Age at autism spectrum disorder diagnosis

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Age at autism spectrum disorder diagnosis: A systematic review and meta-analysis from 2012 to 2019

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Abstract

Between 1990 and 2012, the global mean age at diagnosis of autism spectrum disorder ranged from 38 to 120 months. Measures have since been introduced to reduce the age at autism spectrum disorder diagnosis, but the current global mean age is unknown. This review and meta-analysis report the average age at diagnosis from studies published between 2012 and 2019. We initially identified 1150 articles, including 56 studies that reported the mean or median age at diagnosis across 40 countries (n = 120,540 individuals with autism spectrum disorder). Meta-analysis results (on 35 studies, including 55 cohorts from 35 countries, n = 66,966 individuals with autism spectrum disorder) found a current mean age at diagnosis of 60.48 months (range: 30.90–234.57 months). The subgroup analysis for studies that only included children aged ⩽10 years (nine studies, including 26 cohorts from 23 countries, n = 18,134 children with autism spectrum disorder) showed a mean age at diagnosis of 43.18 months (range: 30.90–74.70 months). Numerous factors may influence age at diagnosis and were reported by 46 studies, often with conflicting or inconclusive findings. Our study is the first to ascertain the global average age at autism spectrum disorder diagnosis from a meta-analysis. Continued efforts to lower the average age at autism spectrum disorder diagnosis are needed.

Lay abstract

We currently assume that the global mean age at diagnosis of autism spectrum disorder ranges from 38 to 120 months. However, this range is based on studies from 1991 to 2012 and measures have since been introduced to reduce the age at autism spectrum disorder diagnosis. We performed a systematic review and meta-analysis (statistical analysis that combines the results of multiple scientific studies) for studies published between 2012 and 2019 to evaluate the current age at autism spectrum disorder diagnosis. We included 56 studies that reported the age at diagnosis for 40 countries (containing 120,540 individuals with autism spectrum disorder). Results showed the current mean age at diagnosis to be 60.48 months (range: 30.90–234.57 months) and 43.18 months (range: 30.90–74.70 months) for studies that only included children aged ⩽10 years. Numerous factors that may influence age at diagnosis (e.g. type of autism spectrum disorder diagnosis, additional diagnoses and gender) were reported by 46 studies, often with conflicting or inconclusive results. Our study is the first to determine the global average age at autism spectrum disorder diagnosis from a meta-analysis. Although progress is being made in the earlier detection of autism spectrum disorder, it requires our constant attention.

Keywords

age at diagnosis, autism spectrum disorder, influencing factors, meta-analysis, review

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Introduction

Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder with an estimated prevalence of one in 54 (1.85%; (Maenner et al., 2020)), 52 million cases worldwide and 7.7 million disability adjusted life years (Baxter et al., 2014). Although ASD can be diagnosed as early as 18 months of age (Hyman et al., 2020), the latest review indicated that, globally, the mean age at ASD diagnosis ranges between 38 and 120 months (Daniels & Mandell, 2014). Early detection of ASD can lead to early treatment (Rogers et al., 2014), which has been shown to improve later language and cognitive abilities and ameliorate the core symptoms (Clark et al., 2018; Dawson & Burner, 2011). Although there is criticism of universal ASD screening due to insufficient evidence of its benefit (Siu & U.S. Preventive Services Task Force, 2016), there is agreement that early identification and intervention is a public health priority and that universal screening is an essential tool for the early detection of ASD (Pierce et al., 2016). Close monitoring of changes in age at ASD diagnosis over time will help us to assess whether efforts to enhance access to earlier identification and intervention have been successful.

There have been several global and regional efforts to enhance early detection, diagnosis and treatment of ASD. The World Health Organization (2014) states that the monitoring of child and adolescent development, in order to ensure timely detection and management of ASD in primary care, is a vital part of a national health system. ASD guidelines (and updates) and practice parameters have recently been released in the United States (Hyman et al., 2020; Johnson et al., 2007; Volkmar et al., 2014), the United Kingdom (National Institute for Health and Care Excellence, 2011), the Netherlands (Berckelaer-Onnes et al., 2015), France (Haute Autorité de Santé, 2018), New Zealand (Ministries of Health and Education, 2016) and India (Dalwai et al., 2017). Collectively, they emphasize the importance of techniques, policies and measures to improve the early detection of ASD.

The original 2014 review reported an average age at diagnosis from 38 to 120 months for studies published from 1990 through 2012 and indicated that more severe symptoms, higher socioeconomic status and greater parental concern about initial symptoms were associated with an earlier diagnosis of ASD (Daniels & Mandell, 2014). This study will update and expand upon this original research with the following aims: (1) to conduct a systematic review of age at ASD diagnosis from studies published between 2012 and 2019 and (2) to perform a meta-analysis of the age at ASD diagnosis reported in these studies to specify the current age at diagnosis.

