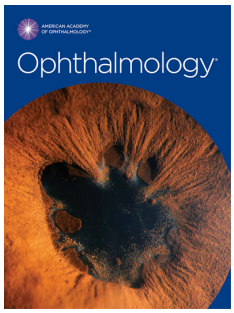

Impact of vision impairment and ocular morbidity and their treatment on depression and anxiety in children: A systematic review

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Running head: Vision impairment, Ocular morbidity, on children's mental health

Abbreviations and acronyms: CI (confidence interval), IQR (Interquartile Range), JBI (Joanna Briggs Institute), NIH (National Institutes of Health), OR (odds ratio), PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis), QoL (Quality of Life), RCT (randomized controlled trial), SD (standard deviation), SMD (standardised mean difference), USA (United States of America).

Keywords: Vision impairment; ocular morbidity; treatment; depression; anxiety; mental health; children

ABSTRACT

Topic:

This systematic review and meta-analysis summarizes existing evidence to establish whether vision impairment, ocular morbidity and their treatment are associated with depression and anxiety in children.

Clinical Relevance:

Understanding and quantifying these associations support early detection and management of mental health symptoms in children with vision impairment and ocular morbidity. Additionally, this review provides evidence in favour of insurance coverage for timely strabismus surgery.

Methods:

We searched nine electronic databases from inception to February 18, 2021, including observational and interventional studies assessing whether vision impairment and/or ocular morbidity and their treatment are associated with depression and/or anxiety in children. We used narrative synthesis and meta-analysis with the residual maximum likelihood method. A protocol was registered and published on The International Prospective Register of Systematic Reviews (PROSPERO, CRD42021233323).

Results:

Among 28,992 studies, 28,956 (99.9%) were excluded as duplicates or unrelated content. Among 36 remaining studies, 21 (58.3%) were observational studies concerning vision impairment, eight (22.2%) were observational studies concerning strabismus, and seven (19.4%) were interventional studies. Vision-impaired children experienced significantly higher scores of depression (Standard Mean Difference [SMD] 0.57, 95% Confidence Interval (CI) 0.26-0.89, 11 studies) and anxiety (SMD 0.61, 95% CI 0.40-0.821, 14 studies) than normally-sighted children. In particular, myopic children experienced higher scores of depression (SMD 0.59, 95% CI 0.36-0.81, six studies) than normally-sighted children. Strabismus surgery significantly improved symptoms of depression (SMD: 0.59 95% CI 0.12-1.06, three studies) and anxiety (SMD: 0.69 95% CI 0.24-1.14, four studies) in children.

Discussion:

Among children, vision impairment is associated with greater symptoms of depression and anxiety. Surgical treatment of strabismus improved these symptoms. Further randomized controlled trials exploring the impact of public health measures for myopia correction on mental health in children are needed. Scaling up access to strabismus surgery could improve the mental health of affected children.

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Introduction

Vision impairment (< 6/12) or blindness (< 3/60) affects at least 2.2 billion people worldwide, including an estimated 19 million children aged 0-14 years, among whom 1.4 million have irreversible blindness.[1,2] Children with vision impairment tend to participate in fewer physical activities,[3] have lower academic achievement,[4] and are more socially isolated.[5,6] Due to these reasons, vision impairment may adversely affect the mental health of children.[7] Depression and anxiety are two common psychiatric disorders associated with vision impairment.[8-11] An existing large body of work focuses on the impact of vision impairment on depression and anxiety in older adults. A recent systematic review found that the prevalence of depression among patients with vision impairment aged older than 65 years was 25%,[8] far higher than that among unaffected persons.[12] It is also estimated that 15.6% of older adults with vision impairment face sub-threshold anxiety, and 7.5% are diagnosed with anxiety disorders.[9]

While the prevalence of ocular morbidity, depression, and anxiety are lower among children compared to adults, the total burden of these conditions is higher due to the length of time children are affected if the underlying disorders are not identified and corrected. Furthermore, adolescents experiencing sub-threshold depressive symptoms have an increased risk of developing mental health problems, such as depression, anxiety, substance dependence, and suicide later in life.[13-16] However, studies investigating mental health in vision-impaired children are relatively few, and their findings are inconsistent. A previous systematic review found that the overall association between vision impairment and mental health among children and young adults was inconsistent due to differences in research aims, study design, and definitions of visual impairment between the included studies.[7]

Beyond vision impairment, common chronic ocular morbidities such as strabismus[17] may also cause adverse cosmetic, functional, and psychological consequences among children,[18-20] eventually affecting their development and maturation. Although much research has been conducted on the impact of strabismus on the quality of life (QoL) and mental health of adults, the effect of strabismus on children has not been extensively studied. A school-based study in China demonstrated that children with strabismus had a significantly higher prevalence of indicators of depression and anxiety than the healthy control group.[20] Several interventional studies have also shown that strabismus surgery offers not only cosmetic benefits, but also can improve the psychosocial health and QoL of children.[21-24]

All of these findings suggest a need to understand the impact of vision impairment, ocular morbidity and their treatment on depression and anxiety in children, providing evidence to guide policies such as insurance coverage for strabismus surgery, which in some countries is frequently excluded as a "cosmetic procedure". This systematic review analyses published literature to establish whether vision

impairment, ocular morbidity and their treatment are associated with depression and anxiety in children.

Methods

We followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) reporting guidelines[25] (PRISMA checklist-Supplementary File 1). A protocol was registered and published on The International Prospective Register of Systematic Reviews (PROSPERO, CRD42021233323).

Search Methods for Identifying Studies

We searched MEDLINE, Embase, Web of Science, PsycINFO, Cochrane Database of Systematic Reviews, and the Cochrane Central Register of Controlled Trials in the Cochrane Library, CINAHL and Chinese databases WANFANG MED ONLINE and China National Knowledge Infrastructure (CNKI) from inception to February 18, 2021, without language restriction. The search strategy was developed under guidance of an information specialist (RF). We tested the search strategy through an iterative process before finalising our combinations of terms (Supplementary File 2). The reference lists of relevant papers were checked for potentially relevant articles.

Eligibility Criteria

According to these criteria, the following types of studies were considered eligible for inclusion: (1) Studies that enrolled children or young adults, as long as the mean age of participants was <18 years. Studies focused on mental health in adults who had vision impairment (defined according to the International Classification of Diseases 11 (2018)[26], distance vision impairment comprises four levels: mild (presenting visual acuity < 6/12), moderate (presenting visual acuity <6/18), severe (presenting visual acuity <6/60) and blindness (presenting visual acuity <3/60). Thus, a participant falling into any of these categories (that is, with presenting visual acuity < 6/12) would be classified as having vision impairment) or ocular morbidity as children were also included in the narrative synthesis; (2) Observational and interventional studies, including randomized controlled trials (RCTs) and before-after studies with no control group. The intervention had to be ophthalmic; (3) Studies with a comparison group, such as normally sighted children; (4) Studies with outcome variables that included the prevalence and/or scores for depression and/or anxiety; (5) Any study setting was permitted. (6) Original studies published in peer-reviewed journals.

Study Selection, Data Collection, and Risk of Bias Assessment

Two reviewers (DL and HN) independently screened all titles and abstracts for eligibility. For potentially eligible studies, reviewers read the full-text articles to determine final inclusion or exclusion. Two reviewers (DL and SO) extracted data independently into an Excel file (version 2201,

Microsoft Corporation, Redmond, WA), while an additional two co-authors (NW and BX) reviewed data extraction forms for English and Chinese articles, respectively, to cross-check for accuracy and validity.

For observational studies, the extracted data consisted of the authors' names, publication year, study design, country, diagnosis, sample size, demographic characteristics of study participants (i.e. age, gender), the instruments used to measure depression and anxiety, and summary of findings. For interventional studies, beyond the characteristics listed above, we also recorded the type of intervention in each group and within- and between-group pre-post changes. Any disagreement was resolved by discussion within the research team. If data regarding the major outcomes were not presented in the article, we contacted the corresponding authors to obtain the raw dataset. In cases where authors could not be contacted despite three attempts, we excluded the studies from the meta-analysis and described them narratively.

