The Prevalence of Autistic Spectrum Disorder: A Systematic Review and Meta-Analysis

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Objectives

Estimates of the prevalence of ASD vary markedly [1,2].The aim of this investigation was to systematically review the ASD prevalence literature and to calculate a robust estimate of prevalence that could be used to inform an economic analysis of the costs of ASD and planning of future service provision in Scotland.

Method

Systematic Review

Three on-line databases (MedLine, PsychArticles and PsychInfo) were searched using key terms relating to ASD and prevalence to identify English-language, peer-reviewed papers which made at least one mention of ASD prevalence and had been published since December, 2002.

These searches returned a total of 40,713 papers, which were subsequently scrutinised to establish their relevance and quality; this process has been described in figure 1. Eight of the papers were considered to have reported reliable primary ASD prevalence data collected using high quality methodologies. This final set of eight papers reported prevalence rates relating to 13 different samples, all of which were represented in our meta-analysis.

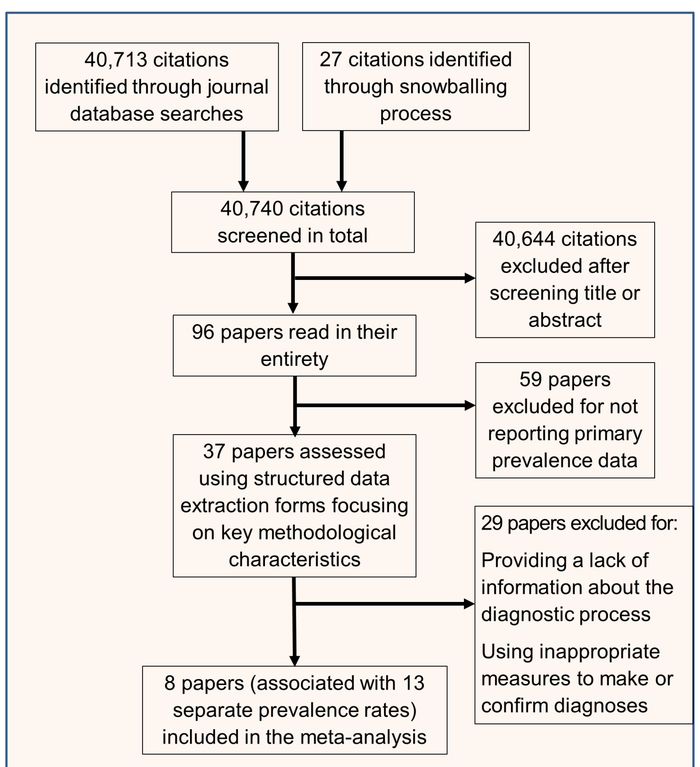


Figure 1. PRISMA flow chart for paper selection process

Meta-Analysis

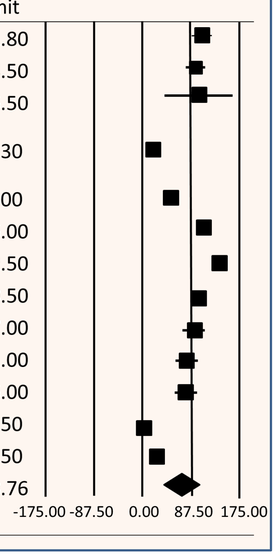
Random effects meta-analyses using the method of moments were carried out on weighted logit-transformed prevalence estimates of ASD per 10,000 with age group as a between-group variable.

Results

Figure 2 shows the forest plots (a plot of the point estimate of prevalence with a 95% confidence interval) which shows the level of variability in the estimate for each of the studies.

