Correlations between Allergic rhinitis and Attention-Deficit/ Hyperactivity Disorder

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Abstract

The allergic rhinitis (AR) is common in children. Symptoms of AR may result in daytime inattention, irritability, and hyperactivity, which are similar to symptoms of ADHD. The goal of this study was to examine the associations between AR and ADHD. The study subjects included 469 patients who received psychiatric care for ADHD in 2005 and the general population (n = 220,599). Distributions of age, gender, and living areas as well as AR in the general population and in the ADHD group were examined by x^2-tests. Multivariate logistic regression models were used to analyze the risk factors associated with AR. The prevalence of AR in ADHD group and the general population was 28.4% and 15.2%, respectively, which was significantly higher in ADHD group than the general population ($p<0.001$). The multivariate logistic regression analysis showed that ADHD was associated with a significantly higher rate of AR than the general population ([OR]=2.10; 95%CI=1.37-3.22; *p<0.0001)*. In a conclusion our data showed that ADHD was significantly associated with the diagnosis of AR. Therefore, psychiatrists should be more aware of the comorbidity of AR when treating ADHD patients.

Keywords : ADHD, Allergic rhinitis, AR, Attention-deficit/hyperactivity disorder

Introduction

Attention-deficit/hyperactivity disorder (ADHD), of which symptoms include inattention, hyperactivity, and impulsivity, is one of the most common childhood-onset neurobehavioral disorders, with an estimated prevalence between 3% and 11% among school-age children (Wasserman, 1999). Health issues associated with ADHD are not limited to the psychiatric field, as ADHD has also been proposed to be correlated with several physical illnesses, such as allergic rhinitis (AR) (Belfer, 2008).

In the recent surveys conducted in Taiwan, the prevalence of AR ranges from 12.5% to as high as 43.6% (Chou et al., 2013; Katelaris et al., 2012; Liao, Huang, Chiang, Wang, & Chen, 2005; Yan, Ou, Tsai, Wu, & Huang, 2005). Characteristic symptoms include sneezing, pruritus, nasal congestion, and rhinorrhea (Skoner, 2001). Sleep disturbances, poor school performance and hyperactivity have also been reported to occur in many patients (Blaiss, 2008). Previous reports revealed conflicting data regarding the associations between ADHD and AR (Schmitt, Buske-Kirschbaum, & Roessner, 2010) (Romanos, Gerlach, Warnke, & Schmitt, 2010) (Brawley et al., 2004; Suwan, Akaramethathip, & Noipayak, 2011). Common methodological concerns in these studies included small sample sizes and inappropriate methods used to define

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Objectives

The aims of this study were to examine the associations between AR and ADHD in children and adolescents.

Methods

Data source

The present study utilized data from the National Health Insurance Research Database (NHIRD) in Taiwan. The Taiwan NHIRD is a claims database maintained by the Department of Health and the National Health Research Institutes of Taiwan. The National Health Insurance (NHI) program was launched in Taiwan on 1 March, 1995. By the end of 2010, more than 23.07 million people out of a total population of 23.16 million were enrolled in the program. Starting in 1999, the Bureau of NHI (NHIB) began to release all claims data in electronic format to be made publicly

available under the NHIRD project. The database provides scrambled patient identification numbers, dates of birth, gender, and diagnoses in the format of the International Classification of Diseases, Revision 9, Clinical Modification (ICD-9-CM), medication prescribed, medical costs, medical care facilities and their specialties (Hwang et al., 2010). In the present study, a total of 1,000,000 persons (approximately 4% of Taiwan's population), were randomly selected from the Taiwan NHIRD in 2005 for analysis.

Diagnostic criteria

Patients with ICD-9-CM code 477.0, 477.1, 477.2, 477.8, or 477.9, were defined as having AR.

Study Subjects

ADHD was determined by the presence of ICD-9-CM code 314. To ensure the validity of the ADHD diagnoses, we required that all study subjects had at least two consensus ADHD diagnoses after the index ambulatory care visit or at least one hospital admission. In the study, we excluded patients who had any inpatient or outpatient diagnosis of other mental illness. This was done to minimize possible confounding effects from other psychiatric conditions (Slattery & Essex, 2011). Because most ADHD diagnoses were made when patients were of school age, we further categorized the patients into three different age groups, including preschool, elementary school, and high school (< 6 years, 6-11 years and 12-17 years) so that the age-related confounding factor could be controlled in the statistical analysis. A total of