The risk of bias and quality of studies were assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist for observational studies and RCTs and the relevant National Institutes of Health (NIH) (USA) quality assessment tool for other study designs. We identified six articles in languages other than English and Chinese (one each in Greek, Korean, Spanish, and Serbian; and two in Portuguese). After reviewing the abstracts, which were in English, we found that none of these studies included the outcome of interest and were therefore excluded.

Data Synthesis and Analysis

Mental health associations with vision impairment and ocular morbidities (i.e. strabismus), were reported separately because strabismus, being an observable condition, could affect children's mental health differently than unobvious causes of vision loss (e.g. amblyopia). We also reported the results separately from observational and interventional studies. We first described the study characteristics and meta-analysed the reported outcomes. Meta-analysis was conducted using the *meta* suite of commands in Stata statistical software (Version 17.0, Stata Corporation, College Station, TX, USA). Meta-analysis was carried out separately for studies reporting depression versus anxiety. A narrative synthesis was conducted for studies not eligible for meta-analysis.

Since various tools were used to measure depression and anxiety in different studies, standardised mean differences (SMD) were used in the pooled analyses. Nine out of the 15 studies covering vision impairment concerned myopia, and many did not specify the participants' visual acuity or the exact cause(s) of non-myopic impaired vision. It was thus not possible to perform subgroup analysis by level or exact cause of vision impairment, and instead, this was done stratifying by myopia versus other causes. A random-effects model was used due to heterogeneity between studies. A 'leave-one-out' sensitivity analysis was carried out to evaluate the relative impact of studies on the meta-analytic outcomes. Data were displayed using Forest plots for depression and anxiety separately.

Results

During initial database searches, 28988 articles were identified, while four studies were located using the reference lists of the identified studies. We excluded 8737 as duplicates. After abstract/title screening, 70 articles were eligible for full-text evaluation, after which a further 34 articles were excluded. In total, 36 studies were included in the systematic review (Figure 1).[6,20-24,27-56]

Insert Figure 1 here

Study Characteristics

Of the 36 included studies, 21 (58.3%) observational studies concerned vision impairment, eight observational studies (22.2.%) concerned strabismus, and the remaining seven (19.4%) were interventional studies. The 21 observational studies concerning vision impairment enrolled 7,064 participants (mean sample size n=346, standard deviation (SD)=363, range: 52–1407) and were published between 1986 and 2020. According to the World Bank income level,[57] 14 of these studies were performed in low- or middle-income countries[37-39,41-48,51-53] and seven in high-income countries.[40,6,49,50,54-56] These 21 studies were of cross-sectional design. Depression and anxiety were reported in 16[6,37-41,44-50,52,53,55] and 17[37-44,46,48,49,51-56]studies, respectively.

The eight observational studies concerning strabismus enrolled 668,463 participants (median=310, interquartile range (IQR), 1388) and were published between 2008 and 2019. Three of these studies were carried out in low- or middle-income countries, all in China[20,29,30] Five were carried out in high-income countries: one in Israel,[32] and four in the United States of America (USA).[31,33,34,36] Depression and anxiety were reported in six[20,30,31,33,34,36] and eight of these studies,[20,29-34,36] respectively.

The seven studies concerning the intervention enrolled 20930 participants (median=98, IQR, 59) and were published between 2005 and 2019. The study from China had the largest sample size of 19,934.[28] Five of these studies were carried out in low- or middle-income countries: three in China,[22,23,28] one in Iran[24] and one in Turkey.[35] Two were carried out in high-income countries, one each in the USA[21] and Korea.[27] Characteristics of the included studies are summarised in Table 1 for observational studies and Table 2 for interventional studies.

Insert Table 1 and 2 here

Methodological quality of included studies

Of the 29 observational studies, 17studies scored low using the JBI quality appraisal checklist. The most common problems were: (1) failure to define inclusion criteria clearly,[37,39-41,44,46,50,52,53,55,56] (2) inability to measure the condition in a valid and reliable manner,[6,37,39-42,44,48,51-56] (3) lack of objective, standard criteria used for measurement of the condition,[6,29,37,39,41,42,44,48,51-54,56] and (4) inability to identify and deal with potential confounding factors.[32] The remaining seven studies concerning the

treatment scored well using the JBI or NIH quality appraisal checklists. The most common problems were (1) absence of sample size justification,[21-24,27] (2) lack of description of the intervention,[21-24] (3) failure to enroll all eligible participants,[21] (4) loss to follow-up of eligible participants,[23] (5) using a convenience sample to recruit eligible participants,[21] (6) lack of description whether cases and controls matched appropriately,[32] and (7) lack of description of whether participants were analysed in the groups to which they were randomised [28] (Table 3).

Insert Table 3 here

Quantitative synthesis with meta-analysis

The 11 studies (3,926 participants, 54.3% vision-impaired) that reported scores for depression were included in a meta-analysis. Children with vision impairment had higher depression scores than controls(pooled SMD: 0.57, 95% CI: 0.26-0.89; I^2 =94.3%; Figure 2). Six studies in which myopia was the cause of vision impairment, showed significantly higher depression scores compared to children with normal vision (SMD: 0.59, 95% CI: 0.36-0.81; I^2 =85.4%). Five studies with other causes of vision impairment found a similar point estimate compared to controls, which was imprecise due to high heterogeneity and did not reach nominal statistical significance (SMD 0.58, 95% CI -0.08-1.25; I^2 =94,7%).

Insert Figure 2 here

Leave-one-out sensitivity analyses showed that after removing the potential outlier studies, the pooled effect size still suggested higher depression scores in visually impaired children compared to normally sighted children. (Supplementary Figures 1 and 2).

Fourteen studies (5245 participants, 60.1% vision-impaired) providing anxiety scores were included in a meta-analysis. Visually impaired children had higher anxiety scores (pooled SMD: 0.61, 95% CI: 0.40-0.82; I^2 =91.1%; Figure 3). Both children with myopia, and those with other causes of vision impairment, had higher anxiety scores than normally sighted children. Effects did not differ between sub-groups with myopic vision impairment (SMD: 0.48, 95% CI: 0.32-0.64, I^2 =82.9%) compared to those with other causes of vision impairment (SMD: 0.93, 95% CI: 0.34-1.53, I^2 =88.7%, p=0.15).

Insert Figure 3 here

Leave-one-out sensitivity analyses showed that, after excluding the potential outlier studies, the pooled effect size suggests a higher anxiety score in visually impaired children compared to normally sighted children. (Supplementary Figures 3 and 4).

Three[21,24,35] and four[21,23,24,35] studies concerning strabismus surgery with complete data were included in the meta-analysis of depression and anxiety, respectively. Strabismus surgery significantly

improved the symptoms of depression (SMD: 0.59, 95% CI: 0.12-1.06; I^2 =85.3%; Figure 4) and anxiety (SMD: 0.69, 95% CI: 0.25- 1.14; I^2 =86.4%; Figure 5).

