Shanghai Archives of Psychiatry 2013, Vol. 25, No. 2

•Meta-analysis•

Prevalence of autism spectrum disorders among children in China: a systematic review

Yumei WAN[1], Qiang HU[1], Ting LI[1], Lijuan JIANG[1], Yasong DU[1], Lei FENG[2], John Chee-Meng WONG[2,3], Chunbo LI[1]*

Background: There are no reliable estimates of the prevalences of autism and autism spectrum disorders (ASD) in China.

Objective: Combine results across studies to estimate the prevalences of autism and ASD among Chinese children under the age of 18, and assess variations in the prevalences with respect to gender, ethnicity, and urban versus rural residence.

Methods: Based on pre-defined inclusion and exclusion criteria, studies were identified by searching the following databases: Chinese National Knowledge Infrastructure, Chongqing VIP database for Chinese Technical Periodicals, WANFANG DATA, Chinese Biological Medical Literature Database, Pubmed, and Web of Science. Statistical analysis was conducted using R-2.15.2 software.

Results: The 24 studies meeting inclusion criteria included 5 registry studies from Taiwan and Hong Kong (covering a total of 14 570 369 children) and 19 community-based screening and diagnostic studies from mainland China (with a combined sample of 771 413 children). The annually reported prevalence of autism in the registry studies ranged from 1.8 to 424.6 per 10 000. A meta-analysis of 18 of the studies from mainland China (excluding a large nationwide study with the lowest prevalence of autism) with a range in rates from 2.8 to 30.4 per 10 000 generated an estimated pooled prevalence of autism of 12.8 per 10 000 (95%CI, 9.4 to 17.5). The pooled prevalence of ASD estimated from 5 of these studies (which had a range in rates from 7.3 to 75.3 per 10 000) was 24.5 per 10 000 (95%CI, 10.4 to 57.4). The reported prevalence of autism varied substantially by gender, location of residence, date of publication, and source of the sample.

Conclusion: The huge difference between the rates for autism reported from registry systems in Hong Kong and Taiwan (a 200-fold difference) and the large differences in rates reported from community-based screening studies in mainland China (a 10- to 15-fold difference) highlight the urgent need for establishing standardized methods for estimating the prevalences of autism and ASD. Until these methodological improvements have been made, it will not be possible to develop evidence-based prevention and treatment strategies for the management of these uncommon but seriously disabling conditions.

1. Introduction

Autism is a developmental disorder with an onset during early childhood that results in social deficits, communication deficits, stereotyped interests, and repetitive behaviors.[1] Recently the term 'autism spectrum disorders' (ASD) has been used to describe a group of disorders that include autism and similar types of disorders.[2] The conditions included under the ASD label vary slightly between the three diagnostic systems commonly used in China – *the 3rd edition of the Chinese Classification and Diagnostic Criteria of Mental Disorders*;[3] *the 10th edition of the International Classification of Diseases (ICD-10)*;[4] and *the 4th edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*.[5] In all three diagnostic systems, ASD includes autism, atypical autism, Rett syndrome, childhood disintegrative disorder, Asperger syndrome, and pervasive developmental disorder not otherwise specified (PDD-NOS). The ASD diagnosis in ICD-10 also includes 'overactive disorder associated with mental retardation and stereotyped movements'. Rett syndrome will be excluded from the ASD diagnosis in the forthcoming DSM-5.[6]

Prevalence studies conducted by the United States Centers for Disease Control and Prevention[7-9] and others

doi: 10.3969/j.issn.1002-0829.2013.02.003

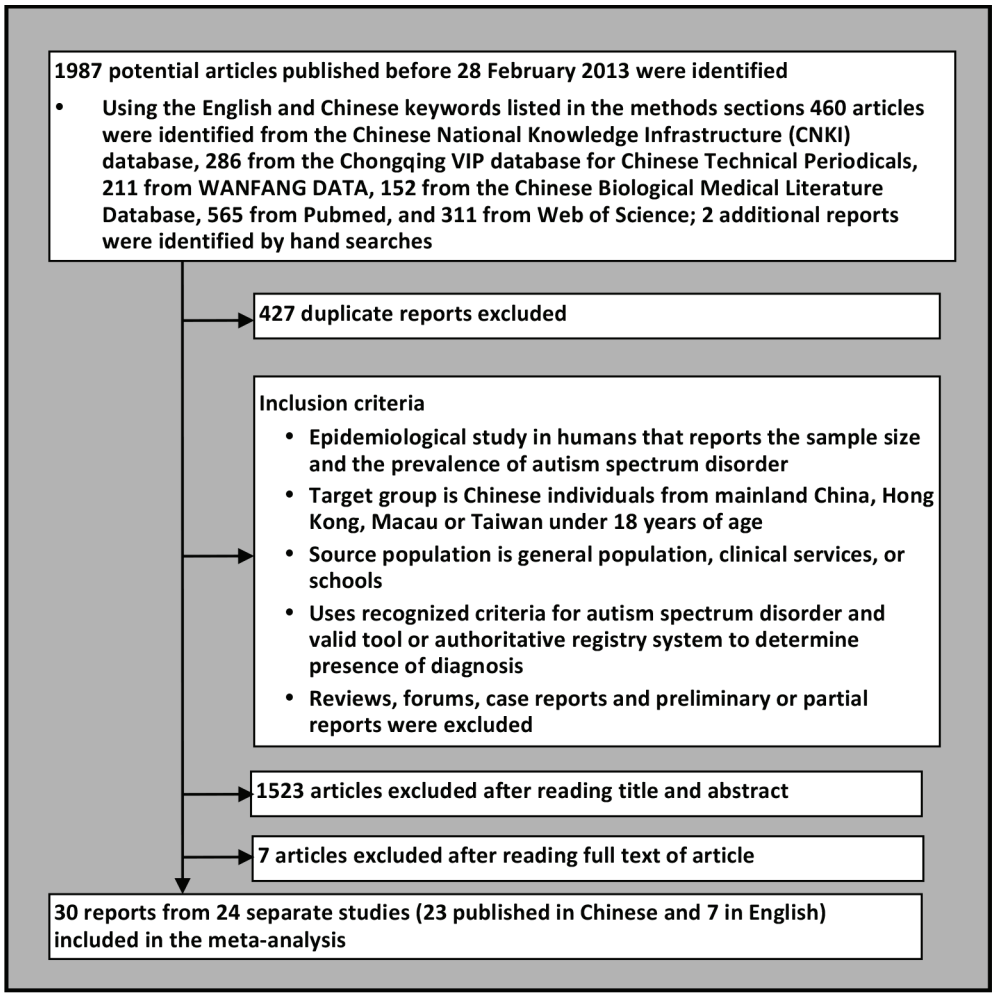
[1] Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China

