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ORIGINAL ARTICLE

Nativity and cognitive disability among children: a unique comparison with reduced selection bias

Emma K. T. Benn

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Abstract
Objectives We examined the impact of nativity on self-reported cognitive disability by comparing children who were born outside of the USA (first-generation immigrants) with US-born offspring (second-generation immigrants) of foreign-born parents.
Methods We analyzed a diverse, nationally representative, sample of 77,324 first-generation immigrant and second-generation immigrant children (aged 5–17 years) from the 2009 American Community Survey. Multivariate logistic regression was used to assess the association between nativity and self-reported cognitive disability after adjustment for demographics and household characteristics.
Results Self-reported cognitive disability was observed in 1.7 % of the sample. The prevalence was higher among first second-generation immigrants than among second first-generation immigrants (1.9 vs 1.1 %, $p < 0.001$). After multivariate adjustment, the advantage of being foreign-born remained (OR = 0.63, 95 % CI = 0.53–0.75). Further analysis revealed effect modification of the immigrant health advantage by household income ($p = 0.003$).
Conclusions We observed an immigrant advantage in self-reported cognitive disability; however, it was only evident among economically disadvantaged children. Future research should examine the contribution of the accumulation of poverty over time to the relationship between nativity and children's health.

E. K. T. Benn (✉)
Department of Health Evidence and Policy, Center for Biostatistics, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, Box 1077, New York, NY 10029, USA
e-mail: emma.benn@mountsinai.org

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Introduction

Within the last decade, there have been numerous examinations of the impact of nativity on self-reported health in the USA. Findings from these studies suggest that immigrants self-report a lower prevalence of poor physical health, asthma, hypertension, functional disability, depressive symptoms, and various other health outcomes, as compared to their US-born counterparts (Borrell and Crawford 2008; Elo et al. 2011; Griffith et al. 2011; Huang et al. 2007; Joseph et al. 2010; Prus 2011). Abraido-Lanza et al. (1999) posit that better health outcomes among immigrants are a result of better health practices, whereas Weitoft et al. (1999) point to the inability of epidemiologic studies to capture the health status of less healthy immigrants who return to their home country. In some studies, researchers have observed worse self-reported health outcomes among immigrants, like higher rates of self-reported diabetes among foreign-born South Asians (Gupta et al. 2011), a higher prevalence of depressive symptoms among foreign-born Asian mothers (Huang et al. 2007), and worse self-reported overall health among Asians and Latinos (Kandula et al. 2007). Internationally, the self-reported health comparisons between foreign-born and native-born have yielded mixed results (Beiser and Hou 2014; Carlerby et al. 2011; Dinesen et al. 2011; Glaesmer et al. 2011; Smith Nielsen and Krasnik 2010; So and Quan 2012). For example, So and Quan (2012) observed higher odds of self-reported chronic conditions among immigrants in Canada, whereas a protective effect against chronic conditions among immigrants as compared

to native-born Canadians was observed by Beiser and Hou (2014). Yet, regardless of the international ambiguity, the frequency of studies in the USA identifying a self-reported health advantage among immigrants far outweighs the number of studies reporting a self-reported health disadvantage in this group.

Most observational studies aimed at exploring the impact of nativity on health essentially compare individuals who have immigrated to the USA with individuals born in the USA. However, this type of study design often lacks internal validity and makes it very difficult to determine whether the findings are depicting a true fundamental difference between the health of foreign-born and US-born individuals or rather reflect a systematic bias induced by self-selection, since individuals who leave their country may exhibit positively selective characteristics, such as higher educational attainment and better health status, on average, than those who remain in their home country (Akresh and Frank 2008; Feliciano 2005; Jasso et al. 2005; Kuhn et al. 2011). Our observations may be confounded by a selection bias that arises when we compare a random sample of US-born individuals whose health and well-being can be generalized to the US-born population to a non-random sample of foreign-born individuals whose health and well-being can be generalized only to a selective minority of individuals from their home country.

