Use of second-generation antipsychotics in autism spectrum disorder: a systematic review and meta-analysis protocol

Luis Phillipe Nagem Lopes, Jardel Corrêa de Oliveira, Cristiane de Cássia Bergamaschi, Izabella Fulone, Elisangela da Costa Lima, Flávia Casale Abe, Lauren Giusti Mazzei, Mabel Fernandes Figueirô, Luciane Cruz Lopes

ABSTRACT

Introduction Atypical antipsychotics have been studied to treat autism spectrum disorder (ASD). However, little is known about whether these drugs are effective and safe when compared in controlled and non-controlled settings. This study aims to assess the efficacy and safety of second-generation antipsychotics in ASD in randomised controlled trials (RCT) and observational studies.

Methods and analysis This systematic review will include RCT and prospective cohorts evaluating second-generation antipsychotics in people 5 years and older diagnosed with ASD. Searches will be conducted in Medline, Embase, Cochrane Library, Epistemonikos, Lilacs, CINAHL, PsycINFO, trial registries and grey literature databases without restriction on publication status, year of publication and language. The primary outcomes will be symptoms of agressive behaviour, quality of life for the individual or their careers, and discontinuation or dropouts/withdrawals of antipsychotics due to adverse events. The secondary outcomes are other not serious adverse events and adherence to pharmacotherapy. Selection, data extraction, and quality assessment will be performed by pairs of reviewers, independently. The Risk of Bias 2 (RoB 2) and Risk of Bias in Non-Randomised Studies of Interventions (ROBINS-I) tools will be used to assess the risk of bias in the included studies. If appropriate, a meta-analysis and network meta-analysis will be conducted to synthesise the results. The overall quality of the evidence for each outcome will be determined by the Recommendation, Assessment, Development and Evaluation approach.

Ethics and dissemination This study will systematically summarise the existing evidence evaluating the use of second-generation antipsychotics for treating ASD, in controlled and uncontrolled studies. The results of this review will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42022353795.

INTRODUCTION

Autism spectrum disorder (ASD), or simply autism, is a unique clinical condition with different levels of severity, characterised by two main symptom domains: (a) deficits in social communication and social interaction and (b) restricted repetitive behaviours, interests and activities and sensory anomalies.

Estimates of the prevalence of ASD vary. About 52 million people live with ASD worldwide. Studies indicate approximately 1%–2% of children in the USA and other developed countries. A systematic review (SR) of prevalence studies of ASD identified an overall estimate of the prevalence of 7.1 per 10000 for autism and 20 per 10000 for all ASD. Another SR found that the average worldwide prevalence of ASD was 17 per 100000, with a range of 2.8–94 per 100000 across all age groups. Hispanic and African-American children are underdiagnosed compared with non-Hispanic white children. People with higher socioeconomic status and better access to healthcare are diagnosed earlier.

ASD is considered a brain-based neurodevelopmental disorder that lasts for life. The three characteristic manifestations of ASD are impaired social interaction, impaired communication, and restricted repetitive and repetitive behaviours. This syndrome, also known as Autism spectrum disorder (ASD), or simply autism, is a unique clinical condition with different levels of severity.
stereotyped patterns of behaviour. Interfering behaviour has a great impact on the quality of life of individuals with ASD, family members and the people they live with. Interfering behaviours may include irritability, aggression and self-harm. These symptoms are the main causes of psychiatric hospitalisation, and the use of antipsychotics is recommended in the absence of effectiveness of behavioural interventions.

Despite the claims of curative interventions, there is no specific treatment for autism and therapies target the symptoms of the disease. Pharmacological interventions have been used as additional to behavioural treatments in both children and adults and may reduce specific autistic symptoms and behaviours such as self-injury and aggression. There is evidence of widespread prescribing of psychotropic drugs to people with ASD. Antipsychotic drugs generally tranquilise and relieve psychotic symptoms without impairing consciousness. Second-generation antipsychotics tend to cause fewer unwanted motor adverse effects than typical ones.

Typical (first-generation) and atypical (second-generation) antipsychotics have been evaluated for the treatment of behavioural symptoms in individuals with ASD. It is well established in the literature that first-generation antipsychotics are not recommended for treating symptoms in ASD due to their adverse effects. First-generation antipsychotics have been associated with drug-induced movement disorders. Haloperidol, for example, has been evaluated for the treatment of ASD in several trials and has been associated with improvements in withdrawal and stereotypies and positive effects on learning. However, it has also been related to extrapyramidal side effects such as acute dystonic reactions, withdrawal dyskinesias, and tardive dyskinesia in this population.

Randomised controlled trials (RCTs) have suggested the efficacy of second-generation antipsychotics to ameliorate some interfering symptoms of ASD in children and adolescents. An SR investigated the use of risperidone for ASD and demonstrated the efficacy of this drug in treating symptoms of aggression, irritability and repetitive behaviour. Notable adverse events, including weight gain, increased appetite and sedation, were described.