Methods

We used the PRISMA statement to report our systematic review and meta-analysis findings (Moher et al., 2009). We did not register the protocol for this review.

Eligibility criteria

In our systematic review, we included published articles that reported any average age at diagnosis for any ASD type, with any study design, published between 1 January 2012 and 11 June 2019 in English. We included studies that reported the mean age at ASD diagnosis, the median age at ASD diagnosis or both, to provide a complete overview of the current literature evaluating age at ASD diagnosis. Studies that were included in the review by Daniels and Mandell (2014) were excluded.

Criteria for inclusion in our meta-analysis were more restrictive: only studies that reported a mean age at diagnosis with standard deviation and sample size (or when these could be calculated) were eligible.

Information sources

We searched the PubMed database for the period from 1 January 2012 to 11 June 2019 (Figure 1). Second, we searched for similar articles using PubMed's *similar articles* option and checked the references of these studies for additional papers.

Search

A search was conducted on 11 June 2019 using the following strategy: (autism (Title/Abstract) AND (age (Title/Abstract) AND (diagnosis (Title/Abstract).

Study selection

Each stage of study selection and data extraction for the review and meta-analysis (Figure 1) was independently performed by two of the authors (M.H. and C.T.). Discrepancies between them were jointly re-evaluated. Our analysis concerned only published data; we did not seek to obtain further data from the authors.

Review. The results identified from the literature search were assessed in two stages (by M.H. and C.T.). First, the titles and abstracts were screened for English and (1) the inclusion of an estimate of age at diagnosis for any ASD or (2) the possibility to identify age at diagnosis from the full paper (e.g. studies on ASD prevalence). Next, full papers were read to see if the record reported mean and/or median age at diagnosis for any ASD.

Meta-analysis. A meta-analysis is a statistical method in which different studies are combined into pooled results. Meta-analyses require normally distributed data with average scores, measures of dispersion and numbers of included participants for each result included in order to calculate pooled results. We only included studies that reported an overall mean age at ASD diagnosis with standard deviation and sample size (or when it was possible to