[2] Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

[3] Department of Psychological Medicine, National University Hospital, Singapore

correspondence: chunbo_li@yahoo.com

Figure 1. Identification of studies included in the meta-analysis



centers[10-12] have documented a rapid increase in the prevalence of ASD. A meta-analysis conducted by Williams and colleagues in 2006[13] reported a pooled estimate of prevalence of 7.1 per 10 000 for autism, and 20.0 per 10 000 for ASD among individuals under the age of 18. Another meta-analysis conducted by Fombonne and colleagues in 2009[14] summarized data from 57 studies and yielded a pooled prevalence of 22 per 10 000 for autism and 60 to 70 per 10 000 for ASD. Elsabbagh and colleagues[15] reviewed studies conducted after the year 2000 and found a median prevalence of 17 per 10 000 for autism and 62 per 10 000 for ASD.

Information from China has not figured prominently in these prevalence estimates for autism and ASD: the 2006 analysis by Williams[13] included no data from China; the 2009 analysis by Fombonne[14] included one study from Hong Kong; and the 2012 report from Elsabbagh[15] combined data from China and Japan together as the 'Western Pacific region'. Most studies on the prevalence of ASD in mainland China have been provincial studies with relatively small sample sizes that report wide variations in prevalence.[16-18] The only national study, a study conducted by Li and colleagues in 2011,[19] reported a very low prevalance of autism (2.4 per 10 000). The current report is a systematic review and meta-analysis of prevalance studies on autism and ASD from mainland China, Hong Kong and Taiwan.

2. Methods

2.1 Identification of studies for inclusion in the meta-analysis

The process of identifying studies for inclusion in the meta-analysis is shown in Figure 1. Two authors (YW and QH) first conducted electronic searches in the following databases: the Chinese National Knowledge Infrastructure database (CNKI, 1979-2013), the Chongqing VIP database for Chinese Technical Periodicals (1989-2013), the WANFANG DATA database (1990-2013), the Chinese Biological Medical Literature Database (1978-2013), Pubmed (1966-2013), and Web of Science (1950-2013). All reports published by 28 February 2013 were included in the search. All articles in which any word denoting

autism (including 'autism spectrum disorders', 'pervasive developmental disorders', 'autism', 'autism disorder', 'zi bi zheng' [an older term for autism in Chinese], 'Asperger', 'Asperger syndrome') in either Chinese or English occurred with any word denoting prevalence (including 'prevalence', 'detectable rate', 'incidence rate', and 'epidemiology') in either Chinese or English were identified. Reference lists of identified studies were hand-searched.

Included studies were epidemiological studies about the prevalence of autism or ASD (as defined by CCMD[3],ICD[4] or DSM[5] diagnostic criteria) among Chinese individuals (including those from mainland China, Hong Kong, Macau, and Taiwan) under the age of 18 who were identified from the general population, from clinical populations, or from student populations. Non-human studies, unpublished reports, reviews, and case reports were excluded. The report of the study had to provide the sample size and estimates of the prevalence of autism or ASD based on the use of a valid diagnostic tool or data from an authoritative health monitoring system.

First, all studies were imported to the literature management software Endnote X5 to eliminate duplicated records. Two authors (WY and HQ) independently conducted a preliminary screening of reports by reading titles and abstracts and then the full texts of potentially relevant articles were downloaded for the second round of screening. The above inclusion criteria were used to select studies for the analysis. There were six articles in which the initial screening result about whether or not to include the article differed between the two raters; after discussion, a third reviewer (TL) made the final decision about inclusion of these articles.

2.2 Data extraction

Two authors (WY and HQ) independently extracted and entered relevant data about the included studies. For each study the basic characteristics of the study (i.e., name of first author; year of publication; location of study; source of sample, sampling method, sample size and number of potential subjects not screened; breakdown of sample by gender, ethnicity, and urban versus rural residence; method of screening and diagnosis) and the reported prevalences of autism and ASD were recorded. Reports of 'current prevalence' and 'point prevalence' were both included.[20] If prevalence by gender, age group, urban versus rural residence, or ethnicity (Han versus other) was provided, this was also recorded.

The quality of the reports of the included studies was assessed using the guidelines recommended for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).[21] This guideline lists 22 criteria, covering specific elements of the methods, presentation of the results, and interpretation of the results that are considered important for assessing the integrity of a study. One point was given for each of these elements that was present in the report, so the total score for quality ranged from 0 to 22 points. The inter-rater reliability of the two raters for this quality score was excellent (intraclass correlation coefficient [ICC], 0.96).

2.3 Statistical analysis

After checking for consistency, the Metaprop module in the R-2.15.2 statistical software package was used for the meta-analysis; the prevalence reported in each study was logit transformed prior to computing the pooled prevalence.[13] Tests of heterogeneity were conducted to decide which method would be used to pool the results. Results were considered homogenous when the I^2 statistic (the percentage of variance due to heterogeneity) was less than 50% and the p-value for the test of heterogeneity was $\geq$0.10, in these cases a fixed-effect model was used to compute the pooled estimate of prevalence. In all other cases (i.e., I^2 >50% or p<0.10) the studies were considered heterogeneous and a random-effect model was used to compute the pooled prevalence.[22] When heterogeneity was present, a sensitivity analysis was conducted to inspect possible reasons for heterogeneity. Subgroup analyses were conducted by gender, urban versus rural residence, source of the study population, and year of publication. Begg's rank method was used to assess potential publication biases.[23]

3. Results

3.1 Characteristics of identified studies

As shown in Figure 1, 30 studies were identified that met the inclusion criteria; 23 of these publications were in Chinese and 7 in English.[16,17, 19,24-50] Several sets of reports were from the same study: Wang (2002)[47] and Wang (2003)[26]; Huang (2010)[48] and Chen (2010)[35]; Li (2010a)[44] and Li (2010b)[49]; Wu [33] and Wang[50]; and Zhang (2005)[39], Zhang (2004)[28] and Guo (2004).[27] Thus, a total of 24 separate studies were identified[16,17,19, 24-26,29-46] including 19 population-based screening and diagnostic studies in mainland China[16,17,19, 24-26,29-39,44,45] (with a combined sample of 771 413 children) and 5 prevalence reports based on health registry data in Hong Kong and Taiwan[40-43,46] (covering a total of 14 570 369 children). Details of the included studies are shown in Table 1.