In addition, evidence from two RCTs suggests that aripiprazole can be effective as a short-term medication for some behavioural aspects of ASD in children and adolescents. Participants included in both RCTs who received aripiprazole had reduced significantly irritability when compared with the placebo groups. Nevertheless, weight gain, sedation, drooling and tremors occurrence must also be considered. Another SR found that antipsychotics (aripiprazole, clozapine, haloperidol, levosulpiride, lurasidone, olanzapine, risperidone, trifluoperazine) for children and adolescents with ASD were more efficacious than placebo in reducing stereotypies, hyperactivity, irritability and obsessions, compulsions, and increasing social communication and global functioning.

SRs published evaluating the use of antipsychotics presented important methodological limitations. An overview of SRs on aripiprazole and risperidone found 16 SRs of critically low methodological quality. Published Cochrane SRs have only evaluated the paediatric population and have not included all second-generation antipsychotics.

This SR will evaluate the performance of second-generation antipsychotics in the treatment of ASD in controlled and non-controlled settings.

METHODS AND ANALYSIS

Study design, protocol and registration

This SR (SR) will be performed according to the recommendations of the Cochrane Handbook for Intervention Reviews. This protocol is reported according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (online supplemental material 1), and registered in the International Prospective Register of Systematic Reviews (PROSPERO) database.

Patient and public involvement

Stakeholders were involved in the development and refinement of the research question. We involved decision-makers from the Brazilian Ministry of Health, primary care physicians, psychiatrists and key stakeholders.

When the SR is completed, the results will be discussed in a dissemination workshop with the same stakeholders. We will involve users in classifying outcomes’ importance and interpretation of evidence. We will summarise the evidence in plain language.

Eligibility criteria

The research question was structured using the Population, Intervention, Comparison and Outcomes structure.

Types of participants

Participants regardless of age group diagnosed with ASD using a standardised diagnostic tool or established diagnostic criteria from DSM-4 or DSM-5.

Studies involving other mental disorders will be included as long as the results are separate or at least 80% of the population has a confirmed diagnosis of ASD.

Type of interventions

Second-generation antipsychotics (amisulpride, aripiprazole, asenapine, brexpiprazole, cariprazine, clozapine, iloperidone, lumateperone, lurasidone, olanzapine, paliperidone, pimavanserin, quetiapine, risperidone, sulpiride, ziprasidone), without restriction as to dose, route of administration, frequency or duration of treatment.

Types of comparators

1. Second-generation antipsychotics other than intervention.
2. Placebo.

Types of outcome measures

We will include studies regardless of the scales used to measure outcomes.
Primary outcomes
1. Number of participants with aggressive behaviour and degree of aggressiveness (agitation; irritability and self-aggression), measured using validated scales reported by the patient, physician or parents.
2. Quality of life for the individual and/or their caregivers.
3. Number of participants who had discontinuation or dropouts/withdrawals of antipsychotics due to adverse events.

Secondary outcomes
1. Number of participants with adverse events of interest according to the guideline on the clinical development of medicinal products for the treatment of ASD:28
   - Central nervous system adverse events.
   - Endocrinological adverse events.
   - Other adverse events, for example, somnolence, insomnia, headache, rash and constipation.
2. Adherence to pharmacotherapy measured by validated scales, or reported by the patient, physician and parents.

Types of studies
We will include RCTs and pragmatic trials irrespective of status of publication (online clinical trials results, summaries of unpublished clinical trials, abstracts, reports from pharmaceutical companies, since that they contain sufficient data for analysis), year of publication and language. Observational studies (cohorts) will be included additionally, only if they are prospective and have a comparator arm for the intervention of interest.

The RCTs will be included because they are the best study designs for evaluating the effectiveness of health interventions and cohorts will be considered especially for safety outcomes as they generally have a longer follow-up. We will not impose any limitation regarding the length of follow-up.

We will exclude non-randomised studies such databases with data from claims or medical records, case series, retrospective cohorts, case–control, control before and after, and times series.

Search methods for identification of studies
The search strategy will use DeCS/MeSH descriptors and synonyms, being adapted according to each database searched (online supplemental material 2). The searches will be conducted by an experienced librarian and will be reviewed by another professional librarian, according to the Peer Review of Electronic Search Strategies.29

Electronic searches
A structured search for eligible primary studies will be conducted in the main electronic databases: MEDLINE via PubMed, Embase via Elsevier, Cochrane Central Register of Controlled Trials (Central), Epistemonikos, Latin American and Caribbean Health Sciences Literature (Lilacs) via Virtual Health Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PsycINFO.

