Socioeconomic status and childhood autism: A population-based study in China

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A B S T R A C T

There is limited evidence on the association between socioeconomic status (SES) and autism in developing nations. The aim of this study was to examine this association among children aged 0–17 years in China. We obtained data from the Second National Sample Survey on Disability, and selected 616,940 children for analysis. Autism was ascertained according to the International Statistical Classification of Diseases, Tenth Revision. Multiple logistic regressions allowing for weights showed that children in middle-income and high-income families were less likely than their low-income peers to have autism, with an odds ratio of 0.60 (95%CI: 0.39, 0.93) and 0.44 (95%CI: 0.27, 0.72), respectively. Children in middle-education families had 63% (95%CI: 41%, 95%) odds of autism relative to their counterparts in low-education families. Stratified analyses found that all observed associations were only in male children, not in female children. In conclusion, children in families with socioeconomic disadvantage, in the form of lower family income and education, had greater risk of childhood autism.

1. Introduction

Childhood autism, a subtype of autism spectrum disorders (ASDs) according to the International Classification of Disease, tenth revision (ICD-10) (World Health Organization, 2004) is characterized by communication and language impairments, along with repetitive stereotyped behavior and narrow interests (Duan et al., 2014; Matson et al., 2011). During past decades, the prevalence of autism rocketed from roughly 2–150 per 10,000 children in developed economies (Baron-Cohen et al., 2009; Christensen et al., 2016; Sun et al., 2014). Due to its low prevalence, conducting a nationally epidemiological investigation is time-consuming and cost-intensive and thus limited studies regarding autism were implemented in Asian nations (Khaiman et al., 2015). For example, population-based research found the prevalence of ASDs in South Korea was 2.64% and varied between institutionalized and non-institutionalized population (Kim et al., 2011). For the Chinese population, most studies on autism were conducted in Taiwan and Hong Kong, and very few studies published in English reported the prevalence of autism ranged from about 2–11 per 10,000 children in China mainland (Feng et al., 2013).

A growing number of studies have focused on the association of socioeconomic status (SES) with health outcomes (Delobel-Ayoub et al., 2015). Socioeconomic disparities in health status are often considered as avoidable and unfair, and therefore must be interrogated and addressed (Marmot, 2005). To date, however, studies on the association between SES and autism have not reached a unanimous conclusion (Rai et al., 2012). On the one hand, a large body of researches found lower SES, in the form of household income and parental education, was associated with decreased risk of childhood autism in the United States (Bhasin and Schendel, 2007; Boyle et al., 2011; Durkin et al., 2010). On the other hand, studies in European and other countries revealed negative or no relationship between SES and childhood autism. For example, an increased risk of autism was associated with lower SES in Sweden, France, and Japan (Delobel-Ayoub et al., 2015; Fujiwara, 2014; Rai et al., 2012), and no such association was found in Denmark (Larsson et al., 2005).

In China, there is very limited evidence about the relationship between SES and childhood autism. A case-control study, using hospital-based data in Zhengzhou, a central city in China, found that lower SES, measured by parental education, was related to higher risk of childhood autism (Zhang et al., 2010). In contrast with Chinese studies including single indicator of SES, studies in developed countries involved multiple socioeconomic variables to examine their independent effects on risk of autism (Bhasin and Schendel, 2007; Khaiman et al., 2015; Larsson et al., 2005; Sun et al., 2014). Therefore, in this study, we aimed to analyze the association of multiple socioeconomic circumstances with

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childhood autism based on a nationally population-based survey in China. Specifically, we sought to examine whether SES was associated with autism in the child, and whether there was sex difference in such association. An examination of this study would fill the gaps on this issue in China and will contribute to the world literature from the perspective of eastern social context.

2. Methods

2.1. Participants

We obtained data from the Second National Sample Survey on Disability, which was conducted from April 1 to May 31, 2006 (Zheng et al., 2011). The survey aimed to estimate the distribution of individuals with different types and levels of disabilities; to examine family SES in disability; to identify the causes, timing, and medical treatment of disability; and to document the activities of disabled persons and their participation in social protection programs. The results of these surveys were considered as scientific evidence for policy making and implementation about disabilities for national and local governments in China (Li et al., 2013).

Multistage, stratified random-cluster sampling, with probability proportional to size, was used in 734 counties (districts), 2980 towns (streets), and 5964 communities (villages) from 31 provinces, autonomous regions, and municipalities in China. Tens of thousands of trained enumerators interviewed and screened all sampled household members for signs of various disabilities. Individuals with potential disabilities were later examined by one of more than 6000 trained medical professionals. This survey, meanwhile, excluded the institutionalized population (Liu et al., 2015). The survey was nationally representative and the sample size was 2526,145, representing 1.9 per 1000 non-institutionalized inhabitants of China (He et al., 2017). The response rate of the survey was 83.5%. In this study, we restricted our analysis to 616,940 children aged 0–17 years.