Table 1: Prevalence of allergic rhinitis in ADHD and general population in 2005

variable	General population (N=220599)		with ADHD (N=469)		*Odds ratio*	*95% CI*	*p-value for x^2 test*
	N	(%)	N	(%)			
Age, year							
<6y	12126	(16.6)	23	(29.5)	2.1	1.29~3.41	0.005
6-11y	13443	(16.9)	94	(29.0)	2.0	1.57~2.50	<0.001***
12-17y	7894	(11.6)	16	(23.9)	2.4	1.37~4.21	0.004
Gender							
Female	13926	(13.1)	16	(18.4)	1.5	0.87~2.57	0.152
Male	19537	(17.1)	117	(30.6)	2.1	1.73~2.67	<0.001***
Area of Taiwan							
East	532	(10.1)	2	(33.3)	4.5	0.82~24.47	0.116
North	17631	(16.3)	77	(25.9)	1.8	1.56~4.83	<0.001***
Central	6552	(15.0)	18	(32.7)	2.7	1.56~4.83	<0.001***
South	8748	(28.7)	36	(23.7)	3.0	2.00~4.45	<0.001***
Residence							
Rural	8505	(13.9)	19	(22.9)	1.8	1.10~3.06	0.025
Urban	20363	(15.9)	104	(30.6)	2.3	1.84~2.93	<0.001***
Suburban	4595	(14.5)	10	(21.7)	1.6	0.81~3.29	0.205

Table 2: Factors associated with allergic rhinitis by multi-variable logistic regression.

variable	Odds ration	95% CI		*p-value*
		Lower	Upper	
Age				
<6y	1.00			
6-11y	1.19	1.13	1.25	<0.001
12-17y	0.65	0.61	0.70	<0.001
Gender				
Female	1.00			
Male	0.86	0.84	0.89	<0.001
Area				
East	1.00			
North	1.22	1.10	1.36	<0.001
Central	1.16	1.04	1.30	0.008
South	1.31	1.18	1.46	<.0001
Residence				
Rural	1.00			
Urban	0.96	0.93	1.00	0.036
Suburban	1.04	0.99	1.09	0.140
ADHD				
No	1.00			
Yes	2.10	1.37	3.22	<0.001

Discussion

In the present study, we found a significant association between ADHD and AR using population-based NHIRD. Although several studies have investigated the relationships between AR and ADHD, the findings have been inconclusive (Brawley et al., 2004; Romanos et al., 2010; Schmitt et al., 2010; Schmitt, Romanos, Schmitt, Meurer, & Kirch, 2009; Suwan et al., 2011). For example , Brawley et al. found 24 of 30 ADHD children (80%) had symptoms of AR (Brawley et al., 2004) in an outpatient pediatric psychiatric clinic. In addition, Suwan and her colleagues reported an increased rate of AR in ADHD patients in one hospital-based study with eighty study subjects (Suwan et al., 2011). Our finding is important because AR-related symptoms such as nasal congestion and obstruction often causes sleep disturbances in affected children, and hence result in poor attention, daytime fatigue, irritable mood, and impulsivity (Beebe, 2011; Blaiss, 2008; Brawley et al., 2004; Dahl, 1996; Paavonen, Porkka-Heiskanen, & Lahikainen, 2009; Paavonen, Raikkonen, et al., 2009; Sadeh, Gruber, & Raviv, 2002; Steenari et al., 2003), which may worsen symptoms of ADHD. Therefore, evaluation and treatment of AR may be crucial in children diagnosed with ADHD (Brawley et al., 2004).

The possible explanations for the associations between AR and ADHD had been revealed in several recent investigations in molecular biology. The first possible mechanism is that the children with atopic disease are exposed to higher levels of inflammatory

cytokines (Schmitt et al., 2010), which may pass through the blood brain barrier (Yarlagadda, Alfson, & Clayton, 2009) and cause activations of immune mechanisms involving brain circuits related to behavior and emotion in ADHD (Raison, Capuron, & Miller, 2006). Another explanation is that executive functions mediated by the prefrontal cortex are activated during atopic episodes as revealed by functional magnetic resonance imaging (Rosenkranz et al., 2005). A sustained release of inflammatory mediators may influence brain circuits relevant to ADHD (Schmitt et al., 2010). Further investigation for the underlying pathophysiology is clearly warranted.

There were several limitations in the present study. First, a cross-sectional design was used which meant that it was not possible to establish a causal relationship based on the observed association between ADHD and AR. Second, data on some important risk factors for atopic diseases, such as exposure to cigarette smoking at home, early life exposure to animals and family histories of allergy were not available (Matheson et al., 2011). Therefore, we were unable to evaluate the influence of these factors. Finally, ADHD diagnoses, which rely on administrative claims data reported by hospitals, may be less accurate than diagnoses made according to standardized instruments (e.g., Structural Clinical Interview forDSM-IV Axis I Disorders). However, the NHIB randomly samples a fixed percentage of claims from every hospital each year to ensure diagnostic validity through reviewing the symptomatologies documented in the medical records by an independent group of professional experts, and false claims would be fined. Moreover, to ensure the validity of the diagnoses, we confirmed that all of the study subjects had at least two consensus diagnoses after the index ambulatory care visit.

In conclusion, we found that ADHD patients have an increased rate of AR in Taiwan. Therefore psychiatrists should pay attention to AR symptoms when treating ADHD children.

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