Searching other resources
1. Grey literature
   - We will adapt a specific structured search strategy for the grey literature, including: ProQuest Dissertations and Theses (https://about.proquest.com/en/products-services/pqdtglobal/), Portal Capes (https://catalogodeteses.capes.gov.br/catalogoleteses/#/1/) and Open Grey (https://opengrey.eu/).
2. Trial registers
   - Clinical Trials (www.ClinicalTrials.gov); International Clinical Trials Platform (www.who.int/ictrp); Registry Platform Current Controlled Trials (www.isrctn.com); EU Clinical Trials Register (www.clinicaltrialsregister.eu) and Brazilian Registry of Clinical Trials (www.ensaiosclinicos.gov.br/).
3. Hand searches
   - Appropriate journals and conference proceedings (online supplemental material 3) relating to second-generation antipsychotic treatment for ASD will be hand searched and incorporated.
4. Personal communication
   - Pharmaceutical companies and experts in the fields will be asked if they knew of any studies that met the inclusion criteria of this review.
5. Reference checking
   - Reference lists of the included studies, previous SRs, systematic scoping reviews and narrative reviews of ASD will be checked for published reports and citations of unpublished research.
6. Automatic alerts
   - We set automatic alerts in each database to receive notifications of published new studies. We monitored the medical literature and kept the review as current as possible.

Data collection and analysis
Selection of studies
We will download all titles and abstracts retrieved through an electronic database search to a reference management database https://www.covidence.org/ and remove duplicates. Pairs of reviewers will independently screen titles and abstracts for inclusion. We will retrieve the full text of potentially relevant references, and pairs of reviewer’s authors will independently assess the full-text articles for inclusion. We will record reasons for exclusion from studies following the full-text review. Any disagreements will be resolved through discussion or, if required, by consulting a third review author.

As described in detail previously,30 for the two selection stages, the reviewers will carry out a pilot exercise for consensus on the eligibility criteria.
Data extraction and management
As described in detail previously a pre-piloted and standardised form will be used to extract data from the included studies.30 The reviewers will be calibrated by extracting at least three articles, in pairs and independently, and, afterward, they will carry out a consensus. This process will take place until the standardisation of the extracted data. The overlap of two articles in all teams of reviewers will be adopted to assess the reliability between reviewers in extracting data in the different teams.

After this stage, two reviewers will extract the data independently, and any discrepancies will be identified and resolved with a third author, when necessary.

The data collected will be (a) bibliometric information (year of study publication, authors, title); (b) characteristics of studies (funding, follow-up time, design: randomised or non-randomised, scales used; clinical setting: hospitals, specialty clinics, primary care, research centres; countries, country, registered number, number of sites, duration of the study, the timing of outcome measurement: weeks or months, numbers of participants in each arm); (c) characteristics of patients (inclusion and exclusion criteria, age, antipsychotics: naive vs experienced, psychiatric comorbidities, other treatments, drug regimen, route and frequency of medication administration and adverse events); (d) outcome (total number of participants in each arm, the total number of participants who presented the outcome, name of the scale used to measure the outcome, numerical value to measure the outcome—mean, median, SD—and time point used). We will extract data comprehensively to cover all relevant outcomes and methods reported across studies.

Where key data are missing from the study reports, we will attempt to contact the authors to obtain such information.31 Where multiple reports of the same trial are published, we will extract data from those we deem to be most complete.

**Assessment of methodological quality of individual studies**

The quality of RCTs will be assessed using Cochrane’s Risk of Bias (RoB) tool version 2.0 for randomised trials on bias arising from the randomisation process, deviations from intended intervention, missing outcome data, measurement of the outcome and selection of the reported result.32

The quality of observational studies will be assessed using Risk of Bias In Non-randomised Studies of Interventions (ROBINS-I) tool on bias arising from the confounding, selection bias, information bias and reporting bias.33

Two reviewers will assess the risk of bias. Reviewers will resolve disagreements through discussion, and a third person will judge unresolved disagreements.

**Statistical analysis**

**Measures of treatment effect**

We will use the standardised mean difference (SMD) to summarise continuous outcomes and the OR to summarise binary outcomes. We will use results based on the intention-to-treat analysis whenever available.

We will convert SMDs to log-OR (or vice-versa) using established methods when necessary. Depending on the data availability, we will convert sample sizes, means and SD directly to 2×2 tables—under the assumption of an approximately normal distribution and a cut-off. The thresholds that separate the continuous outcome into two categories (eg, event and non-event) will be defined by current guidelines and an expert group of psychiatrists and clinical pharmacologists.

**Missing data**

We will employ standard techniques to back-calculate the necessary statistics from reported CIs, SEs, z, t or p values. We will use approximate Bayesian computation models to derive the necessary information for meta-analysis when reported data are more complex34 (eg, median and IQR, continuous variables divided into mutually exclusive groups based on cut-offs). We will extract data from figures if data are reported graphically.

**Pair-wise meta-analysis**

We will use fully Bayesian random-effects models. Throughout our analyses, we will use only random-effects models. The choice of a random-effects model is based on the anticipated clinical and methodological heterogeneity across studies.35

We will use the binomial likelihood for binary outcomes and model the log OR. If results in primary studies are available as ORs (95% CI), we will model binary outcomes using the normal likelihood. We will use the normal likelihood and the identity link for continuous outcomes. As suggested, statistical heterogeneity will be interpreted based on the between-study variance ($\tau^2$).36 37

**Network meta-analysis**

We will use the generalised linear model framework (the ‘NICE’ model) described previously.38 If feasible, we will use the arm-based approach. The model preserves randomisation, assumes consistency and allows for multi-arm trials. However, if necessary, we will employ an adapted model that uses arm-level and comparison-level data. For binary outcomes, we will use the binomial likelihood. We will use the normal likelihood and the identity link for continuous outcomes.39

To evaluate the plausibility of the transitivity assumption, we will investigate the distribution of presumed effect modifiers across treatment comparisons. The list of potential effect modifiers will be defined by listing all covariates investigated at the baseline. This list will be evaluated by a multidisciplinary panel of practicing psychiatrists and clinical pharmacologists, who will rank the importance of each covariate regarding the treatment effect. Transitivity will be judged based on the five most relevant potential effect modifiers.

