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Exploring Rural-Urban Differences in Polygenic Associations for Health Among Older Adults in the United States

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What's Known: U.S. Rural Health and Health Disparities + Genes

- Poorer health than urban residents¹⁻⁴:
 - Less likely to engage in regular physical activity,
 - more likely to smoke and smoke heavily,
 - less adequate sleep,
 - higher rates of alcohol consumption, and
 - more likely to experience teen pregnancy.
- Recent work utilizes genetic variation to better understand social determinants of health^{5,6}.
- Social research on health has typically focused on explaining “nurture” (i.e., social-behavioral aspects)⁷⁻¹⁰.
- Increasing availability of physiological/genetic markers □ “nature” can be added to investigations on social behaviors and outcomes.
 - e.g., increasing heritability of cigarette smoking over time^{11,12}



What Wasn't Known: GxE + Rural Health

- GxE anticipates rural HD may differ due to genetic risk.
- Stress exposure in urban/rural areas may differ substantially¹³.
- To our knowledge, only a handful of studies have applied a GxE approach to understanding rural health (Davis et al. 2017; Legrand et al. 2008; Rose et al. 2001; Taylor et al. 2011)¹⁴⁻¹⁷.
- **Are rural HD magnified or reduced among those with the highest genetic risk for a specific health problem?**

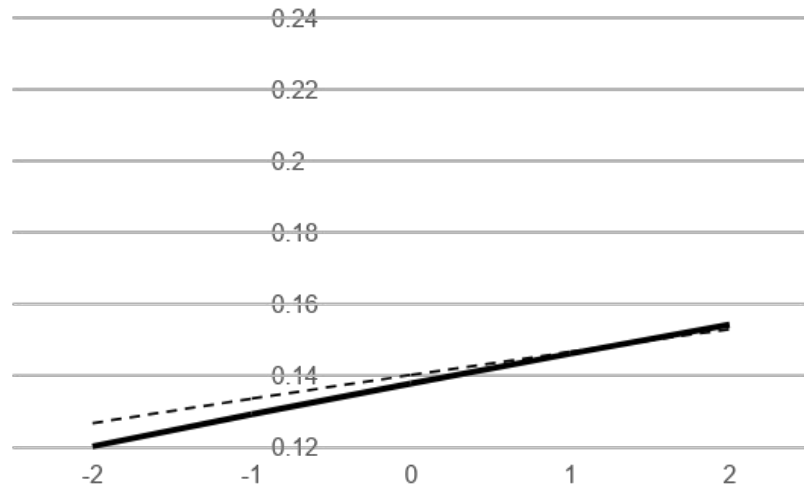


What We Did

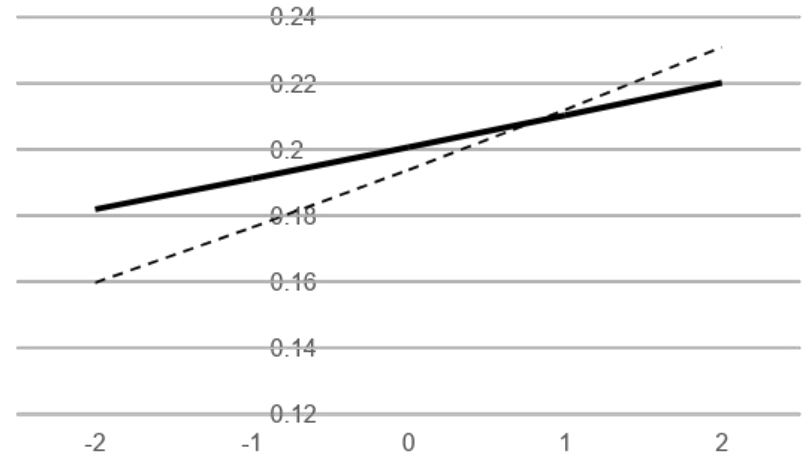
- Health and Retirement Study; $n = \sim 15,000$ older (i.e., 50+) adults.
- Polygenic scores (PGS)
- Urban-Rural Continuum (USDA Economic Research Service).
- Outcomes: Current Cigarette Smoker, Depression, BMI, and Heart Condition.
- Data contain observations nested within individuals over time—we use GLM and MLM approach (Stata 16).