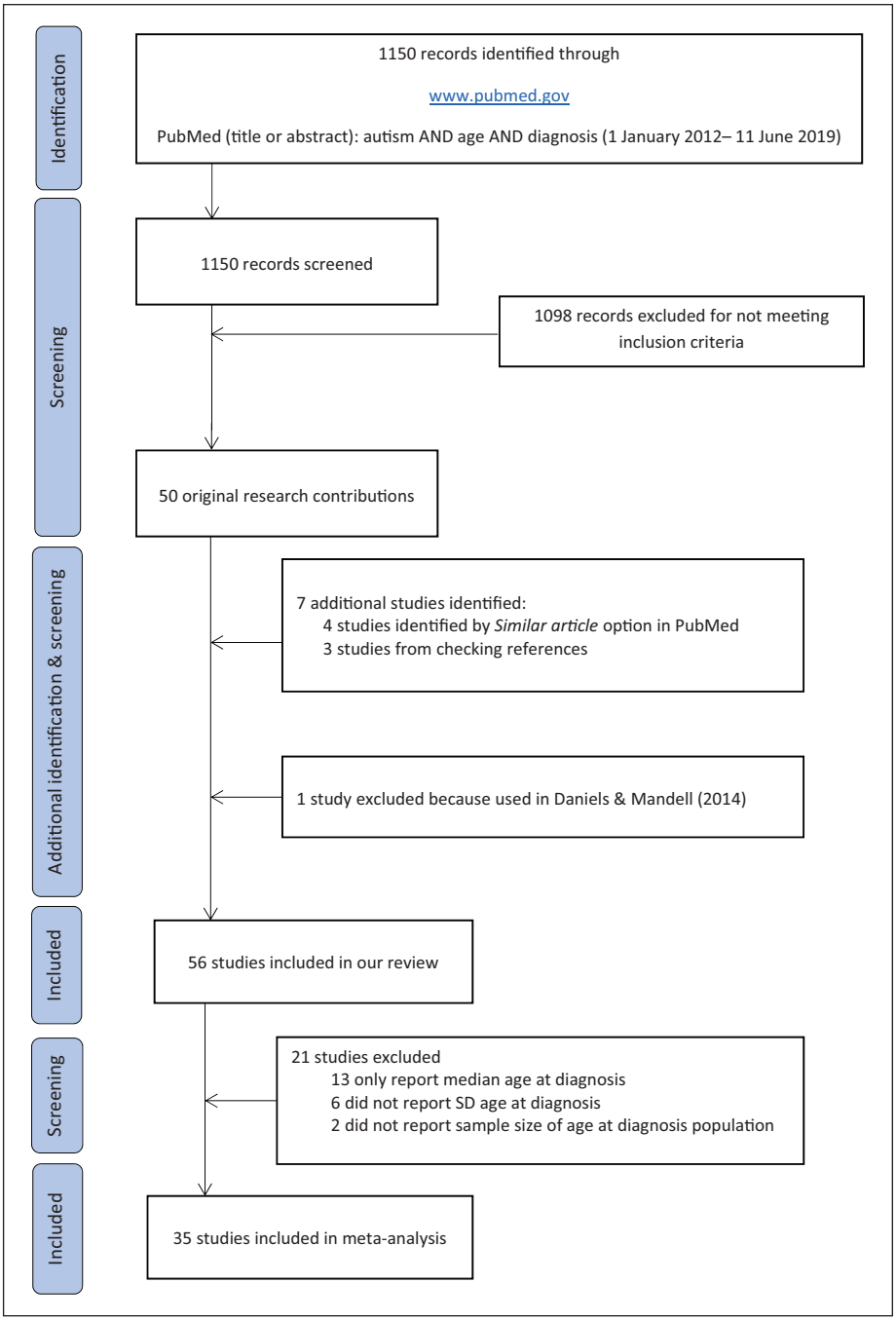

Figure 1. PRISMA flow diagram. Summary of literature search and selection process.

calculate these) in the meta-analysis. Studies that reported the mean age at ASD diagnosis for only a subsample (e.g. by gender) were excluded.

Data collection process

The data from the studies were extracted independently by two authors (M.H. and C.T.); discrepancies between them were jointly re-evaluated. If they disagreed, a third author (W.E.) adjudicated. All included studies were read by either M.H. or C.T. to collect data on potential factors associated with age at ASD diagnosis.

Data items

The following data were abstracted from the studies: author name(s), study year; location; study period; total number of participants in the study and number of participants in ASD sample on which age at diagnosis was based; general study description; male percentage in ASD study sample; age

range of ASD study sample; overall mean (SD) and/or median age at ASD diagnosis; and mean (SD) and/or median age at ASD diagnosis by the type of ASD diagnosis. Information regarding potential predictors of age at ASD diagnosis (e.g. age, gender and ethnicity) was also included. With respect to the systematic review, we used the original number of decimals as reported in the studies.

Risk of bias in individual studies

The risk of bias (RoB) of the individual studies was assessed using a checklist. As we found no optimal way to approach the bias analysis using an existing RoB tool, we developed an RoB tool suitable for this review and meta-analysis based on items from several standardized critical appraisal tools developed by the Joanna Briggs Institute (2020). This six-item tool evaluates the RoB related to the reported age at diagnosis based on sample size, methods description (e.g. recruitment procedures), ASD diagnosis determination method, reported sample characteristics and results, and if gender, age and ASD type are taken into consideration as confounding factors. The completed RoB tool (including description, item scoring and item reference) is included in Table S1 and Table S2 of Supplemental Material 1. The RoB score for each study is included in Table S3 (Supplemental Material 3), presenting the characteristics of included studies. Also, to provide insight into the possible RoB in the studies, we also recorded the study period, location and the size, sex ratio and age range of the sample. An overview of the studies' reports on potential predictors of age at ASD diagnosis is briefly described in section 'Results' (see Supplemental Material 2).

Synthesis of results

Age at diagnosis in years was converted to age in months. Missing total/pooled sample sizes and SDs were calculated if possible. We have included studies that reported the mean and median age at ASD diagnosis, in both the mean and median results of this review.

Planned methods of analysis

We performed random-effects meta-analysis using the Sidik–Jonkman model error variance estimator (Sidik & Jonkman, 2005) due to the large heterogeneity and as recommended by Sidik and Jonkman (2007). The meta-analysis was performed in R (R Core Team, 2018) using the metafor package (Viechtbauer, 2010).

Risk of publication bias across studies

Since we evaluated data on the age at diagnosis that did not include an effect size, we were unable to evaluate publication bias using a funnel plot as introduced by Sterne and Egger (2001).

Additional analyses

As age of the study sample has a large effect on the age at ASD diagnosis, we also conducted a meta-analysis on a subgroup of studies reporting the overall mean age at ASD diagnosis for children aged ⩽10 years.

