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The prevalence and correlates of mental and neurodevelopmental disorders among deaf children and adolescents: a systematic review protocol

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The prevalence and correlates of mental and neurodevelopmental disorders among deaf children and adolescents: a systematic review protocol

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TITLE: The prevalence and correlates of mental and neurodevelopmental disorders among deaf children and adolescents: a systematic review protocol

ABSTRACT

Introduction

There are a paucity of studies estimating the prevalence of mental and neurodevelopmental disorders among deaf children and adolescents. Existing studies suggest that the prevalence of these disorders is 2-3 times higher among deaf children and adolescents compared to hearing comparison groups of the same age. However, prevalence figures tend to vary widely from 19% to 77%. The objective of this review is to systematically examine and summarize evidence on mental and neurodevelopmental disorders among deaf children and adolescents.

Methods and analysis

We will conduct a systematic search of the following electronic data bases to identify published observational epidemiological studies on the prevalence of mental and neurodevelopmental disorders among deaf children and adolescents: EBSCOhost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS and Web of Science. The search terms we use will be related to mental and neurodevelopmental disorders as well as deaf children and adolescents. Two reviewers will review and extract data from each article independently and then meet face-to-face for consensus. Additionally, the same two reviewers will assess overall study quality and risk of bias using a quality appraisal scale. We will then synthesize the evidence from different studies to produce a narrative review that summarizes existing evidence on mental and neurodevelopmental disorders among deaf children and adolescents.

Ethics and dissemination

This systematic review will use publicly available data and therefore does not require a direct ethical review. The protocol was however submitted for ethics waiver clearance with Stellenbosch University Health Research Ethics Committee. The protocol will be disseminated in a peer-reviewed journal. We will register the protocol through the PROSPERO International Prospective Register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO). A registration number will be updated after registration.

Strengths and limitations of this study

Strengths

- To our knowledge this will be the first systematic literature review conducted on this topic.
- Data synthesis and analysis will be based on a thorough assessment of methodological quality and risk of bias using a Systematic Appraisal of Quality in Observational Research (SAQOR) tool to ensure that studies are appraised and analyzed to their methodological rigor.

Limitations

- This review will be restricted to English articles only.
- Due to the paucity of research on this topic, older studies may need to be included.
- If most of the studies are cross-sectional, we will have limited opportunity to infer causality.

INTRODUCTION

Background

Deaf adults, adolescents and children are at higher risk of the onset of mental and neurodevelopmental disorders when compared to hearing individuals (1–10).

To our knowledge, there are no meta-analyses or systematic reviews of correlates of the onset of mental and neurodevelopmental disorders in deaf individuals. However, observational epidemiological and qualitative studies suggest there may be several reasons for the onset of these disorders in this group including damage to the central nervous system, cognitive impairment, additional disabilities, low socio-economic status, social exclusion, bullying and neglect or abuse (11–20).

Further, there could be other correlates of mental disorders among deaf children and adolescents including type of hearing loss, degree of hearing loss, age of diagnosis, delay in language acquisition, differences in communication (e.g. sign versus oral), quality of parent-child communication and type of educational context (e.g. mainstream or special school for the deaf) (21–28).

Given that there is no summary to date on the evidence of mental disorders in deaf people, we plan to conduct a systematic review to collate the current state of the evidence.

OBJECTIVES

The objective of this review is therefore to systematically examine and summarize observational epidemiological evidence of prevalence and correlates of mental and neurodevelopmental disorders among deaf children and adolescents.

METHODS AND ANALYSIS

Types of studies

This review will be restricted to peer-reviewed, English, observational epidemiological studies that investigate the prevalence and correlates of mental and neurodevelopmental disorders among deaf children and adolescents up to 18 years of age. Studies from high and low-income countries will be included.

Search methods for identification of studies

We will conduct a systematic search of the following electronic data bases EBSCOHost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS and Web of Science. We have developed a search strategy that will be adapted to different search engines (see Table 1 on a separate sheet). The search strategy will include both free text and Medical Subject Headings (MeSH) terms. Duplicate articles generated by the search engines will be removed. In addition to database search results, reference sections of the identified journal articles will also be reviewed to identify any relevant articles that were missed by search engines. We will also use citation indices to follow up on articles which cite earlier articles found through our search.

Exclusion criteria

This systematic review will exclude unpublished articles, opinion pieces, case and narrative reports as well as qualitative studies and randomized controlled trials (RCTs). Publications that do not have primary data as well as a clear description of the methods used will also be excluded. In cases where studies analyzing the same data are published in more than one journal, we will include only the most recent and complete publication.