One strategy that could reduce the selectivity-related bias is to conduct a comparison of health outcomes of similar-aged cohorts of foreign-born children who immigrated to the USA with their foreign-born parents, often referred to as "contemporary immigrants" or the "1.5 generation" (Rumbaut 1991; Zhou 1997), to US-born offspring of foreign-born parents. For the purpose of this study, we have classified foreign-born children and US-born children of foreign-born parents as first-generation and second-generation immigrants, respectively. By conditioning on the foreign-born nativity of the children's parents, we are, in essence, "matching" first-generation and second-generation immigrant children on the nativity of their parents and a host of unmeasured parental-level factors (culture, selectivity, health-related beliefs and stigma, diet, religion, etc.), which simultaneously inform both the parents' and children's backgrounds. This may not completely account for all unmeasured confounding when comparing self-reported health outcomes between US-born and foreign-born individuals; however, we posit that the selectivity of the foreign-born group, using this type of study design, should be relatively similar to that of the US-born group, given both groups represent the offspring of a selective minority of the population of foreign-born parents who immigrated to the USA. Thus, if a difference in self-reported health were observed between first- and second-generation immigrants to the US, after accounting for important individual-level and macro-level covariates, we would have more confidence that the observed difference is due to nativity rather than selectivity.

In the present study, we employed this more optimal design in the analysis of a nationally representative sample from the 2009 American Community Survey of second-generation and first-generation immigrants to assess the impact of nativity on self-reported cognitive disability. We were particularly interested in cognitive disability because children with cognitive disability must often confront numerous barriers in adulthood. Some of these barriers include, but are not limited to, financial instability, less self-determination, lower quality of life, and smaller social networks (Hall et al. 2005; Nota et al. 2007). Thus, we posited that the public health implications of assessing the impact of possible risk factors, like nativity, on childhood cognitive disability may help to draw attention to vulnerable subgroups. The publicly available 2009 American Community Survey data provided us with the unique opportunity to assess differences in self-reported cognitive disability in a diverse sample of children living in the USA while capturing essential information about their origin along with the origin of their parent(s).

Methods

Study sample

We used the 2009 American Community Survey Public Use Microdata Sample (ACS PUMS), which included a nationally representative sample of households and persons living within those households. Detailed information about the design and methodology of the American Community Survey (ACS) can be found online (US Census Bureau 2009). We restricted the sample to the offspring of foreign-born parent(s) who were between 5 and 17 years of age. We used this age range for two major reasons: (1) self-reported cognitive disability was not assessed for children below the age of 5 years and (2) information about the nativity of parent(s) could only be linked indirectly to offspring above 17 years of age.

Main predictor

All children in the study sample were living in a household in the USA in 2009 with two foreign-born parents, or one foreign-born parent in the case of single-parent households. We classified these children as being first-generation immigrants (FGIs) if they were born outside of the USA or second-generation immigrants (SGIs) if they were born within the USA. Children living in a two-parent household for which only one of their parents was foreign-born were not included in this study.

Outcome

The FGI and SGI children were categorized as having self-reported cognitive disability (SRCD) if they, or a member of their household completing the survey for them, responded affirmatively to the following question: "Because of a physical, mental, or emotional condition, do [you] have serious difficulty concentrating, remembering, or making decisions?" (Erickson 2012).

Covariates

The covariates were split into two domains: demographics and household characteristics. Demographics included age-group in years at time of interview (5–10, 11–13, or 14–17), sex (male or female), and race/ethnicity (White, Black, Hispanic, Asian, or Other). Household characteristics included household language (English only or Other language), single-parent household (yes or no), multigenerational household (yes or no), household income (<25, 25 to <50, 50 to <75, 75 to <100 K, or 100 K+), and household region of the USA (Northeast, Midwest, South, or West).

Statistical analysis

Categorical variables are summarized using unweighted frequencies and weighted proportions. The Rao and Scott (1987) Chi square test was used to test for associations between categorical variables in bivariate analyses. All analyses were performed using the SURVEYFREQ and SURVEYLOGISTIC procedures in SAS 9.2 (Cary, NC), thus taking into account the complex survey design and methodology (SAS Institute Inc 2008; US Census Bureau 2009).

