



Cochrane
Library

Cochrane Database of Systematic Reviews

Identification of children in the first four years of life for early treatment for otitis media with effusion (Review)

Simpson SA, Thomas CL, van der Linden M, MacMillan H, van der Wouden JC, Butler CC

Simpson SA, Thomas CL, van der Linden M, MacMillan H, van der Wouden JC, Butler CC.
Identification of children in the first four years of life for early treatment for otitis media with effusion.
Cochrane Database of Systematic Reviews 2007, Issue 1. Art. No.: CD004163.
DOI: 10.1002/14651858.CD004163.pub2.

www.cochranelibrary.com

TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	2
OBJECTIVES	4
METHODS	4
RESULTS	5
DISCUSSION	10
AUTHORS' CONCLUSIONS	11
ACKNOWLEDGEMENTS	12
REFERENCES	12
CHARACTERISTICS OF STUDIES	14
DATA AND ANALYSES	21
APPENDICES	21
WHAT'S NEW	22
HISTORY	23
CONTRIBUTIONS OF AUTHORS	23
DECLARATIONS OF INTEREST	23
NOTES	23
INDEX TERMS	23

[Intervention Review]

Identification of children in the first four years of life for early treatment for otitis media with effusion

Sharon A Simpson¹, Chantal L Thomas¹, Mariska van der Linden², Harriet MacMillan³, Johannes C van der Wouden², Christopher C Butler¹

¹Department of Primary Care and Public Health, School of Medicine, Cardiff University, Cardiff, UK. ²Department of General Practice, Erasmus MC, University Medical Center, Rotterdam, Netherlands. ³Psychiatry, Behavioural Neurosciences & Pediatrics, McMaster University, Hamilton, Canada

Contact address: Sharon A Simpson, Department of Primary Care and Public Health, School of Medicine, Cardiff University, Heath Park, Cardiff, CF14 4XN, UK. simpsonsa@cf.ac.uk.

Editorial group: Cochrane ENT Group.

Publication status and date: New search for studies and content updated (no change to conclusions), published in Issue 1, 2010.

Citation: Simpson SA, Thomas CL, van der Linden M, MacMillan H, van der Wouden JC, Butler CC. Identification of children in the first four years of life for early treatment for otitis media with effusion. *Cochrane Database of Systematic Reviews* 2007, Issue 1. Art. No.: CD004163. DOI: 10.1002/14651858.CD004163.pub2.

Copyright © 2010 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

This is an update of a Cochrane Review first published in *The Cochrane Library* in Issue 2, 2003 and previously updated in 2006.

Otitis media with effusion (OME) is the most common cause of acquired hearing loss in childhood and has been associated with delayed language development and behavioural problems. Some have argued that children should be screened and treated early if found to have clinically important OME, however there is a high rate of spontaneous resolution and in some children effusions may not reduce hearing significantly or impact negatively on language development or behaviour.

Objectives

The aim of this review was to assess evidence from randomised controlled trials about the effect, on language and behavioural outcomes, of screening and treating children with clinically important OME in the first four years of their life.

Search methods

Our search included the Cochrane Ear, Nose and Throat Disorders Group Trials Register, the Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, EMBASE and additional sources for published and unpublished trials. The date of the most recent search was 30 June 2009, following previous update searches in January 2006 and original searches in February 2002.

Selection criteria

1. Randomised controlled trials evaluating interventions for OME among children with OME identified through screening.
2. Comparison of outcomes for children randomised to be screened for OME and outcomes for children who were not randomised to be screened for OME.

Data collection and analysis

Four authors independently extracted data and assessed trial quality; two in the original review and two for the updates.

Identification of children in the first four years of life for early treatment for otitis media with effusion (Review)

Copyright © 2010 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Main results

We identified no trials comparing outcomes for children randomised to be screened for OME with outcomes for children who were not randomised to be screened for OME. We identified three trials (668 participants) evaluating interventions for OME among children with OME identified through screening, one of which generated five published studies. These were trials of treatment in children identified through screening rather than trials of treatment programmes. From these trials, we found no evidence of a clinically important benefit in language development from screening and treating children with clinically important OME.

Authors' conclusions

The identified randomised trials do not show an important benefit on language development and behaviour from screening of the general population of asymptomatic children in the first four years of life for OME. However, these trials were all conducted in developed countries. Evidence generated in the developed world, where children may enjoy better nutrition, better living conditions and less severe and different infections, may not be applicable to children in developing countries. The screening aspect of some of these studies was aimed primarily at identifying suitable children in whom to evaluate the effects of treatment, rather than to evaluate the effects of screening programmes. Younger children and children with milder disease may have been included in these treatment trials compared to children who are offered treatment in pragmatic settings.

PLAIN LANGUAGE SUMMARY

Identification (through screening) of children in the first four years of life for early treatment for otitis media with effusion (OME)

Otitis media with effusion (OME - also known as 'glue ear') is a common condition in children, where sticky fluid accumulates in the middle ear. Although the fluid usually resolves without treatment, it may remain and cause long periods of hearing loss. This may lead to problems with language development and behaviour. Children with OME may show no other symptoms so some have suggested that all children should be checked (screened) for this condition. However, the review of trials in the developed world found that checking children for, and early treatment of, OME before they are four does not result in improved outcomes.