Data collection and analysis

Selection of studies to be included in the review

The selection of studies to be included in the systematic review will follow a rigorous screening process to ensure adherence to inclusion criteria. Two reviewers will independently collect data. Working in pairs, we will then go through a thorough four stage screening process following PRISMA guidelines. The first stage will include a detailed search of articles from the eight search engines as well as reference sections of studies, and removal of duplicates which may occur due to the same article appearing in multiple databases. This will be followed by a screening process through the review of publication titles and abstracts to retain only eligible articles as per criteria. In the same pairs, we will then independently review full-text articles of potentially eligible studies we selected in the first review in detail and exclude studies that do not meet the inclusion criteria. We will document reasons for exclusion of each article. All articles that meet the inclusion criteria will be included for the systematic review. Any discrepancies will be addressed through

discussions with the third expert. Details of the study selection process is shown on a PRISMA flowchart (see Figure 1).

Data extraction and management

We will extract data from included studies using a data extraction table that we developed to summarize key study characteristics, findings and conclusions (see Table 2 on a separate sheet). Data to be extracted will include study details (authors, title, year of publication, country of study), methodology (study design, disorders assessed, correlates assessed, inclusion and exclusion criteria, study setting, population or sample size, age of participants, type of hearing loss, details of comparison group, informants, instruments used) and findings.

Quality appraisal and assessment of bias

The included studies will be assessed for methodological quality and risk of bias using a Systematic Appraisal of Quality in Observational Research (SAQOR) tool. The tool has 6 sections as follows: sample, control/ comparison group, exposure/outcome measurements, follow up, confounders and reporting of data. Each section has 2 to 5 questions. In this study, we will omit the follow up domain as it is not applicable for cross-sectional studies (see Table 3 on a separate sheet). In conducting the quality assessment, we will summarize the findings under each section and then determine an overall grade/ rank for each study based on domain or section findings. Assessed studies will then be ranked for overall quality as either high, moderate or low.

Data synthesis and analysis

The data analysis methods will largely employ qualitative synthesis of extracted data from included studies to provide a synthesized summary of evidence on the prevalence of mental disorders among deaf children and adolescents. A summary of the methodology and results of each of the included studies will also be summarized in a tabular form. We will then summarize these findings in the form of a systematic review report.

Patient and public involvement

This study involves a review of publicly available peer reviewed papers with no direct involvement of patients, so no patients were directly involved in the study.

ETHICS AND DISSEMINATION

This systematic review will use publicly available peer-reviewed data from the eight identified search engines (EBSCOHost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS, Web of Science) and therefore will not require a direct ethical review but an ethics waiver. The systematic review protocol was submitted for ethics waiver clearance with the Stellenbosch University Health Research Ethics Committee as part of a larger study. The findings from this review will be disseminated through peer-reviewed publications.

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Authors' contributions

BS, LS and SM contributed to the conception of the study. The protocol was drafted by BS and reviewed by LS and SM. BS and RK will screen all potential studies and extract data from the included studies independently. BS and RK will also assess the risk of bias. BS will conduct data synthesis. LS and SM will arbitrate any review differences and ensure quality assurance during the research process.

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Competing interest statement

None.

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Table 1: Search terms

Concept A: Mental Disorders and Neurodevelopmental Disorders	AND Concept B: Deafness	AND Concept C: Child/adolescent
Within Concept A, terms used will include:	Within Concept B, terms used will include:	Within Concept C, terms used will include:
mental disord* OR mental illness OR emotional disord* OR neurodevelopmental disord* OR intellectual disab* mental handicap OR mental retardation OR cognitive impair* OR OR autism* OR aspergers OR attention deficit disord* OR ADD OR ADHD OR learning disord* OR tic disord* OR tourette disord* OR psychotic disord* OR schizo* OR dysregulated mood disord* OR mood disord* OR bipolar disord* OR manic depression OR cyclothymic disord* OR depressive disord* OR depression OR anxiety disord* OR separation anxiety disord* OR panic disord* OR agoraphobia OR obsessive compulsive disord* OR OCD OR body dysmorphic disord* OR hoarding disord* OR trichotillomania OR excoriation OR skin-picking disord* OR trauma disord* OR attachment disord* OR adjustment disord* OR post-traumatic stress disord* OR stress disord* OR dissociative disord* OR somatic disord* OR feed disord* OR eating disord* OR pica OR rumination disord* OR anorexia OR bulimia OR elimination disord* OR enuresis OR encopresis OR sleep disord* OR insomnia OR narcolepsy OR sexual disord* OR gender dysphoria OR gender identity disord* OR disruptive behavior disord* OR impulse control disord* OR conduct disord* OR oppositional defiant disord* OR pyromania OR kleptomania OR substance disord* OR alcohol disord* OR personality disord* OR factitious disord* OR psychopath*	Deaf OR deaf* OR hard of hearing OR hearing impair* OR PCHI	Child* OR adolesc* OR juvenile* OR youth OR toddler OR pubescent OR infan*