Using multivariate logistic regression, we assessed the difference in the odds of SRCD between FGI and SGI children first unadjusted (Model 1) and then adjusted for demographics (Model 2) and household characteristics (Model 3) in two separate models, and lastly after simultaneous adjustment for both domains of covariates (Model 4). Potential confounders significantly associated with both the nativity of the children and SRCD in bivariate analyses, along with independent predictors of SRCD, were included in the adjusted models. Additionally, we explored the possibility of an interaction between each covariate included in the adjusted models and the nativity of the children by introducing *covariate* × *nativity* interaction terms to the fully adjusted Model 4. The Likelihood Ratio Test was used to evaluate the logistic models. All associations were assessed at the 0.05 level of significance. All figures were created in R 2.13.1.

Results

The study sample consisted of 77,324 children living in the USA in 2009, of which 23.4 % were foreign-born. The prevalence of SRCD in this sample was 1.7 %. The sample was majority male (51.5 %) and Hispanic (59.1 %).

Table 1 Distribution of sample characteristics ($N = 77{,}324$): United States, 2009 American Community Survey

Nativity	
First-generation immigrant—Foreign-born	17,970 (23.4 %)
Second-generation immigrant—US-born	59,354 (76.6 %)
Self-reported cognitive disability (SRCD)	
No	75,922 (98.3 %)
Yes	1,402 (1.7 %)
Covariates—demographics	
Age-group	
5–10	35,050 (47.1 %)
11–13	17,917 (23.2 %)
14–17	24,357 (29.7 %)
Sex	
Male	39,588 (51.5 %)
Female	37,736 (48.5 %)
Race	
White	9,276 (11.8 %)
Black	5,742 (8.0 %)
Hispanic	43,723 (59.1 %)
Asian	17,159 (19.3 %)
Other	1,424 (1.8 %)
Covariates—household characteristics	
Language	
Other language	72,930 (93.4 %)
English only	4,934 (6.6 %)
Single parent	
No	55,575 (68.9 %)
Yes	21,749 (31.1 %)
Multigenerational	
No	67,173 (87.6 %)
Yes	10,151 (12.4 %)
Income	
<25 K	17,819 (25.7 %)
25 to <50 K	22,253 (29.6 %)
50 to <75 K	14,239 (18.2 %)
75 to <100 K	8,007 (9.8 %)
≥100 K	15,006 (16.7 %)
Region	
Northeast	12,874 (17.7 %)
Midwest	7,515 (10.7 %)
South	24,551 (31.5 %)
West	32,384 (40.1 %)

Data are unweighted frequency (weighted %)

Table 2 Bivariate assessments of the relationship between covariates and nativity among first-generation immigrant and second-generation immigrant children: United States, 2009 American Community Survey

	Nativity of Child		*p* value
	Second-generation immigrant US-born (n = 59,354)	First-generation immigrant Foreign-born (n = 17,970)	
Demographics			
Age-group			<0.001
5–10	29,455 (51.6 %)	5,595 (32.4 %)	
11–13	13,194 (22.0 %)	4,723 (26.9 %)	
14–17	16,705 (26.4 %)	7,652 (40.7 %)	
Sex			0.27
Male	30,302 (51.4 %)	9,286 (51.9 %)	
Female	29,052 (48.6 %)	8,684 (48.1 %)	
Race			<0.001
White	6,454 (10.6 %)	2,822 (15.5 %)	
Black	4,180 (7.7 %)	1,562 (9.2 %)	
Hispanic	34,795 (61.2 %)	8,928 (52.3 %)	
Asian	12.782 (18.6 %)	4,377 (21.4 %)	
Other	1,143 (1.9 %)	281 (1.6 %)	
Household characteristics			
Language			<0.001
Other language	55,457 (93.1 %)	16,933 (94.4 %)	
English only	3,897 (6.9 %)	1,037 (5.6 %)	
Single parent			<0.001
No	41,990 (67.6 %)	13,585 (73.0 %)	
Yes	17,364 (32.4 %)	4,385 (27.0 %)	
Multigenerational			<0.001
No	51,239 (87.1 %)	15,934 (89.3 %)	
Yes	8,115 (12.9 %)	2,036 (10.7 %)	
Income			<0.001
<25 K	13,138 (24.5 %)	4,681 (29.4 %)	
25 to <50 K	16,898 (29.4 %)	5,355 (30.5 %)	
50 to <75 K	11,101 (18.5 %)	3,138 (17.2 %)	
75 to <100 K	6,268 (10.0 %)	1,739 (8.9 %)	
≥100 K	11,949 (17.6 %)	3,057 (14.1 %)	
Region			<0.001
Northeast	9,735 (17.3 %)	3,139 (18.8 %)	
Midwest	5,560 (10.3 %)	1,955 (12.1 %)	
South	17,891 (30.2 %)	6,660 (36.0 %)	
West	26,168 (42.2 %)	6,216 (33.1 %)	