BACKGROUND

This is an update of a Cochrane Review first published in *The Cochrane Library* in Issue 2, 2003 and previously updated in 2006.

This is one of a number of reviews prepared within the Cochrane Ear, Nose and Throat Disorders Group on management options for patients with otitis media with effusion (OME). Previous reviews have evaluated studies of the association between OME and language development (Haggard 1991; Roberts 1997). More recently, an 'analytic pathway' approach was used to assess evidence about early detection of OME in preventing delayed language development (Butler 2001). Most of the studies included in these reviews have used case-control or non-randomised, prospective cohort designs. The focus of this review is on evidence from randomised controlled trials of screening children in the first four years of life for OME to improve language and behavioural outcomes.

Symptoms, prevalence and aetiology

OME is a chronic inflammation of the middle ear in which a collection of liquid is present in the middle ear space, in the absence of acute inflammation (Bluestone 2002). It is common in children, especially between the ages of one and three years and in the winter months. OME has a prevalence of about 20% at around two years (Zielhuis 1990a). It remains common up to the age of seven years at which time the prevalence is between 3% and 8% (Casselbrant 1985; Casselbrant 1995; Fiellau 1977; Fiellau 1983; Lous 1981; Teele 1989). It is by far the commonest cause of acquired conductive hearing loss in childhood. The aetiology of OME is uncertain, but low-grade infection, poor clearance due to poor Eustachian tube function, local inflammatory reactions and adenoidal infection or hypertrophy have all been implicated (Bluestone 1988). Both viral and bacterial micro-organisms have been found in children with OME (Heikkinen 1999; Stephenson 1991). OME often resolves spontaneously with a median dura-

tion of about three months (Zielhuis 1990b), however about 50% of those recovering will have a further episode of OME (Fiellau 1979; Zielhuis 1990b). About one-fifth of UK children had either unilateral or bilateral OME for more than half of their first three years of life (Hogan 1997). OME may be associated with significant hearing loss (20 to 30 dB), especially when the disorder is bilateral and has lasted for more than a month (Fiellau 1983; Fria 1985), although not all children suffer clinically important hearing loss (MRC 1999). The mean hearing loss from OME is 27 dB (Fria 1985). The hearing loss and discomfort associated with OME may have linguistic, developmental, behavioural, motor and social consequences if the disorder is bilateral and of long duration, although the full implications of this are still unclear (Butler 2001; Friel-Patti 1990; Grievink 1993; Lous 1995; Paradise 1999; Paradise 2000).

Diagnosis

The recommended techniques for diagnosing OME are impedance audiometry (tympanometry) in combination with otomicroscopy or pneumatic otoscopy (Bluestone 1988). OME is deemed to be present when the tympanometry results in a flat curve (relative gradient less than 0.1, type B) or in a curve with a middle ear pressure between -399 to -200 daPa (C2 curve) (Jerger 1970; Zielhuis 1990b), when mobility of the tympanic membrane is absent or reduced, or fluid or air bubbles are evident behind the ear drum. The presence of a significant (10 dB) air-bone gap correlates well with the presence of fluid in the middle ear. However, tympanometry is a surrogate measure of hearing loss associated with OME. Positive predictive values ranged from 49% to 66% for a hearing loss greater than or equal to 25 dB (over 0.5, 1 and 2 kHz) after an abnormal tympanogram in referred populations (Dempster 1991; Kzanas 1994; MRC 1999).

Management options

Many patients with OME require no specific treatment. The most common medical treatment options include the use of decongestants, antihistamines (Griffin 2006), antibiotics, mucolytics, steroids (Thomas 2006) and autoinflation (Perera 2006). Surgical treatment options include grommet insertion (Lous 2005), myringotomy (tympanocentesis, i.e. surgical incision of the eardrum, with or without aspiration of fluid from the middle ear cavity) and adenoidectomy. Approaches to treatment remain controversial and there is wide variation in clinical practice.

Design of trials evaluating screening and treatments

Studies evaluating screening and treatment generally use one of two designs (Barratt 1999). Randomised controlled trials may evaluate interventions among subjects identified with the target condition through screening. Alternatively, subjects eligible for screening are randomised to be screened or not screened and outcomes compared between these groups, some of whom will have been treated as a result of being identified through screening and some of whom will be treated as a result of identification through usual care. In either design, patient outcomes reflect the impact of diagnostic as well as treatment manoeuvres. An overall positive effect suggests that the two-stage procedure is beneficial. If no beneficial effect is shown, then either the diagnostic or the treatment manoeuvre may be ineffective. Trials in which the main purpose is to evaluate the effectiveness of treatment may use screening to identify suitable subjects. However, whilst such trials may give useful information about screening, their findings may not be applicable to screening programmes that are suitable for conditions of pragmatic care. For example, screening to find cases for trials may identify less severe cases than pragmatic screening programmes identify. As such, treatment effects may be underestimated in studies of screening to find cases for treatment trials.