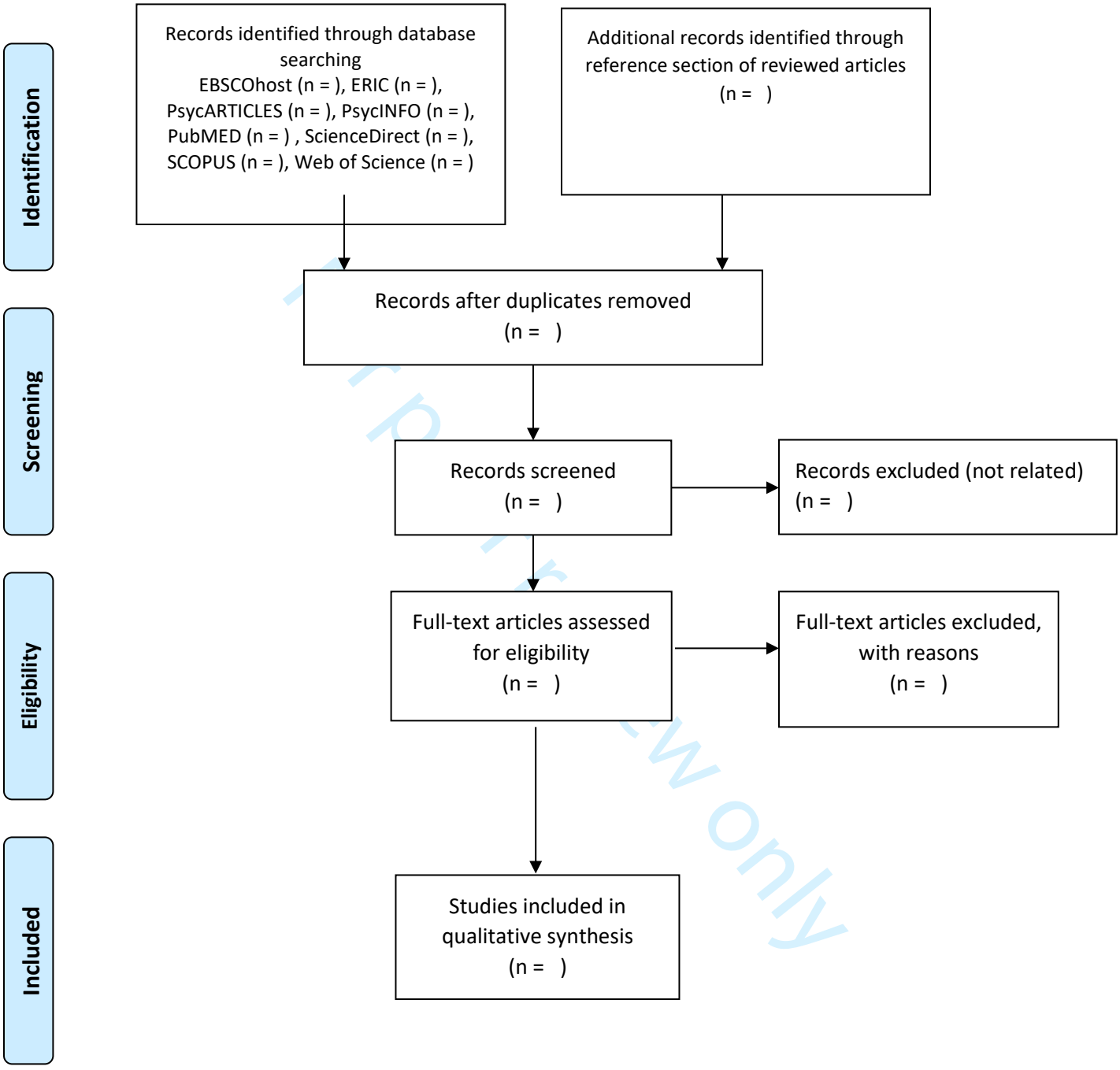
Table 2: Data extraction table

Study Details				Methodology													Findings	
Authors	Title	Year	Country	Study design	Disorders assessed	Correlates assessed	Inclusion criteria	Exclusion criteria	Setting	Sample Size	Age	Type of HL	Comparison group	Informant for disorder	Informant for correlate	Instruments used to measure disorder	Instruments used to measure correlate	Findings WRT disorders	Findings WRT correlates

Table 3: Quality assessment of papers included in systematic review

Paper	Sample	Exposure/outcome variables	Cofounders	Reporting of data	Overall quality

Figure 1: PRIMSA 2009 flow diagram of the study selection process



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

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Title: The prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents: a systematic review protocol

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Key words: EPIDEMIOLOGY, mental disorders, child & adolescent psychiatry, deafness, prevalence

Word count: 2383

ABSTRACT

Introduction

Little is known of the prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents. Research suggests that this is a vulnerable population group at high risk of these disorders. However, little is known of correlates of prevalence estimates of these mental disorders and it seems that heterogenous tools have been used to examine these estimates. Given the heterogeneity of studies measuring the prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents, we seek to systematically examine and synthesize observational epidemiological evidence in this area to articulate a more detailed account of these symptoms and disorders and their correlates among this population group.