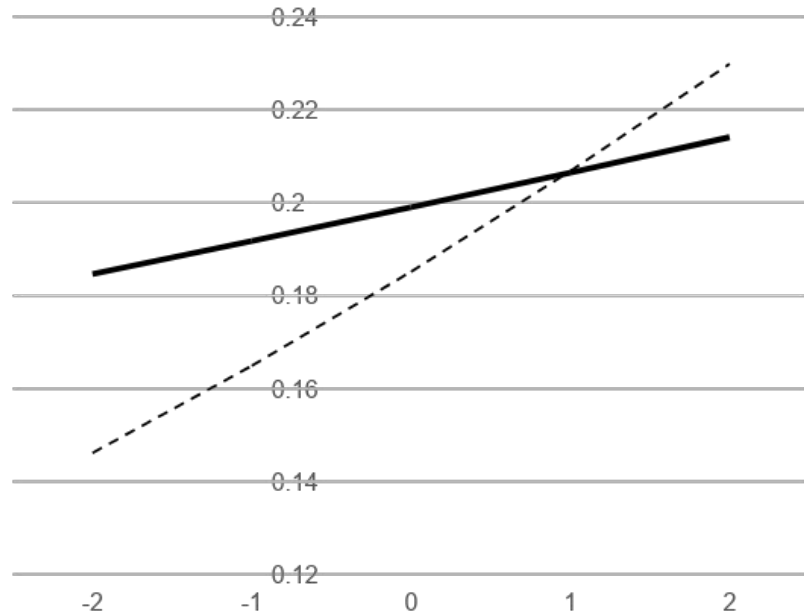
Current Smoker



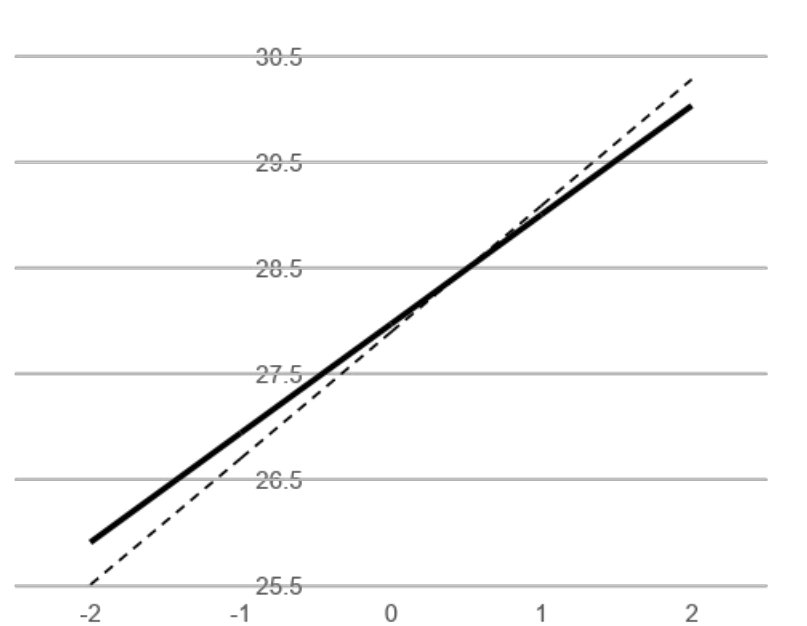
Heart Condition*



Depression



Body Mass Index*



Why We Think This Is Interesting

- Latent genetic risks for heart conditions and obesity are not triggered by rural residence.
- GxE: Genetic information sheds a light on HD.
- RD models highlight the centrality of environmental differences across residential contexts.