Screening for otitis media with effusion

A suitable screening manoeuvre exists

OME is most often asymptomatic. Rapid evaluation of middle ear function has been made possible by automatic tympanometers that assess tympanic membrane compliance (Zielhuis 1990b), which is reduced in the presence of fluid in the middle ear. Tympanometry is an easy, reliable and accurate test to detect fluid in the middle ear cavity in young people (Paradise 1979).

OME is common and potentially serious

OME may be associated with adverse language and behavioural outcomes (Roberts 1997). Screening is only useful when early detection is followed by referral and treatment that leads to improved clinical outcome (Wilson 1968).

Effective treatment exists

Effective treatment options exist for clearing effusions (e.g. ventilation tube insertion). Some have argued, therefore, that this condition is suitable for inclusion in a screening programme, although the evidence base for this is unclear. Some programmes screening for hearing loss included a considerable focus on identifying OME without empirical evidence for its value.

Problems with screening for OME

There is a high rate of spontaneous resolution of effusions, so positive assessments need follow up. Early detection may not lead to improvements in outcomes, in that identification and management of OME through routine care may result in similar outcomes after screening. Effusions may represent a physiological response that does not reduce hearing significantly or endure long enough to impact negatively on language, development or behaviour in a majority of cases.

Trials evaluating the effect of screening with early treatment on language and behavioural outcomes have therefore been conducted to shed light on the question of screening asymptomatic children in the general population for OME.

OBJECTIVES

The aim of this review was to assess the evidence from randomised controlled trials about the effect, on language and behavioural outcomes, of screening and treating children identified from the general population with clinically important OME in the first four years of life.

METHODS

Criteria for considering studies for this review

Types of studies

1. Randomised controlled trials of interventions for OME among children with clinically important OME identified through screening.
2. Comparison of outcomes for children randomised to be screened for OME and outcomes for children who were not randomised to be screened for OME (Barratt 1999).

Types of participants

In the trials of treatment in screened populations (see 1 above):

- Children in the first four years of life with OME identified through screening.

In trials comparing screened children to children not screened (see 2 above):

- Children in the general population in the first four years of life.

Types of interventions

- Screening procedures.
- Interventions for treating OME.

Types of outcome measures

Primary outcomes

- Language and behavioural assessments. Expressive and receptive language test (for example, the Reynell test).

Secondary outcomes

- Hearing assessment and resolution of effusions assessed by tympanometry, clinical examination or both.

Search methods for identification of studies

We conducted systematic searches for randomised controlled trials. There were no language, publication year or publication status restrictions. Original searches were completed in February 2002, and updated in January 2006. The date of the most recent searches was 30 June 2009.

Electronic searches

We searched the following databases from their inception: the Cochrane Ear, Nose and Throat Disorders Group Trials Register; the Cochrane Central Register of Controlled Trials (CENTRAL, *The Cochrane Library* Issue 2, 2009); PubMed; EMBASE; CINAHL; LILACS; KoreaMed; IndMed; PakMediNet; CAB Abstracts; Web of Science; BIOSIS Previews; CNKI; *mRCT* (Current Controlled Trials); ClinicalTrials.gov; ICTRP (International Clinical Trials Registry Platform); and Google.

We modelled subject strategies for databases on the search strategy designed for CENTRAL. Where appropriate, we combined subject strategies with adaptations of the highly sensitive search strategy designed by the Cochrane Collaboration for identifying randomised controlled trials and controlled clinical trials (as described in *The Cochrane Handbook for Systematic Reviews of Interventions* Version 5.0.1, Box 6.4.b. (Handbook 2008)). Search strategies for key databases, including CENTRAL, are shown in Appendix 1.

Searching other resources

We scanned reference lists of identified studies for further trials. We searched PubMed, TRIPdatabase, NHS Evidence- ENT and Audiology, and Google to retrieve existing systematic reviews possibly relevant to this systematic review, in order to search their

reference lists for additional trials. Abstracts from conference proceedings were sought via the Cochrane Ear, Nose and Throat Disorders Group Trials Register. For the original review, we wrote to the first authors of each of the trials meeting our inclusion criteria. We did this to inform them of the review and to establish communication for clarification of trial results and methods, and for interventions about relevant unpublished data. All first authors replied.

Data collection and analysis

Data extraction and management

Data from the studies were independently extracted by two authors using standardised forms that were pilot-tested. For each trial, the following aspects were documented: (1) methods (design of screening trial), methods of allocation, blinding, study structure; (2) participants (including age, setting, inclusion criteria, exclusion criteria, methods of screening); (3) interventions (nature of screening procedures and treatment offered to children with clinically significant OME) and; (4) outcomes (language and behaviour tests, hearing tests and resolution of effusions).

Assessment of risk of bias in included studies

The quality of the included studies was independently assessed by the two authors (CCB and MKvdL) in the original review, CT and SS in 2006 and CCB and SS in this update, using the scheme described in the *Cochrane Handbook for Systematic Reviews of Interventions*. This involved assessing studies for:

1. selection bias (presence or absence of adequate allocation concealment);
2. performance bias (presence or absence of blinding outcome assessors);
3. attrition bias (losses to follow up);
4. detection bias (quality of outcome assessment and selective reporting of results).

