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The more the heavier? Family size and childhood obesity in the U.S

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ABSTRACT

Childhood obesity remains a top public health concern and understanding its drivers is important for combating this epidemic. Contemporaneous trends in declining family size and increasing childhood obesity in the U.S. suggest that family size may be a potential contributor, but limited evidence exists. Using data from a national sample of children in the U.S. this study examines whether family size, measured by the number of siblings a child has, is associated with child BMI and obesity, and the possible mechanisms at work. The potential endogeneity of family size is addressed by using several complementary approaches including sequentially introducing of a rich set of controls, subgroup analyses, and estimating school fixed-effects and child fixed-effects models. Results suggest that having more siblings is associated with significantly lower BMI and lower likelihood of obesity. Children with siblings have healthier diets and watch less television. Family mealtimes, less eating out, reduced maternal work, and increased adult supervision of children are potential mechanisms through which family size is protective of childhood obesity.

1. Introduction

The prevalence of childhood overweight and obesity in the U.S. has increased dramatically since the mid 1970s and a significant amount of research has sought to understand the drivers of this epidemic. A number of societal and economic changes occurred contemporaneously with increases in childhood obesity. For example, decline in food prices, changes in the built environment, and increases in mothers' labor force participation have all been suggested as contributors to the epidemic (Anderson and Butcher, 2006). Around this same time period, another significant change occurred in American households. Among households with own children, there was a substantial decline in the average number of children per family - from 2.44 in 1965 to 1.86 in 2008 (Census Bureau, 2013). It appears, therefore, that childhood obesity was increasing around the same time as family size was declining in the U.S. leading to the question as to whether family size can also contribute to childhood obesity. Understanding this relationship can provide additional opportunities for targeting obesity prevention efforts.

Theoretical predictions regarding the effects of family size on child obesity are ambiguous. Economic models of household behavior, in particular the well-known Quantity-Quality model (Becker and Lewis, 1973, Becker and Tomes, 1976), predict an inverse relationship between the number of children and their "quality". That is, given household income, more children implies fewer per capita resources, which would have a detrimental effect on child well-being. This is also referred to as the resource-dilution hypothesis in the sociology and demography literature (Conley, 2000). The quantity-quality model has primarily been tested in the context of educational and labor market outcomes. Most studies in developed countries have found that larger family size has a negative association with educational and labor market outcomes (Steelman et al., 2002; Black et al., 2010; Cáceres-Delpiano, 2006), although some have found no significant relationship (de Haan, 2010; Aslund and Gronqvist, 2010; Black et al., 2005). The evidence in developing countries is more mixed, likely due to cultural, institutional, and economic/developmental differences (Buchmann and Hannum, 2001). In contrast, the literature on family size and health is much more limited. There is some support for the Quantity-Quality model for adult height (Glick et al., 2007; Lawson and Mace, 2008; Hatton and Martin, 2010), however, less is known about whether the predictions from this model would extend to child health outcomes, specifically obesity. On the one hand, the quantity-quality tradeoff model would predict that as family size increases and per capita resources decline, families might substitute away from healthy foods like fruits and vegetables, which are more costly, towards cheaper, high-calorie foods (e.g. fast food). On the other hand, there could be economies of scale in home

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meal preparation in larger families. Given that foods prepared at home have been shown to have lower fat density and higher nutrient density relative to foods prepared away from home (Lin et al., 1999), larger families might improve nutrition and lower obesity. Larger families might also lower the likelihood of mothers working (Angrist and Evans, 1998), which has been shown to have a protective effect on children's BMI (Datar et al., 2014; Morrissey et al., 2011). In addition, hypothesized links between family size and child health have also emerged from the medical literature. According to the "Hygiene Hypothesis", growing up with more children may increase exposure to infections in childhood that strengthen the body's immunological systems, thereby improving health outcomes. This hypothesis has found support in some studies that show that larger families reduce the risk of atopic eczema, asthma, wheezing, hay fever and allergic sensitization (Karmaus and Botezan, 2002) and some cancers (Bevier et al., 2011) and increase adult height (Lundborg et al., 2013). However, whether this mechanism also influences body weight and obesity is unknown.

Only a few studies, all in developed countries, have specifically examined how family size is related to children's body weight or obesity (Wang et al., 2007; Ochiai et al., 2012; Haugaard et al., 2013; Chen and Escarce, 2010, 2014). These studies focused on children ages 9–13 years and found that children with no siblings were more likely to be obese than children with siblings. However, there are limitations in these studies. First, none of the studies have addressed the potential endogeneity of family size. Families with more children might differ from families with fewer children in observed (e.g. socioeconomic status, location) or unobserved (e.g. tastes and preferences) ways that can also directly influence child's BMI and obesity. Failure to adequately control for these confounders can lead to biased estimates of the link between family size and child obesity. Second, none have elucidated the mechanisms linking family size and childhood obesity, which is important for designing effective policies. Finally, several of them are based on non-U.S. data (e.g. Japan, Denmark), making them less generalizeable to the U.S. context (Wang et al., 2007; Ochiai et al., 2012; Haugaard et al., 2013). As described below, our study addresses these limitations.