Data are unweighted frequency (weighted column %)

Almost one-half were in the 5- to 10-year age-group (47.1 %), and almost one-third (31.1 %) lived in single-parent households. About one-quarter (25.7 %) of the children lived in households with a household income below 25 K. The sample characteristics are described in detail in Table 1.

We observed statistically significant associations between all demographics, except for sex (p = 0.27), and between all household characteristics, and the nativity of the children as reported in Table 2. SGI children were younger than FGI children with more than two-thirds between 5 and 13 years of age in the SGI group and between 11 and 17 years in the FGI group. Although both groups of children consisted of majority Hispanics, a higher proportion of Hispanics were observed among SGI children. Asians and Whites were the second and third most common race/ethnicities in each group. A higher proportion of SGI children lived in English only, single-parent, and multigenerational households compared with FGI children. SGI children were also slightly wealthier than FGI children.

We observed statistically significant associations between all demographics and between all household characteristics, except for multigenerational household

Table 3 Bivariate assessments of the relationship between nativity, covariates, and self-reported cognitive disability among first-generation immigrant and second-generation immigrant children: United States, 2009 American Community Survey

	Self-reported cognitive disability		*p* value
	No ($n = 75{,}922$)	Yes ($n = 1{,}402$)	
Nativity of child			<0.001
Second-generation immigrant—US-born	58,187 (98.1 %)	1,167 (1.9 %)	
First-generation immigrant—Foreign-born	17,735 (98.8 %)	235 (1.1 %)	
Demographics			
Age-group			0.041
5–10	34,392 (98.2 %)	658 (1.8 %)	
11–13	17,582 (98.2 %)	335 (1.8 %)	
14–17	23,948 (98.5 %)	409 (1.5 %)	
Sex			<0.001
Male	38,671 (97.8 %)	917 (2.2 %)	
Female	37,251 (98.8 %)	485 (1.2 %)	
Race			<0.001
White	9,148 (98.8 %)	128 (1.2 %)	
Black	5,618 (98.1 %)	124 (1.9 %)	
Hispanic	42,819 (98.1 %)	904 (1.9 %)	
Asian	16,950 (98.8 %)	209 (1.2 %)	
Other	1,387 (97.6 %)	37 (2.4 %)	
Household characteristics			
Language			<0.001
Other language	71,115 (98.3 %)	1,275 (1.7 %)	
English only	4,807 (97.7 %)	127 (2.3 %)	
Single parent			<0.001
No	54,788 (98.7 %)	787 (1.3 %)	
Yes	21,134 (97.4 %)	615 (2.6 %)	
Multigenerational			0.91
No	65,956 (98.3 %)	1,217 (1.7 %)	
Yes	9,966 (98.3 %)	185 (1.7 %)	
Income			<0.001
<25 K	17,350 (97.6 %)	469 (2.4 %)	
25 to <50 K	21,828 (98.3 %)	425 (1.7 %)	
50 to <75 K	14,021 (98.6 %)	218 (1.4 %)	
75 to <100 K	7,894 (98.6 %)	113 (1.4 %)	
≥100 K	14,829 (98.9 %)	177 (1.1 %)	
Region			0.12
Northeast	12,614 (98.2 %)	260 (1.8 %)	
Midwest	7,404 (98.5 %)	111 (1.5 %)	
South	24,076 (98.1 %)	475 (1.9 %)	
West	31,828 (98.4 %)	556 (1.6 %)	