We will compare the fit of the consistency model to the fit of a random-effects model that relaxes the consistency.
assumption (‘inconsistency model’). Models will be compared via the posterior mean of the residual deviance and the deviance information criterion (DIC), with lower DIC values indicating a better model fit.

We will present summary treatment effect estimates and between-trial variance derived from the median and 95% credibility intervals (CrIs) from the 2.5th and 97.5th percentile of the posterior distribution. Treatment rankings (with 95% CrI) and the probability that each treatment is the best will be calculated from the posterior distributions.

**Meta-regression models**
If pertinent, we will examine the association between the magnitude of treatment effects and study-level characteristics, via random-effects Bayesian meta-regression models. We will not employ average patient-level characteristics to avoid ecological fallacy.

**Priors**
We will assume non-informative, but biologically plausible priors for treatment effects for all models and between-study variances. However, in sensitivity analyses, we will also use informative priors for the between-study variances.

**Funnel plot asymmetry and small-study bias in pair-wise meta-analysis**
Whenever feasible (ie, 10 or more estimates), we will investigate funnel plot asymmetry using graphical and statistical approaches. For pair-wise meta-analyses, we will employ contour-enhanced plots and generate Doi plots. We will calculate the LFK index and conduct Egger’s linear regression test or Peter’s test.

**Funnel plot asymmetry and small-study bias in network meta-analysis**
For network meta-analysis, we will create a comparison-adjusted funnel plot, as suggested by Chiuocchia et al. We will also use the recently proposed Risk of Bias due to Missing Evidence in Network meta-analysis approach.

**Implementation**
All Bayesian models will be implemented in MultiBUGS 2.0 (Cambridge, UK), and estimates will be obtained via Markov chain Monte Carlo methods. Models will be fitted with three chains (166667 simulations each), totalising 500000 iterations. The burn-in period will be 100000 simulations. Convergence will be checked graphically by running three chains and using the Gelman-Rubin statistic, R. We will check autocorrelation and density of the posterior estimates graphically in Stata V.16.

**Subgroup analysis and investigation of heterogeneity**
If appropriate, we will perform subgroup analyses or meta-regression to investigate differences among two or more subgroups according to each of the following characteristics of participants, which might have an effect on the outcomes: type of clinical conditions: infantile autism (F84.0); atypical autism (F84.1); other childhood disintegrative disorder (F84.3); Asperger’s syndrome (F84.5); and other pervasive developmental disorders (F84.8); participants’ mean age; types of scales used to measure outcomes; duration of follow-up; sex; dose of antipsychotics; presence of comorbidities.

If additional analyses cannot be conducted by RevMan 5, we will perform analyses in Stata Statistical Software (Stata 2015).

**Sensitivity analysis**
We will perform sensitivity analyses of outcomes to assess the robustness of the findings. If feasible, we will restrict the analysis of outcomes to studies of low risk of bias, impute missing data considering worst-case scenario, and effects of fixed-effect or random-effects methods.

**Summary of findings and assessment of the certainty of the evidence**
After the results have been grouped, two reviewers will independently assess the overall certainty of the evidence for each outcome using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system. The main results of the review will be presented in outcome tables (Summary of Findings—SoF), as recommended by The Cochrane Collaboration. This table will be built with the aid of the GRADEpro software programme.

**ETHICS AND DISSEMINATION**
Since it is a literature-based study, ethical approval is not required. The results will be shared through publication in scientific journals of high impact, peer-reviewed and also published in national and international conferences.

**DISCUSSION**
The results could inform decision-making processes in the use of antipsychotics for the treatment of ASD. The evidence systematised in this study may contribute to improvements in healthcare based on the best evidence on the use of antipsychotics in the treatment of ASD. Our future results may impact public policy for ASD patients, healthcare professionals and decision-makers by providing evidence that can highlight challenges and areas for improvement, with a special look at pharmacological interventions in ASD.

The analysis of evidence from observational studies can improve the understanding of the use of antipsychotics in the treatment of ASD and support more assertive decisions about the actual performance of these interventions.

This is the first SR with a robust proposal for controlled and non-controlled settings involving the use of second-generation antipsychotics in ASD. Nevertheless, there are potential limitations. Primary studies may bring...
limitations to this review considering the confounders present in observational studies; meta-analyses may be hampered by a lack of standardisation in the measurement of efficacy outcomes and diagnostic criteria for ASD.