What's Next

- We **do not** explicitly focus on the selection into/out of rural areas as a function of age, race, education, or gender.
- PGS effects are attenuated in rural areas, but the strongest version of GxE is not supported here.
- Future directions: USDA Urban-Rural Continuum; Rural Selection.



Table 1. Descriptive Statistics for all Data Used in the Analyses

Wave	Age	Sex	Race	Educ	Rural	Heart	Deprx	BMI	Smoke	N
1992	56.174	0.540	0.155	12.690	0.114	0.113	.	27.057	0.219	4,973
1994	60.875	0.588	0.143	12.615	0.092	0.079	0.143	26.906	0.173	6,343
1996	62.594	0.595	0.141	12.626	0.071	0.167	0.142	27.074	0.162	6,471
1998	63.557	0.584	0.139	12.756	0.060	0.162	0.184	27.334	0.156	8,954
2000	65.304	0.589	0.136	12.774	0.052	0.182	0.184	27.463	0.142	9,115
2002	67.080	0.589	0.138	12.782	0.040	0.219	0.191	27.529	0.130	9,369
2004	66.626	0.580	0.149	12.929	0.025	0.228	0.186	27.710	0.141	11,174
2006	68.425	0.583	0.147	12.935	0.016	0.258	0.199	28.031	0.131	11,439
2008	70.007	0.586	0.148	12.968	0.015	0.278	0.188	28.068	0.123	11,341
2010	67.940	0.579	0.204	13.112	0.013	0.262	0.199	28.399	0.143	13,260
2012	69.172	0.584	0.206	13.163	0.012	0.271	0.204	28.404	0.135	12,650
2014	70.374	0.595	0.209	13.223	0.012	0.285	0.204	28.463	0.121	11,531
2016	71.364	0.599	0.215	13.293	0.021	0.292	0.192	28.509	0.111	10,143
Total	67.021	0.585	0.168	12.957	0.034	0.229	0.189	27.889	0.140	
N (Obs)	126,763	126,763	126,763	126,763	126,763	126,699	118,092	125,556	126,123	126,763
N (Ind)	14,994	14,994	14,994	14,994	14,994	14,994	14,992	14,989	14,986	14,994



Table 2. Sample Sizes by Number of Observations

Number of Waves	n (obs)	%.	n (ind)	%
1	151	0.12	151	1.01
2	736	0.58	368	2.45
3	1,692	1.33	564	3.76
4	9,472	7.47	2,368	15.79
5	1,945	1.53	389	2.59
6	3,516	2.77	586	3.91
7	11,914	9.40	1,702	11.35
8	7,376	5.82	922	6.15
9	9,612	7.58	1,068	7.12
10	20,470	16.15	2,047	13.65
11	9,548	7.53	868	5.79
12	13,944	11.00	1,162	7.75
13	36,387	28.70	2,799	18.67
Total	126,763	100.00	14,994	100.00



Results

Table 3. Multilevel Regression Estimates: Polygenic Risk by Rural Residence

	BMI		Heart Condition		Depression		Current Smoker	
	b	pr.<	b	pr.<	b	pr.<	b	pr.<
PGS	1.241	0.000	0.519	0.000	0.231	0.000	0.385	0.000
Rural	-0.160	0.042	0.197	0.095	0.150	0.093	-0.139	0.325
PGS*Rural	-0.185	0.018	-0.244	0.023	-0.153	0.065	0.108	0.461
Age	-0.100	0.000	0.206	0.000	-0.005	0.033	-0.236	0.000
Sex (F)	0.005	0.954	-1.082	0.000	0.708	0.000	-0.611	0.000
Race (B)	1.672	0.000	-0.052	0.731	0.672	0.000	0.993	0.000
Education	-0.138	0.000	-0.236	0.000	-0.230	0.000	-0.565	0.000
N Obs	119,651		125,473		113,250		125,958	
N Ind	14,882		14,895		14,884		14,888	



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