We used a three-point scale for overall validity, with the grading of:

- A: Low risk of bias - plausible bias is unlikely to alter the results seriously.
B: Moderate risk of bias - plausible bias raises some doubt about the results.
C: High risk of bias - plausible bias seriously weakens confidence in the results.

Data synthesis

Studies were assessed for heterogeneity regarding setting, participants, screening procedure, treatment and outcome assessment.

We planned to combine data from studies to perform a meta-analysis, provided there were no important differences across studies in terms of populations, setting, follow up, outcome measures, findings and methodological quality.

RESULTS

Description of studies

From the 2009 update searches a total of 428 references were retrieved; 206 of these were removed in first-level screening (i.e. removal of duplicates and clearly irrelevant references), leaving 222 references for further consideration.

We identified no studies in which children were randomised to be screened or not screened for OME.

We identified seven studies, based on three trials (668 participants), that reported the effect of screening and treatment on those children identified with clinically significant OME in the first four years of life (Johnston 2004; Rovers 2000a; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007; Zielhuis 1989). These studies each had two phases. Children were screened for OME and those with clinically significant OME were invited to participate in a randomised trial of treatment.

Age

All three trials included children during the first four years of their life and one trial included subjects who were followed up between the ages of nine and eleven years.

Setting and subjects

Two of the studies were undertaken in the Netherlands (Zielhuis 1989 and Rovers 2000a) and five were carried out in the United States (Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007). Children eligible for the Dutch studies were recruited from a general population of children born in a defined geographic area. Zielhuis and colleagues invited children to participate in a screening programme (Zielhuis 1989). Rovers and colleagues studied children who were part of an existing screening programme (Rovers 2000a). Paradise and colleagues in the United States screened children for the purposes of describing epidemiology and natural history, and for identifying children suitable for inclusion in a trial of early versus later treatment for OME (Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007). Children eligible for the US studies were born in selected hospitals.

Screening procedure

Zielhuis and colleagues invited children to participate in a screening trial. These children were screened in their own homes by tympanometry every three months, to a total of nine consecutive occasions between their second and fourth birthday. If the tympanogram was positive for OME, otoscopy was done to exclude causes other than OME, and a second tympanogram was done at the same visit for confirmation. Children who were not Dutch speaking, those with multiple illnesses and those with congenital defects were excluded. Only children with bilateral flat tympanograms on at least two successive screenings at an interval of three months were referred by their general practitioner to an otolaryngology clinic to confirm the diagnosis. When OME was confirmed by an ENT surgeon, parental permission was requested for their child to participate in the randomised trial.

The study by Rovers and colleagues was embedded in a large cohort of children who were invited for routine screening (Ewing Test) at age nine months. Children who failed a hearing test were recalled one month later. Those who failed three successive tests were referred to an ENT outpatient clinic for diagnosis and follow up. The parents of infants found to be suffering from persistent (four to six months) bilateral OME (confirmed by tympanometry and otoscopy) by the ENT surgeon in subsequent observations were invited to enter their children into a randomised controlled trial. Children with Down's syndrome, schisis, asthma, cystic fibrosis and sensorineural hearing loss were not eligible for the trial. Paradise and colleagues (Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007) enrolled healthy infants from two days to 61 days of age and evaluated them at least monthly for OME by tympanometry and pneumatic otoscopy. Children with a birth weight less than 2270 g, small size for gestational age, history of neonatal asphyxia or other serious illness, major congenital malformation or chronic illness and children who were the product of a multiple birth were excluded. Children were also excluded if their mother was dead, seriously ill, a drug or alcohol abuser, or younger than 18 years of age. To determine eligibility for the randomised trial, they estimated the cumulative proportions of days each child had unilateral effusion and bilateral effusion on the basis of diagnoses made at individual visits with interpolated data for intervals between visits. Children became eligible for the trial if, beginning at the age of two months and within the first three years of life, they had middle-ear effusions that appeared substantial in degree and that persisted, despite treatment with antimicrobial drugs, for 90 days in the case of bilateral effusion or 135 days in the case of unilateral effusion. Children with intermittent or unilateral middle-ear effusion for specified proportions of longer periods were also eligible.

The main differences in screening therefore were:

Age

Zielhuis and colleagues invited the children for screening at the age of 24 months. Rovers and colleagues invited the children for screening at the age of nine months. Paradise and colleagues (including Johnston 2004) invited the children for screening at the age of 2 to 61 days.

Screening procedure

Zielhuis and colleagues used tympanometry every three months for two years and otoscopy was done if the tympanogram was flat. Rovers and colleagues used a hearing screening test (Ewing test) and the children who failed three successive tests with one-month intervals were referred to an ENT outpatient clinic. The diagnosis of OME was confirmed by tympanometry and otoscopy. Paradise and colleagues used tympanometry and pneumatic otoscopy every month for three years. In their study which was embedded in the same trial, Johnston and colleagues repeated otomicroscopic examination at the age of five years.