3.2 Reported prevalence of autism in the registry studies from Taiwan and Hong Kong

Wong and colleagues[40] reported an interval

prevalence of 16.1 per 10 000 in Hong Kong during the period of 1986 to 2005. In Taiwan Hsu and colleagues[43] reported a 12-month prevalence of 424.6 per 10 000 individuals under the age of 15 in 2007; Lin and colleagues[41] reported that the 12-month prevalence of autism in individuals under the age of 18 increased from 3.2 to 12.3 per 10 000 from 2000 to 2007; Chien and colleagues[42] reported that the 12-month prevalence of ASD increased at a rate of 1.8 per 10 000 annually from 1996 to 2005, reaching 28.7 per 10 000 in 2005; and Lai and colleagues[46] reported that from 2004 to 2010 the 12-month prevalence of ASD increased steadily from 8.6 to 20.0 per 10 000.

3.3 Pooled prevalence estimates of autism and ASD from studies in mainland China

The registry-based data from Taiwan and Hong Kong were not suitable for inclusion in the meta-analysis because, unlike the studies from mainland China, there was no screening process used to identify cases. Thus, only the 19 population-based screening and diagnostic studies from mainland China[16,17,19, 24-26,29-39,44,45] were considered for the meta-analysis. However, the heterogeneity of these studies was great (I^2=94.9%, p<0.001) so we first used sensitivity analysis to identify the causes of heterogeneity prior to pooling the results. Based on these analyses, the 2011 study by Li and colleagues[19] – the largest and only nationwide study (the other studies were conducted in provinces and had much smaller samples) – was excluded because it was the cause of substantial heterogeneity in the estimated prevalence. After excluding this study, the I^2 for the remaining 18 studies decreased from 94.9% to 76.3%. Using a random-effect model to pool results from the 18 remaining studies (after excluding the study by Li [19]), the pooled sample was 154 473 individuals, and the current prevalence of autism was 12.8 per 10 000 (95%CI, 9.4 to 17.5 per 10 000). These results are shown in the Forest plot in Figure 2.

The five studies from mainland China that reported the prevalence of ASD were also quite heterogeneous (I^2=94.4%, p<0.001). However, sensitivity analysis did not identify any factors that substantially influenced the heterogeneity of the results (i.e., removal of the identified study with the factor did not result in a substantially reduced I^2), so all 5 studies were included in the meta-analysis. Using a random-effect model to pool results from the 5 studies, the pooled sample was 45 694 individuals and the current prevalence of ASD was 24.5 per 10 000 (CI, 10.4 to 57.4 per 10 000). These results are shown in the Forest plot in Figure 3.

Among studies in mainland China, one study[17] reported a prevalence of 40.9 per 10 000 for Asperger syndrome; two studies[16,35] reported a prevalence of atypical autism of 0.46 and 8.53 per 10 000, and a prevalence of Rett Syndrome of 0.46 and 1.42 per 10 000; and three studies[17,34,37] reported a prevalence of PDD-NOS of between 1.4 and 8.3 per 10 000. Due to the small number of studies for these subtypes of ASD, separate, diagnosis-specific meta-analyses could not be conducted.

Figure 2. Forest plot of prevalence estimates of autism and 95% confidence intervals from 18 studies in mainland China

