The Cognitive Effects of Micronutrient Deficiency: Evidence from Salt Iodization in the United States

Online Appendix

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1 Robustness check: Falsification exercise with other diseases

One might worry that a high prevalence of goiter in a region reflected general ill health, or perhaps a general low level of some particular dimension of health. Our narrative of the tight link between goiter prevalence and low iodine levels in local food and water makes us doubt such a possibility, but we proceed nonetheless. Thus, our third robustness check is to see whether a pattern of coefficients similar to those observed for goiter obtains for other medical conditions. Given that there are 271 different conditions enumerated in our data, it would not be a surprise to find several of them having interesting, statistically significant patterns of coefficients in our exercise. This being said, however, it is important to remember

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that our analysis of the effect of goiter prevalence on adult outcomes, and the use of 1924 as the cutoff year for pre- and post-treatment groups, was not the result of a search through the data for significant patterns. Quite the contrary, the underlying medical literature, and our a priori expectations of the effect of the policy intervention of iodization, led us to focus on this particular specification. By contrast, we do not have a theory regarding the pattern of coefficients for other diseases.

We proceed along two paths, looking first at a set of particular health conditions, and then at some measures of broader health. Examining all 271 conditions that appear in *Defects* seems unreasonable, especially since most of them were extremely rare. Simple goiter, the condition on which we focus, was the 26th most prevalent condition, affecting 4.35 men per thousand recruits. Using this as a natural cutoff, we compare our results for goiter with the 25 most prevalent conditions. The results are shown in Tables 1, 2, and 3. For each condition, the top row of the table shows its prevalence in the *Defects* data. We run the same regression as in Column 3 of Table 3 in the paper, simply substituting the prevalence of a different condition, at the section level, for that of goiter. For comparison, we also show the specification using goiter prevalence in the leftmost column of each page of the table. Conditions include pes planus (flat feet), which is the most common, with a prevalence of 109.4 per thousand; several general health descriptions, such as underweight, defective and deficient teeth, mental deficiency, and general unfitness for military; two venereal diseases; various injuries and physical deformities; and several specific diseases such as tuberculosis.

The coefficients in Tables 1, 2, and 3 do not suggest to us that other diseases in the *Defects* data predict outcomes in the World War II data in the same manner that goiter does. There are certainly significant coefficients on the interactions of different diseases with different birth years, but they generally do not follow a pattern as in the case of goiter. Partial exceptions to this rule are the venereal diseases syphilis and gonorrhea (gonococcus infection). Both have negative and significant coefficients for the birth years 1925 and 1926, but both also have negative and significant coefficients for years before iodization in 1924

(specifically 1922 for syphilis and 1921 for gonococcus infection). The same is roughly true with general unfitness for military service and, with the sign reversed, loss of fingers and flat feet.

Our second path for checking robustness to other diseases involves looking at more general measures of health. To get measures of general health for each section, we extract principal components from our set of 271 conditions that appear in *Defects*. In the interest of practicality, we focus on the first ten principal components. Cumulatively, these components account for 33.4% of the variation in the *Defects* data. The first principal component explain 6.1% of the variation[1]. The results in Table 4 show even less of a systematic pattern than that observed in the robustness exercise that looks at individual diseases.

[1]Kaiser's rule suggests using all principal components with eigenvalue higher than one. In our case, this would come to 72 principal components. Together, these explain 88.4% of the variation. We viewed presenting results from this many components as excessive.

Table 1: Falsification exercise with the most common diseases in *Defects* (part 1)