Insert Figure 4 and 5 here

Qualitative synthesis

Overall, the six studies concerning vision impairment and depression and anxiety among children included in the qualitative synthesis indicated that the impact of vision impairment on depression and anxiety was mixed [45,47,50,53-55] (Table 1). Four studies (949 participants) found that vision-impaired adolescents had higher prevalence or scores of depression and anxiety than their normally sighted peers.[45,50,54,55] The other two studies (358 participants) found that vision-impaired children did not have a significantly higher score in the subdomain of proxy-reported anxiety/depression than normally sighted children.[47,53]

The observational studies concerning strabismus were also described narratively due to the heterogeneity of the study design and the diverse outcomes reported. Five studies (667,211 participants) indicated a positive association of strabismus and depression and/or anxiety in children.[20,29-32] Two retrospective studies (1,068 participants) suggested that although the children with strabismus were at increased risk for developing mental illness by early adulthood, the differences of prevalence in depression and anxiety were not statistically significant compared to children without strabismus.[33,34]

Of the four studies (1,927 participants) assessing the impact of strabismus treatment on depression and anxiety not included in the meta-analysis,[22,27,32,36] one interventional study found strabismus surgery statistically improved the symptoms of anxiety and depression in both heterotropia and heterophoria patients.[22] Another interventional study indicated that the depression/anxiety subscale scores were unchanged after occlusion therapy in children with intermittent exotropia.[27] One case-control study found a borderline significant association between strabismus correction and anxiety (Odds Ratio [OR]=2.98; 95% CI, 1.01-8.75; P=0.06).[32] A retrospective observational case series study suggested that strabismus surgery for children with intermittent exotropia did not decrease or alter the development of mental illnesses including major depression by early adulthood, regardless of surgical success or age at surgery.[36] The only cluster-RCT included 19934 participants and found that providing free glasses to primary school children in China did not reduce students' fear of examinations or excessive concern about test scores (learning anxiety); however, there was a small, yet significant, reduction in students' excessive concerns about their bodies (physical anxiety).[28]

DISCUSSION

In this systematic review, we observed a significant positive association between vision impairment and scores of depression and anxiety in children and significant improvement of depression and anxiety symptoms after strabismus surgery among children. The difference in anxiety scores between children with visual impairment due to either myopia or other causes compared to emmetropic or control children, respectively, were both significant, while the difference in depression scores was only significant among children with visual impairment due to myopia (but not due to other causes) compared to emmetropic or control children, respectively.

The quality of most included studies was low to moderate. Most studies did not clearly describe the sampling methods employed, did not report the definition of vision impairment, and used various tools to measure depression and anxiety in children. These limitations made it challenging to interpret the results collectively and limited external validity.

Twenty-two out of the 36 studies are from low- and middle-income countries, and nine studies[28,38,39,41-43,45,48,52] concerning myopia were conducted in China with larger sample sizes (including 24964 participants). The high proportion of studies from China and LMICs in general, likely reflects the high prevalence of myopia in the former[58] and the importance of unaddressed children's vision deficits in the latter, potentially reducing the generalizability of our conclusions. Uncorrected refractive error continues to be the leading cause of vision impairment worldwide,[59] and over half of the children aged 6-18 years in China are myopic.[60] The inability to see clearly and the proven impact of poor vision on educational performance might be a source of anxiety and depression, especially in the highly-pressurized Chinese educational environment.[4] Further, only 15% of children needing glasses and living in China's underserved rural western areas have them.[4] This review identified only one RCT involving myopia correction and mental health, and although it found providing free eyeglasses did not reduce learning anxiety, a small but statistically significant reduction was observed in physical anxiety.[28] More RCTs are needed to explore the causal association between ophthalmic treatment and mental health among children, with special attention to myopia.

The difference in the burden of depression between controls and those with vision impairment due to causes other than myopia was not significant. The predominant causes of vision impairment in these studies were congenital eye conditions. These children may have lived for a long time with vision impairment and adapted to the disability and resulting functional limitations. In addition, most children in these studies were recruited from blind schools or hospitals, which might be better equipped than conventional schools to provide the support system these children require.[7] Certainly, it is encouraging for program planners that the children whose vision impairment is most strongly linked with depression and anxiety, i.e. those with myopia, have the most readily treatable ocular condition.

Interestingly, of the six studies concerning vision impairment and depression and anxiety among children included in the qualitative synthesis, four studies found that vision-impaired adolescents had higher prevalence or scores of depression and anxiety than their normally sighted peers.[45,50,54,55] In comparison, two studies which used proxy-reported anxiety/depression found that vision-impaired children (compared to normally sighted children) did not have significantly higher scores.[47,53] This may indicate difficulty for proxies (parent/guardian/caretaker) to identify signs of anxiety/depression in children. Future studies to improve proxy identification of signs of anxiety/depression in children are needed.

Most observational studies concerning strabismus found a positive association between strabismus and depression and/or anxiety, except for two studies in which the numbers of strabismus patients were small (n=127 and 407).[33,34] A recent large study in South Korea (n=654152) found that children with strabismus did not have higher depression and anxiety prevalence than children with conjunctivitis after adjusting for age, preterm birth, or cerebral palsy and mental retardation.[61] However, this study used administrative data from health insurance records, which might have underdiagnosed strabismus-related depression and anxiety. Another study has reported that children with allergic conjunctivitis had reduced QoL.[62] Additionally, one recent study using commercial insurance claims data including 12,005,189 participants found that children younger than 18 years with strabismus have higher odds of mental illnesses including anxiety and depression than children without strabismus. However, 64.5% and 46.0% in the strabismus and control group, respectively, also had at least one systemic comorbid condition such as cancer of the brain and nervous system or Leukaemia, which was adjusted for in the multivariable analysis.[63] Interestingly, a study from 2003 suggests that an association between strabismus and mental illness has a genetic basis: a transcription factor gene named *PMX2B* was associated with both schizophrenia and constant exotropia.[64]

Interventional studies showed that treating strabismus could improve mental health, including depression and anxiety. The worldwide estimated prevalence of strabismus is as high as 1.93%,[17] and the present review indicates that early detection and treatment might profoundly impact children's mental health. Negative attitudes towards strabismus appear to emerge as early as six years and increase with age.[65] However, in developing countries, including China, India and Vietnam, strabismus surgery is often considered cosmetic and may not be covered by medical insurance.[66-68] The average costs of strabismus surgery in China and Vietnam are USD 700[67] and USD 154,[68] respectively. Eight in ten patients in China paid out-of-pocket for the surgery,[67] which could deter patients of low socioeconomic status from seeking treatment. The current review provides evidence in favour of insurance coverage for strabismus surgery.

Strengths of this review include the broad and comprehensive nature of the search strategy and the inclusion of studies from low-middle- and high-income countries. However, only one included study

was conducted in a lower-middle-income country.[44] Thus, extrapolation of these results to such settings must be done with care.

The main limitation of this systematic review was that there was high heterogeneity among the included studies. All observational studies concerning vision impairment included in the meta-analysis were cross-sectional, most of the interventional studies followed before-after designs without a control group, and there was only one RCT for myopia. This precluded a clearer understanding of any mechanism of causality. In addition, the average age of the participants in studies concerning vision impairment and strabismus included in the meta-analysis were 14.9 and 9.78 years, respectively, which may limit generalizing our results to children of all ages.

Despite its limitations, our findings have importance for health care planners designing interventions and prioritising resource allocation. We suggest that further RCTs on myopia correction and its impact on mental health are needed to identify strategies to improve myopic children's mental health. This review also underscored the importance and potential impact of early detection and treatment of strabismus in children and provides evidence in favour of insurance coverage for timely strabismus surgery to help improve children's overall health and, in turn, decrease costs for future mental health disorders.

Additional Information

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560

561 **FIGURE 1.** Flow chart of the study selection process

562

563 **FIGURE 2**. Forest plot of the random-effects model for the association between depression and
564 vision impairment in children

565 [Figure. 2 footnotes] *: boys; **: girl.

566

567 **FIGURE 3**. Forest plot of the random-effects model for the association between anxiety and vision
568 impairment in children

569 [Figure 3 footnotes] *: boys; **: girl.

570

571 **FIGURE 4**. Forest plot of the random-effects model of the impact of strabismus surgery on
572 depression in children

573 [Figure 4 footnotes] *Higher score represents better function, the original SMD is -0.58, we change
574 the sign of the SMD.

575 **: Latent deviation group, ***: Manifest exotropia group.

576

577 **FIGURE 5**. Forest plot of the random-effects model of the impact of strabismus surgery on anxiety in
578 children

579 [Figure 5 footnotes] *Higher score represents better function, the original SMD is -0.58, we change
580 the sign of the SMD

581 **a: Latent deviation group, ***b: Manifest exotropia group.