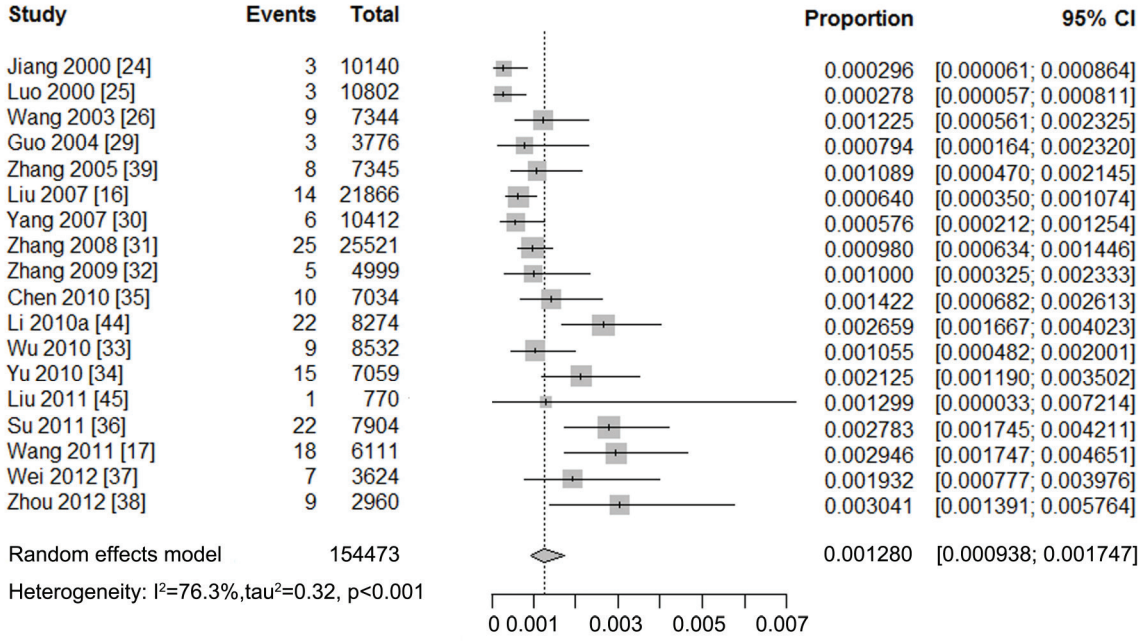


Table 1. Characteristics of the 24 included studies

Study	region	Sampling method[a]	Population source[b]	Diagnostic criteria[c]	Sample size	Age range	Autism events	ASD events
Jiang 2000[24]	Henan/Luoyang	R	E	DSM-III	10 140	3-14	3	—
Luo 2000 [25]	Fujian	CL,R	G	CCMD-2-R, DSM-III-R	10 802	0-14	3	—
Wang 2003[26]	Changzhou, Yizheng	S,CL,R	G	CCMD-2-R	7344	2-6	9	—
Guo 2004[29]	Gansu/Dingxi	R	G	DSM-IV	3776	2-6	3	—
Zhang 2005[39]	Tianjin	R	G	DSM-IV	7345	2-6	8	
Liu 2007[16]	Beijing	S,CL	G	DSM- IV	21 866	2-6	14	16
Yang 2007[30]	Guizhou/Zunyi	R	E	DSM-IV	10 412	3-12	6	—
Wong 2008[40]	Hong Kong	—	REG	DSM-III-R, DSM-IV	4 247 206	0-14	—	682
Zhang 2008[31]	Jiangsu/Wuxi	S,R,CL	C,E	DSM-IV	25 521	1-6	25	—
Lin 2009[41]	Taiwan	—	REG	—	*2000:* 5 850 535 *2001:* 5 711 309 *2002:* 5 583 696 *2003:* 5 442 398 *2004:* 5 376 458 *2005:* 5 267 440 *2006:* 5 140 471 *2007:* 5 054 196	0-17	1846 2276 2170 3354 4040 4710 5407 6179	—
Zhang 2009[32]	Guizhou/Yunyan	S,CL	G	CCMD-2-R	4999	0-6	5	—
Chen 2010[35]	Daqing	S,R,CL	C,G	DSM-IV	7034	2-6	10	17
Li 2010a[44]	Tianjin	R,CL	C	DSM-IV	8274	1.5-3	22	—
Wu 2010[33]	Lianyungang	R,S,CL	C	DSM-IV	8532	0-3	9	—
Yu 2010[34]	Haerbin	S,CL	E,G	DSM-IV	7059	2-6	15	16
Chien 2011[42]	Taiwan	R	REG	ICD-9	*1996:* 268 753 *1997:* 264 191 *1998:* 259 255 *1999:* 253 671 *2000:* 249 336 *2001:* 245 666 *2002:* 241 252 *2003:* 237 361 *2004:* 233 365 *2005*: 229 454	0-17	—	48 68 102 177 259 358 429 486 565 659
Hsu 2011[43]	Taiwan	R	REG	ICD-9	162 171	0-15	6886	—
Liu 2011[45]	Shanghai	—	G	DSM-IV	770	1.5-2	1	—
Li 2011[19]	Nationwide	S,M,CL	G	ICD-10	616 940	0-17	77301[d]	—
Su 2011[36]	Tianjin	S,CL	C	DSM-IV	7904	1.5-3	22	—
Wang 2011[17]	Guangzhou	S,R,CL	E	DSM-IV	6111	2-6	18	46
Lai 2012[46]	Taiwan	—	REG	DSM-IV-TR DSM-IV, DSM-III-R	*2004:* 4 664 310 *2005:* 4 601 833 *2006:* 4 387 827 *2007:* 4 395 283 *2008:* 4 268 630 *2009:* 4 157 940 *2010:* 4 044 433	3-17	—	3995 4684 5345 6119 6771 7429 8072
Wei 2012[37]	Shenzhen	—	C	DSM-IV	3624	1.5-2	7	10
Zhou 2012[38]	Shenzhen	—	G	—	2960	1-2	9	—

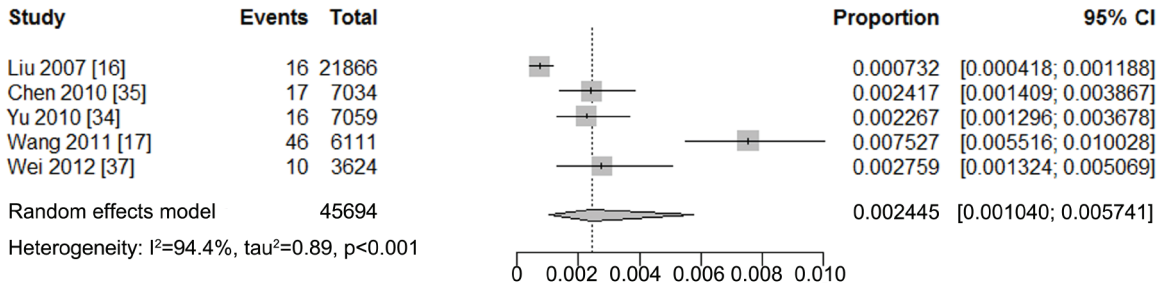
[a] R, random; CL, cluster; S, stratified; M, multiphase

[b] E, educational services; G, general population; REG, registration data; C, clinical services;

[c] DSM, Diagnostic and Statistical Manual; CCMD, Chinese Classification of Mental Disorders; ICD, International Classification of Diseases

[d] weighted number of cases to account for complex survey sample design; the prevalence (95% CI) estimated using the Taylor series linearization method was 2.38 (1.92-2.84)

Figure 3. Forest plot of prevalence estimates and 95% confidence intervals from 5 studies of autism spectrum disorders in mainland China