Interventions to which children identified with clinically significant OME were randomised

In all studies, children with OME were randomised either to treatment with ventilation tube insertion or 'no treatment', 'watchful waiting' or 'late treatment with ventilation tubes'.

Zielhuis compared two groups: in one group the children were treated by ventilation tubes insertion; in the other group children received no treatment.

Rovers compared two groups: one group received treatment with ventilation tubes and one group had a period of watchful waiting. Those children in the watchful waiting group received no treatment, unless there was a medical indication. The children in the watchful waiting group who needed treatment received no ventilation tube insertion but other treatments (e.g. antibiotics).

Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005 and Paradise 2007 compared two groups: children assigned to the early treatment group were scheduled to have tympanostomy tubes inserted as soon as practical. Those assigned to the late treatment group were to undergo the operation six months later if bilateral effusion persisted, or nine months later if unilateral effusion persisted, but children in this group could receive ventilation tubes earlier if their parents requested the operation.

Duration of follow up in treatment stage of the studies

Zielhuis 1989 and colleagues followed up children for two years by tympanometry every three months. The mean age of the treatment group at randomisation was 39.5 months; for the non-treatment group this was 39.2 months. Both before randomisation and six months afterwards, all children were tested for language by means of a standard Reynell test.

Rovers 2000a and colleagues followed up children for 12 months and tympanometry and otoscopy were performed every three

months. The mean age at randomisation of the treatment group was 19.5 months (SE 1.7) and of the watchful waiting group, 19.4 months (standard error (SE) 1.9 months). Hearing loss and expressive and comprehensive language were assessed every six months. Paradise and colleagues (Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007) followed up the children by pneumatic otoscopy, supplemented by tympanometry, to evaluate the middle-ear status of the children at least monthly until they were three years old. The mean age when the children met the randomisation criteria was 15 months, the median age was 14 months. Audiometric testing was carried out whenever possible in all children who had unilateral or bilateral middle-ear effusion continuously for eight weeks, and every four weeks thereafter as long as effusion remained present, and once effusion had resolved. Developmental testing of the children in the treatment trial was undertaken as soon as possible after their third, fourth and sixth birthdays and between their ninth and 12th birthdays. Further audiometric testing was performed in all children who were about to undergo developmental testing and in any child in whom a parent or clinician suspected hearing loss.

Johnston and colleagues (Johnston 2004) followed up the early-treatment, late-treatment and non-trial cohorts from the Paradise trial (Paradise 2001) by performing otomicroscopy at the age of five years and audiometric testing, in conjunction with pneumatic otoscopic examination and tympanometric testing, at the age of six years. The non-trial cohort were followed up at age six years (Paradise 2005) and between their ninth and 12th birthdays and developmental testing was completed (Paradise 2007).

Measurement of outcomes from treatment of OME in a population identified through screening

Zielhuis and colleagues measured the prevalence and the duration of OME. Both before group allocation and six months afterwards, all children were tested for language development by means of a standard Reynell test. Clinical outcome was measured by the amount of improvement in language development.

Rovers and colleagues evaluated the natural course of OME by estimating the mean time spent with OME during their follow-up period, as well as estimating the mean time that children experienced hearing thresholds of equal to or less than 35 dB. They also used the Reynell test to measure comprehensive language development and the Schlichting test and the Lexi test to measure the expressive language development. The language assessments were made every six months.

Paradise and colleagues (Paradise 2001) evaluated middle-ear status, hearing status and developmental status in the two groups at the age of three years. They used the following tests to assess developmental outcomes: the Number of Different Words Test, the Percentage of Consonants Correct-Revised Test, the General Cognitive Index of McCarthy Scales of Children's Abilities, including General Cognitive Index and Verbal, Perceptual Perfor-

mance and Quantitative Sub scales, Peabody Picture Vocabulary Test-Revised, Mean Length of Utterance in Morphemes, Parenting Stress Index and a Child's Behaviour Checklist. In their follow-up study in 2003, Paradise and colleagues (Paradise 2003) used the above methods of developmental assessment at the age of four years together with a nonsense-word repetition task and samples of conversation. In their 2005 follow up (Paradise 2005) they also used the Wechsler Intelligence Scale for Children, a teacher's rating of behaviour and the SCAN test. In the 2007 follow-up study (Paradise 2007) the authors were able to assess a number of developmental aspects that they had been unable to assess until the children were older. The children were tested using the following: the Woodcock Reading Mastery Tests (an oral reading fluency test); the Woodcock-Johnson III test of achievement (writing, calculation, spelling subtests), the Comprehensive Test of Phonological Processing; the Hearing in Noise Test; the Disruptive Behaviour Disorder Rating Scale; the Child Behaviour Checklist; Impairment Rating Scales, the Social Skills Scale of the Social Skills Rating System, the Continuous Performance Test and the Wechsler Abbreviated Scale of Intelligence.

Johnston and colleagues evaluated tympanic membrane abnormalities and hearing levels at the ages of five and six years in relation to persistent otitis media and tympanostomy tube insertion in the first three years of life. Children underwent otomicroscopy at the age of five years and audiometric testing, in conjunction with pneumatic otoscopic examination and tympanometric testing, at the age of six years as described. The results of the developmental testing for the non-trial cohort are described in the Paradise 2005 and the Paradise 2007 studies.

