(1.06–1.14)	<0.001	1.09(1.05–1.14)	<0.001	1.08(1.03–1.13)	0.001
P-Buttocks pain								
No	3563	672	Ref		Ref		Ref	
Yes	32	10	1.04(0.92–1.18)	0.522	1.00(1.89–1.14)	0.895	1.00(0.86–1.15)	0.954
P-Leg pain								
No	3256	581	Ref		Ref		Ref	
Yes	273	83	1.08(1.03–1.13)	<0.001	1.07(1.02–1.12)	0.002	1.02(0.97–1.08)	0.403
P-Knees pain								
No	3300	598	Ref		Ref		Ref	
Yes	251	71	1.07(1.02–1.12)	0.003	1.07(1.02–1.12)	0.004	1.03(0.97–1.09)	0.349
P-Ankle pain								
No	3501	662	Ref		Ref		Ref	
Yes	85	16	1.01(0.93–1.10)	0.749	1.01(0.93–1.10)	0.811	1.00(0.91–1.11)	0.921
P-Toes pain								
No	3556	670	Ref		Ref		Ref	
Yes	40	11	1.05(0.94–1.17)	0.376	1.07(0.95–1.19)	0.273	1.06(0.92–1.22)	0.442
P-Neck pain								
No	3524	653	Ref		Ref		Ref	
Yes	67	26	1.17(1.07–1.27)	<0.001	1.18(1.09–1.29)	0.008	1.10(0.99–1.22)	0.078
Chronic Pain state								
1None pain	1758	285	Ref		Ref		Ref	

2none or single --more site pain	298	47	0.99(0.96–1.04)	0.877	0.99(0.95–1.03)	0.577	0.98(0.94–1.03)	0.532
3Persistent- multisite pain	336	104	1.10(1.06–1.14)	<0.001	1.10(1.06–1.14)	<0.001	1.06(1.01–1.11)	0.020
4multisite pain-less site pain	292	66	1.05(1.00–1.09)	0.031	1.03(0.99–1.08)	0.110	1.00(0.95–1.05)	0.883
Pain_level								
0	1749	282	Ref		Ref		Ref	
1A Little	590	111	1.02(0.99–1.05)	0.224	1.01(0.98–1.05)	0.420	0.99(0.96–1.03)	0.758
2Some	311	75	1.06(1.02–1.10)	0.006	1.05(1.01–1.09)	0.021	1.02(0.98–1.07)	0.333
3Quite A Bit	200	67	1.12(1.07–1.17)	<0.001	1.12(1.07–1.17)	<0.001	1.08(1.02–1.14)	0.013
4A Lot	110	31	1.08(1.02–1.15)	0.011	1.08(1.01–1.15)	0.021	1.05(0.97–1.13)	0.266

**Supplementary Table S3. Results of Interaction Analyses Testing Effect Modification**

Pain Phenotype	Effect Modifier	LRT P-value	Interpretation	Sample Size
Chronic persistent pain	Age	0.563	No significant interaction	3,526
Chronic persistent pain	Smoking status	0.731	No significant interaction	3,526
Chronic persistent pain	Alcohol use	0.650	No significant interaction	3,526
Chronic persistent pain	Sleep duration	0.185	No significant interaction	3,526
Persistent waist pain	Age	0.773	No significant interaction	3,526
Persistent waist pain	Smoking status	0.608	No significant interaction	3,526
Persistent waist pain	Alcohol use	0.186	No significant	3,526

Pain Phenotype	Effect Modifier	LRT P-value	Interpretation	Sample Size
			interaction	
Persistent waist pain	Sleep duration	0.656	No significant interaction	3,526
Pain state trajectory	Age	0.455	No significant interaction	3,526
Pain state trajectory	Smoking status	0.223	No significant interaction	3,526
Pain state trajectory	Alcohol use	0.311	No significant interaction	3,526
Pain state trajectory	Sleep duration	0.422	No significant interaction	3,526
Pain severity level	Age	0.445	No significant interaction	3,526
Pain severity level	Smoking status	0.651	No significant interaction	3,526
Pain severity level	Alcohol use	0.909	No significant interaction	3,526
Pain severity level	Sleep duration	0.633	No significant interaction	3,526

**Footnote:**LRT = Likelihood Ratio Test. All interaction tests were non-significant ( $p > 0.05$ ), indicating consistent associations between pain phenotypes and CVD risk across different levels of age, smoking status, alcohol use, and sleep duration.

**Supplementary Table S4: Variance Inflation Factors (VIF) for Covariates in the Fully Adjusted Model (Model 3)**

Variable	GVIF	Df	$GVIF^{1/(2 \times Df)}$
Chronic_Pain	1.16	1	1.08
Age	1.34	1	1.16

Variable	GVIF	Df	$GVIF^{1/(2 \times Df)}$
Menopause_year	1.03	1	1.01
Education	1.37	2	1.08
marital	1.22	1	1.10
Location	1.27	1	1.13
Smoking	1.02	1	1.01
Drinking	1.03	1	1.02
BMI	1.16	1	1.07
Sleep_lunch_hours	1.04	1	1.02
Sleep_hours	1.16	1	1.07
Hypertension	1.13	1	1.06
Diabetes	1.10	1	1.05
Stroke	1.05	1	1.02
Dyslipidemia	1.12	1	1.06
Depression	1.59	30	1.01

\*Note: GVIF = Generalized Variance Inflation Factor; Df = Degrees of freedom. All  $GVIF^{1/(2 \times Df)}$  values are well below the conventional threshold of 5, indicating no concerning multicollinearity.\*