Factors associated with age at ASD diagnosis. Of the 56 studies, 10 did not report any influencing factors on age at diagnosis (Cawthorpe, 2018; Garrido et al., 2018; Hausman-Kedem et al., 2018; Lo et al., 2017; Martinez et al., 2018; Masri et al., 2013; May et al., 2017; Mpaka et al., 2016; Nadeem et al., 2019; Ribeiro et al., 2017).

However, 46 studies reported many possible influencing factors on age at ASD diagnosis, including type of ASD diagnosis, additional diagnoses and gender among the most frequently reported (Supplemental Material 2).

Briefly, these studies show conflicting results regarding most of the reported factors. Multiple studies indicated that autistic disorder is associated with a lower age at diagnosis and Asperger's syndrome with a higher age (Begeer et al., 2013; Bent et al., 2015). Also, comorbid *attention deficit hyperactivity disorder* (ADHD) diagnosis, along with ASD, is associated with a higher age at ASD diagnosis (Brett et al., 2016; Frenette et al., 2013; Miodovnik et al., 2015; Wei et al., 2018). In 17 studies, there was no difference between the age at diagnosis for boys and girls, whereas five studies reported a higher age at diagnosis for girls.

Supplemental Material 2 includes an overview of the clinical, sociodemographic, parental, geographical, system interaction and cohort and period factors affecting age at ASD diagnosis as reported by the 46 studies.

Results

Study selection

The study selection process is shown in Figure 1.

Study characteristics

The 56 included studies reported mean or median age at diagnosis estimates across 40 countries (24 European, five Asian, three North American, two South American, two African, one Western Asian, one Oceanian and one Southwest Asian/Southeast European). In total, we included 120,540 individuals with ASD in this review. Characteristics of the 56 included studies can be found in Table S3 in Supplementary Material 3.

Review: mean and median age at diagnosis

We included 56 studies that reported the mean and/or median age at ASD diagnosis, of which 46 reported an overall ASD mean age at diagnosis between 30.9 and 574.4 months (Becerra-Culqui et al., 2018; Begeer et al., 2013; Bello-Mojeed et al., 2017; Bent et al., 2015; Berg

et al., 2018; Bravo Oro et al., 2012; Brett et al., 2016; Carias & Wevrick, 2019; Cawthorpe, 2018; Crane et al., 2016; Daniels et al., 2017; Darcy-Mahoney et al., 2016; Emerson et al., 2016; Garrido et al., 2018; Goodwin et al., 2017; Hagberg & Jick, 2017; Hall-Lande et al., 2018; Hausman-Kedem et al., 2018; Höfer et al., 2019; Hrdlicka et al., 2016; Jo et al., 2015; Kentrou et al., 2019; Kurasawa et al., 2018; Lagunju et al., 2014; Larsen, 2015; Lo et al., 2017; Magaña et al., 2013; Manohar et al., 2019; Martinez et al., 2018; Masri et al., 2013; May et al., 2017; Mazurek et al., 2014; Miodovnik et al., 2015; Mishaal et al., 2014; Mpaka et al., 2016; Ribeiro et al., 2017; Rutherford et al., 2016; Salomone et al., 2016; Sheldrick et al., 2017; Shrestha et al., 2019; Sicherman et al., 2017; Talero-Gutiérrez et al., 2012; Ververi et al., 2012; Wei et al., 2018; Zablotsky et al., 2018). Of the 56 studies, 24 reported an overall ASD median age at diagnosis (only or combined with mean age at diagnosis score) between 28 and 96 months (Baio et al., 2018; Becerra-Culqui et al., 2018; Bent et al., 2015; Brett et al., 2016; Christensen, Baio, et al., 2016; Christensen, Bilder, et al., 2016; Christensen et al., 2019; Darcy-Mahoney et al., 2016; Frenette et al., 2013; Goodwin et al., 2017; Hall-Lande et al., 2018; Hinkka-Yli-Salomäki et al., 2014; Hrdlicka et al., 2016; Idring et al., 2012; Kurasawa et al., 2018; Larsen, 2015; Lo et al., 2017; Manohar et al., 2019; Nadeem et al., 2019; Sheldrick et al., 2017; Sicherman et al., 2017; Talero-Gutiérrez et al., 2012; Thomas et al., 2012; U.S. Department of Health and Human Services, 2014).