582

TABLE 1. Characteristics of observational studies included in the systematic review (N=29)

Author (Year)	a) Country b) Study design c) Setting d) Diagnosis	a) Sample size b) Sex (%) c) Age, years Mean ±SD (range)	a) Definition of exposure b) Ascertainment of exposure c) Control group	a) Outcome indicator(s) b) Outcome measurement tool(s)	Summary of findings
Hasselt et al, (1986)[54]	a) United States b) Cross-sectional c) School d) Blindness	a) 52 b) 100% male c) Mean age:17.2 SD: not specified Range (13-19)	a) The degree of corrected vision in the better eye was 20/200 or worse, or there was severe restriction in the visual field b) Not specified c) Normally sighted	a) Anxiety b) Child Behavior Checklist (CBCL)	Both residential and public-school groups with visual impairment were significantly more anxious than the normally sighted control group by teacher proxy-reported CBCL ($p<0.03$).
Chen, (1992)[48]	a) China b) Cross-sectional c) School d) Myopia	a) 266 b) Not specified c) Not specified	a) Not specified b) Health check record c) Normally sighted	a) Depression and anxiety b) Symptom Checklist (SCL-90)	Depression ($P<0.005$) and anxiety ($P<0.005$) scores were higher in children with myopia versus emmetropia.
Huurre et al, (2000)[6]	a) Finland b) Cross-sectional c) School d) Vision impairment	a) 722 b) 48.6% male c) Not specified (12-17)	a) Not specified b) Not specified c) Normally sighted	a) Depression b) Modified 13-item Beck's Depression Inventory (RS-BDI)	Vision impaired girls had significantly higher depression score than their normally sighted counterpart ($P<0.05$).

Koenes et al, (2000)[50]	a) United States b) Cross-sectional c) School d) Blindness	a) 51 b) 49% male c) Blind group mean age 15, Sighted group 16 rang (12-18)	a) The state standard for legal blindness (State of New Mexico, 1993) b) Measured c) Without myopia	a) Depression b) The Beck Depression Inventory	The incidence of depression among blind adolescents was significantly higher than that of normally sighted peers (P<0.005)
Wang et al, (2003)[46]	a) China b) Cross-sectional c) Hospital d) Amblyopia	a) 160 b) 58.8% male c) Not specified (6-16)	a) Consensus of Strabismus and amblyopia Group, Pediatric Ophthalmology Society, Chinese Medical Association (1985) b) Measured c) Healthy children	a) Depression and anxiety b) Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), Child Behavior Checklist (CBCL)	Depression (P<0.01) and anxiety (P<0.01) scores in children with amblyopia were significantly higher than that of the control group.
Hu et al, (2007)[47]	a) China b) Cross-sectional c) School d) Amblyopia	a) 200 b) 47% male c) Study group 5.62±0.77 (4-6) Control group 5.68±0.73 (Not specified)	a) Consensus of Strabismus and amblyopia Group, Pediatric Ophthalmology Society, Chinese Medical Association (1996) b) Measured c) Healthy children	a) Depression b) Child Behaviour Checklist (CBCL)	The difference in depression scores between the two groups was not significant (P =0.051).

Garaigordobil et al, (2009)[40]	a) Spain b) Cross-sectional c) School d) Vision impairment	a) 90 b) 54.4% male c) 14.99±2.02 (12–17)	a) Not specified b) Medical record c) Normally sighted	a) Depression and anxiety b) The Revised Symptom Checklist (SCL-90-R)	The difference in depression and anxiety subscales between vision-impaired children and the control group is not significant.
Bolat et al, (2010) [37]	a) Turkey b) Cross-sectional c) School d) Vision impairment	a) 80 b) 57.5% male c) 12.82±1.17 (11-14)	a) Congenital complete visual impairment b) Not specified c) Normally sighted	a) Depression and anxiety b) The Piers-Harris Children's Self-Concept Scale, Children's Depression Inventory (CDI)	Prevalence of depression among adolescents with visual impairment is similar to that of normally sighted peers (P=0.582), whereas anxiety was more common among impaired adolescents (P=0.025).
Wei et al, (2011)[53]	a) China b) Cross-sectional c) Hospital d) Amblyopia	a) 158 b) 50.6% male c) Not specified (4-11)	a) Diagnostic criteria of Strabismus from Chinese Association for Pediatric Ophthalmology and Strabismus (1985) b) Measured c) Healthy children	a) Depression and anxiety b) Child Behavior Checklist (CBCL)	The difference in depression and anxiety scores between amblyopic children and the normally sighted group were not significant, in either girls or boys.
Liu et al, (2012)[41]	a) China b) Cross-sectional c) School d) Myopia	a) 286 b) 46.9% male c) Study group 13.8±2.4(14-16) Control group	a) Not specified b) Health check record c) Normally sighted	a) Depression and anxiety b) Symptom Checklist (SCL-90)	The depression (P<0.05) and anxiety (P<0.05) subscales of vision-impaired children were significantly higher than that of control group.

		13.6±2.5(14-16)			
Alimovic et al, (2013)[55]	a) Croatia b) Cross-sectional c) School d) Vision impairment	a) 80 b) 51.3% male c)Not specified (4-11)	a) Visual impairments were defined according to Croatian regulations on the composition and working methods of expert evaluation in social welfare realisation process (Ministry of Labor and Social Welfare and Ministry of Health 2002). b) Medical record c) Normally sighted	a) Depression and anxiety b) Child Behavior Check List/4–18(CBCL/4–18)	Anxiety and depression scores of vision-impaired children were not significantly higher than that of normally sighted peers.
Guo et al, (2015)[39]	a) China b) Cross-sectional c) School d) Myopia	a) 650 b) Not specified c) Not specified	a) Not specified b) Not specified c) Normally sighted	a) Depression and anxiety b) Symptom Checklist (SCL-90)	The depression (P<0.01) and anxiety (P<0.01) subscales were significantly higher in myopic children than in emmetropic peers.

Panday et al, (2015)[44]	a) India b) Cross-sectional c) School d) Congenital visual impairment	a) 60 b) 0 male c) Study group 14.93±2.03 Control group 14.73±1.79	a) Not specified b) Not specified c) Normally sighted	a) Depression and anxiety b) Depression, Anxiety and Stress Scale (DASS)	Depression (P=0.01) and anxiety (P=0.01) were greater among adolescent girls with visual impairment in comparison to normally sighted peers.
Ayaki et al, (2016)[49]	a) Japan b) Cross-sectional c) Hospital d) Myopia	a) 278 b) 44% male c) 14.2 ± 2.6 (10-19)	a) High myopia (≤ −6.00D), mild myopia (−5.75D to −0.50D), and no myopia (−0.25D to+2.75D) b) Measured c) Without myopia	a) Depression and anxiety b) The Hospital Anxiety and Depression Scale (HADS)	The differences in depression and anxiety scores among children with high myopia, mild myopia and no myopia were not statistically significant.
Hamurcu et al, (2016)[51]	a) Turkey b) Cross-sectional c) School d) Vision impairment	a) 74 b) 47.3% male c) Study group 12.32 ± 3.38 (7-18) Control group 10.82 ± 2.18 (7-15)	a) Not specified b) Medical record c) Normally sighted	a) Anxiety b) The State-Trait Anxiety Inventory for Children (STAI-C)	A higher level of anxiety was found in visually impaired children and adolescents compare to the normally sighted control (P=0.004).