Methods and analysis

We will conduct a systematic search of the following electronic data bases to identify published observational epidemiological studies examining the prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents: EBSCOhost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS and Web of Science. As research in this area is limited, eight data bases have been included to widen our search to include as many articles as possible. The search terms will be related to mental and neurodevelopmental symptoms and disorders as well as deaf children and adolescents. Two reviewers will review and extract data from each article independently and, where relevant, discuss differences to reach consensus. Additionally, the reviewers will assess overall study quality and risk of bias using a quality appraisal scale. Findings from studies will be synthesized to produce a quantitative review that summarizes existing evidence on mental and neurodevelopmental symptoms and disorders among deaf children and adolescents, and their correlates. The publication date of studies will not be restricted so that as much data as possible that fits our inclusion criteria can be included. We will conduct our searches between August 2020 and March 2021.

Ethics and dissemination

This systematic review will use publicly available data and therefore does not require a direct ethical review. The protocol was however submitted for ethics waiver clearance with Stellenbosch University Health Research Ethics Committee. The protocol will be disseminated in a peer-reviewed journal. The review protocol was registered with the PROSPERO International Prospective Register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO) (registration number CRD42020189403).

Strengths and limitations of this study

Strengths

- To our knowledge this is the first systematic review to synthesize rigorous prevalence and correlates of mental disorders in deaf children and adolescents.
- Inclusion criteria have been devised by a team of experienced researchers.
- Data synthesis and analysis will be based on a detailed assessment of methodological quality and risk of bias.

Limitations

- If most of the studies are cross-sectional, we will have limited opportunity to infer causality or risk factors for the onset of mental disorders in deaf children and adolescents.
- We anticipate a paucity of research in the area and thus may have to include older studies.

INTRODUCTION

Background

Research suggests that deaf children and adolescents are at high risk of mental and neurodevelopmental disorders with prevalence figures ranging between 19% to 77%. Despite the wide range these estimates present, they do suggest that the risk of mental disorders might be higher among deaf children and adolescents compared to hearing children and adolescents (1–9). Mental and neurodevelopmental disorders include intellectual disabilities, autism spectrum disorder, mood disorders, schizophrenia spectrum and psychotic disorders, and trauma and stress related disorders, classified by the Diagnostic and Statistical Manual of Mental Disorders (DSM), the International Classification of Diseases (ICD) or similar manuals used in the study country.

Generalization of these findings is however difficult, as studies seem to vary widely on the range of symptoms and disorders assessed, the instruments used to assess symptoms and disorders, sample characteristics and research participants. Some studies base results on questionnaires or checklists administered to parents and teachers (2,4,7,10) whilst others base findings on self-report questionnaires administered to adolescents (5,11). It is noteworthy that very few studies have based results on direct clinical assessments of deaf children and adolescents. Furthermore, sample characteristics in prevalence studies vary considerably in terms of etiology of deafness, type and degree of hearing loss, age of hearing-impaired diagnosis, primary language, use of assistive device, educational level, and any coexisting disabilities or comorbidities.

Although studies report a high prevalence of mental and neurodevelopmental symptoms and disorders among this group, very few studies investigate the types of disorders that affect this group. Those that do, find deaf children and adolescents at risk of depression, anxiety, oppositional defiant disorder, conduct disorder, attention deficit hyperactivity disorder, psychosis, somatoform disorder and pain disorder (7,9).

The causes of mental and neurodevelopmental disorders also remain unknown, as studies tend to focus on correlates which vary widely among studies. Correlates that have been reported include: communication and developmental delays (12), quality of parent-child communication (13) , early detection of hearing loss (14), degree of hearing loss (15,16), secondary disabilities (1,2,17), maternal stress (2,18), physical and sexual abuse (19,20), teasing and bullying (15) and type of school attended (21). To further our understanding of the additional difficulties experienced by deaf children and adolescents, it is important to quantify and synthesize the findings to date.

Given the heterogeneity of studies measuring the prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents, we seek to systematically examine and synthesize observational epidemiological evidence in this area. In doing so we wish to examine and synthesize prevalence estimates and their correlates among this population group. To our knowledge there are two published systematic reviews related to mental disorders in deaf children and adolescents: the first focuses on behaviour problems in deaf children and the interventions used to address these problems (22), and the second is limited to studies measuring emotional and behaviour problems among deaf children using one assessment tool, the Strengths and Difficulties Questionnaire (SDQ) (23). Thus, while these reviews are valuable, their

contribution is limited to an explication of behavioural problems in this population, and their prevalence as assessed by the SDQ.

