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Role of parental occupation in autism spectrum disorder diagnosis and severity

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ABSTRACT

Some have suggested that parents of children with autism spectrum disorder (ASD) may present with less recognizable autistic-like phenotypic characteristics, leading them to highly systemizing occupations. Using secondary analysis of data from two previous studies of children with ASD, we tested associations between parental occupations and ASD diagnosis and the association of parental occupational characteristics on ASD severity. We found that fathers in healthcare ($P < 0.01$) and finance ($P = 0.03$) were more likely to have children with ASD. Additionally, joint effects of parental technical occupations were associated with communication ($P < 0.01$) and social impairment ($P = 0.04$). These results support that a "broader phenotype" and possible assortative mating in adults with autistic-like characteristics might contribute to intergenerational transmission and having offspring with greater ASD severity.

1. Introduction

1.1. Autism spectrum disorder

Autism spectrum disorder (ASD) is characterized by deficits in social interaction and communication, as well as restricted interests and repetitive behaviors which first manifest in early childhood (American Psychiatric Association (APA), 2013; Holzer et al., 2006; Volkmar et al., 2014). This complex neurodevelopmental disorder affects between 1 and 3% of children globally (Autism and Developmental Disabilities Monitoring Network (ADDM) Surveillance Year 2010 Principal Investigators, 2014; Baron-Cohen et al., 2009; Kim et al., 2011). According to recent estimates, approximately 1 in 68 children in the United States has an ASD diagnosis (ADDM Surveillance Year 2010 Principal Investigators, 2014), with

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presence in all racial and ethnic groups and higher prevalence observed in boys (ADDM Surveillance Year 2010 Principal Investigators, 2014). Additionally, according to a recent study of parent reports, prevalence of ASD in the US could be as high as 1 in 50 (Blumberg et al., 2013).

1.2. ASD etiology

Despite this growing literature on prevalence and incidence of ASD, less is known about the etiology of this disorder. Genetic studies have suggested that ASD might be at least partially due to genes expressed when exposed to environmental factors (Blake, Hoyme, & Crotwell, 2013; Herbert et al., 2006; LaSalle, 2013). Recent studies of environment factors have focused on heavy metals (Rahbar et al., 2012, 2013), pesticides (Roberts et al., 2007), and particulate matter (Volk, Hertz-Picciotto, Delwiche, Lurmann, & McConnell, 2011). Previous studies have also shown an increased risk as high as 19% in siblings of children with ASD (Ozonoff et al., 2011; Rutter, 2005). It also has been hypothesized that exposure to environmental factors may trigger or enhance genetic risks (Volk et al., 2014).

1.3. Broader ASD phenotype

Though specific genotypic aspects of ASD have yet to be identified, some investigators have suggested that parents of children with ASD may present with less recognizable autistic-like phenotypic characteristics, sometimes referred to as a "broader phenotype" (Bishop et al., 2004; Bolte, Knecht, & Poustka, 2007; Briskman, Happe, & Frith, 2001; Constantino & Todd, 2005; Dawson et al., 2007; Hoekstra, Bartels, Verweij, & Boomsma, 2007; Piven, Palmer, Jacobi, Childress, & Arndt, 1997; Sasson, Lam, Parlier, Daniels, & Piven, 2013; Scheeren & Stauder, 2008; Wheelwright, Auyeung, Allison, & Baron-Cohen, 2010). These traits may include obsessive-compulsive symptoms (Kano, Ohta, Nagai, Pauls, & Leckman, 2004), decreased ideational and word fluency (Wong, Maybery, Bishop, Maley, & Hallmayer, 2006), impairments in phonological processing (Schmidt et al., 2008), facial emotion processing deficits (Adolphs, Spezio, Parlier, & Piven, 2008), social impairment (Constantino & Todd, 2005; Sasson et al., 2013), and lack of empathy (Szatmari et al., 2008). Bishop et al. (2004) reported that parents of children with ASD scored higher on the social subscale ($P = 0.004$) and communication subscale ($P = 0.015$) of the Autism Spectrum Quotient (AQ), a screening instrument for severity of autistic symptoms with greater scores indicative of more autism-like symptomology (Bishop et al., 2004). Furthermore, Wheelwright et al. (2010) reported that both mothers and fathers of children with ASD scored higher than parents of typically developing (TD) controls ($P < 0.05$) on all five subscales of the AQ, including social skills, attention switching, attention to detail, communication, and imagination (Wheelwright et al., 2010). The Broad Autism Phenotype Questionnaire is an instrument designed to measure personality and language traits indicative of ASD in non-autistic relatives of people with ASD (Hurley, Losh, Parlier, Reznick, & Piven, 2007). The Broad Autism Phenotype Questionnaire has statements such as "I like to be around other people" and "I am comfortable with unexpected changes in plans" with responses on a Likert scale of 1 – very rarely, 2 – rarely, 3 – occasionally, 4 – somewhat often, 5 – often, and 6 – very often (Hurley et al., 2007). Recently, Sasson et al. (2013) reported that pairs of parents who were "broader phenotype" positive, according to the Broad Autism Phenotype Questionnaire, were more likely to have children with ASD (Sasson et al., 2013). Conversely, in another study, no significant difference was observed between mean AQ scores of parents of children with ASD versus those of TD children (Scheeren & Stauder, 2008).

Some researchers have suggested that many professionals in highly systemized occupations, especially those involving mathematical proficiency (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Fitzgerald, 2002; James, 2003) and musical talent (Pring, Ryder, Crane, & Hermelin, 2012), function with undiagnosed Asperger's Disorder while exceling in their chosen fields. Baron-Cohen et al. (2001) even demonstrated that a group of undergraduate students with majors in science and mathematics, including physical sciences, biological sciences, mathematics, computer science, and engineering, scored significantly higher on all areas of the AQ in comparison to classmates with majors in humanities and social sciences (Baron-Cohen et al., 2001). Given the "broader phenotype" symptoms of ASD seen in some parents of children with ASD, some have proposed that these parents may have highly technical and structured occupations in fields such as science, engineering, and accounting (Baron-Cohen, Wheelwright, Scott, Bolton, & Goodyear, 1997; Baron-Cohen, 2006; Buchen, 2011; Jarrold & Routh, 1998; Wheelwright & Baron-Cohen, 2001). For example, Baron-Cohen et al. (1997) reported that a community sample of fathers of children with ASD were more likely to be engineers. Further, Jarrold and Routh (1998) analyzed the same data and reported that occupations in accounting, science, and medicine were also more frequent in fathers of children with ASD. Notably, Windham, Fessel, and Grether (2009) most recently demonstrated in a population based study in San Francisco, CA that risk of having a child with ASD was almost two times greater for mothers in highly technical occupations (AOR = 1.7; 95% CI: 1.1–2.8).

1.4. Environmental exposures

Considering growing recognition of the effects of environmental exposures on brain development and function (Landrigan, 2010), and the increase in susceptibility during in utero development (Miodovnik, 2011; Miodovnik et al., 2011), some have suggested that environmental factors may contribute to de novo mutations, increasing risk of ASD (Kinney, Barch, Chayka, Napoleon, & Munir, 2010). These environmental factors could be mediated through pesticides (Roberts, Karr, & Council on Environmental Health, 2012), lead (Kim et al., 2013; Parajuli, Fujiwara, Umezaki, & Watanabe, 2013; Rahbar,