Data are unweighted frequency (weighted row %)

($p = 0.91$) and household region ($p = 0.12$), and SRCD as reported in Table 3. The prevalence of SRCD was higher for SGI than FGI children. The proportion with SRCD was almost double among males as compared to females and among those children living in single-parent households as compared to those living in two-parent households. SRCD was most prevalent among Blacks, Hispanics, and Others. A negative association between household income and SRCD was also observed.

The unadjusted odds of SRCD were 40 % lower among FGI children compared with SGI children (OR = 0.60, 95 % CI = 0.51–0.71, Model 1). The unadjusted and the adjusted results of the logistic regression analyses are reported in Table 4. The magnitude of the difference in odds of SRCD between FGI and SGI children was virtually unchanged, even after adjustment for covariates significantly associated with both the nativity of the children and SRCD in the bivariate analyses, which included age-group, race/ethnicity, household language, single-parent household and household income, and sex, which was an independent predictor of SRCD (OR = 0.63, 95 % CI = 0.53–0.75, Model 4).

Moreover, in the fully adjusted Model 4, we no longer observed a racial/ethnic difference in SRCD between Blacks and Whites. Upon further assessment, we determined that the lack of statistical significance of the Black–White difference in Model 4 was not linked to the introduction of household language and household income to the model, but was actually the result of there being a higher proportion of Black children living in single-parent households than White children (48 vs 22 %). Children living in single-parent households experienced higher rates of SRCD with 1.71-fold (95 % CI = 1.49–1.95) higher odds compared with children living in both parents households.

We observed statistically significant effect modification of the association between the nativity of the children and SRCD by household income ($p = 0.003$). We did not observe effect modification with respect to any of the other covariates included in Model 4. As depicted in Fig. 1, the lower odds of SRCD among FGI children as compared to SGI children were only statistically significant for those living in households with a household income <25 K (OR = 0.44, 95 % CI = 0.33–0.60) or between 25 and <50 K (OR = 0.62, 95 % CI = 0.46–0.83). We condensed the three highest household income groups, given their odds of SRCD were shown to be similar in Model 4. More specifically, the observed advantage of being foreign-born was stronger among those living in households making <25 K than among those in the 25 to <50 K group. FGI and SGI children living in households making at least 50 K had similar odds of SRCD (OR = 0.91, 95 % CI = 0.69–1.20).

Table 4 Unadjusted and adjusted ORs (95 % CI) of self-reported cognitive disability between first-generation immigrant and second-generation immigrant children: United States, 2009 American Community Survey

	Model 1	Model 2	Model 3	Model 4
Nativity of child				
Second-generation immigrant—US-born	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
First-generation immigrant—Foreign-born	0.60 (0.51–0.71)	0.63 (0.53–0.74)	0.61 (0.51–0.72)	0.63 (0.53–0.75)
Demographics				
Age-group				
5–10		1.00 (ref)		1.00 (ref)
11–13		1.07 (0.92–1.26)		1.08 (0.92–1.26)
14–17		0.90 (0.78–1.04)		0.90 (0.78–1.04)
Sex				
Male		1.81 (1.58–2.06)		1.82 (1.59–2.07)
Female		1.00 (ref)		1.00 (ref)
Race/ethnicity				
White		1.00 (ref)		1.00 (ref)
Black		1.48 (1.10–1.98)		1.14 (0.82–1.58)
Hispanic		1.49 (1.20–1.86)		1.31 (1.05–1.65)
Asian		0.91 (0.70–1.18)		1.03 (0.79–1.34)
Other		1.89 (1.22–2.94)		1.59 (1.01–2.50)
Household				
Language				
Other language			1.00 (ref)	1.00 (ref)
English only			1.22 (0.98–1.53)	1.31 (0.99–1.73)
Single parent				
No			1.00 (ref)	1.00 (ref)
Yes			1.73 (1.51–1.98)	1.71 (1.49–1.95)
Income				
<25 K			1.86 (1.50–2.31)	1.68 (1.34–2.11)
25 to <50 K			1.47 (1.19–1.81)	1.33 (1.06–1.66)
50 to <75 K			1.24 (0.98–1.58)	1.14 (0.86–1.52)
75 to <100 K			1.20 (0.91–1.60)	1.14 (0.86–1.51)
≥100 K			1.00 (ref)	1.00 (ref)