Several studies reported the age at ASD diagnosis for distinct ASD subtypes. For instance, the mean age at diagnosis for autistic disorder (eight studies) ranged between 33.8 and 194 months and the median age at diagnosis (nine studies) between 30 and 68.1 months (studies for mean age: Begeer et al., 2013; Bent et al., 2015; Bravo Oro et al., 2012; Brett et al., 2016; Hall-Lande et al., 2018; Höfer et al., 2019; Montiel-Nava et al., 2017; Sicherman et al., 2017 and studies for median age: U.S. Department of Health and Human Services, 2014; Baio et al., 2018; Bent et al., 2015; Bickel et al., 2015; Brett et al., 2016; Christensen, Baio, et al., 2016; Hall-Lande et al., 2018; Hinkka-Yli-Salomäki et al., 2014; Sicherman et al., 2017).

For Asperger's syndrome, the reported Christensen mean age at diagnosis (seven studies) was between 59.5 and 316 months and the median age at diagnosis (nine studies) was between 30 and 84 months (studies for mean age: Begeer et al., 2013; Bent et al., 2015; Bravo Oro et al., 2012; Brett et al., 2016; Hall-Lande et al., 2018; Höfer et al., 2019; Sicherman et al., 2017 and studies for median age: U.S. Department of Health and Human Services, 2014; Baio et al., 2018; Bent et al., 2015; Bickel et al., 2015; Brett et al., 2016; Christensen, Baio, et al., 2016; Hall-Lande et al., 2018; Hinkka-Yli-Salomäki et al., 2014; Sicherman et al., 2017).

For pervasive developmental disorder-not otherwise specified (PDD-NOS), the reported mean age at diagnosis (eight studies) ranged between 34.60 and 211 months and the median age at diagnosis (five studies) ranged between 61 and 114 months (studies for mean age: Begeer et al., 2013; Bent et al., 2015; Bravo Oro et al., 2012; Brett et al., 2016; Hall-Lande et al., 2018; Höfer et al., 2019; Montiel-Nava et al., 2017; Sicherman et al., 2017, and studies for median age: Bent et al., 2015; Bickel et al., 2015; Brett et al., 2016; Hall-Lande et al., 2018; Hinkka-Yli-Salomäki et al., 2014).

Four studies reported a median age at diagnosis between 49 and 56 months for PDD-NOS and ASD-other together (U.S. Department of Health and Human Services, 2014; Baio et al., 2018; Christensen, Baio, et al., 2016). One study reported that the median age at diagnosis for autistic disorder and PDD-NOS combined was 34.8 months (Bickel et al., 2015). For ASD-other (two studies), the mean age was between 43.1 and 50.7 months and a median age at diagnosis was between 33 and 47.0 months (Hall-Lande et al., 2018; Sicherman et al., 2017).

Meta-analysis

We excluded eight of 45 papers reporting the mean age at diagnosis from the meta-analysis: six because no SD was reported (Bravo Oro et al., 2012; Goodwin et al., 2017; Hagberg & Jick, 2017; Jo et al., 2015; Masri et al., 2013; Sheldrick et al., 2017) and two because no sample size for the ASD population was given (Crane et al., 2016; May et al., 2017). Total sample sizes and SDs were calculated from three studies that reported the age at diagnosis by age group (Begeer et al., 2013; Rutherford et al., 2016) or gender (Cawthorpe, 2018) but not for the entire sample.

In total, the meta-analysis included 35 papers (reporting on 55 study samples with a total study population of 66,966 individuals with ASD) across 35 countries that led to a mean age at diagnosis between 30.90 and 234.57 months. Figure 2 presents the forest plot of the reported mean age at diagnosis estimates with 95% confidence interval (CI) for all the included studies. The meta-analysis shows a mean age at diagnosis of 60.48 months (95% CI: 50.12–70.83). Of the 35 studies, nine reported age at diagnosis estimates ranging from 30.90 to 74.70 months in 23 countries (26 study samples with a total study population of 18,134). The forest plot results show a mean age at diagnosis of 43.18 months (95% CI: 39.79–46.57) for children aged ⩽10 years (Figure 3).

Results also indicate that the exclusion of three studies with the 95% CI bars well outside the range of the main group in the forest plot in Figure 2 (Begeer et al., 2013; Kentrou et al., 2019; Rutherford et al., 2016) lowered the age at diagnosis to 52.48 months (95% CI: 47.47–57.49) for all included studies instead of 60.48 months (range: 30.90–234.57 m). Regarding children aged ⩽10 years, the exclusion of one study with the 95% CI bars well outside the range of the main group in the forest plot (Hrdlicka et al., 2016) resulted in a lower age at diagnosis of 41.99 months (95% CI: 39.39–44.59) instead of 43.18 months (range: 30.90–74.70 m) (Figure 3).