OBJECTIVES

The objective of this review is to systematically examine and synthesize observational epidemiological evidence of prevalence and correlates of mental and neurodevelopmental symptoms and disorders among deaf children and adolescents, thereby providing an in-depth examination of prevalence estimates and correlates among this population group.

METHODS AND ANALYSIS

Types of studies

We summarize our inclusion and exclusion criteria in Table 1. Our review will include English and non-English studies from high, middle, and low-income countries. The specific inclusion criteria for this review include; 1) peer-reviewed, 2) observational, 3) cross-sectional and, 4) cohort studies, that 5) investigate the prevalence and, where available, correlates of mental and neurodevelopmental symptoms and disorders among all subgroups of school going deaf children and adolescents (typically six to eighteen years of age) 6) using validated questionnaires or standardized psychiatric assessments administered to 7) parents, teachers, clinicians, or children to assess mental health. The various instruments and informants used will be specified in our data extraction table and in the article. We are aware that in some countries, deaf individuals may not reach the level of their hearing peers and can attend school past the age of eighteen. We will include participants older than eighteen years of age in our study on condition that they are still attending school.

Type of participants

All subgroups of school-going deaf participants will be included. Subgroups include individuals with coexisting disabilities (developmental, physical or otherwise), congenital or post-lingual hearing loss, mild to profound hearing loss, oral or sign language communication users, participants with and without cochlear implants or hearing aids, and those attending mainstream

or specialized schooling. The different subgroups will be specified in our data extraction table and discussed in the review.

Types of variables to be measured

Exposure variables

The exposure variables will be all the correlates of mental and neurodevelopmental symptoms and disorders mentioned in the existing literature e.g. communication and developmental delays, quality of parent-child communication, early detection of hearing loss, degree of hearing loss, maternal stress, secondary disabilities, physical and sexual abuse, teasing and bullying and sociodemographic factors.

Outcome variables

The outcome variables will be all mental and neurodevelopmental symptoms and disorders as classified and defined by the DSM (all revisions thereof), the ICD (all revisions thereof), or similar manuals used in the study country (and revisions thereof), and assessed using validated instruments or standardized assessments. In our analysis we will distinguish between diagnostic outcomes according to DSM or other algorithms, and outcomes in terms of symptoms, which may or may not reach the threshold of diagnostic caseness. We anticipate that several studies will assess symptoms (by use, for example, of standard questionnaires) but will not have a formal assessment of diagnosis.

Search methods for identification of studies

We will conduct a systematic search of the following electronic data bases EBSCOHost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS and Web of Science. Eight data bases have been included to widen our search and to include as many articles as possible. We have developed a search strategy that will be adapted to different search engines (see Table 2). The search strategy will include both free text and Medical Subject Heading (MeSH) terms. Duplicate articles generated by the search engines will be removed. In addition to database search results, reference sections of the included journal articles will also be reviewed to identify any relevant articles that were missed by search engines. We will also use citation indices to follow up on articles which cite earlier articles found through our search. Restrictions on the publication date of studies that fit our inclusion criteria have not been imposed as our objective is to glean as much

evidence as possible on what we expect to be an under-researched field. We will conduct our searches between August 2020 and March 2021.

Exclusion criteria

This systematic review will exclude 1) grey literature, 2) unpublished articles, 3) opinion pieces, 4) case reports, 5) narrative reports, 6) qualitative studies, 7) case-control studies, 8) randomized controlled trials (RCTs) and, 9) publications that do not have primary data and a clear description of the methods used. In cases where studies analyzing the same data are published in more than one journal, we will only include the most recent and complete publication. Qualitative studies, RCTs and case-control studies have been excluded as they do not measure prevalence estimates.

Data collection and analysis

Selection of studies to be included in the review

The selection of studies to be included in the systematic review will follow a rigorous screening process to ensure adherence to inclusion criteria. Two reviewers will independently collect data. Working in pairs, we will go through a thorough four stage screening process following PRISMA guidelines. The first stage will include a detailed search of articles from the eight search engines and removal of duplicates which may occur due to the same article appearing in multiple databases. This will be followed by a screening process through the review of publication titles and abstracts to ensure that only eligible articles are retained as per the inclusion criteria. In the same pairs, we will then independently review the selected full-text articles of potentially eligible studies and exclude those that do not meet the full inclusion criteria. We will document reasons for excluding articles, whilst those that meet the full inclusion criteria will form part of the systematic review. We will address any discrepancies through discussions with the third expert. Details of the study selection process is shown on a PRISMA flowchart (see Figure 1).

Data extraction and management

We will extract data from included studies using a data extraction table developed to summarize key study characteristics, findings, and conclusions (see Table 3). Extracted data will include study details (author, year of publication, country of study), methodology (study type, inclusion, and exclusion criteria, sample size, instruments used to assess disorders and correlates, and study participants), sample characteristics (age, sex, coexisting disabilities, type and degree of hearing

loss, primary language use, use of cochlear implant or hearing aid, special or mainstream schooling) and findings (types and prevalence rates of disorders and their correlates and confidence intervals).