Discussion

Our assessment of self-reported cognitive disability among foreign-born and US-born children of foreign-born parents living in the USA in 2009 revealed a higher prevalence of unfavorable outcome among the US-born group. Even after accounting for important covariates, such as age-group, sex, race/ethnicity, household language, single-parent household, and household income, the nativity-related difference remained. We also observed that the children's household economic composition modified the association between nativity and self-reported cognitive disability. Specifically, we found that the lower odds of self-reported cognitive disability among foreign-born first-generation immigrants as compared to US-born second-generation immigrants were only statistically significant for those children living in households with an annual income <$50,000.

One possible explanation for the nativity–household income interplay is that because second-generation immigrant children were born in the USA, their amount of time spent in the USA, on average, is longer than that of first-generation immigrant children. If we also make a reasonable assumption that the foreign-born parents of second-generation immigrants have also lived in the USA for a longer time period, on average, than those of first-generation immigrants, then we posit that the accumulation of the health-related effects of being poor in the USA over time has a more detrimental impact on the cognitive development of second-generation immigrants than on first-generation immigrants. The fact that the immigrant health advantage is relatively diminished for children living in households with an annual income of at least $50,000 might suggest that the economic stability that these children and their parents are afforded not only reduces the

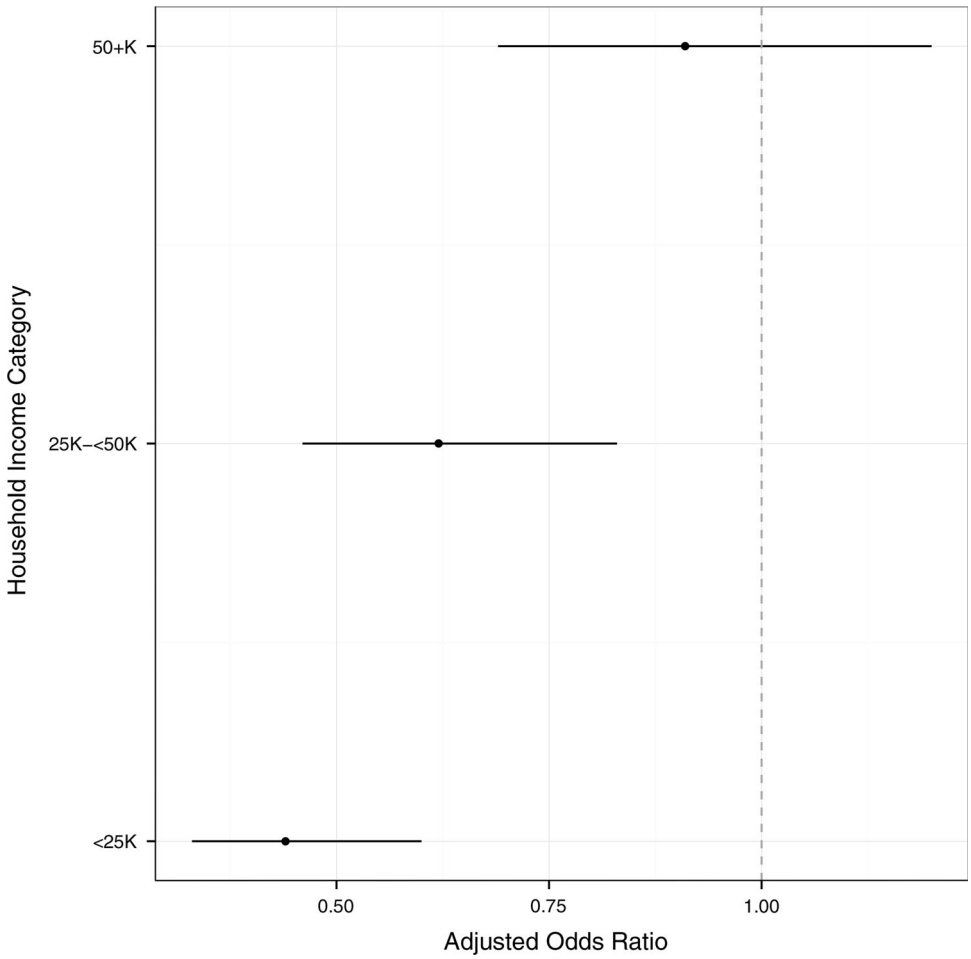

Fig. 1 Forest *plot* demonstrating effect modification of the nativity-self-reported cognitive disability association by household income. Adjusted ORs (95 % CI) compare foreign-born first-generation immigrant children to US-born second-generation immigrant children (ref). *Dashed line* at OR = 1.0 represents no association: United States, 2009 American Community Survey

children's risk for self-reported cognitive disability, but also balances out this risk across both groups regardless of the amount of time they have lived in the USA.

A second, yet very plausible, explanation for the nativity–household income interplay is that foreign-born parents with fewer economic resources to mitigate the challenges associated with immigrating to the USA may be forced to leave their foreign-born offspring with cognitive disabilities in the care of other family members in their home country. Wealthier foreign-born parents of foreign-born offspring would be less likely to have to confront the unfortunate decision to leave their foreign-born children with cognitive disabilities behind. Thus, the observed effect modification of the association between nativity and self-reported cognitive disability by household income may be a mere reflection of the offspring poorer foreign-born parents leave behind, rather than an immigrant health advantage among children living in poorer households.