Łazarczyk et al, (2016)[56]	a) Poland b) Cross sectional c) School d) Myopia	a) 239 b) 33.1% male c) Not specified (13-17)	a) Not specified b) Medical record c) Emmetropia	a) Anxiety b) State-Trait Anxiety Inventory (STAIC)	Girls with myopia had a higher prevalence of trait anxiety as compared to their emmetropic peers without vision defects.
Li et al, (2016)[52]	a) China b) Cross-sectional c) School d) Myopia	a) 252 b) 41.3% male c) 16.21±2.36 (15-18)	a) Not specified b) Health check record c) Normally sighted	a) Depression and anxiety b) Symptom Checklist (SCL-90)	Depression (P< 0.01) and anxiety (P< 0.01) scores in myopic students were higher than that of emmetropes.
Zhou, (2019)[42]	a) China b) Cross-sectional c) School d) Myopia	a) 300 b) 50.3% male c) Not specified	a) Using visual acuity as a surrogate measurement for refractive error b) Measured c) Normally sighted	a) Anxiety b) Self-Rating Anxiety Scale	Anxiety score was greater with higher levels of myopia (P<0.05),
Li et al, (2020)[38]	a) China b) Cross-sectional c) School d) Myopia	a) 1103 b) 53.0% male c) 15.3 (14-17)	a) The mild myopia group (spherical equivalent (SE) < 3.00 D), the moderate myopia group (SE 3.00–6.00 D), and the severe myopia group (SE > 6.00 D). b) Measured	a) Depression and anxiety b) Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS)	Depression (P=0.03) and anxiety scores (0.018) among students with myopia were significantly higher than that of emmetropic students.

			c) Emmetropia		
Cai et al, (2020)[43]	a) China b) Cross-sectional c) School d) Myopia	a) 1407 b) 54.3% male c) Not specified	a) The myopia group (SE < -0.5 D), the moderate myopia group (-0.5 D -3.00 D), and the moderate and severe myopia group (SE > 3.00 D). b) Measured c) Emmetropia	a) Anxiety b) Social Anxiety Scale for Children (SASC)	Children with myopia had worse measures of social anxiety) than those with emmetropia (P <0.01).
Xu et al, (2020)[45]	a) China b) Cross-sectional c) Community d) Myopia	a) 766 b) 56.4% male c) 14.32±2.64 (12-16)	a) Myopia is defined as VA<5.0 and SE<-0.5D. b) Measured c) Normally sighted	a) Depression and anxiety b) Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS)	The prevalence of depression (25.4% vs 8.65%, P < 0.001) and anxiety (22.4% vs 10.6%, P=0.006) in myopic children were higher than in emmetropic children.
Mohney et al, (2008)[33]	a) United States b) Case–control c) Hospital d) Strabismus	a) 814 b) 50.4% male c) Not specified (< 19)	a) Not specified b) Medical record c) Without strabismus	a) Depression and anxiety b) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition codes (DSM-4)	There was no significant difference in terms of depression and anxiety between the strabismus group and the control group.

McKenzie et al, (2009)[31]	a) United States b) Case-control c) Hospital d) Strabismus	a) 366 b) 35.8% male c) Not specified (< 19)	a) Acquired, intermittent exodeviation of at least 10 prism diopters (PD) b) Medical record c) Without strabismus	a) Depression and anxiety b) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition codes (DSM-4)	Boys with intermittent exotropia were more likely to develop major depression (P=0.02). Girls with intermittent exotropia were more likely to develop anxiety or phobia (P=0.04).
Kilgore et al, (2010)[36]	a) United States b) Retrospective observational case series c) Hospital d) Strabismus	a) 184 b) 35.9% male c)Not specified (<19)	a) Acquired, intermittent exodeviation of at least 10 PD b) Strabismus surgery c) Young adults who had childhood Intermittent Exotropia and did not had surgery	a) Depression and anxiety b) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition codes (DSM-4)	Strabismus surgery for children with intermittent exotropia, regardless of success or age at surgery, did not alter the development of mental illness including depression by early adulthood
Olson et al, (2011)[34]	a) United States b) Case–control c) Hospital d) Strabismus	a) 254 b) 52.0% male c) Not specified (<19)	a) Congenital esotropia was defined as a nonaccommodative esotropia that developed by 6 months of age in a neurologically intact child.	a) Depression and anxiety b) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition codes (DSM-4)	There was no significant difference in terms of depression and anxiety between the two groups.

			b) Medical record c) Without strabismus		
Lin et al, (2014)[20]	a) China b) Cross-sectional c) School d) Strabismus	a) 3903 b) 52.2% male c) Mean age:12.9 SD: Not specified Rang: (10-17)	a) If any tropia was present at distance or near, with or without spectacles. b) Measured c) Without strabismus	a) Depression and anxiety b) Key screening questions recommended by health bodies in the United States and United Kingdom	Children with strabismus had a significantly higher prevalence of depression and anxiety (P < 0.01 for all).
Ji et al, (2017)[30]	a) China b) Cross-sectional c) Hospital d) Strabismus and amblyopia	a) 203 b) 52.2% male c) Study group 8.83±2.92 (6–14) Control group 8.52±3.11(5-14)	a) Expert consensus on amblyopia diagnosis, Pediatric Ophthalmology Society, Chinese Medical Association. (2011) b) Measured c) Healthy children	a) Depression and anxiety b) Children's social anxiety scale	Children with strabismus and amblyopia have worse psychological problems, including depression (P < 0.05) and anxiety(P < 0.05).
Merdler et al, (2017)[32]	a) Israel b) Case-control c) Military Pre-conscription assessment d) Strabismus	a) 662641 b) 59% male c) 17.3±0.59 (Not specified)	a) Not specified b) Medical record c) Without strabismus	a) Anxiety b) Presence of corresponding fitness-for-service (FFS) codes	Children with uncorrected strabismus were more likely to develop anxiety (OR=1.91, 95%CI, 1.02-3.57; P=0.047).

Merdler et al (2017)[32]	a) Israel b) Case-control c) Military pre-conscription assessment d) Strabismus	a) 1598 b) Corrected strabismus 55.7% Uncorrected strabismus 55.2% c) Corrected strabismus 17.25±0.49 Uncorrected strabismus 17.45±0.63	a) Not specified b) Strabismus correction c) Participants with uncorrected strabismus	a) Anxiety b) Presence of corresponding fitness-for-service (FFS) codes	Anxiety was more common in those with uncorrected strabismus. Strabismus correction was not significantly associated with anxiety disorder was observed (OR =2.978; 95% CI, 1.013-8.754; P =0.06).
Zhang et al, (2019)[29]	a) China b) Cross-sectional c) Hospital d) Strabismus	a) 98 b) 48.0% male c) Not specified (7-13)	a) Not specified b) Measured c) Healthy children	a) Anxiety b) Children's social anxiety scale	Strabismus worsens children's mental health including anxiety (P=0.006).

SD: Standard Deviation

TABLE 2. Characteristics of intervention studies included in the systematic review(N=7)

Author (Year)	**a) Country** **b) Study design** **c) Setting** **d) Diagnosis**	**a) Sample size taken** **b) Sex (%)** **c) Age, years** **Mean ±SD (range)**	**a) Definition of exposure** **b) Intervention of study group** **c) Intervention of control group**	**a) Outcome indicator(s)** **b) Outcome measurement tool(s)**	**Summary of findings**
Archer et al (2005)[21]	a) United States b) Before-after studies with no control group c) Hospital d) Strabismus	a) 98 b) Not specified c) 4.5±3.3(Not specified)	a) Not specified b) Strabismus surgery c) NA	a) Depression and anxiety b) Modified version of the RAND Health Insurance Study questionnaire	Statistically significant improvements were observed in the subscale of depression (<0.01) and anxiety (0.01) after strabismus surgery.
Chai et al (2009)[22]	a) China b)Prospective interventional c) Hospital	a) 120 b) 46.7% male c)Heterophoria	a) Not specified b) Strabismus surgery	a) Depression and anxiety b) The Hospital Anxiety and	Compared with pre-operative values, significant improvements were noted after

	d) Strabismus	8.3 ± 2.8 (Not specified) Heterotropia 8.4 ± 2.6 (Not specified)	c) NA	Depression Scale (HADS)	surgery in anxiety (P<0.05) and depression scores (P<0.05).
Jing (2009)[23]	a) China b) Before-after studies with no control group c) Hospital d) Strabismus	a) 168 b) Not specified c) Not specified (8-14)	a) Not specified b) Strabismus surgery c) NA	a) Anxiety b) Children's social anxiety scale	Social anxiety can be significantly improved after strabismus surgery (P<0.001).
Ziaei et al (2016)[24]	a) Iran b) Before-after studies with no control group c) Hospital d) Strabismus	a) 87 b) 47.1% male c) 8.7±4 (5-15)	a) Not specified b) Strabismus surgery c) NA	a) Depression and anxiety b) Modified RAND Health Insurance Study questionnaire	Depression (p <0.001) and anxiety (p <0.001) scores improved significantly after strabismus surgery.