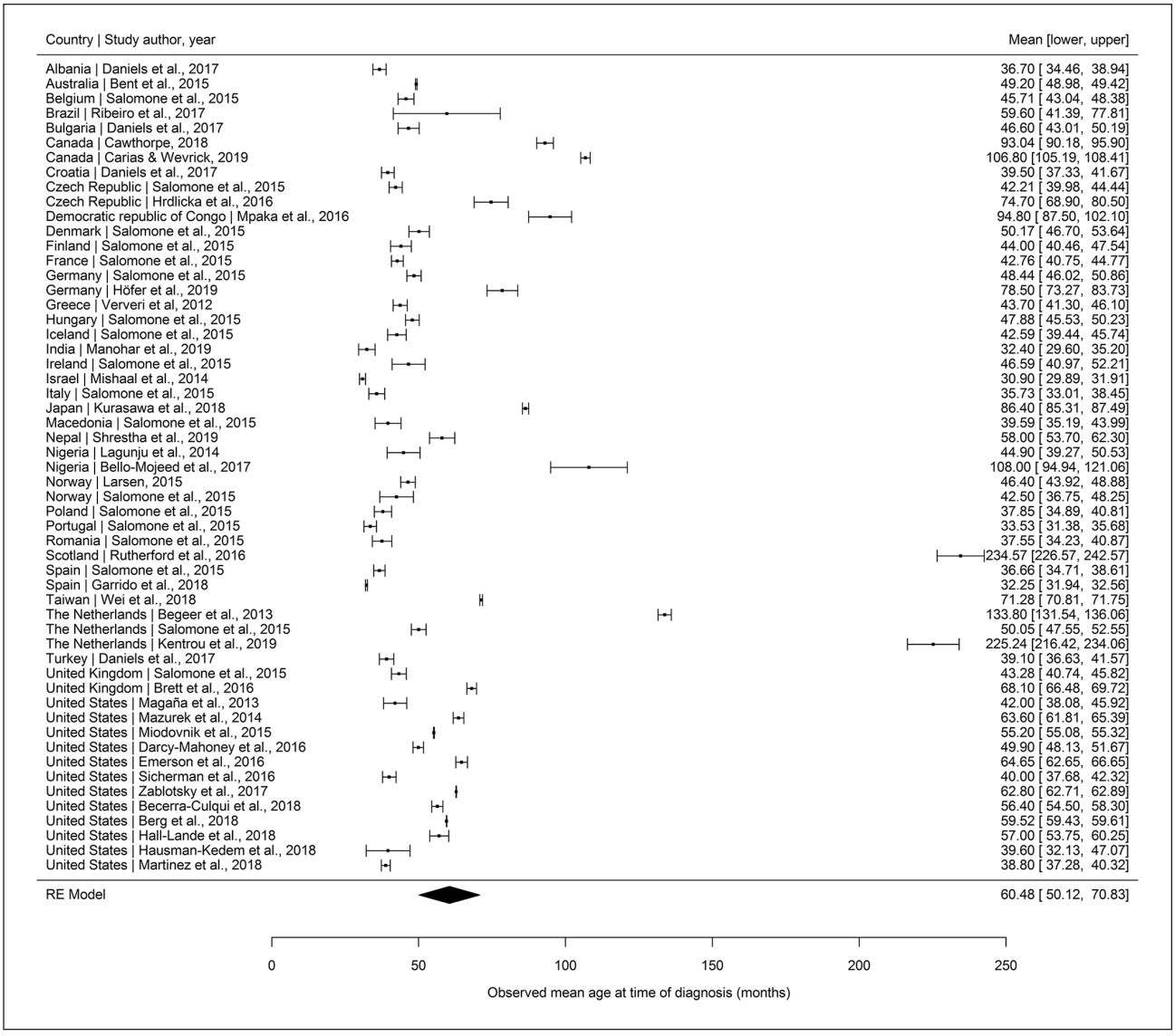

Figure 2. Forest plot of the mean age at ASD diagnosis with 95% confidence interval.

Discussion

Our review of 56 studies covering 40 countries between 2012 and 2019 identified a mean or median age at ASD diagnosis on a total of 120,540 individuals. Our meta-analysis (35 studies, covering 55 samples from 35 countries, n = 66,966 individuals with ASD) found a mean age at diagnosis of 60.48 months (95% CI: 50.12–70.83) with a range of 30.90–234.57 months. The subgroup analysis for studies that only included children (⩽10 years) found a mean age at diagnosis of 43.18 months (95% CI: 39.79–46.57) with a range of 30.90–74.70 months. Factors associated with age at ASD diagnosis (e.g. type of ASD diagnosis, additional diagnoses and gender) were reported by 46 studies, often with contradictory results.