Risk of bias in included studies

In all three trials, children with OME identified through screening were randomised either to treatment or control conditions, and concealment of allocation was described. Two of the three trials, which produced six of the included studies, used blinding of outcome assessment (Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007; Zielhuis 1989). In the remaining trial, there was no blinding of outcome assessment (personal correspondence, Rovers 2002). Withdrawals and drop-outs were adequately described.

Retention of children in screening and treatment aspect of the studies

Zielhuis and colleagues invited 1439 children for screening. Of these children, 1328 children participated: 1249 children were screened in the first round and 1050 children screened in the last round. This means that 73% of eligible children completed the screening programme. Two hundred and eighty-eight children met the criteria for treatment (persistent bilateral flat tympanograms during the study) and were referred to their general practitioner;

of these 194 children were assessed. Eighty-four children were eligible for the trial. The parents of 52 children (62%) consented to participate in the trial. Data from at least two language development tests were collected from 43 children (43/51 = 83% of those randomised, 43/83 = 51% of those eligible).

Rovers and colleagues embedded their trial in a cohort of 30,099 children who were invited to participate in a routine screening programme at the age of nine months. Of these children, 1081 failed three successive tests and were referred to and visited an ENT department. During the screening programme, 3649 children were lost to follow up. This means that 88% of children completed the screening programme (Rovers 2000b). The parents of the 386 children identified with persistent (four to six months) OME and who attended for follow up were invited to enter their child into a randomised controlled trial. Of these children, 187 parents provided consent (48%). Verbal comprehension, expressive language and hearing level were assessed in 158 children after 12 months of follow up (158/187 = 81% of those randomised, 158/386 = 41% of those eligible).

Paradise and colleagues (Johnston 2004; Paradise 2001; Paradise 2003; Paradise 2005; Paradise 2007) invited 6350 children for screening and 588 children met the eligibility criteria for the clinical trial. It is not clear how many children completed the screening programme. Four hundred and twenty-nine children aged three years (73%) with persistent OME were randomised. Speech, language, cognition and psychological development was assessed at the age of three years in 402 of these children (402/429 = 94% of those randomised, 402/588 = 68% of those eligible). Three hundred and ninety-seven (93%) underwent developmental testing at four years of age and 309 (72%) underwent both otomicroscopic examination at the age of five years and audiometric testing at the age of six years. In the 2005 follow-up study 395 children aged six years were assessed for developmental outcomes (395/429 = 92% of those randomised, 395/588 = 67% of those eligible) and 233 (97%) of the non-trial group underwent developmental testing. In the 2007 follow-up study of children aged nine to 11, 391 were assessed for developmental outcomes (391/429 = 91% of those randomised, 391/588 = 66% of those eligible) and 223 (93%) of the non-trial group.

Zielhuis and colleagues did not mention transfers between treatment arms after randomisation. In the Rovers trial, ten children allocated to watchful waiting had ventilation tubes inserted, but the timing of the procedures was not given. Of the 213 children in the Paradise trial who were assigned to late treatment, four had ventilation tubes inserted within 30 days of randomisation, nine within 60 days of randomisation, 22 within 180 days of randomisation, 65 by the age of three years, and 75 by age four years (cumulative figures). In their follow-up studies, of the 204 children assigned to the early treatment group who were followed up at age four years, 34 (17%) did not receive ventilation tubes. However, of those assigned to late treatment, 117 (61%) of the 193 children tested at four years did not receive ventilation tubes. By the age

of six years 73% of children in the early-treatment group, 37% in the late-treatment group and 3% in the non-trial group had undergone tube insertion. By the age of nine to 11 years of age 76% of children in the early-treatment group, 41% in the late-treatment group and 3% in the non-trial group had undergone tube insertion.

Effects of interventions

The main outcome measure in these screening trials was language development. We found no reliable evidence that screening and treating children with clinically important OME improves language development. Secondary outcomes in these studies included resolution of effusion and improved hearing.

Zielhuis trial

The effect of screening children for OME and subsequent treatment was evaluated by assessment of language performance. Detailed information was also collected on the epidemiology of OME and its natural history (duration, recovery and recurrence).

When analysing all children in the treatment phase as one group, bilateral long-lasting OME for at least three to six months caused significant impairment of expressive language skills but its effect on verbal comprehension was not significant.

Verbal comprehension and expression were measured using the Reynell test before randomisation and six months after randomisation. When comparing outcomes between the group who underwent surgical treatment after a positive screening test for OME and the group who did not receive such treatment after the same screening result, Zielhuis and colleagues did not find significant differences in language development over six months ($P = 0.74$ for comprehension and $P = 0.60$ for expression). Effects on hearing were not reported.

Rovers trial

The mean duration of effusion over one-year follow up was 142 days (36%) in the ventilation tube group versus 277 days (70%) in the watchful waiting group.