Quality appraisal and assessment of bias

We will assess the included studies for quality and risk of bias using the instrument developed by Giannakopoulos et al. (24). In comparison to other instruments (25–27) this instrument was chosen as it is specifically designed to assess quality in prevalence studies that use heterogeneous examination and diagnostic protocols. Moreover, this instrument is validated by an extensive literature review and expert consensus supporting its reliability for use in scientific reviews. Kappa and the Interrater Correlation Coefficient (ICC) was used to test interrater reliability. The latter was assessed on the results of three independent investigators. The ICC's ranged between 0.94 and 1.00 indicating near perfect agreement between the investigators. The instrument has 11 items that assess sampling, measurement, and analysis. It also allows for the calculation of a Total Quality Score (TQS) by totaling the points assigned to each of the items. The TQS ranges from 0–4 (poor), 5–9 (moderate), 10–14 (good), and 15–19 (outstanding). TQS scores will not be used to exclude studies but to comment on study quality. Quality appraisal and assessment of bias for each study will be summarized in tabular form and discussed in the review (see Table 4).

Data synthesis and analysis

The study design is quantitative. Extracted data from included studies will be quantified and synthesized to provide a summary of evidence on the prevalence of mental disorders among deaf children and adolescents. A summary of the methodology and results of each included study will also be summarized in tabular form. Finally, the summarized findings will be discussed in a systematic review of existing literature in the field.

Patient and public involvement

This study involves a review of publicly available published peer reviewed papers. We did not directly include PPI in this study.

ETHICS AND DISSEMINATION

This systematic review will use publicly available peer-reviewed data from the eight identified search engines (EBSCOHost, ERIC, PsycARTICLES, PsycINFO, PubMED, ScienceDirect, SCOPUS, Web of Science) and will therefore not require an ethical review but an ethics waiver. The systematic review protocol was submitted for ethics waiver clearance with the Stellenbosch University Health Research Ethics Committee as part of a larger study. The findings from this review will be disseminated through peer-reviewed publications.

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Authors' contributions

BS, LS, and SM contributed to the conception of the study. The protocol was drafted by BS and reviewed by LS, RG and SM. BS and RG will screen all potential studies and extract data from the included studies independently. BS and RG will also assess the risk of bias. BS and RG will conduct data synthesis. LS and SM will arbitrate any review differences and ensure quality assurance during the research process.

Funding statement

This review received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interest statement

None declared.

Table 1: Inclusion and exclusion criteria

	INCLUDED	EXCLUDED
PUBLICATION TYPE	English and non-English.	Grey literature, unpublished articles, opinion pieces, case and narrative reports, publications that do not have primary data and a clear description of methods used.
	Any date.	
STUDY DESIGN	Peer reviewed systematic reviews, cross-sectional and cohort studies.	Randomized controlled trials and case-control studies.
STUDY POPULATION	All subgroups of school going deaf children and adolescents (typically aged six to eighteen years of age). Subgroups include individuals with coexisting disabilities (developmental, physical or otherwise), congenital or post lingual hearing loss, mild to profound hearing loss, oral or sign language communication users, participants with and without cochlear implants or hearing aids, and those attending mainstream or specialized schooling. We are aware that in some countries, deaf individuals may not reach the level of their hearing peers and can attend school past the age of eighteen. We will include participants older than eighteen years of age in our study on condition that they are still attending school.	Participants not attending school.
	Studies conducted in high, middle, and low-income countries.	
EXPOSURE VARIABLES	The exposure variables will be all the correlates of mental and neurodevelopmental symptoms and disorders mentioned in the existing literature e.g. communication and developmental delays, quality of parent-child communication, early detection of hearing loss, degree of hearing loss, maternal stress, secondary disabilities, physical and sexual abuse, teasing and bullying and sociodemographic factors.	
OUTCOME VARIABLES	The outcome variables will be all mental and neurodevelopmental symptoms and disorders as classified and defined by the DSM (all revisions thereof), the ICD (all revisions thereof), or similar manuals used in the study country (and revisions thereof) and assessed using validated instruments or standardized assessments.	All other disorders.
		Instruments that have not been validated and assessments that are not standardized.