Review of our findings

Of the 56 studies covered in our review, 45 reported an overall mean age at ASD diagnosis ranging from 30.9 to 574.4 months. Twenty-five studies reported an overall median age at ASD diagnosis (only or combined with mean age at diagnosis score) that ranged between 28 and 96 months. While most of the studies' findings included in this review were consistent with the mean (38–120 months) and median (36–82 months) ranges found by Daniels and Mandell (2014) in the 1990–2012 review, the ranges were wider.

The wider mean and median ranges might be explained by the ages of the study populations. Studies that reported a lower or partly lower mean or median age in comparison to those included in the Daniels and Mandell (2014) review all included populations with children aged ⩽10 years

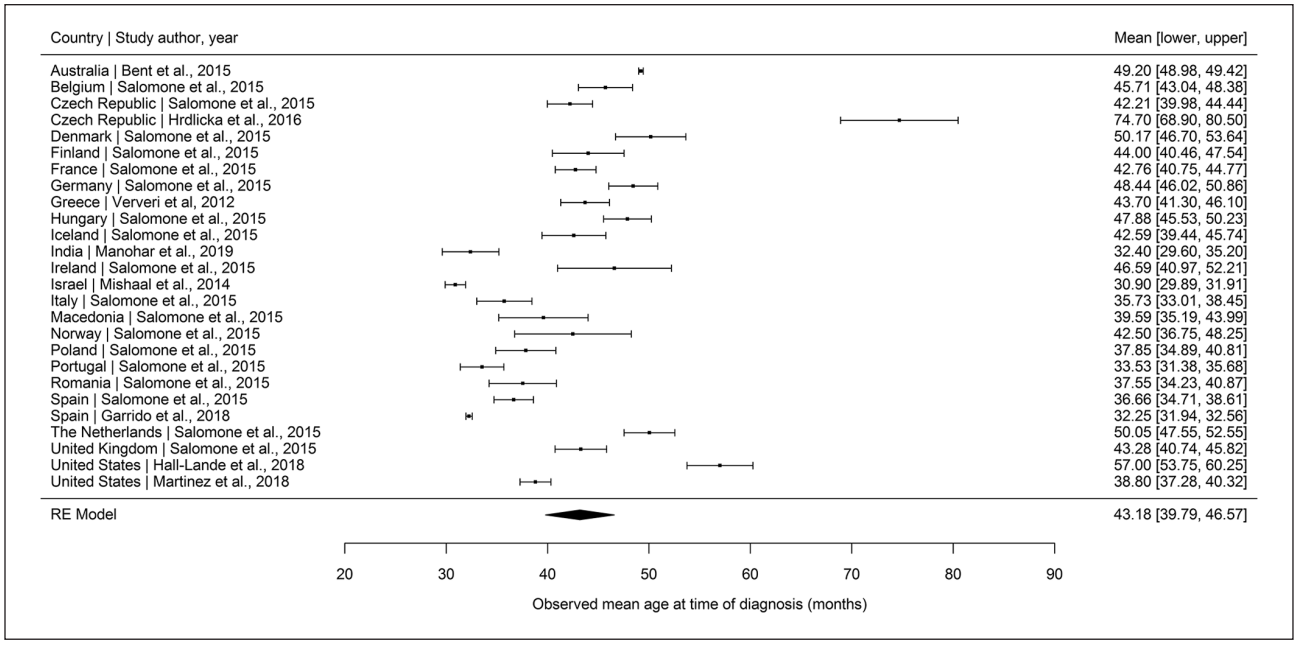

Figure 3. Forest plot of the mean age at ASD diagnosis with 95% confidence interval for sub-analysis population aged 0–10 years.

(Christensen, Baio, et al., 2016; Christensen et al., 2019; Garrido et al., 2018; Manohar et al., 2019; Mishaal et al., 2014) or had a majority of the children aged ⩽10 years (Jo et al., 2015). Thus, the age at ASD diagnosis among these younger populations is logically lower. Conversely, studies that reported a higher mean or median age included 26% to 53% adults in their populations (Begeer et al., 2013; Idring et al., 2012; Kentrou et al., 2019; Rutherford et al., 2016), which explains the higher age at ASD diagnosis.

This wider range in age might also be explained by recent developments in ASD research with more attention being paid to detecting ASD in very young children as well as in older populations. The change in research trends and the major differences between studies make it unreliable to compare different review findings on age at diagnosis.