Kim et al (2013)[27]	a) Korea b) Before-after studies with no control group c) Hospital d) Strabismus	a) 25 b) 60% male c) Mean age 4.7 years (3-7)	a) Not specified b) Part-time occlusion c) NA	a) Depression and anxiety b) The Child Behavior Checklist (CBCL)	There was no significant difference in terms of depression /anxiety after part-time occlusion.
Guan et al (2018)[28]	a) China b) Cluster-Randomized Controlled Trial c) School d) Myopia	a) 19934 b) 52.0% male c) 10.5±1.10	a) Myopia is ≤−0.5 diopters b) Providing free glasses c) Providing Prescription	a) Learning Anxiety Physical Anxiety b) Mental Health Test (MHT).	Treatment has no effect on Learning Anxiety and the Mental Health Test, and a small but significant reduction in Physical Anxiety
Ozates et al, (2019)[35]	a) Turkey b) Before-after studies with no control group	a) 83 b) 49.4% male	a) Not specified b) Strabismus surgery	a) Depression and anxiety	Strabismus surgery improved the trait anxiety symptom in children with Latent deviation(P=0.006), while in Manifest exotropia group,

	c) Hospital d) Strabismus	c) Latent deviation group16.6±2.1(14-21) Manifest exotropia group 17.5±2.0(14-21)	c) Before-after design, without control group	b) Depression subscale Hospital Anxiety and Depression Scale (HAD-D), State-Trait Anxiety Inventory (STAI)	both anxiety and depression symptoms were improved (P<0.001).

SD: Standard Deviation; NA: Not applicable

TABLE 3. The checklist results for assessing the methodological quality of the selected studies (N=36)

CROSS-SECTIONAL STUDY	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Hasselt et al (1986)[54]	☑	☑	±	±	◆	◆	☑	☑
Chen et al (1992)[48]	☑	☑	±	±	◆	◆	☑	±
Huurre et al (2000)[6]	☑	☑	☒	☒	◆	◆	☑	☑
Koenes et al (2000)[50]	±	☑	☑	☑	◆	◆	☑	☑
Wang et al (2003)[46]	±	☑	☑	☑	◆	◆	☑	☑

Hu et al (2007)[47]	☑	☑	☑	☑	◆	◆	±	☑
Garaigordobil et al (2009)[40]	±	☑	±	☑	◆	◆	☑	☑
Bolat et al (2010)[37]	±	☑	±	±	◆	◆	☑	☑
Wei et al [(9)] (2011)[53]	±	☑	±	±	◆	◆	☑	☑
Alimovic et al (2012)[55]	±	☑	±	☑	◆	◆	☑	☑
Liu et al (2012)[41]	☒	☑	±	±	◆	◆	☑	☑

Lin et al (2014)[20]	☑	☑	☑	☑	☑	☑	☑	☑
Guo et al (2015)[39]	☒	☑	☒	☒	◆	◆	☑	☑
Panday et al (2015)[44]	☒	☑	☒	☒	◆	◆	☑	☑
Ayaki et al (2016)[49]	☑	☑	☑	☑	☑	☑	☑	☑
Łazarczyk et al (2016)[56]	☒	☑	☒	☒	◆	◆	☑	☑
Li (2016)[52]	±	☑	☒	±	◆	◆	☑	☑

Hamurcu et al (2016)[51]	☑	☑	±	±	◆	◆	☑	☑
Ji et al (2017)[30]	☑	☑	☑	☑	◆	◆	☑	☑
Zhou et al (2019)[42]	☑	☑	☒	☒	◆	◆	☑	☑
Zhang et al (2019)[29]	☑	☑	±	±	◆	◆	☑	☑
Cai et al (2020)[43]	☑	☑	☑	☑	◆	◆	☑	☑
Li et al (2020)[38]	☑	☑	☑	☑	◆	◆	☑	☑
Xu et al (2020)[45]	☑	☑	☑	☑	☑	☑	☑	☑

BEFORE-AFTER STUDIES WITH NO CONTROL GROUP	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**
Archer et al (2005)[21]	☑	☑	☑	☒	※	☑	☑	◆	☑	☑	◆	◆
Chai et al (2009)[22]	☑	☑	☑	☑	※	☑	☑	◆	☑	☑	◆	◆
Jing (2009)[23]	☑	☑	☑	☑	※	☑	☑	◆	☒	☑	◆	◆
Ziaei et al (2016)[24]	☑	☑	☑	☑	※	☑	☑	◆	☑	☑	◆	◆
Ozates et al (2019)[35]	☑	☑	☑	☑	☑	☑	☑	◆	☑	☑	◆	◆

Kim et al (2012)[27]	☑	☑	☑	☑	※	☑	☑	◆	☑	☑	◆	◆	
RANDOMIZED CONTROLLED TRIAL	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**
Guan et al (2018)[28]	☑	☑	☑	☑	◆	◆	☑	☑	±	☑	☑	☑	☑
CASE-CONTROL	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**			
Mohney et al (2008)[33]	☑	☑	☑	☑	☑	☑	☑	☑	◆	☑			
McKenzie et al (2009)[31]	☑	☑	☑	☑	☑	☑	☑	☑	◆	☑			

Olson et al (2012)[34]	☑	☑	☑	☑	☑	☑	☑	☑	◆	☑
Merdler et al (2017)[32]	±	±	☑	☑	☑	☒	☒	☑	◆	☑
CASE SERIES	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Kilgore et al (2014)[36]	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Question key: ***JBI tool questions for cross-sectional study assessment:*** Q1 = "Were the criteria for inclusion in the sample clearly defined?", Q2 = 2 Were the study subjects and the setting described in detail?", Q3 = "Was the exposure measured in a valid and reliable way?", Q4 = "Were

objective, standard criteria used for measurement of the condition?", Q5 = "Were confounding factors identified?", Q6 = "Were strategies to deal with confounding factors stated?", Q7 = "Were the outcomes measured in a valid and reliable way?", Q8 = "Was appropriate statistical analysis used?" (Joanna Briggs Institute, 2020).

NIH tool questions for before-after studies with no control group study assessment: Q1 = " Was the study question or objective clearly stated?", Q2 = “Were eligibility/selection criteria for the study population prespecified and clearly described?", Q3 = " Were the participants in the study representative of those who would be eligible for the test/service/intervention in the general or clinical population of interest?", Q4 = " Were all eligible participants that met the prespecified entry criteria enrolled?", Q5 = " Was the sample size sufficiently large to provide confidence in the findings?", Q6 = " Was the test/service/intervention clearly described and delivered consistently across the study population?", Q7 = " Were the outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?", Q8 = " Were the people assessing the outcomes blinded to the participants' exposures/interventions?”, Q9 =“Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?", Q10 =“Did the statistical methods examine changes in outcome measures from before to after the intervention? Were statistical tests done that provided p values for the pre-to-post changes?", Q11 =“Were outcome measures of interest taken multiple times before the intervention and multiple times after the intervention (i.e., did they use an