Table 2: Search terms

Concept A: Mental Disorders and Neurodevelopmental Disorders	AND Concept B: Deafness	AND Concept C: Child/adolescent
Within Concept A, terms used will include:	Within Concept B, terms used will include:	Within Concept C, terms used will include:
("mental disord*" OR "mental illness" OR "emotional disord*" OR "neurodevelopmental disord*" OR "intellectual disab*" OR "mental handicap" OR "mental retardation" OR "cognitive impair*" OR autism* OR aspergers OR "attention deficit disord*" OR "attention deficit hyperactivity disord*" OR ADD OR ADHD OR "learning disord*" OR "tic disord*" OR "tourette disord*" OR "psychotic disord*" OR schizo* OR "dysregulated mood disord*" OR "mood disord*" OR "bipolar disord*" OR "manic depressive disord*" OR "manic depression" OR "cyclothymic disord*" OR "depressive disord*" OR depression OR suicide OR self-harm OR self-mutilation OR "anxiety disord*" OR "separation anxiety disord*" OR "selective mutism" OR "social anxiety disord*" OR "panic disord*" OR agoraphobia OR "generalized anxiety disord*" OR "obsessive compulsive disord*" OR OCD OR "body dysmorphic disord*" OR "hoarding disord*" OR trichotillomania OR excoriation OR "skin-picking disord*" OR "trauma disord*" OR "stress disord*" OR "reactive attachment disord*" OR "attachment disord*" OR "disinhibited social engagement disord*" OR "post-traumatic stress disord*" OR "acute stress disord*" OR "adjustment disord*" OR "dissociative disord*" OR "dissociative amnesia" OR "depersonalization disord*" OR "derealization disord*" OR "somatic disord*" OR "illness anxiety disord*" OR "conversion disord*" OR "feeding disord*" OR "eating disord*" OR pica OR "rumination disord*" OR "avoidant food intake disord*" OR "anorexia nervosa" OR anorexia OR "bulimia nervosa" OR bulimia OR "binge eating disord*" OR enuresis OR encopresis OR "sleep disord*" OR insomnia OR "hypersomnolence disord*" OR narcolepsy OR "sex* disord*" OR "gender dysphoria" OR "gender identity disord*" OR "behavior disord*" OR "disruptive behavior disord*" OR "impulse control disord*" OR "conduct disord*" OR "oppositional defiant disord*" OR pyromania OR kleptomania OR "substance disord*" OR "substance related disord*" OR "alcohol disord*" OR "cannabis disord*" OR "hallucinogen disord*" OR "opioid disord*" OR "neurocognitive disord*" OR delirium OR "traumatic brain injury" OR "personality disord*" OR "schizo* personality disord*" OR "paranoid personality disord*" OR "factitious disord*" OR psychopath* OR sociopath* OR "antisocial personality disord*" OR "borderline personality disord*" OR "histrionic personality disord*" OR "narcissistic personality disord*" OR "avoidant personality disord*" OR "dependent personality disord*" OR "obsessive compulsive personality disord*")	(Deaf OR deaf* OR "hard of hearing" OR "deaf or hard of hearing" OR "deaf and hard of hearing" OR DHH OR "hearing impair*" OR "permanent childhood hearing loss" OR PCHL OR "sign language")	(Child* OR adolesc* OR juvenile* OR youth OR toddler OR pubescent OR infan*)

Table 3: Data extraction table

	Author	Year	Country	Study Type	Study Population	Inclusion Criteria	Exclusion Criteria	Sample Size	Instrument used to measure Disorders	Instrument administered to	Instrument used to measure Correlates	Instrument administered to	Age	Sex	Coexisting Disability	Congenital Hearing Loss	Post lingual Hearing Loss	Type of Hearing Loss	Degree of Hearing Loss	Primary Language Use	Cochlear Implant	Hearing Aid	Mainstream School	Special School	Prevalence rate of Disorder	Prevalence rate of Correlate	Confidence Interval	Type of Disorder	Type of Correlate
1																													
2																													
3																													
4																													

Table 4: Quality assessment of papers included in systematic review

	Study	Ethics commission approval?	Recruitment procedure	Sample power	Target pop. clearly defined?	Probability sampling used?	Do respondents match the target pop.?	Standardized data collection methods?	Reliable survey instruments?	Valid survey instruments?	Were special features accounted for?	Satisfactory confidence intervals?	Total Quality Score
1													
2													
3													
4													