The methodological rigour and data analysis plan proposed in this review will provide transparency to the evidence found and may demonstrate the degree of confidence in the estimates found. To refine the construction of the final protocol of this SR, we are proposing the involvement of stakeholders such as patient representatives, decision-makers and health professionals who work in the treatment of ASD. On completing the SR, the results will be disseminated among healthcare professionals, patients and their representatives through a virtual meeting. Stakeholder perspectives will be incorporated into the SR.

Twitter Luciane Cruz Lopes @lulopesbr

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Contributors LPNL is the principal investigator and wrote the protocol and the final version. JCDiF, JF, CoCB, EnCL, FQA, LSG and MFF reviewed and edited the manuscript. LCL is the review guarantor, advised on background, helped to write the protocol and revised the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been vetted by any external entity. Comments about the peer review process and any potential conflicts of interest are welcome, but should be raised as issues of concern during the peer review process.

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REFERENCES


## SUPPLEMENTARY MATERIAL 1 - Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) 2015 checklist: recommended items to address in a systematic review protocol*

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<thead>
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<th>Section and topic</th>
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<td><strong>ADMINISTRATIVE INFORMATION</strong></td>
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<td>Title:</td>
<td>1a</td>
<td>Identify the report as a protocol of a systematic review</td>
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<td>Identification</td>
<td>1b</td>
<td>If the protocol is for an update of a previous systematic review, identify as such</td>
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<td>Update</td>
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<td>If registered, provide the name of the registry (such as PROSPERO) and registration number</td>
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<td>Authors:</td>
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<tr>
<td>Contact</td>
<td>3a</td>
<td>Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author</td>
<td>1-2</td>
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<tr>
<td>Contributions</td>
<td>3b</td>
<td>Describe contributions of protocol authors and identify the guarantor of the review</td>
<td>17-18</td>
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<td>Amendments</td>
<td>4</td>
<td>If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments</td>
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<td>Support:</td>
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<td>Sources</td>
<td>5a</td>
<td>Indicate sources of financial or other support for the review</td>
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<td>Sponsor</td>
<td>5b</td>
<td>Provide name for the review funder and/or sponsor</td>
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<td>Role of sponsor or funder</td>
<td>5c</td>
<td>Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol</td>
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<tr>
<td><strong>INTRODUCTION</strong></td>
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<td>Rationale</td>
<td>6</td>
<td>Describe the rationale for the review in the context of what is already known</td>
<td>5-7</td>
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<td>Objectives</td>
<td>7</td>
<td>Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)</td>
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<td><strong>METHODS</strong></td>
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<td>Eligibility criteria</td>
<td>8</td>
<td>Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review</td>
<td>7-9</td>
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<tr>
<td>Information sources</td>
<td>9</td>
<td>Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage</td>
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<tr>
<td>Search strategy</td>
<td>10</td>
<td>Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated</td>
<td>Suppl. Material 2</td>
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<td>Study records:</td>
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<tr>
<td>Data management</td>
<td>11a</td>
<td>Describe the mechanism(s) that will be used to manage records and data throughout the review</td>
<td>11-12</td>
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<tr>
<td>Selection process</td>
<td>11b</td>
<td>State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)</td>
<td>11-12</td>
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<td>Data collection process</td>
<td>11c</td>
<td>Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators</td>
<td>11-12</td>
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<td>Data items</td>
<td>12</td>
<td>List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications</td>
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<td>Outcomes and prioritization</td>
<td>13</td>
<td>List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale</td>
<td>8-9</td>
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<tr>
<td>Risk of bias in individual studies</td>
<td>14</td>
<td>Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis</td>
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<tr>
<td>Data synthesis</td>
<td>15a</td>
<td>Describe criteria under which study data will be quantitatively synthesised</td>
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<td>15b</td>
<td>If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as ( I^2 ), Kendall’s ( \tau ))</td>
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<td>Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)</td>
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<td>15d</td>
<td>If quantitative synthesis is not appropriate, describe the type of summary planned</td>
<td>N/A</td>
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<td>Meta-bias(es)</td>
<td>16</td>
<td>Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)</td>
<td>15-16</td>
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<td>Confidence in cumulative evidence</td>
<td>17</td>
<td>Describe how the strength of the body of evidence will be assessed (such as GRADE)</td>
<td>16</td>
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</table>

* It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.

SUPPLEMENTARY MATERIAL 2 – Search strategies

Database Portal da BVS e Lilacs <April, 2022> Results: 548 (Portal da BVS) e 16 (Lilacs). Search Strategy