3.4 Study quality and publication bias

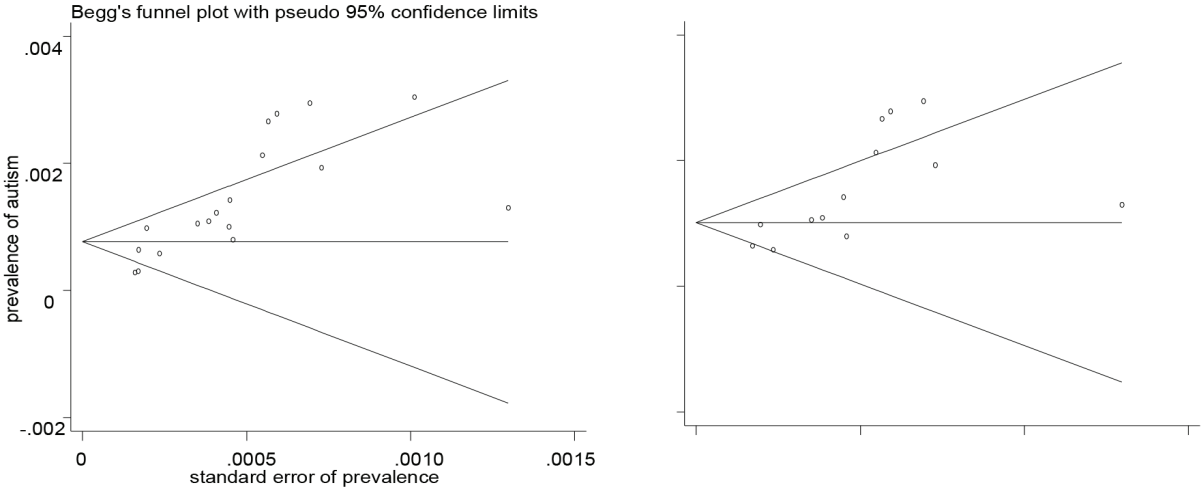
Only 8 of the 19 (42%) studies from mainland China[17,26,32,34-36,39,44] considered the influence of non-response in the estimation of prevalence and 3 of the 19 (16%) studies[37,38,45] did not provide a description of the sampling methods. Based on criteria listed in the STROBE, the quality score of the 19 community-based prevalence studies from mainland China (with a theoretical range of 0 to 22) ranged from 9 to 19 with a mean (sd) of 13.1 (3.2). Four studies[24,30,37,45] with a score of <11 (i.e., less than 50% of the theoretical maximum score) were classified as 'poor quality'. Of the 22 items from the STROBE assessment, the most common problems were a failure to estimate the required sample size (which was done in only 2 of the 19 reports), and the poor generalizability of the results (which was considered in only 4 of the 19 reports).

A minimum of 10 studies are needed to assess potential publication bias so it was only possible to conduct this analysis for the 18 studies used to estimate the prevalence of autism in mainland China and for the subgroup of 13 studies that assessed the prevalence of autism using DSM-IV as the diagnostic criteria. The Begg's funnel plots are shown in Figure 4. Based on the plots, the studies with smaller sample sizes tended to report a higher prevalence of autism. The Z-test for the plot of all 18 studies of the prevalence of autism was 2.95 (p=0.003) and that for the 13 studies that used DSM-IV criteria to make the diagnosis of autism was 2.95 (p<0.001); this indicates that publication bias was present in both analyses.

3.5 Prevalences of autism and ASD in mainland China by subgroup

The pooled estimates of the prevalences of autism and ASD in different subgroups of individuals are shown in Table 2. There are significant differences in the estimated prevalence of autism by gender (male prevalence is more than 2-fold female prevalence), residence (urban prevalence is 3-fold rural prevalence), age (children under 2 have a lower prevalence than children 2 to 6 years of age), diagnostic criteria (the prevalence reported in studies using DSM-IV or CCMD criteria is much higher than in the single study using DSM-III criteria), year of publication (reported prevalence is higher in more recent publications), and

Figure 4. Begg's funnel plots of publication bias for 18 studies of the prevalence of autism in mainland China (left) and the subgroup of 13 studies that used DSM-IV diagnostic criteria (right)



source of population (estimated prevalence is highest in clinical populations and lowest in samples identified from schools). The reported prevalence of ASD was also much high in males than in females and higher in more recent publications than in older publications. However, the difference in the urban versus rural prevalence of ASD and the difference in the prevalence of ASD in Han children versus that in children from other ethnic groups were not statistically significant.

4. Discussion

4.1 Main findings

Based on available registry data from Hong Kong and Taiwan, the reported prevalence of autism over the period from 2000 to 2010 ranged from a low of 1.8 per 10 000 to a high of 424.6 per 10 000, a more than 200-fold difference. Most of the studies reported increasing rates over time, but there must be substantial methodological differences in these studies to result in such a huge range in the estimated prevalence, so it was not possible to pool the results of the registry studies or to integrate them with the community-based screening and diagnostic studies from mainland China.

The 19 identified studies from mainland China had an estimated prevalence of autism ranging for 2.38 per 10 000 to 30.41 per 10 000, a 13-fold difference. Sensitivity analysis found that by eliminating the study with the lowest prevalence – the large nationwide study – the extremely high heterogeneity of the studies improved substantially (I^2 decreased from 94.9 to 76.3%), so the meta-analysis only included the remaining 18 studies in which the estimated prevalence of autism ranged from 2.78 per 10 000 to 30.41 per 10 000 (an 11-fold difference). The resulting pooled prevalence of autism from the 18 included studies from mainland China was 12.8 per 10 000 individuals.

Five of these 18 studies also reported the prevalence of ASD in mainland China. The reported prevalence ranged from 7.32 per 10 000 to 75.27 per 10 000, a 10-fold difference. The heterogeneity of these studies was also quite high (I^2=94.4%), but sensitivity analysis did not identify factors that could exclude specific studies, so all 5 studies were included in the meta-analysis. The pooled prevalence of ASD estimated from these studies was 24.5 per 10 000.

Our estimated prevalences of autism and ASD are substantially lower than the corresponding prevalences reported by most meta-analyses from other countries,[14,15] but some international meta-analyses[13] have reported lower prevalences than those estimated in this study. There are many possible explanations for these cross-national differences in the reported prevalences of autism and ASD. Methodological differences – particularly in the source population, in the diagnostic criteria, and in the methods of identifying cases – probably explain the majority of the difference. But there may also be biological and cultural determinants that affect the 'true' prevalences of these conditions. Moreover, there appears to be an upward trend in the trajectory of the prevalences of these conditions over time that is more than a simple increase in clinical awareness or an increase in care-seeking. If this is the case, it is certainly possible that part of the reason for the lower prevalences in China is that China is at an earlier stage in this trajectory than other regions. However, one major caveat to the suggestion that rates in mainland China are increasing with time is that the large nationwide study conducted in 2011 (with a sample several times the combined sample of the remaining 18 studies) had the lowest reported prevalence of autism (2.38 per 1000).