	(1) Simple goiter	(2) Pes planus	(3) Defective vision	(4) Under-weight	(5) Gonococcus infection	(6) Hyper-trophic tonsillitis	(7) Hernia	(8) Pulmonary tuber-culosis	(9) Enlarged inguinal rings	(10) Unclassified valvular lesions
Prevalence (per 1,000)	4.35	109.35	28.3	26.5	24.59	23.09	20.83	20.2	18.99	16.27
disease X Born 1920	-0.0229	-0.00483	-0.0161	-0.0375	-0.0629	-0.0440	0.385***	-0.0415	0.0243	0.0276
	(0.184)	(0.0360)	(0.0635)	(0.0431)	(0.0573)	(0.0645)	(0.117)	(0.0662)	(0.0325)	(0.0894)
disease X Born 1921	0.0491	0.0187	-0.00529	-0.0545	-0.0824**	-0.0657	0.242	-0.0423	0.0253	0.0462
	(0.137)	(0.0262)	(0.0478)	(0.0365)	(0.0417)	(0.0564)	(0.150)	(0.0560)	(0.0312)	(0.0729)
disease X Born 1922	-0.0352	0.0379**	0.00465	-0.0563	-0.0332	-0.0958**	0.328***	-0.0168	0.0368	0.0354
	(0.0707)	(0.0188)	(0.0351)	(0.0373)	(0.0346)	(0.0395)	(0.111)	(0.0483)	(0.0281)	(0.0619)
disease X Born 1923	-0.135***	-0.00748	0.0372*	-0.00327	-0.00476	0.0248*	-0.0352	-0.0296	0.0189	0.0213
	(0.0533)	(0.00774)	(0.0201)	(0.0145)	(0.0143)	(0.0144)	(0.0347)	(0.0209)	(0.0199)	(0.0296))
disease X Born 1925	0.516***	0.0809***	0.0183	-0.0647**	-0.100***	-0.0135	0.155	-0.0765	0.127***	0.0138
	(0.158)	(0.0288)	(0.0490)	(0.0317)	(0.0341)	(0.0635)	(0.159)	(0.0546)	(0.0387)	(0.0856)
disease X Born 1926	0.726***	0.122***	0.0659	-0.0579	-0.147***	-0.201***	0.0275	-0.117	0.0805	-0.0387
	(0.259)	(0.0388)	(0.0747)	(0.0666)	(0.0503)	(0.0746)	(0.197)	(0.0868)	(0.0582)	(0.115)
disease X Born 1927	0.491**	0.0446	-0.115*	-0.105**	-0.0335	-0.299***	0.102	-0.0563	-0.111**	-0.199**
	(0.209)	(0.0318)	(0.0604)	(0.0420)	(0.0380)	(0.0695)	(0.195)	(0.0394)	(0.0560)	(0.0792)
disease X Born 1928	-0.370	-0.230**	-0.435***	0.116	0.336***	-0.0886	-0.268	0.0730	-0.346***	-0.209
	(0.399)	(0.0905)	(0.134)	(0.112)	(0.103)	(0.100)	(0.167)	(0.0942)	(0.106)	(0.134)
Constant	77.03***	34.20	23.61**	64.46***	78.80***	44.92***	3.519	60.42***	33.20***	46.64***
	(16.81)	(43.14)	(11.76)	(8.194)	(10.11)	(10.78)	(10.50)	(8.872)	(7.615)	(10.28)
Observations	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444
R-squared	0.153	0.154	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Birth X Enlist. year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State trends	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1; Coefficients correspond to percentage point changes in the probability of enlisting in the Air Force during the enlistment period January 1940 to November 1945. Disturbances are clustered at the section and birth year levels.

Table 2: Falsification exercise with the most common diseases in *Defects* (part 2)