1. “Transtorno Autístico” or “Autistic Disorder”
2. “Autismo” or “Autism”
3. “Autismo Infantil” or “Child Autism”
4. “Transtorno do Espectro Autista” or “Autism Spectrum Disorder” or “Transtorno do Espectro do Autismo”
5. or/1-4
6. Antipsicóticos
7. “Agente Antipsicótico” or “Antipsychotic Agents”
8. “Agente Neuroléptico” or “Medicamento Neuroléptico” or “Medicamento Antipsicótico”
9. “Agentes Antipsicóticos”
10. “Droga Antipsicótica” or “Drogas Antipsicóticas”
11. “Fármaco Antipsicótico”
12. “Droga Neuroléptica” or “Fármaco Neuroléptico”
13. “Efeito Antipsicótico”
15. “Risperidona” or “Risperidone”
16. Aripiprazol or aripiprazole
17. Clozapina or clozapine
18. Lurasidona or lurasidone
19. Quetiapina or quetiapine
20. Olanzapina or olanzapine
21. Ziprasidona or ziprasidone
22. Paliperidona or paliperidone
23. Brexiprazol or brexiprazone
24. Asenapina or asenapine
25. Cariprazina or cariprazine
26. Iloperidona or iloperidone
27. Lumateperona or lumateperone
28. Pimavanserina or pimavanserine
29. or/6-28
30. 5 AND 29

Database MEDLINE <April, 2022> Results: 1303. Search Strategy

1. “Autistic Disorder” or “(Disorder, Autistic)” or “(Disorders, Autistic)”
2. “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early”
3. “Autism Spectrum Disorder” or “Autism Spectrum Disorders” or “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum” or “Autistic Disorder” or “Autism Spectrum Disorder” or “Disorder, Autistic” OR “Disorders, Autistic”
4. “Child Development Disorders, Pervasive”
5. “Asperger Syndrome”
6. “Kanner's Syndrome” or “Kanner Syndrome” or “Kanners Syndrome”
7. “Autism, Infantile” or “Infantile Autism” or Autism or “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early” or “Autism Spectrum Disorders”
8. “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum”
9. “Pervasive Child Development Disorders” or “Pervasive Development Disorders”
10. “Syndrome, Asperger” or “Asperger's Disease” or “Asperger's Diseases” or “Aspergers Disease” or “Asperger Disease” or “Asperger Diseases” or “Disorder, Asperger” or “Disorder, Asperger's” or “Disorder, Aspergers” or “Disorder, Asperger's Syndrome” or “Disorder, Aspergers Syndrome”
11. or/1-10
12. “Tranquilizing Agents, Major” or “Major Tranquilizing Agents” or “Major Tranquilizer” or “Tranquilizer, Major”
13. “Antipsychotic Drug” or “Drug, Antipsychotic” or “Antipsychotic Agent” OR “Agent, Antipsychotic”
14. “Antipsychotic Medication” or “Medication, Antipsychotic”
15. “Neuroleptic Agent” or “Agent, Neuroleptic” or “Neuroleptic Drug” or “Drug, Neuroleptic” or Neuroleptic or Antipsychotic
16. “Antipsychotic Drugs” or “Dopamine Antagonists” or “Dopamine Receptor Antagonists” or “Dopaminergic Antagonists” or “Dopaminergic Antagonist” or “Dopamine Blockers” or Blockers, Dopamine or “Dopamine Receptor Antagonists” or “Receptor Antagonists, Dopamine” or “Dopamine Blocker” or “Blocker, Dopamine” or “Dopamine Receptor Antagonist” or “Antagonist, Dopamine Receptor” or “Antagonist, Dopamine” or “Dopaminergic Antagonist” or “Antagonist, Dopaminergic” or “Dopaminergic Antagonists” or “Dopamine Antagonist” or “Antagonist, Dopamine”
18. aripiprazole
10. 'tranquillizing agents, major' or 'major tranquillizing agents' or 'major tranquilizer' or 'tranquilizer, major'
11. 'antipsychotic drug' or 'drug, antipsychotic' or 'antipsychotic agent' or 'agent, antipsychotic' or 'antipsychotic medication' or 'medication, antipsychotic'
12. 'neuroleptic agent' or 'agent, neuroleptic' or 'neuroleptic drug' or 'drug, neuroleptic' or 'neuroleptic'
13. antipsychotic or 'antipsychotic drugs' or antipsychotics or 'major tranquilizers'
14. 'neuroleptic agents' or 'neuroleptic drugs' or neuroleptics
15. antipsychotic or 'antipsychotic effect' or 'effect, antipsychotic' or 'antipsychotic effects' or 'antipsychotic agents'
16. 'dopamine antagonists' or 'antagonists, dopamine' or 'antagonists, dopaminergic' or 'dopamine blockers' or 'blockers, dopamine' or 'dopamine receptor antagonists' or 'receptor antagonists, dopamine' or 'dopamine blocker' or 'blocker, dopamine' or 'dopamine receptor antagonist' or 'antagonist, dopamine receptor' or 'receptor antagonist, dopamine' or 'dopaminergic antagonist' or 'antagonist, dopaminergic' or 'dopaminergic antagonists' or 'dopamine antagonist' or 'antagonist, dopamine'
17. aripiprazole
18. clozapine
19. lurasidone
20. quetiapine
21. olanzapine
22. risperidone
23. ziprasidone
24. brexiprazole
25. asenapine
26. cariprazine
27. iloperidone
28. Lumateperone
29. pimavanserine
30. or/10-31
31. 9 AND 32
32. or/10-31
33. 9 AND 32