The mean hearing levels in the best ear at randomisation were 46.4 dB A (SE = 1.1) in the ventilation tube group and 43.4 dB A (SE = 1.2) in the watchful waiting group. At six months of follow up, the improvement in hearing levels in the ventilation tube group was 10.2 dB versus 4.6 dB in the watchful waiting group; at 12 months of follow up, these values were 13.1 dB and 8.5 dB, respectively. At three, six, nine and 12 months follow up, 15%, 29%, 27% and 27% of the children in the ventilation tube group were diagnosed with bilateral OME, respectively. In the watchful waiting group, these percentages were 77%, 66%, 57% and 52%, respectively.

In the watchful waiting group 25 (27%) children were diagnosed as having bilateral OME at all visits, while 10 (11%) children only had one episode of bilateral OME.

The mean hearing deficit in the ventilation tube group decreased from about 45 dB A to about 35 dB A; the estimated mean duration with a hearing deficit of equal or smaller than 35 dB A were 50% and 40% in the ventilation tube group and the watchful waiting group, respectively.

The Reynell test was used to measure comprehensive language development and the children in the ventilation tube group improved by a mean of 0.7 months (95% CI -0.3 to 1.7) more than the children in the watchful waiting group ($P = 0.18$), a non-significant difference.

The overall increase in expressive language measured by the Schlichting test was 1.4 (95% CI 0.2 to 2.5) and 1.9 (95% CI 0.65 to 3.1) months in the ventilation tube group and watchful waiting group, respectively. After adjustment for confounders, the children in the watchful waiting group improved one month more than those in the ventilation group; this difference was not statistically significant ($P = 0.17$).

Expressive language development was also assessed by the Lexi Test. This test consists of words that appear in normal language; the parents were asked to mark the words that their child spoke spontaneously. The children in the watchful waiting group improved eight words more on the Lexi Test than the children in the ventilation tube group ($P = 0.32$), a non-significant difference.

Rovers and colleagues did not find any statistically significant differences in language development between young children who were screened and received ventilation tubes and those who were screened and underwent watchful waiting.

The effect of screening and treatment with ventilation tubes on group average hearing levels was evident at six-month follow up, but the benefit had essentially disappeared by one-year follow up.

Paradise trial

During the first 12 months after randomisation, the percentage of children in the late treatment group who had effusion for more than 50% of the time was approximately three times that of the early treatment group. During the first 24 months, the percentage in the late treatment group was approximately twice that in the early treatment group.

Cognition was measured using four tests (McCarthy General Cognition Index, McCarthy Verbal Sub scale, McCarthy Perceptual Performance Sub scale and McCarthy Quantitative sub scale). Receptive language was measured using the Peabody Picture Vocabulary Test-Revised. Expressive language was measured with three tests (Number of Different Words, Mean Length of Utterance in Morphemes, and Percentage of Consonants Correct-Revised). Paradise and colleagues (2001) did not find statistically significant differences between the children who were screened and underwent early treatment with ventilation tubes and the children who

were screened and underwent late treatment with ventilation tubes in this wide range of developmental outcomes. The associated confidence intervals indicated that differences as small as 0.33 SD favouring the early treatment group, if present, would have been detected. In their follow-up study, Paradise and colleagues (2003) again used testing methods which included the General Cognitive Index of the McCarthy Scales of Children's abilities; the Peabody picture Vocabulary Test-Revised, a measure of receptive language; the Nonword Repetition Test, a measure of phonological memory; the Number of Different Words, a measure of word diversity; the Mean Length of Utterance in Morphemes, a measure of sentence length and grammatical complexity; and the percentage of Consonants Correct-Revised, a measure of speech-sound production. There were no significant differences between the two groups on any of these developmental measures at the age of four years except for a modest but statistically significant difference in scores on the Nonword Repetition Test which favoured the late-treatment group.

In addition, Paradise and colleagues assessed parent-child stress and children's behaviour at the age of three years and compared scores for the early and late treatment group. Four scales of the Parent Stress Index, Short Form and seven scales of the Child Behaviour Checklist were compared. Of the 11 comparisons made, one comparison favoured the late-treatment group ($P = 0.05$). Differences in hearing between the early and the late-treatment groups were not reported. At the age of four years, there were no significant differences between the early and late-treatment groups on parent-rated measures of parent-child stress and children's behaviour.

In the 2005 follow up, children aged six years were tested using the Wechsler Intelligence Scale for Children, the SCAN test which tests for deficits in central auditory processing, and parent and teacher ratings of children's behaviour using the Child Behaviour Checklist. Children were also tested using the Peabody picture Vocabulary Test-Revised, a measure of receptive language; the Nonword Repetition Test, a measure of phonological memory; the Number of Different Words, a measure of word diversity; the Mean Length of Utterance in Morphemes, a measure of sentence length and grammatical complexity; and the percentage of Consonants Correct-Revised, a measure of speech-sound production and finally the Parenting Stress Index which measures parent-child stress. There were no significant differences between early and late-treatment groups except for a moderately higher score among the children in the late-treatment group on the Nonword Repetition Task ($P = 0.05$). In children who were randomised (irrespective of treatment group), the mean scores for those who did not receive tympanostomy tubes before the age of three was higher on the Nonword Repetition Task than those who received tympanostomy tubes ($P = 0.04$).