Figure 2. Summary of random-effects meta-analysis of prevalence estimates of ASD (8 final studies, 13 samples)

Study Name	Point Estimate	Lower Limit	Upper Limit
Baird et al. (2006) [4]	116.10	90.40	141.80
Baron-Cohen et al. (2009) [5]	94.00	73.50	114.50
Brugha et al. (2011) [6]	98.00	30.50	166.50
Chakrabarti & Fombonne (2005) [7]	22.00	12.70	31.30
Idring et al (2012a) [8]	66.00	59.00	71.00
Idring et al (2012b) [8]	120.00	114.00	126.00
Idring et al (2013c) [8]	146.00	139.50	152.50
Idring et al. (2012d) [8]	105.00	99.50	110.50
Kocovska et al. (2012) [8]	94.00	71.00	117.00
Matilla et al. (2011) [9]	84.00	57.00	111.00
Nygren (2012a) [10]	80.00	54.00	106.00
Nygren (2012b) [10]	4.00	-2.50	10.50
Nygren (2012c) [10]	18.00	4.50	31.50
Pooled Estimate	79.87	50.97	108.76



The results revealed an overall pooled prevalence estimate of 79.87 per 10,000 (95% CI 50.97 - 108.76). However, there were highly significant levels of heterogeneity ($Q = 1433.43$, $df = 12$, $I^2 = 99.16$, $\tau^2 = 2689.96$), indicating that the point prevalence estimates were not all from the same type of population. A funnel plot (see Figure 3) revealed that there was no indication of publication bias (all p-values > .43). As age differences were known to exist across the different samples, a mixed effects analysis[11], with age as a between-group (independent) variable , was used to test whether this factor could explain the observed heterogeneity. This confirmed a significant age effect ($Q_b = 16.36$, 2 df, $p < .0001$).

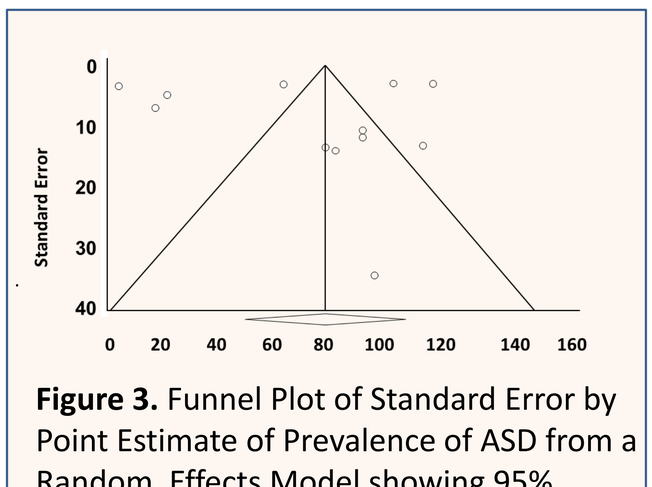


Figure 3. Funnel Plot of Standard Error by Point Estimate of Prevalence of ASD from a Random Effects Model showing 95% Confidence Intervals.

Results (Cont.)

Prevalence rates by each age group are shown in Table 1.

Table 1. Pooled prevalence rates per 10,000 for estimates relating to those < 6 years, 6-12 years and > 12 years

Age Group (years)	No. of Prevalence Estimates	Pooled Prevalence Estimate per 10,000 (95% C.I)
< 6	5	36.66 (9.72-63.59)
6 – 12	4	104.16 (73.02 – 135.31)
> 12	4	113.54 (81.14-145.93)

Analysis revealed a pooled prevalence estimate for aged 6 and older of 109.83 per 10,000 (95% CI 93.88 – 125.77). Further sensitivity analysis [11] revealed the presence of two outliers, the Idring (2012b) and (2012c) datasets. Analysis with these data-sets removed yielded a prevalence estimate of 103.50 per 10,000 (95% CIs 98.53 – 108.48) with no significant heterogeneity ($p > .45$).

Discussion

The studies included in this meta-analysis met rigorous standards in terms of diagnostic criteria, diagnostic procedures, sample size, representiveness, statistical analysis and all other relevant aspects of methodology. There were some limitations to the investigation, however. There may have been additional relevant papers which were not included in the databases searched. In addition, the paper selection process focused only on English language papers, and it is possible that usable data could have been found in papers published in other languages or in non-peer reviewed sources. Further, our final analysis only included studies from 4 countries (England, Sweden, Finland and the Faroe Islands). However there was no evidence to suggest that there were regional variations in the prevalence estimates associated with ASD.

Conclusion

We propose that the most reliable ASD prevalence estimate at present is 1.04% (95% CI 0.99% - 0.108%). We trust that the results of this meta-analysis will provide researchers, service providers and economic planners with a confident basis within which to view the prevalence of autism spectrum disorders.

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