Database CINAHL <April, 2022> Results: 1800. Search strategy

1. “Autistic Disorder” or “(Disorder, Autistic)” or “(Disorders, Autistic)”
2. “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early”
3. “Autism Spectrum Disorder” or “Autism Spectrum Disorders” or “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum” or “Autistic Disorder” or “Autism Spectrum Disorder” or “Disorder, Autistic” OR “Disorders, Autistic”
4. “Child Development Disorders, Pervasive”
5. “Asperger Syndrome”
6. “Kanner’s Syndrome” or “Kanner Syndrome” or “Kanners Syndrome”
7. “Autism, Infantile” or “Infantile Autism” or Autism or “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early” or “Autism Spectrum Disorders”
8. “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum”
9. “Pervasive Child Development Disorders” or “Pervasive Development Disorders”
10. “Syndrome, Asperger” or “Asperger’s Disease” or “Asperger’s Diseases” or “Aspergers Disease” or “Disease, Asperger’s” OR “Diseases, Asperger’s” or ‘Asperger Disease” or “Asperger Diseases” or “Disease, Asperger” or “Diseases, Asperger” or “Asperger Disorder” or “Asperger Disorders” or “Disorder, Asperger” or “Disorders, Asperger” or “Asperger’s Disorder” or “Aspergers Disorder” or “Disorder, Asperger’s” or “Asperger’s Syndrome” or “Aspergers Syndrome” or “Syndrome, Asperger’s”
11. or/1-10
12. “Tranquillizing Agents, Major” or “Major Tranquilizing Agents” or “Major Tranquilizer” or “Tranquilizer, Major”
13. “Antipsychotic Drug” or “Drug, Antipsychotic” or “Antipsychotic Agent” OR “Agent, Antipsychotic”
14. “Antipsychotic Medication” or “Medication, Antipsychotic”
15. “Neuroleptic Agent” or “Agent, Neuroleptic” or “Neuroleptic Drug” or “Drug, Neuroleptic” or Neuroleptic or Antipsychotic
16. “Antipsychotic Drugs” or Antipsychotics or “Major Tranquilizers” or “Neuroleptic Agents” or “Neuroleptic Drugs” or Neuroleptics or “Tranquilizing Agents, Major” or “Major Tranquilizing Agents”
17. “Antipsychotic Effect” or “Effect, Antipsychotic” or “Antipsychotic Effects” or “Antipsychotic Agents”
18. “Dopamine Antagonists” or “Antagonists, Dopamine” or “Antagonists, Dopamine Receptor” or “Antagonists, Dopaminergic” or “Dopamine Blockers” or “Blockers, Dopamine” or “Dopamine Receptor Antagonists” or “Receptor Antagonists, Dopamine” or “Dopamine Blocker” or “Blocker, Dopamine” or “Dopamine Receptor Antagonist” or “Antagonist, Dopamine” or “Dopamine Receptor” or “Receptor Antagonist, Dopamine” or “Dopaminergic Antagonist” or “Antagonist, Dopaminergic” or “Dopaminergic Antagonists” or “Dopamine Antagonist” or “Antagonist, Dopamine”
19. aripiprazole
20. clozapine
21. lurasidone
22. quetiapine
23. olanzapine
24. risperidone
25. ziprasidone
26. paliperidone
27. brexiprazole
28. asenapine
29. cariprazine
30. iloperidone
31. Lumateperone
32. pimavanserine
33. or/12-32
34. 11 AND 33

Database PSYCINFO <April, 2022> Results: 1898. search strategy

1. “Autistic Disorder” or “(Disorder, Autistic)” or “(Disorders, Autistic)”
2. “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early”
3. “Autism Spectrum Disorder” or “Autism Spectrum Disorders” or “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum” or “Disorder, Autism” OR “Disorders, Autistic”
4. “Child Development Disorders, Pervasive”
5. “Asperger Syndrome”
6. “Kanner's Syndrome” or “Kanner Syndrome” or “Kanners Syndrome”
7. “Autism, Infantile” or “Infantile Autism” or Autism or “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early” or “Autism Spectrum Disorders”
8. “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum”
9. “Pervasive Child Development Disorders” or “Pervasive Development Disorders”
10. “Syndrome, Asperger” or “Asperger's Disease” or “Asperger's Diseases” or “Aspergers Disease” or “Disease, Asperger's” OR “Diseases, Asperger's” or “Asperger Disease” or “Asperger Diseases” or “Disease, Asperger” or “Diseases, Asperger” or “Asperger Disorder” or “Asperger Disorders” or “Disorder, Asperger” or “Disorders, Asperger” or “Asperger's Disorder” or “Aspergers Disorder” or “Disorder, Asperger's” or “Asperger's Syndrome” or “Aspergers Syndrome” or “Syndrome, Asperger's”
11. or/1-10
12. “Tranquillizing Agents, Major” or “Major Tranquillizing Agents” or “Major Tranquilizer” or “Tranquilizer, Major”
13. “Antipsychotic Drug” or “Drug, Antipsychotic” or “Antipsychotic Agent” OR “Agent, Antipsychotic”
14. “Antipsychotic Medication” or “Medication, Antipsychotic”
15. “Neuroleptic Agent” or “Agent, Neuroleptic” or “Neuroleptic Drug” or “Drug, Neuroleptic” or Neuroleptic or Antipsychotic
16. “Antipsychotic Drugs” or Antipsychotics or “Major Tranquilizers” or “Neuroleptic Agents” or “Neuroleptic Drugs” or Neuroleptics or “Tranquilizing Agents, Major” or “Major Tranquilizing Agents”
17. “Antipsychotic Effect” or “Effect, Antipsychotic” or “Antipsychotic Effects” or “Antipsychotic Agents”
18. “Dopamine Antagonists” or “Antagonists, Dopamine” or “Antagonists, Dopamine Receptor” or “Antagonists, Dopaminergic” or “Dopamine Blockers” or “Blockers, Dopamine” or “Dopamine Receptor Antagonists” or “Receptor Antagonists, Dopamine” or “Dopamine Blocker” or “Blocker, Dopamine” or “Dopamine Receptor Antagonist” or “Antagonist, Dopamine” or “Dopaminergic Antagonists” or “Dopamine Antagonist” or “Antagonist, Dopamine”
19. aripiprazole
20. clozapine
21. lurasidone
22. quetiapine
23. olanzapine
24. risperidone
25. ziprasidone
26. paliperidone
27. brexiprazole
28. asenapine
29. cariprazine
30. iloperidone
31. Lumateperone
32. pimavanserine
33. or/12-32
34. 11 AND 33