2.2. Ethical approval

The survey was conducted in 31 provinces by the Leading Group of the National Sample Survey on Disability and the National Bureau of Statistics. The survey was approved by the China State Council (No. 20051104) and implemented within the legal framework governed by the Statistical Law of the People's Republic of China (1996 Amendment). All respondents provided consent to the Chinese government, which covered their participation in the survey and the clinical assessment process.

2.3. Childhood autism

Individuals with childhood autism were identified by the combination of parents' self-reports and on-site medical diagnosis by psychiatrists in the survey. The survey first ascertained participants who were mentally disabled and then identified autism among the mentally disabled. The definitions of disabilities, including hearing, visual, speech, motor, intellectual and mental disabilities, were based on the WHO International Classification of Functioning, Disability, and Health (WHO-ICF) (World Health Organization, 2001).

First, we recruited interviewers from local primary care institutions and trained them in the methods of survey and screening. Children aged 0–6 years were screened for mental disability by specialists at local primary health facilities. Children aged 7–17 years were screened by trained interviewers at their homes using a screening questionnaire, which was developed for the survey according to the 'Guideline and Principle for the Development of Disability Statistics', and had been shown good validity in prior studies (Liu et al., 2013). Afterwards, all suspected children of being mentally disabled aged 0–17 years were referred to psychiatrists at hospitals to make the final diagnosis of

mental disability. Finally, children with mental disability were screened with autism using the Autism Behavior Checklist by psychiatrists (Sun et al., 2013), and were ascertained with childhood autism (diagnostic code: F84) according to the ICD-10 (Li et al., 2011).

2.4. Socioeconomic status

Following previous studies (Laaksonen et al., 2007; Lahelma et al., 2006; Larson and Halfon, 2010; Lewis et al., 1998), we selected family income, adults' education and housing tenure to measure SES in this study. Of these, annual household income per capita was divided into three tertiles, and tertile 1–3 was defined as low-, middle- and high-income family, respectively. The highest education of family adults was also classified into three groups: illiterate and primary school (low-education family), junior high school (middle-education family), as well as senior high school and above (high-education family). Housing tenure was treated as a binary variable, i.e., housing owners versus renters and others.

2.5. Analytical approach

Considering the complex sample design, standard weighting procedures were used to construct sample weights. Population weighted cases and prevalence of autism and their 95% confidence intervals (CIs) by socioeconomic indicators were presented in the current study. Logistic regression models allowing for weights were performed to estimate the association between socioeconomic indicators and autism. To begin with, bivariate analyses were utilized to calculate unadjusted odds ratios (ORs) with 95% CIs for each socioeconomic indicator and autism. In the next three models, every socioeconomic variable was step by step placed into multivariate regressions to obtain adjusted ORs with 95% CIs. To be specific, we first fitted a multivariate model adjusting for household income per capita, child age (0–6 years and 7–17 years) and ethnicity (Han and others). After that, we continued to place highest education of family adults and housing tenure into models. In the final model, all three socioeconomic indicators were simultaneously adjusted for. All analyses were conducted separately for female and male children after pooled analyses to find if there was sex difference in this relationship. P value less than 0.05 was set as statistically significant. The software Stata version 12 for Windows (Stata Corp, College Station, TX, USA) was utilized for the statistical analysis.

3. Results

3.1. Prevalence of childhood autism by socioeconomic indicators

Table 1 shows the distributions of weighted cases and prevalence of childhood autism by socioeconomic indicators. Among all children, the prevalence of childhood autism decreased with increased household income. The highest prevalence of childhood autism was in low-education families. Housing tenure tended to present a similar pattern, with slightly lower prevalence in families with housing ownership.

Among male children, the patterning of childhood autism was similar to that among all children by multiple socioeconomic measures. By contrast, female children reported different variation in parallel analyses. For instance, among female children, the prevalence gap in families with different level of income and education was minimal. Girls in housing-occupier families yet showed larger proportion of autism than those renters and others.

3.2. Association between socioeconomic status and autism in all children

Table 2 illustrates the results of the logistic regression analyses between autism and SES among all children. Unadjusted odds ratios (ORs) in bivariate analyses (Model 0) virtually confirmed the prevalence percentages of autism by four socioeconomic indicators in