Subgroup differences in the prevalences of autism and ASD found in this study were similar to those reported in other countries. Male prevalence was three-fold female prevalence, in line with findings from elsewhere.[9,51-53] The prevalences of autism and ASD in urban communities was higher than that in rural communities (though the difference was not statistically significant for ASD), a finding that is also reported in high-income countries.[13] Our study found a higher prevalence of autism among children who were 2 to 6 years of age than in younger children; some authors suggest that this may be related to the different clinical manifestations of the condition at different developmental stages during childhood (and the difficulty of establishing the diagnosis at younger ages).[13,54] The one study that used DSM-III criteria to diagnose autism (in 10 140 individuals) had a much lower reported prevalence than the 13 studies that used DSM-IV criteria or the 2 studies that used CCMD; these differences may have been related to different characteristics of the samples, but other authors have suggested that the use of different diagnostic criteria can result in substantial differenes in the estimated prevalences of these conditions.[10]

4.2 Limitations

Our analyses identified several weaknesses in the included studies, so the results need to be interpreted with caution. Many of the included studies were either based in school systems (where rates are much lower) or in clinical populations (where rates are much higher), so their representativeness of the population as a whole is uncertain. The substantial heterogeneity of the results suggests that there were important methodological differences across studies. There was a clear suggestion of publications bias, with smaller studies tending to report

Table 2. Prevalences of autism and Autism Spectrum Disorder (ASD) in different subgroups

	number of studies	*n*	events	I^2	*p*	prevalence (per 10 000)	95% CI	U-value	*p*
AUTISM									
current prevalence	18	154 473	189	76.3%	<0.001	(R)12.80	9.38-17.47	—	—
males	10	51 017	99	75.2%	<0.001	(R)19.51	12.82-29.68	5.09	<0.001
females	10	45 837	28	15.5%	0.300	(F)7.46	5.15-10.80		
urban	5	29 471	39	25.0%	0.255	(F)15.10	11.03-20.66	2.44	0.014
rural	5	29 815	28	82.2%	<0.001	(R)8.54	3.17-22.96		
sample 0 to 2 years old	7	23 404	21	60.2%	0.020	(R)10.23	4.57-22.92	-1.98	0.047
sample 2 to 6 years old	11	91 811	134	82.5%	<0.001	(R)15.78	10.35-24.06		
use CCMD criteria(A)	2	12 343	14	0%	0.716	(F)11.40	6.75-19.23	A>B 2.28	0.022
use DSM-III criteria(B)	1	10 140	3	—	—	2.96	0.61-8.64	A v C -0.83	0.407
use DSM-IV criteria(C)	13	118 228	160	75.5%	<0.001	(R)14.32	10.26-19.97	B<C -2.99	0.003
study published 2000-2005 (A)	5	39 407	26	54.2%	0.068	(R)6.94	3.81-12.62	A<B -2.63	0.009
study published 2006-2010 (B)	8	93 697	106	75.6%	<0.001	(R)11.91	7.97-17.79	A<C -6.39	<0.001
study published 2011-2012 (C)	5	21 369	57	0%	0.807	(F)27.11	20.92-35.13	B<C -5.13	<0.001
source: educational system (A)	3	26 663	27	90.7%	<0.001	(R) 8.47	1.99-36.03	A<B -3.79	<0.001
source: clinical services (B)	4	28 334	60	56.8%	0.074	(R)21.00	14.00-31.48	A v C -0.61	0.542
source: general population (C)	8	59 862	52	64.0%	0.007	(R)10.02	6.16-16.29	A<D -2.02	0.043
source: mixed populations (D)	3	39 614	50	64.8%	0.058	(R)14.06	8.65-22.85	B>C 4.20	<0.001
								B>D 2.19	0.029
								C v D -1.86	0.063
AUTISM SPECTRUM DISORDER (ASD)									
Overall prevalence	5	45 694	105	94.4%	<0.001	(R)24.45	10.40-57.41	—	—
males	5	24 005	85	93.7%	<0.001	(R)36.72	14.85-90.48	5.52	<0.001
females	5	21 689	20	38.3%	0.166	(F)11.05	7.17-17.03		
urban	3	21 516	38	66.8%	0.049	(R)18.46	10.59-32.16	1.77	0.077
rural	3	14 443	11	78.2%	0.010	(R)11.20	2.72-45.95		
Han ethnicity	2	27 500	31	91.9%	<0.001	(R)12.95	3.72-44.94	-0.83	0.407
other ethnicity	2	1400	2	35.9%	0.212	(F)21.88	6.33-75.34		
study published 2006-2010	3	35 959	49	86.3%	0.001	(R)15.91	7.46-33.90	-5.80	<0.001
study published 2011-2012	2	9735	56	88%	0.004	(R)47.40	17.75-125.95		

I^2, heterogeneity coefficient (proportion of variance in results due to heterogeneity of included studies); CI, confidence interval; (R), computed using random-effects model; (F), computed using fixed-effects model; DSM, Diagnostic and Statistical Manual

higher rates. And the formal assessment of quality of the reports of the study used in the meta-analysis based on the STROBE criteria identified several limitations. Few of the studies reported the prevalences of the subtypes included under the ASD rubric so it was not possible to make robust estimates of the prevalences of these conditions. The huge difference between the rates reported from registry systems (200-fold differences) and the large differences in rates reported from community-based screening studies (10 to 15-fold differences) indicate that substantial improvements and standardization of the methodology for estimating the prevalences of these uncommon but serious conditions are needed.

4.3 Significance

Studies from other countries have reported a clear upward trajectory in the prevalences of autism and ASD over time. The current systematic review and meta-analysis identified 24 studies published since 2000 that had estimated the prevalences of autism or ASD in Chinese children. There were widely varying rates reported in these studies, presumably due to methodological differences across studies, so it is not certain whether or not China is also experiencing the upward trend in the prevalences of autism and ASD reported from high-income countries. There is, however, an increased awareness of the importance of autism since the first reported cases in mainland China in 1982.[56] Improved study methodology is needed to provide valid estimates of the prevalences of these conditions over time. Until these methodological improvements have been made it will not be possible to develop evidence-based prevention and treatment strategies for the management of these seriously disabling conditions.

Conflict of interest

Authors declare no conflict of interest related to this article.

Acknowledgement

Authors would like to thank PhD candidate Yi JIN at the Institute of Psychology, Chinese Academy of Sciences for technical support on R software.

Funding

This study is funded by the Research Leadership Development Plan of the city of Shanghai (XBR2011005).