	(1) Simple goiter	(2) Mental deficiency	(3) Defective and deficient teeth	(4) Mitral insufficiency	(5) Otitis media	(6) Syphilis	(7) Pronated foot	(8) Suspected tuberculosis	(9) Curvature of spine
Prevalence (per 1,000)	4.35	14.45	13.48	10.75	7.84	6.94	6.31	6.22	5.53
disease X Born 1920	-0.0229	0.0899	0.0382	0.0950	-0.0693	-0.0547	-0.0966	0.333**	0.860*
	(0.184)	(0.0738)	(0.0710)	(0.130)	(0.138)	(0.128)	(0.101)	(0.151)	(0.500)
disease X Born 1921	0.0491	-0.00244	-0.00744	0.191	0.0576	-0.157	-0.0958	0.167	0.712*
	(0.137)	(0.0874)	(0.0567)	(0.127)	(0.118)	(0.0962)	(0.0824)	(0.114)	(0.398)
disease X Born 1922	-0.0352	-0.214***	-0.0310	0.172**	0.111**	-0.177***	-0.179***	-0.108	-0.218
	(0.0707)	(0.0745)	(0.0518)	(0.0785)	(0.0529)	(0.0667)	(0.0682)	(0.130)	(0.326)
disease X Born 1923	-0.135***	-0.0468	0.0309	-0.0411	0.114**	-0.0153	0.0334	-0.135**	-0.0743
	(0.0533)	(0.0308)	(0.0191)	(0.0394)	(0.0490)	(0.0332)	(0.0268)	(0.0665)	(0.0827)
disease X Born 1925	0.516***	-0.125	0.00848	0.368***	0.0505	-0.203**	0.0955	-0.226**	0.969
	(0.158)	(0.0850)	(0.0426)	(0.114)	(0.145)	(0.0813)	(0.0772)	(0.109)	(0.603)
disease X Born 1926	0.726***	-0.213*	0.0323	0.257	0.108	-0.389***	-0.0519	-0.130	1.619**
	(0.259)	(0.124)	(0.0650)	(0.164)	(0.269)	(0.124)	(0.0861)	(0.207)	(0.780)
disease X Born 1927	0.491**	0.0150	-0.174***	0.144	-0.269*	-0.0715	-0.402***	0.105	-0.305
	(0.209)	(0.0957)	(0.0501)	(0.179)	(0.137)	(0.0975)	(0.0763)	(0.203)	(0.522)
disease X Born 1928	-0.370	0.329**	-0.293**	-0.825**	-1.300***	0.679**	-0.162	1.208***	-3.636***
	(0.399)	(0.166)	(0.123)	(0.323)	(0.314)	(0.284)	(0.160)	(0.380)	(1.382)
Constant	77.03***	64.63***	41.13***	28.14***	29.98***	64.47***	51.69***	67.52***	-18.43
	(16.81)	(11.15)	(8.095)	(9.454)	(9.376)	(7.913)	(8.201)	(9.865)	(26.61)
Observations	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444
R-squared	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Birth X Enlist. year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State trends	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1; Coefficients correspond to percentage point changes in the probability of enlisting in the Air Force during the enlistment period January 1940 to November 1945. Disturbances are clustered at the section and birth year levels.

Table 3: Falsification exercise with the most common diseases in *Defects* (part 3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Simple goiter	Defective hearing	Blindness in one eye	Epilepsy	Loss of fingers	Deformity of lower extremity	Hallux valgus	General unfitness for military	Other diseases of bones & organs of locomotion
Prevalence (per 1,000)	4.35	5.47	5.4	5.15	5.05	4.71	4.65	4.65	4.54
disease X Born 1920	-0.0229	0.0370	-0.404	0.107	1.303**	0.246	-0.0394	0.0378	0.138
	(0.184)	(0.194)	(0.484)	(0.365)	(0.628)	(0.365)	(0.187)	(0.249)	(0.376)
disease X Born 1921	0.0491	-7.39e-05	-0.359	0.0731	1.143**	0.0514	-0.0438	-0.158	0.000667
	(0.137)	(0.224)	(0.365)	(0.392)	(0.530)	(0.292)	(0.161)	(0.213)	(0.303)
disease X Born 1922	-0.0352	0.119	-0.0268	-0.238	0.231	-0.275	-0.156	-0.398*	-0.437**
	(0.0707)	(0.220)	(0.252)	(0.264)	(0.488)	(0.225)	(0.133)	(0.207)	(0.216)
disease X Born 1923	-0.135**	0.00892	-0.218***	0.211*	-0.264	-0.259**	0.108*	-0.170**	-0.0722
	(0.0533)	(0.0540)	(0.0811)	(0.109)	(0.191)	(0.108)	(0.0609)	(0.0731)	(0.0953)
disease X Born 1925	0.516***	0.234	-0.611*	-0.683**	1.308**	-0.569*	0.150	-0.455**	0.457
	(0.158)	(0.291)	(0.348)	(0.326)	(0.632)	(0.328)	(0.164)	(0.204)	(0.348)
disease X Born 1926	0.726***	0.703*	-0.923*	-0.210	2.352**	-0.964*	-0.153	-0.945***	-0.150
	(0.259)	(0.413)	(0.496)	(0.512)	(0.938)	(0.502)	(0.204)	(0.319)	(0.450)
disease X Born 1927	0.491**	-0.117	-0.00926	-0.679*	0.442	-0.433	-0.743***	-0.135	-0.961*
	(0.209)	(0.283)	(0.409)	(0.353)	(0.641)	(0.343)	(0.285)	(0.221)	(0.498)
disease X Born 1928	-0.370	-1.514*	2.124***	0.469	-3.173*	2.860***	-0.453	2.164***	-1.074*
	(0.399)	(0.878)	(0.715)	(0.684)	(1.652)	(0.758)	(0.298)	(0.557)	(0.609)
Constant	77.03***	29.19**	90.64***	64.42***	-10.61	86.40***	37.68***	81.23***	37.59***
	(16.81)	(12.01)	(14.22)	(13.68)	(32.79)	(13.66)	(11.66)	(11.25)	(12.13)
Observations	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444
R-squared	0.153	0.153	0.153	0.153	0.154	0.153	0.153	0.153	0.153
Birth X Enlist. year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
State trends	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1; Coefficients correspond to percentage point changes in the probability of enlisting in the Air Force during the enlistment period January 1940 to November 1945. Disturbances are clustered at the section and birth year levels.