Meta-analysis

Our meta-analysis on the global age at ASD diagnosis yielded a mean age of 60.48 months (95% CI: 50.12–70.83) with a range of 30.90–234.57 months (35 studies, including 55 samples from 35 countries, n = 66,966 individuals with ASD). The subgroup analysis for studies that only included children aged ⩽10 years (nine studies, including 26 samples from 23 countries, n = 18,134 children with ASD) found a mean age at diagnosis of 43.18 months (95% CI: 39.79–46.57) with a range of 30.90–74.70 months. Our meta-analysis is the first attempt to provide a standard point of reference for future research comparisons of the age at ASD diagnosis.

The results indicate that the exclusion of studies with the 95% CI bars well outside the range of the main group in the forest plot from the meta-analysis all report a high age at diagnosis and lower the age at ASD diagnosis from 60.48 to 52.48 months. The high mean age at diagnosis from the excluded studies can be explained by the inclusion of a large adult study sample. There is currently increased attention to the detection and diagnosis of ASD in the middle and late adulthood population after perceived decades of underdiagnosis. It can therefore be relevant to evaluate the mean age at ASD diagnosis in these specific age groups in order to track the progress of these detection efforts.

Factors influencing age at diagnosis

Evaluating factors affecting the age at ASD diagnosis was not a primary aim of this review and meta-analysis. However, the large number of factors reported in this review demonstrates their clinical interest and relevance. It is challenging to draw conclusions based on the results we found as most are inconsistent and/or have not been explored thoroughly. Extensive studies – evaluating a wide variety of factors and using a study design that enables adjusting for covariates – are needed to gain insight into which factors affect age at ASD diagnosis.

Clinical implications

The results from our meta-analysis are a potentially useful benchmark for the comparison of future meta-analyses on the age at ASD diagnosis. It is certainly relevant to evaluate how age at ASD diagnosis changes over time so that we can estimate the effects of national and global ASD early detection programmes, methods and so on.

However, we must be aware that the age at diagnosis is not fully representative as a measure of the effectiveness of the early ASD detection system. Delays in excess of 4 years were found in the process from first parental concern to first contact with a healthcare professional and receipt of an ASD diagnosis (Crane et al., 2016). Improvements to healthcare and education systems, including the development of ASD guidelines and the training of professionals to implement these guidelines are crucial to reducing the overall age at ASD diagnosis.

Limitations

This review has five main limitations. First, the RoB and the differences between the 56 studies in the type of reported outcome score (mean/median) and study characteristics (design, period, study sample and sample size) complicated the comparison of individual study results and of the age at diagnosis found in our meta-analysis. Comparability could be increased by a meta-analysis that includes additional factors besides SD and sample size, for example, age and gender; but this would necessitate more extensive study results. We included age, gender, study location and time period for transparency in Table S3. Second, unreported data (SD and sample size) led to the exclusion of eight studies (14%) from the meta-analysis. How far the exclusion of these studies affected our results, and thereby their validity, is unclear. Third, we only used one data source (PubMed) so we may have missed some studies. However, this effect is likely minimal, due to our comprehensive search method. Fourth, we included only studies published in English, thereby excluding studies in other languages. Finally, due to varied study design, we could not identify a robust tool to evaluate the quality of the studies we included. Thus, a reliable comparison of the quality of the studies was not possible. However, as our meta-analysis included 37 studies from 35 countries, comprising 69,545 individuals with ASD, our meta-analysis represents a good proxy for the current age at ASD diagnosis.

Strengths

Our review has three main strengths. The first is the large number of participants included in the meta-analysis (n = 66,966 individuals, including 18,134 children aged ⩽10 years), enhancing the generalizability and power of its results. Second, the method used to screen all papers found in our initial search results led to a large number of included papers and secondary references that would have otherwise been missed because they were not obviously reporting the age at ASD diagnosis. Third, the subgroup analysis in children aged up to 10 years partly corrects for the fluctuating age reported in the papers and is relevant to the early detection of ASD.

Future research

Future research on age at ASD diagnosis should (1) evaluate and report more detailed data on age at ASD diagnosis in subgroups (e.g. gender, age and ethnicity) of the study samples, (2) conduct a more extensive meta-analysis using this detailed data to adjust for extensive factors and thereby better standardize the age at diagnosis and (3) develop an assessment tool to evaluate the quality of studies used in the meta-analysis, thereby making it easier to assess the scientific value of the results.

Conclusion

We report the global average age at ASD diagnosis as determined by our meta-analysis based on 35 studies from 35 countries, comprising 66,966 individuals with ASD. The current mean age at ASD diagnosis is 60.48 months (95% CI: 50.12–70.83) with a range of 30.90–234.57 months. Although progress is being made, the early detection of ASD should continue to be a global priority.

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Declaration of Conflicting Interests

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Supplemental material

Supplemental material for this article is available online.

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