References

1. Kanner L. Autistic disturbances of affective contact. *Nervous Child* 1943; **2**(3): 217-250.
2. Szatmari P. New recommendations on autism spectrum disorder. *BMJ* 2011; **342**:d2456.
3. Chinese Society of Psychiatry. *Chinese Classification and Diagnostic Criteria of Mental Disorders*, 3rd edition. Jinan: Shandong Science and Technology Publisher; 2001.
4. World Health Organization. *The International Classification of Diseases (10th revision)*. Geneva: World Health Organization; 1992.
5. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, 4th ed*. Washington: American Psychiatric Assoation; 1994.
6. American Psychiatric Association [Internet]. Washington: *American Psychiatric Association* [updated 2012; cited 2013 Mar 20]. DSM-5 Proposed Criteria for Autism Spectrum Disorder Designed to Provided More Accurate Diagnosis and Treatment. Available from: //www.dsm5.org/Documents/12-03%20 Autism%20Spectrum%20Disorders%20-%20 DSM5.pdf.
7. Prevalence of autism spectrum disorders--autism and developmental disabilities monitoring network, 14 sites, United States, 2002. *MMWR Surveill Summ* 2007; **56**(1): 12-28.
8. Prevalence of autism spectrum disorders - Autism and Developmental Disabilities Monitoring Network, United States, 2006. *MMWR Surveill Summ* 2009; **58**(10): 1-20.
9. Prevalence of autism spectrum disorders--Autism and Developmental Disabilities Monitoring Network, 14 sites, United States, 2008. *MMWR Surveill Summ* 2012; **61**(3): 1-19.
10. Matson JL, Kozlowski AM. The increasing prevalence of autism spectrum disorders. *Res Autism Spectr Disord* 2011; **5**(1): 418-425.
11. Manning-Courtney P, Murray D, Currans K, Johnson H, Bing N, Kroeger-Geoppinger K, et al. Autism spectrum disorders. *Curr Probl Pediatr Adolesc Health Care* 2013;**43**(1): 2-11.
12. Feng L, Li C, Chiu H, Lee TS, Spencer MD, Wong JCM. Autism spectrum disorder in Chinese populations: a brief review. *Asia-Pacific Psychiatry* 2013 (in press).
13. Williams JG, Higgins JP, Brayne CE. Systematic review of prevalence studies of autism spectrum disorders. *Arch Dis Child* 2006; **91**(1): 8-15.
14. Fombonne E. Epidemiology of pervasive developmental disorders.*Pediatr Res* 2009; **65**(6): 591-598.
15. Elsabbagh M, Divan G, Koh YJ, Kim YS, Kauchali S, Marcin C, et al. Global prevalence of autism and other pervasive developmental disorders. *Autism Res* 2012;**5**(3): 160-179.
16. Liu J, Yang X, Jia M, Qu C, Shi J, Liu G, et al. A cross-sectional study of pervasive developmental disorders among children 2-6 years of age in Beijing, 2004. *Chinese Mental Health Journal*, 2007;**21**(5): 290-293.
17. Wang X, Yang W, Jin Y, Jing J, Huang X, Li X, et al. A study on the prevalence of autism spectrum disorders and associated factors in kinder gardens in Guangzhou. *Chinese Mental Health Journal*. 2011; **25**(6): 401-408.
18. Yu R, Lin L, Xu D, Li X, Qiu F. An analysis of prevalence of autism in Chinese children. *Maternal and Child Health Care in China* 2011;**26**(29): 4563-4565.
19. Li N, Chen G, Song XM, Du W, Zheng XY. Prevalence of autism-caused disability among Chinese children: A national population-based survey. *Epilepsy Behav* 2011;**22**(4): 786-789.
20. Wang J, Wang B. *Clincial epidemiology, 3rd edition*. Beijing:People's Medical Publishing House,2002:14.

21. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration. *Epidemiology* 2007;**18**(6): 805-835 10.1097/EDE.0b013e3181577511.
22. Higgins J, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;**327**(7414): 557-560.
23. Fang J, Lu Y. Modern medical statistics. Beijing: People's Medical Publishing House,2002:202-204.
24. Jiang L, Li R, Li Y, LiY, Li F. A health survey of child mental health in Luoyang. *Journal of psychological health* 2000; **8**(1): 27-28.
25. Luo W, Lin L, Chen R, Cheng W, Huang Y, Hu T, et al. An epidemiological survey of autism in Fujian province. *Shanghai Archives of Psychiatry* 2000;**12**(1): 3-5.
26. Wang W, Zhai L, Zheng L, Zhu J, Qu X, Feng Q, et al. An epidemiological survey of autism in Jiangsu province. *China Behavioral Science* 2003;**12**(2): 173-174.
27. Guo R. An epidemiological study of autism in 5000 children aged 0-6 years in Tianjin. *China Clinical Rehabilitation* 2004;**8**(6): 1122-1123.
28. Zhang X, Ji C, Li J, Sun J. A survey of autism among children 2-6 years old in Tianjin. *Chinese Journal of Reproductive Health* 2004;**15**(4): 206-208.
29. Guo C. An epidemiological survey of psychiatric disability among children 2-6 years of age in Dingxi county. *China Rehabilitation Theory and Practice*. 2004;**10**(2): 118-119.
30. Yang S, Hu Y, Han Y. An epidemiological analysis of autism. *Practical Pediatrics* 2007; **22** (24): 1872-1873.
31. Zhang F, Gui Q, Wang J, Xue S, Lu X, Ma X, et al. A cross-sectional study of autism among children 1-6 years of age in the city of Wuxi. China Women and Children's Health.*Maternal and Child Health Care in China* 2008;**23**(27): 3979-3980.
32. Zhang G, Xu Y, Huang C, Yang H, Lu Y. An epidemiolgoical survey of autism in the Yunyan district of Guiyang city. *Journal of Guiyang Medical College* 2009;**34**(4): 463+465.
33. Wu X, Lu Y, Wang Y, Zheng Q, Wang T, Lin J, et al. A prevalence survey of autism in infants and children in Lianyungang city. *Journal of Modern Medicine and Health* 2010;**24**(24): 3724-3276.
34. Yu C, Xia W, Sun C, Zhou Y, Liu L, Li J, et al. A cross-sectional survey of autism spectrum disorders among children 2-6 years old in Harbin city. *Chinese Journal of Child Health Care* 2010;**18**(10): 750-753.
35. Chen Y, Huang H, Zhao Y, Li D, Li J, Yao L, et al. An epidemiological survey of autism spectrum disorders in children 2-6 years old in Ranghulu district of Daqing city. *Chinese Journal of Child Health Care* 2010;**18**(4): 331-333.
36. Su Y, Zhang X, Li A, Li Y, Liu G. Prevalence of autism and associated factors in infants and children in Tianjin. *Maternal and Child Health Care in China* 2011;**26**(32): 5004-5007.
37. Wei Q, Ren L, Wong L, Gao W, He H, Wang W, et al. The screening and 3-year follow-up study of autism spectrum disorder among infants 18-24 months old in Shenzhen city. *Chinese Journal of Child Health Care* 2012;**20**(4): 354-357.
38. Zhou L, Shi J. A clincial diagnostic analysis of infant and child autism. *China Modern Doctor* 2012;**50**(17): 50-51.
39. Zhang X, Ji CY. Autism and mental retardation of young children in China. *Biomed Environ* SCI 2005;**18**(5): 334-340.
40. Wong VC, Hui SL. Epidemiological study of autism spectrum disorder in China. *J Child Neurol* 2008;**23**(1): 67-72.
41. Lin JD, Lin LP, Wu JL. Administrative Prevalence of autism spectrum disorders based on national disability registers in Taiwan. Res *Autism Spectr Disord* 2009;**3**(1): 269-274.
42. Chien IC, Lin CH, Chou YJ, Chou P. Prevalence and inCIdence of autism spectrum disorders among national health insurance enrollees in Taiwan from 1996 to 2005. *J Child Neurol* 2011;**26**(7): 830-834.
43. Hsu SW, Chiang PH, Lin LP, Lin JD. Disparity in autism spectrum disorder prevalence among Taiwan National Health Insurance enrollees: Age, gender and urbanization effects. *Res Autism Spectr Disord* 2012; **6**(2): 836-841.
44. Li A. A cross-sectional study of autism and early presentations among children 1.5-3 years old in Tianjin. Tianjin: Tianjin Medical College, Master thesis,2010.
45. Liu J. Early screening and a clincial record study of autism spectrum disorder. Shanghai: Fudan University, Master thesis,2011.
46. Lai DC, Tseng YC, Hou YM, Guo HR. Gender and geographic differences in the prevalence of autism spectrum disorders in children: analysis of data from the national disability registry of Taiwan. *Res Dev Disabil* 2012; **33**(3): 909-915.
47. Wang W, Zhai L, Zheng L, Qu X, Feng Q, Sun W, et al. An epidemiological study of autism in Changzhou city. *Journal of Clinical Psychiatry* 2002;**12**(3): 148-149.
48. Huang H. An epidemiological survey of autism spectrum disorders in children 2-6 years old in Ranghulu district of Daqing city. Heilongjiang: China Medical University, Master thesis, 2010.
49. Li A. An analysis of autism behavior among children 1.5-3 years old in Tianjin. *Chinese Journal of Mental Health* 2010;**24**(3): 215-218.
50. Wang Y, Lu Y, Wu X, Chen J, Zheng Q. Eearly diagnosis and recognition of child autism spectrum disorders. *Maternal and Child Health Care in China* 2012;**27**(27): 4236-4238.
51. Samadi SA, Mahmoodizadeh A, McConkey R. A national study of the prevalence of autism among five-year-old children in Iran. *Autism* 2012;**16**(1): 5-14.
52. Bertrand J, Mars A, Boyle C, Bove F, Yeargin-Allsopp M, Decoufle P. Prevalence of autism in a United States population: the Brick Township, New Jersey, investigation. *Pediatrics* 2001;**108**(5): 1155-1161.
53. Fombonne E. Epidemiological surveys of autism and other pervasive developmental disorders: an update. *J Autism Dev Disord* 2003;**33**(4): 365-382.
54. Hertz-PicClotto I, Delwiche L. The rise in autism and the role of age at diagnosis.*Epidemiology* 2009;**20**(1): 84-90.
55. Perkins EA,Berkman, KA.Into the unknown: aging with autism spectrum disorders. *Am J Intellect Dev Disabil* 2012;**117**(6):478-496.
56. Tao G. Diagnosis and categorization of infant autism. *Chin J Nerv Ment Dis* 1982;**15**(2):104-107. (In Chinese)

Yumei Wan graduated with a Bachelor of Medicine from Jining Medical University in Shandong Province in 2011. She is currently a master degree student in psychiatry at the Shanghai Jiao Tong University School of Medicine. Her research interests are the evaluation of clinical guidelines of mental disorders and the conduct of systematic reviews.

Shanghai Archives of Psychiatry 2013, Vol. 25, No. 2

•Meta分析•

中国儿童孤独症谱系障碍患病率的系统综述

万玉美[1] 胡强[1] 李婷[1] 姜丽娟[1] 杜亚松[1] Lei FENG[2] John Chee-Meng WONG[2,3] 李春波[1]*

[1]上海交通大学医学院附属精神卫生中心 上海
[2] Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[3] Department of Psychological Medicine, National University Hospital, Singapore

*通信作者:chunbo_li@yahoo.com

摘要

背景 中国孤独症和孤独症谱系障碍(autism spectrum disorders, ASD)的患病率缺乏可靠的估计。

目的 运用Meta分析综合评价中国18岁以下人群孤独症和ASD患病情况，并分析其在性别、民族、城乡等不同因素间的差异。

方法 检索中国知识资源总库、中国科技期刊数据库、万方数据检索系统、中国生物医学文摘数据库、PubMed和Web of Science等数据库，收集关于中国孤独症谱系障碍患病率的文献，按照预先制定的纳入及排除标准筛选相关研究。采用R-2.15.2软件对资料进行统计学分析。

结果 共纳入24项研究，其中5项来自香港和台湾的注册研究（涉及14,570,369名儿童），19项来自大陆以人群为基础的筛查和诊断研究（合并样本量为771,413名儿童）。港台注册研究报道的孤独症年患病率为1.8~424.6/10,000。中国大陆的18项研究（剔除一个患病率最低的全国性研究）报道孤独症患病率为2.8~30.4/10,000，合并后孤独症患病率为12.8/10,000（95%CI,9.4~17.5）。5项研究报道ASD（患病率为7.3~75.3/10,000）合并后患病率24.5/10,000(95%CI,10.4~57.4)。不同性别、居住地点、发表时间和抽样来源之间报道的患病率存在明显差异。

结论 港台注册研究报道的孤独症患病率存着巨大差异（达200倍），大陆以人群为基础的筛查诊断研究报道的患病率存在较大差异（10~15倍），凸显迫切需要建立标准的方法来估计孤独症和ASD的患病率。只有方法学质量得到改善，才有可能为这些不常见但严重致残的疾病提供循证的防治策略。