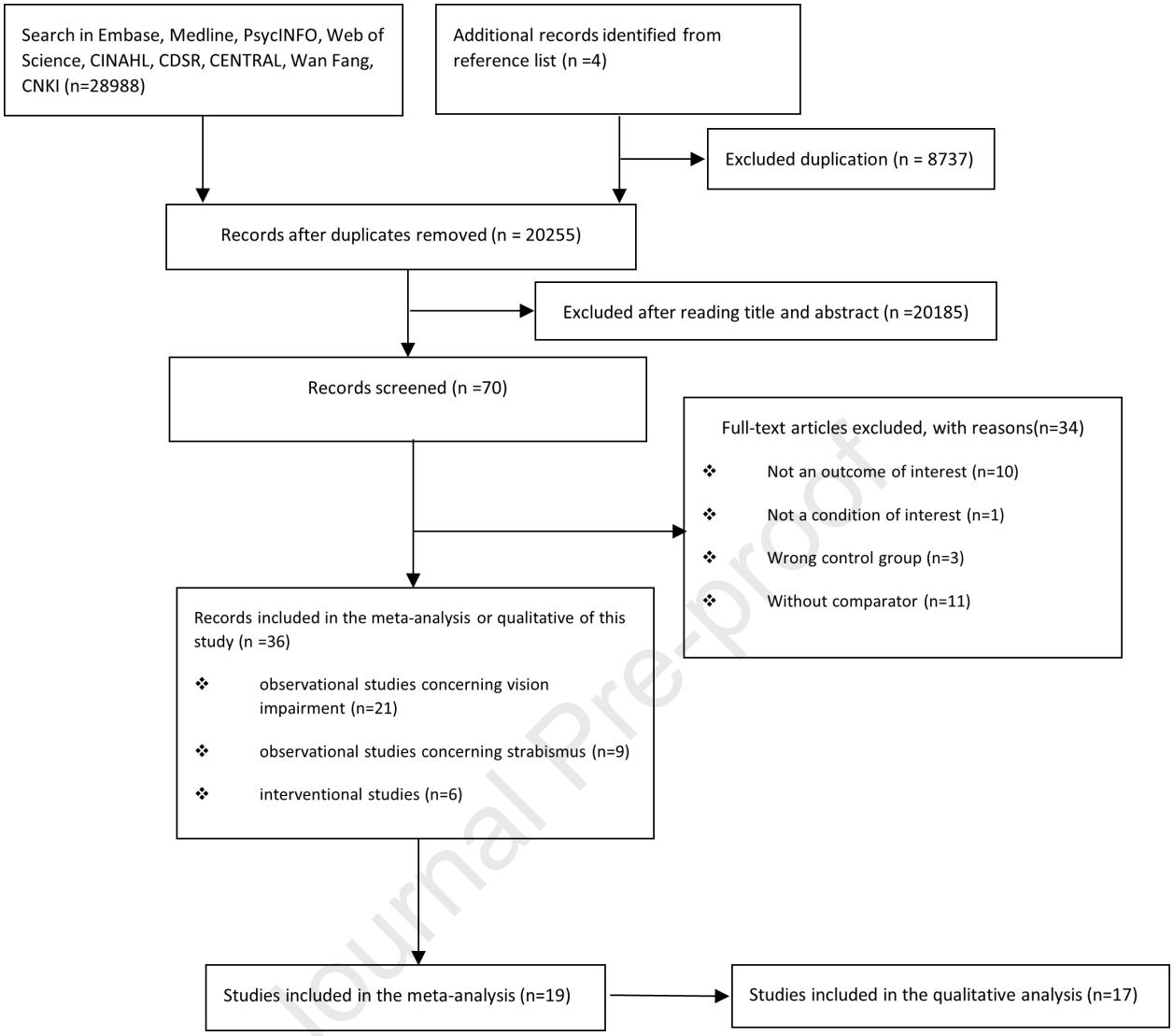
interrupted time-series design)?", Q12 ="If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level?" (National Heart, Lung and Blood Institute, 2021)

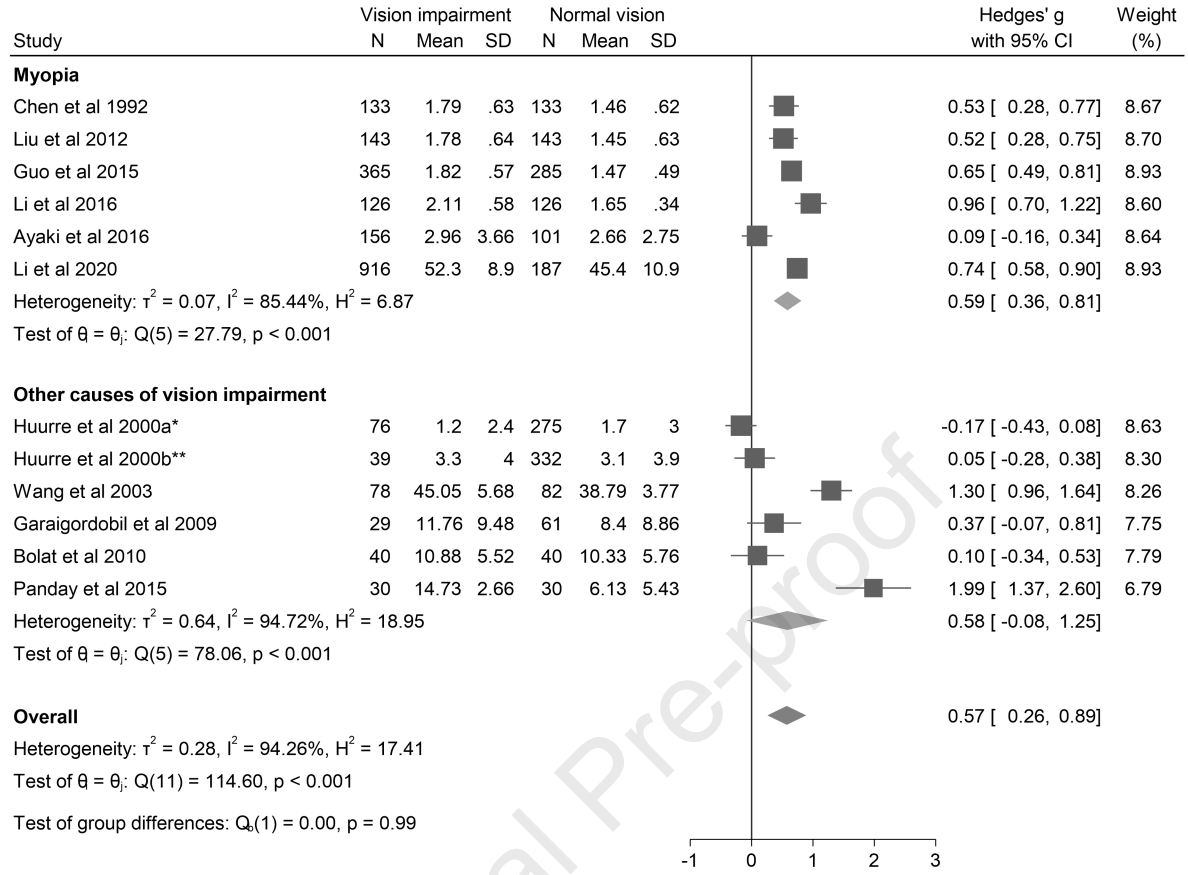
JBI tool questions for randomized controlled trials study assessment: Q1 = "Was true randomization used for assignment of participants to treatment groups?", Q2 = "Was allocation to groups concealed?", Q3 = " Were treatment groups similar at the baseline?", Q4 = " Were participants blind to treatment assignment?", Q5 = "Were those delivering treatment blind to treatment assignment?", Q6 = "Were outcomes assessors blind to treatment assignment?", Q7 = " Were treatment groups treated identically other than the intervention of interest?", Q8 = " Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?", Q9 ="Were participants analyzed in the groups to which they were randomized?", Q10 ="Were outcomes measured in the same way for treatment groups?", Q11 ="Were outcomes measured in a reliable way?", Q12 ="Was appropriate statistical analysis used?", Q13 ="Was the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis?"(Joanna Briggs Institute, 2020).

JBI tool questions for case-control study assessment: Q1 = "Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?", Q2 = "Were cases and controls matched appropriately?", Q3 = "Were the same criteria used for identification of cases and controls?", Q4 = "Was exposure measured in a standard, valid and reliable way?", Q5 = "Was exposure measured in the same way for cases and controls?", Q6 = "Were confounding factors identified?", Q7 = "Were strategies to deal with confounding factors stated?", Q8 = "Were outcomes assessed in a standard, valid and reliable way for cases and controls?", Q9 = "Was the exposure period of interest long enough to be meaningful?", Q10 = "Was appropriate statistical analysis used?" (Joanna Briggs Institute, 2020).