Database Cochrane <April, 2022> Results: 459. Search strategy

1. Autism or “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early”
2. “Autism Spectrum Disorder” or “Autism Spectrum Disorders” or “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum” or “Autistic Disorder” or “Autism Spectrum Disorder”
3. or/1-2
4. aripiprazole
5. clozapine
6. lurasidone
7. quetiapine
8. olanzapine
9. risperidone
10. ziprasidone
11. paliperidone
12. brexiprazole
13. asenapine
14. cariprazine
15. iloperidone
16. Lumateperone
17. pimavanserine
18. “Antipsychotic Drug” or “Drug, Antipsychotic”
19. “Antipsychotic Agent” or “Agent, Antipsychotic”
20. “Antipsychotic Medication” OR “Medication, Antipsychotic”
21. or/4-20
22. 3 AND 21

Database EPISTEMONIKOS <April, 2022> Results: 800. Estratégia de busca

1. Autism or “Autism, Early Infantile” or “Early Infantile Autism” or “Infantile Autism, Early”
2. “Autism Spectrum Disorder” or “Autism Spectrum Disorders” or “Autistic Spectrum Disorder” or “Autistic Spectrum Disorders” or “Disorder, Autistic Spectrum” or “Disorder, Autistic Spectrum Disorder” or “Autistic Disorder” or “Autism Spectrum Disorder”
3. or/1-2
4. Risperidone
5. aripiprazole
6. clozapine
7. lurasidone
8. quetiapine
9. olanzapine
10. risperidone
11. ziprasidone
12. paliperidone
13. brexiprazole
14. asenapine
15. cariprazine
16. iloperidone
17. Lumateperone
18. pimavanserine
19. “Antipsychotic Drug” or “Drug, Antipsychotic”
20. “Antipsychotic Agent” or “Agent, Antipsychotic”
21. “Antipsychotic Medication” OR “Medication, Antipsychotic”
22. or/4-21
23. 3 AND 22

CLINICAL TRIALS <April, 2022> Results: 192. Search strategy

1. Autism
2. Antipsychotic
3. 1 AND 2

WHO International Clinical Trials Registry Platform <April, 2022> Results: 126. Search strategy

1. Autism
2. Antipsychotic
3. 1 AND 2

EU Clinical Trials Register <April, 2022> Results: 100. Search strategy

1. Autism
2. Antipsychotic
3. 1 AND 2

Portal CAPES (Teses e Dissertações) <April, 2022>. Results: 619. Search strategy

1. Autismo
2. Antipsicótico
3. 1 AND 2
4. Filtro: Ciências da Saúde

ProQuest <April, 2022>. Results: 80. Search strategy
1. Autism
2. Antipsychotic
3. 1 AND 2

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SUPPLEMENTARY MATERIAL 3 - Journals and Conference

- International Congress on Psychopharmacology;
- Annual Meeting of the American Academy of Child & Adolescent Psychiatry;
- European Congress of Psychiatry;
- European College of Neuropsychopharmacology Congress;
- International Congress on Psychopharmacology and International Symposium on Child and Adolescent Psychopharmacology;
- International Congress of European Society for Child and Adolescent Psychiatry
- World Congress of the International Association for Child and Adolescent Psychiatry and Allied Professions;
- International Conference on Pharmacoepidemiology and Therapeutic Risk
- World Congress of the International Association for the Scientific Study of Intellectual and Developmental Disabilities;
- Annual Meeting of the College of Psychiatric and Neurologic Pharmacists;
- Annual Conference of the American College of Neuropsychopharmacology;
- Annual National Institute of Mental Health;
- Annual Meeting of the International College of Spectrum Disorders.