Figure 1: PRISMA 2009 Flow Diagram

Figure 1: PRISMA 2009 Flow Diagram

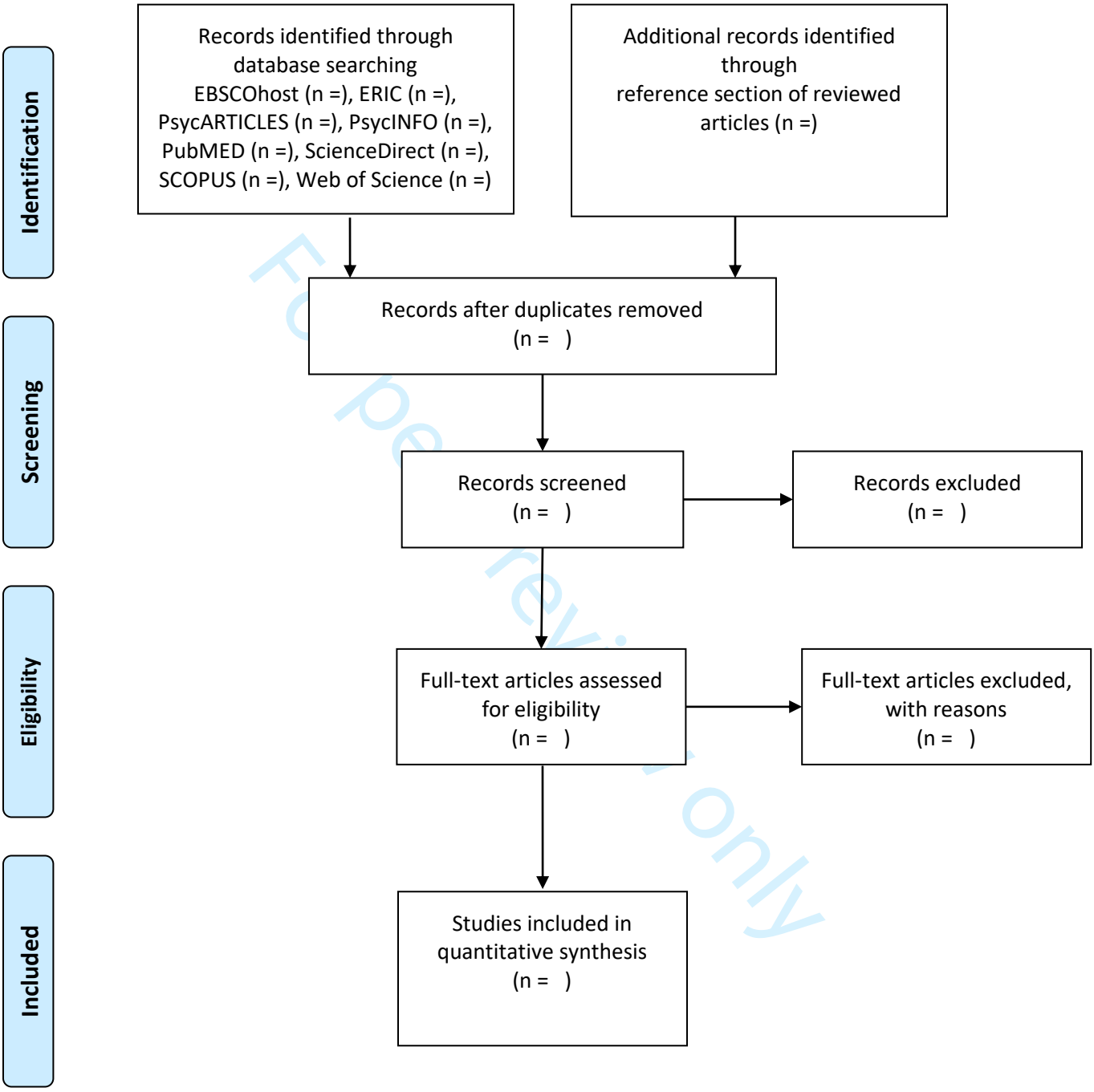

Figure 2: PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Our reference
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	Page 1 (Line 1 and 2)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	N/a
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	Page 4 (Line 34-36)
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Page 12 (Line 309-317)
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	Page 12 (Line 319-324)
Amendments	4	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	See Letter to Editor
Support:			
Sources	5a	Indicate sources of financial or other support for the review	Page 12 (Line 326-328)
Sponsor	5b	Provide name for the review funder and/or sponsor	N/a
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	N/a
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	Page 3 (Line 4-13) and page 2 (Line 48-89)
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	Page 4 (Line 91-95)
METHODS			
Eligibility criteria	8	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	Page 4 (Line 98-116) and page 13 (Line 336)
Information sources	9	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	Page 4 (Line 16-29) and page 5 (Line 133-145)

Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Page 14 (Line 338)
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Page 6 (Line 170-182) and page 15 (line 345)
Selection process	11b	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)	Page 1 (Line 22-27) and page 6 (Line 155-167)
Data collection process	11c	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	Page 6 (Line 170-182) and page 15 (Line 345)
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Page 5 (Line 118-123) We have defined all variables insofar as it is possible to do in advance – there may be correlates or exposure variables we have not anticipated
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	Page 5 (Line 124-132)
Risk of bias in individual studies	14	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	Page 7 (Line 184-197) and page 15 (Line 348)
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	Given the wide range of assessment tools used in the various studies, we will look at various analytical techniques once we have more information.
	15b	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 τ)	Given the wide range of assessment tools used in the various studies, we will look at various analytical techniques once we have more information.
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/a
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	N/a
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/a

Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	Page 7 (Line 184-197) We have described our approach to data quality but do not anticipate being able to make an overall assessment on the body of evidence given diversity of methods.

*** 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.**

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