Table 4: Falsification exercise with the first 10 principal components of diseases in *Defects*

	(1) goiter	(2) pc1	(3) pc2	(4) pc3	(5) pc4	(6) pc5	(7) pc6	(8) pc7	(9) pc8	(10) pc9	(11) pc10
variable X Born 1920	-0.0229	0.202	-0.0332	0.306*	0.722***	0.0330	-0.0586	0.332	-0.784*	-1.315***	-0.177
	(0.184)	(0.203)	(0.243)	(0.181)	(0.274)	(0.326)	(0.362)	(0.466)	(0.439)	(0.466)	(0.499)
variable X Born 1921	0.0491	0.266*	-0.212	0.0677	0.492**	-0.163	-0.319	-0.0761	-0.479	-1.006***	-0.163
	(0.137)	(0.154)	(0.186)	(0.162)	(0.216)	(0.218)	(0.289)	(0.332)	(0.313)	(0.380)	(0.357)
variable X Born 1922	-0.0352	0.116	-0.438***	-0.0926	0.442*	-0.375**	-0.201	0.0806	0.101	-0.400	-0.116
	(0.0707)	(0.144)	(0.133)	(0.160)	(0.264)	(0.154)	(0.239)	(0.253)	(0.235)	(0.345)	(0.309)
variable X Born 1923	-0.135**	0.105	-0.0141	-0.0925	-0.306*	-0.264	-0.238	-0.0532	0.332	0.0809	0.183
	(0.0533)	(0.0950)	(0.110)	(0.108)	(0.161)	(0.182)	(0.219)	(0.224)	(0.300)	(0.282)	(0.259)
variable X Born 1925	0.516***	0.288*	-0.430***	-0.577***	-0.0492	-0.138	-0.548**	0.00717	0.123	-0.818***	0.676*
	(0.158)	(0.172)	(0.152)	(0.175)	(0.249)	(0.194)	(0.220)	(0.202)	(0.361)	(0.295)	(0.410)
variable X Born 1926	0.726***	0.335	-0.923***	-0.337	0.0614	-0.775*	-0.563	-0.389	-0.652	-1.327***	0.635
	(0.259)	(0.235)	(0.271)	(0.261)	(0.330)	(0.424)	(0.413)	(0.449)	(0.583)	(0.515)	(0.647)
variable X Born 1927	0.491**	-0.583***	-0.787***	0.127	0.833**	-0.357	0.116	-0.781**	-1.226***	-0.656*	-0.138
	(0.209)	(0.219)	(0.232)	(0.367)	(0.366)	(0.327)	(0.344)	(0.342)	(0.398)	(0.352)	(0.359)
variable X Born 1928	-0.370	-1.508***	1.134**	1.003***	1.807***	2.349**	2.258**	0.389	-0.460	1.362	-4.016***
	(0.399)	(0.404)	(0.480)	(0.388)	(0.536)	(1.017)	(1.053)	(0.876)	(1.377)	(1.502)	(1.219)
Constant	77.03***	53.16***	61.63***	56.43***	46.29***	39.87***	49.75***	41.53***	49.72***	49.93***	50.50***
	(16.81)	(6.538)	(8.261)	(7.326)	(6.618)	(4.486)	(5.981)	(5.090)	(5.883)	(7.234)	(6.023)
Observations	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444	1,935,444
R-squared	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Birth X Enl.year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Section FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State trends	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1; Coefficients correspond to percentage point changes in the probability of enlisting in the Air Force during the enlistment period January 1940 to November 1945. Disturbances are clustered at the section and birth year levels.