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Meta-analysis of the comorbidity rate of allergic rhinitis and asthma in Chinese children

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ABSTRACT

Objectives: Allergic rhinitis (AR) and asthma often occur concomitantly and are the two most common inflammatory conditions of the airways in children. Large-scale studies investigating the comorbidity of asthma and AR in children are rare. So, we performed a meta-analysis to describe the comorbidity rate of asthma and AR in Chinese children.

Methods: We retrieved related studies from Pubmed, Science, Springer, Elsevier, Embase, BMJ, and four Chinese biomedical databases, including Wanfang Data, VIP, CBM, and CNKI. From these individual studies, the comorbidity rate of asthma and AR in Chinese children was extracted and pooled to generate summary effect estimates in R version 3.2.3.

Results: The meta-analysis included 25 cross-sectional studies. The results indicated that in China, the incidence of asthma in children with AR is 35.01% (95% CI: 32.32%–37.70%) and the incidence of AR in children with asthma is 54.93% (95% CI: 53.05%–56.80%).

Conclusions: The comorbidity of AR and asthma is high in Chinese children. Statistically, the prevalence of AR was higher in children with asthma, as opposed to the prevalence of asthma in children with AR. The comorbidity rate of AR and asthma signifies the importance of improving the recognition and treatment under both conditions by respiratory physicians and otolaryngologists.

1. Introduction

Childhood allergic respiratory diseases, allergic rhinitis (AR) and asthma, are rightly called the 21st century epidemic. Although the conditions affect different parts of the respiratory tract, they are similar in etiology pathogenesis and pathological changes [1]. Childhood AR and asthma are generally perceived as separate disorders in clinical treatment, and they are diagnosed by pediatric otolaryngologists and respiratory physicians, respectively. However, if a doctor only treats AR or asthma in children with comorbidity of both disorders, the treatments are less effective [2,3]. Therefore, to effectively control both diseases, the incidence of asthma in children with AR and the incidence of AR in children with asthma must be better understood. This in turn would improve pediatric respiratory physicians' and otolaryngologists' abilities to provide clinical treatment and medical advice for children with both conditions.

To date, there have been few large-scale, multi-center studies investigating the association between childhood AR and asthma. Thus, we sought to determine the prevalence of asthma in children with AR and AR in children with asthma. By collecting clinical epidemiology studies on childhood asthma and AR from the last 10 years, we performed a meta-analysis to provide a more scientific basis for the diagnosis and treatment of children with the comorbidity of asthma and AR.

2. Methods

A protocol for the review was devised in accordance with PRISMA guidelines [4]. Searches of *Pubmed*, *Science*, *Springer*, *Elsevier*, *Embase*, BMJ Journals electronic databases, and four Chinese biomedical databases, including Wanfang Data, VIP, CBM, and CNKI were performed from January 2006 to May 2016 for articles reporting the comorbidity prevalence of asthma and AR in children. The search terms used were "(allergic rhinitis) AND (asthma) and (epidemiology OR prevalence OR morbidity OR incidence OR attack rate) AND (children OR childhood OR adolescent OR pediatric)". The titles and abstracts of the articles were browsed, and papers with relevant information were identified and included in the meta-analysis. Reference lists of included articles and other relevant studies were scanned to find additional studies.

To meet the analysis requirement and reduce systematic and random error, the included literature fulfilled the following criteria: (1)

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Table 1
Overview of the studies included in systematic review.

Study	Study Design	Age Range(Y)	Criteria	AR(n)	AR with Asthma (n)
Wang Yuan et al.,2015	Cross-sectional study	7–15	ARIA	467	152
Su liang et al.,2015	Cross-sectional study	3–7	ARIA	802	312
Huang Yanping et al.,2012	Cross-sectional study	7–11	ARIA	151	38
Huang Sui et al.,2011	Cross-sectional study	0–14	ISAAC	319	111
Chen Yan et al.,2012	Cross-sectional study	13–14	ARIA	2104	738
Wu Jun et al.,2008	Cross-sectional study	7–11	ARIA	131	43
Jiang Manjie et al.,2006	Cross-sectional study	9–10	ARIA	48	19
Lu Diqing et al.,2006	Cross-sectional study	2–12	ARIR	472	186

Table 2
Overview of the studies included in systematic review.