The present study adds to the limited literature in several important ways. First, it uses data from a nationally representative sample of children in the U.S. to examine the link between family size, i.e. number of siblings, and child BMI and obesity. Second, it addresses the potential endogeneity of family size by using several complementary approaches, including the sequential introduction of a rich set of controls, and estimating school fixed-effects and child fixed-effects models. And third, it conducts a detailed examination of the mechanisms that link family size with child BMI and obesity, including dietary behaviors, physical activity, sedentary behavior, maternal work, family meal times, eating out, and adult supervision.

Findings from the study suggest that having more siblings is associated with a significantly lower likelihood of childhood obesity. These findings are robust to several subgroup analyses. Results also indicate that children with siblings have healthier diets and watch less television. Furthermore, family mealtimes, eating out less frequently, reduced maternal work, and increased adult supervision of children may be potential mechanisms through which more siblings can have a protective effect on childhood obesity.

2. Data

The study uses data from the ECLS-K, a longitudinal survey of a nationally representative cohort of U.S. kindergarteners starting in the 1998–1999 school year (Tourangeau et al., 2006). The ECLS-K, conducted by the National Center for Education Statistics, used a multistage probability sample design where the primary sampling units (PSUs) were geographic areas of counties or groups of counties across the U.S. Schools were sampled within PSUs and children were sampled within schools. Data were collected in fall of kindergarten and spring of 1st, 3rd, 5th and 8th grades on children's cognitive, health and developmental outcomes, and contextual data on their families, teachers and schools. While BMI and physical activity were collected in most waves, data on dietary behaviors were first collected in the spring of 5th (2004) grade. Therefore, the analyses are based primarily on the 5th grade data, although some models examine changes between kindergarten and 5th grade.

The analysis sample includes 10,080 children in 5th grade. The 5th grade sample represents about 50% of the initial kindergarten sample. The primary source of attrition is from children who changed schools from one wave to the next and were not selected for follow up. The attrition bias is minimized because the ECLS-K followed a random sub-sample of half the movers in each wave prior to 5th grade and all the movers between grades 5 and 8. Children with missing follow-up data were more likely to be Black and of lower socioeconomic status relative to those with complete data, but there were no statistically significant differences in mean BMI, obesity prevalence, percent male, and age at kindergarten.

Sample sizes reported in the tables are rounded to the nearest 10 per ECLS-K's restricted data use agreement. Descriptive statistics for all variables are reported in Table 1.

Table 1
Sample characteristics by number of siblings.

	Number of siblings				Chi^2 test
	0	1	2	>=3	
BMI percentile	68.6	64.8	65.6	64.8	**
Obese	0.25	0.20	0.19	0.19	**
Male	0.48	0.50	0.52	0.48	
Child's Race					**
White	0.60	0.66	0.59	0.48	
Black	0.14	0.08	0.10	0.12	
Hispanic	0.15	0.15	0.21	0.24	
Asian	0.05	0.06	0.05	0.07	
Other	0.06	0.04	0.05	0.08	
Birthweight<2500 g	0.10	0.06	0.05	0.07	**
>=2500 & <3500	0.57	0.53	0.52	0.53	
>=3500 & <4000	0.24	0.30	0.29	0.27	
>=4000 g	0.09	0.12	0.14	0.14	
Birth order					**
First born	0.95	0.52	0.39	0.26	
Second born	0.04	0.46	0.33	0.26	
Third born or higher	0.01	0.02	0.29	0.48	
Child's age (months)	134.6	134.5	134.9	134.6	
Mother's age (years)	41.0	40.1	39.1	38.9	
Single parent	0.32	0.17	0.16	0.17	**
Number of adults	1.94	2.04	2.22	2.43	**
Household SES Quintile					**
First	0.17	0.10	0.16	0.26	
Second	0.20	0.17	0.18	0.19	
Third	0.22	0.20	0.18	0.17	
Fourth	0.25	0.24	0.22	0.17	
Fifth	0.19	0.28	0.26	0.21	
Urbanicity					*
Lives in city	0.35	0.33	0.36	0.37	
Lives in town	0.41	0.44	0.41	0.39	
Lives in rural area	0.24	0.23	0.23	0.24	
Percent of Sample	13.09	42.37	28.81	15.74	

Notes: N = 9300. Figures represent column proportions or means unless otherwise indicated. * significant at 5%; ** significant at 1%.