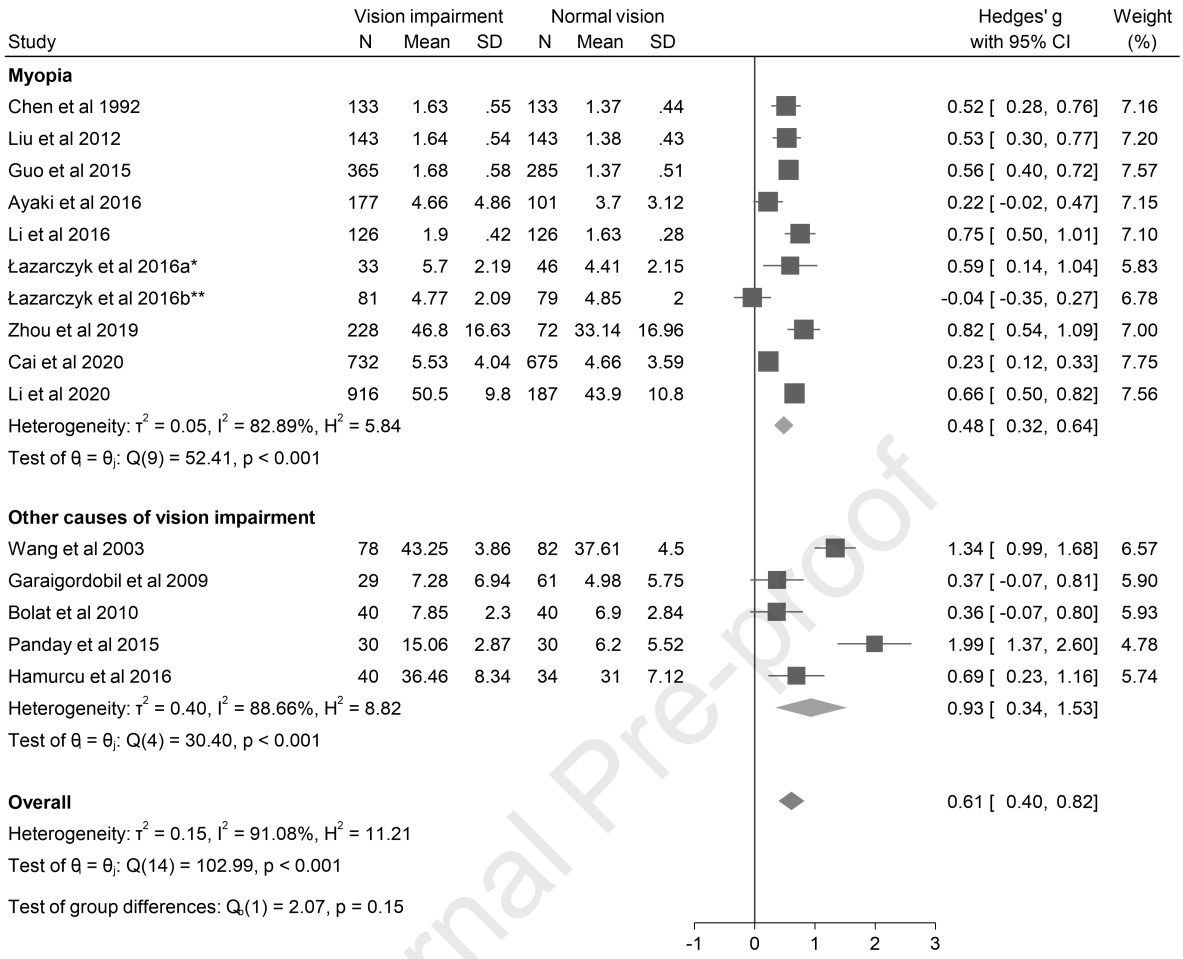
JBI tool questions for case series assessment: Q1 = " Were there clear criteria for inclusion in the case series? ", Q2 = "Was the condition measured in a standard, reliable way for all participants included in the case series?", Q3 = "Were valid methods used for identification of the condition for all participants included in the case series?", Q4 = "Did the case series have consecutive inclusion of participants? ", Q5 = "Did the case series have complete inclusion of participants?", Q6 = "Was there clear reporting of the demographics of the participants in the study?", Q7 = "Was there clear reporting of clinical information of the participants?", Q8 = "Were the outcomes or follow-up results of cases clearly reported?", Q9 = "Was there clear reporting of the presenting site(s)/clinic(s) demographic information?", Q10= "Was statistical analysis appropriate?" (Joanna Briggs Institute, 2020).

Answers legend: ☑ = yes the study satisfactorily met the respective quality criterion; ☒= no the study did not meet the respective quality criterion; ◆ = not applicable; and ± = unclear whether the study has met the respective quality criterion; ※= cannot determine.





Random-effects REML model
Sorted by: year



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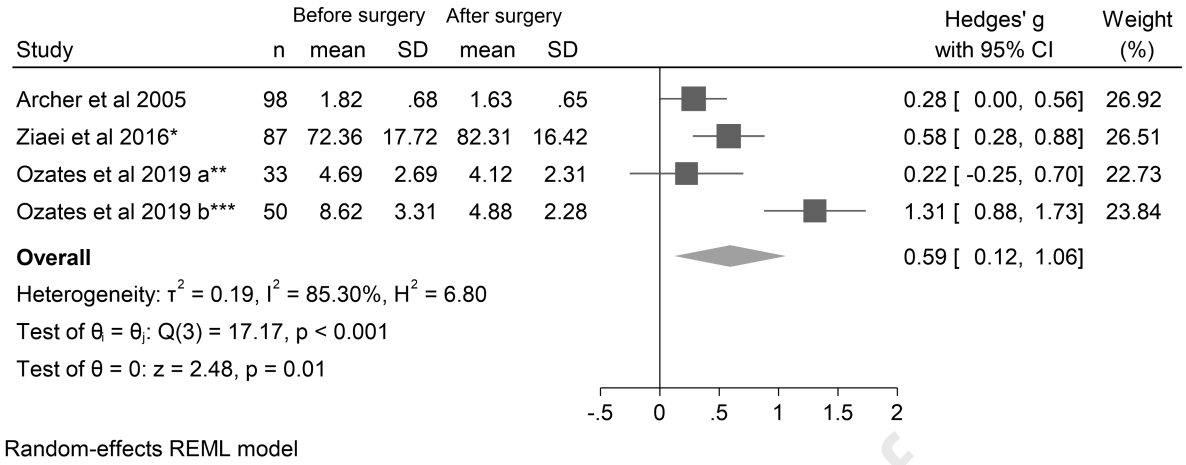

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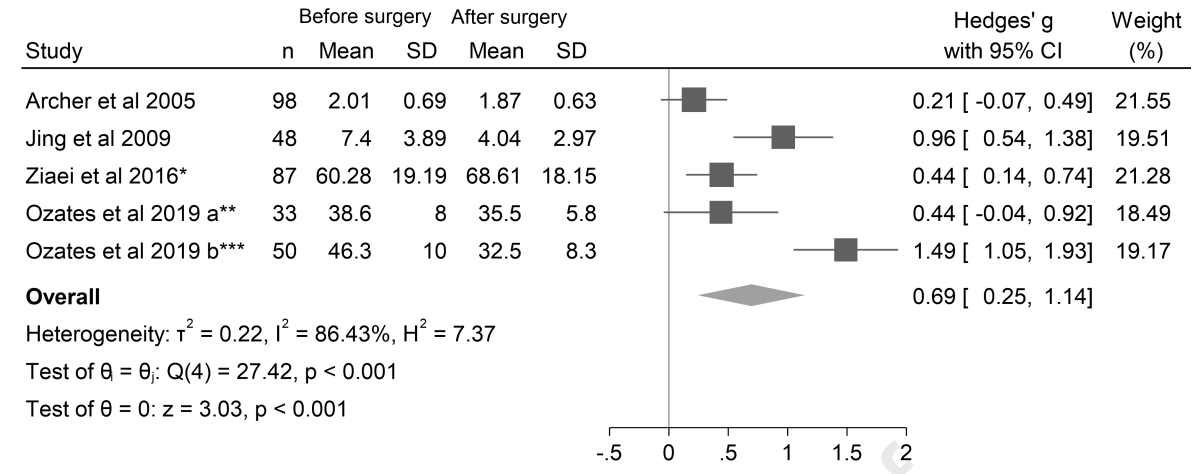

Random-effects REML model

Précis

We systematically reviewed the existing evidence for the association between eye condition and mental health in children. Meta-analysis revealed vision impairment is associated with greater symptoms of depression and anxiety in children.