Study	Study Design	Age Range(Y)	Criteria	Asthma(n)	Asthma with AR (n)
Lu Xu et al.,2015	Cross-sectional study	0–14	ARIA	47	28
Ning Lihua et al.,2014	Cross-sectional study	0–14	ISAAC	127	75
Yang Yungang et al.,2013	Cross-sectional study	0–14	ISAAC	368	219
Gu Jiali et al.,2013	Cross-sectional study	0–14	ARIA	169	97
Li Min et al.,2013	Cross-sectional study	0–14	ARIA	551	286
Liu Chuanhe et al.,2013	Cross-sectional study	0–14	ISAAC	497	261
Wei Qing et al.,2013	Cross-sectional study	0–14	ARIA	370	208
Ding Yanxia et al.,2012	Cross-sectional study	0–14	ARIA	338	162
Lu Gen et al.,2012	Cross-sectional study	0–14	ISAAC	215	121
Xiong Mei et al.,2012	Cross-sectional study	0–14	ARIA	495	272
Liu Jixian et al.,2012	Cross-sectional study	0–14	ARIA	540	332
Jin ke et al.,2012	Cross-sectional study	0–14	ISAAC	132	74
Lei Xingli et al.,2012	Cross-sectional study	2–7	ISAAC	791	430
Sun Libin et al.,2009	Cross-sectional study	0–14	ISAAC	348	172
Shen Chunlin et al.,2007	Cross-sectional study	6–14	ISAAC	422	219
Kong Yun et al.,2006	Cross-sectional study	0–14	ISAAC	324	172
Liu Changpeng et al.,2006	Cross-sectional study	0–14	ARIA	320	188

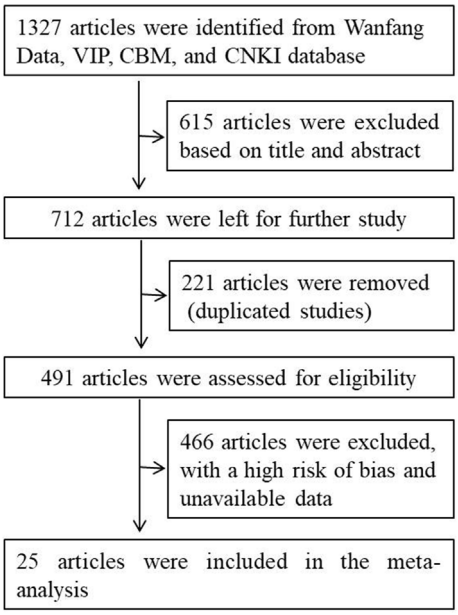

Fig. 1. The figure displayed the information retrieval process for valuable articles and exclusion process of irrelative articles for the study.

The research subjects were under the age of 16; (2) The studies met the clinical diagnostic criteria for children with AR and asthma [5]; (3) The research reported the comorbidity prevalence of asthma and AR in children, or, contained data that could be used to calculate the incidence; (4) The studies were cross-sectional surveys; (5) The research had an appropriate study design and statistical treatment. Studies were excluded if they (1) presented data collected prior to 2006; (2) presented data of inferior quality; (3) presented data on a study population that had already been included in the study.

Two authors independently screened all the articles by title and abstract to identify those that met the inclusion criteria. If studies were shortlisted, their full text was assessed for eligibility. Articles likely to contain data on the incidence of asthma in children with AR were then retrieved. Any disagreements regarding the suitability of individual studies were resolved through appraisal by a third author.

Two reviewers independently evaluated the literature quality and bias risks according to Combie criteria for cross-sectional studies which include the following seven domains [5]: (1) The study's design is scientific. (2) The data collection strategy is reasonable. (3) The research reports sample response rates. (4) The population's representation of samples is very good. (5) The research purpose and method are reasonable. (6) The study reports the statistical power of the data.

The data analysis was conducted using R version 3.2.3. The prevalence of asthma in children with AR at 95% confidence intervals (CIs) was counted, and heterogeneity across studies was also determined. If $P > 0.1$ and $I^2 < 50\%$, the fixed effects model was used for meta-analysis; otherwise, the random effects model was used. In our study, the random effects model was used for meta-analysis as a result of the heterogeneity test.

3. Results

After the removal of duplicates, our initial search generated 491 studies. Studies were excluded if they presented a high risk of bias. Articles were mainly excluded if they surveyed populations unrepresentative of the general population. In total, 25 cross-sectional studies were included in the meta-analysis (Table 1 and Table 2). The flow chart of the studies screening process is shown in Fig. 1.

Seventeen studies (6054 Chinese children with asthma) reported prevalence of AR in children with asthma [6–13]. After determining heterogeneity across all studies, the random effects model was used for