We also would like to draw attention to the racial/ethnic differences in self-reported cognitive disability. We initially observed worse outcomes for Blacks, Hispanics, and Others as compared to Whites. However, after accounting for single-parent household, the Black–White difference in self-reported cognitive disability disappeared. This is consistent with findings by Fryer and Levitt (2006) in their study of racial/ethnic differences in mental function among young children, where they observed substantial confounding of the racial/ethnic difference in mental function by household characteristics inclusive of socioeconomic status and family configuration.

Our study had two major strengths. First, the 2009 American Community Survey gave us the unique opportunity to comprehensively explore the impact of nativity on self-reported cognitive disability in a nationally representative sample of children in the USA, while reducing selection bias. Our methodological strategy presented a novel paradigm shift for the study of nativity-related differences in cognitive outcomes, with the potential for extrapolation to other important health outcomes. Second, our research presented unique evidence for the complex interplay between the immigrant health advantage and household income, which to our knowledge, has not previously been examined in research related to self-reported cognitive outcomes in children.

Our research had some limitations. First, the cross-sectional study design prevented us from determining the

directionality of the observed associations. Second, our assessment of cognitive disability lacked specificity and relied on self-report by the child or other household member. Therefore, we must interpret the findings from this study with caution (Carr et al. 2001; Elo et al. 2011; Fanelli Kuczmarski et al. 2001; Kandula et al. 2007). Additionally, our analysis did not account for information related to the length of time spent in the USA, country of origin, or cognitive status of the children's parents, which could be useful in gaining a more comprehensive overview of nativity-related differences in self-reported cognitive disability. We do, however, believe that our study established an important foundation from which we can formulate novel hypotheses related to nativity and cognitive disability in the future.

In conclusion, although the immigrant health advantage was observed with respect to self-reported cognitive disability among children in the USA, the absence of this advantage among children living in wealthier households presents an interesting paradox. Further research is needed to examine whether the nativity–wealth interplay holds for diagnostically assessed cognitive disability and other important childhood health outcomes in order to target more effective interventions to the most vulnerable populations.

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