In the non-trial cohort at age six years significant negative correlations (range -0.13 to -0.18) existed between percentage of days of effusion in the first three years of life and scores on the Peabody

Picture Vocabulary Test and the Mean Length of Utterances in Morphemes test and significant positive correlations (range 0.13 to 0.22) between percentages of days of effusion and scores on the Parenting Stress Index and on some scales of the parent and child versions of the Child Behaviour Checklist. These correlations were mostly weak and the percentage of variance accounted for by time with effusion was negligible (1.8% to 4.9%).

In the 2007 follow-up study children aged nine to 11 were tested using the following: the Woodcock Reading Mastery Tests, for reading progress; an oral reading fluency test, the Woodcock-Johnson III test of achievement (writing, calculation and spelling subtests); to assess phonological awareness, the Elision and Rapid Letter Naming Subtest of the Comprehensive Test of Phonological Processing; the Hearing in Noise Test, to assess auditory processing ability; the Disruptive Behaviour Disorder Rating Scale; the Child Behaviour Checklist; the Impairment Rating Scales; the Social Skills Scale of the Social Skills Rating System (completed separately by parents and teachers); visual and auditory continuous performance tests and the Wechsler Abbreviated Scale of Intelligence. There were no significant differences between early or late-treatment groups on any of the measures. For those who were randomised (regardless of treatment group) there were no significant differences on any of the measures between those who received tympanostomy tubes before three years and those who did not.

In the non-trial cohort at nine to 11 years of age, after adjustment for demographic factors there were some significant correlations between the duration of the effusion and scores on four of the 19 tests and 16 of the 28 measures based on teacher and parent reports. A longer duration of effusion was associated with a poorer score. This does raise the possibility that prolonged effusion may have contributed to some negative effects on development. However, the percentage of the variance explained by the duration of effusion was low (mean 3%, range 1.8% to 6.4%) and the authors suggest that residual confounding may explain the results.

Johnston study

Reporting the otomicroscopic findings of the cohorts from the Paradise trial, Johnston 2004 found that, at the age of five years, one or more types of tympanic membrane abnormality were found in one or both ears in 70.7% of the children in the early-treatment group, 42.5% of the children in the late-treatment group, and 9.5% of the children in the non-trial group ($P < 0.001$). Segmental atrophy and tympanosclerosis were the most common abnormalities found, present in 74.7% and 40.4%, respectively, of children who had received ventilation tubes but in only 3.0% and 0.6%, respectively, of children who had not received tubes.

Among children in the study population as a whole who had undergone myringotomy with tympanostomy tube insertion, the proportion who had any tympanic membrane abnormality was higher in those whose only or initial procedure was performed before the age of 24 months than in those in whom the procedure

was performed at a later age (86.3% versus 67.9%, $P = 0.027$).

In terms of audiometric findings, in those who participated in the randomised clinical trial, mean thresholds in the early-treatment group were slightly higher (i.e. less favourable) than in the late-treatment group, but this was not statistically significant ($P = 0.13$ for left ears, 0.80 for right ears). However, the thresholds in the early and late-treatment groups were significantly higher than in the non-trial group (early versus late-treatment, $P < 0.001$ for left and right ears; late-treatment versus non-trial, $P = 0.04$ and $P < 0.001$ for left and right ears, respectively).

Number of children needed to be screened for OME to find one child eligible for treatment for OME

We calculated the numbers of children needed to be invited to participate in a screening programme to identify one child with OME considered eligible for treatment. We divided the total number of children invited to participate in the screening by the number that we found eligible to participate in the treatment trial, and found that the number of children needed to be screened for OME ranged from between four and 78 (Zielhuis: $1249/288 = 4.3$; Rovers: $30099/386 = 78.0$; Paradise: $6350/588 = 10.8$).

Notable heterogeneity was observed across trials in terms of setting, age of participants, inclusion criteria (e.g. unilateral versus bilateral OME), screening procedure and outcome assessment. Because of this non-similarity, data for the three trials were not pooled. Despite these differences, the direction of the effect for the main findings was consistent across the three trials. The wide variation in numbers needed to be screened to detect one clinically important case of OME is partly explained by differences in study design and sample characteristics, particularly the age of the children who were screened.

It should be noted that not all children found eligible for treatment go on to receive interventions that may be offered to them. The numbers consenting to participate in the treatment trial aspect of these studies are not a valid estimation of this, since many subjects who declined to participate in the trials opted for and received early treatment.

Suitability for meta-analysis

Because of the important differences identified in terms of setting, inclusion criteria, outcome measures, follow up and results, we decided not to pool data from these studies.

DISCUSSION

In this review of randomised controlled trials, we found no evidence for a clinically important benefit in terms of language development and behaviour from screening children in the first four years of life for OME and treating those identified with OME.

Previous reviews have evaluated studies of the association between OME and language development (Haggard 1991; Lous 1984; Roberts 1997). More recently, an 'analytic pathway' approach was used to assess evidence about early detection of OME in preventing delayed language development (Butler 2001). Most of the studies included in these reviews have used case-control or non-randomised, prospective cohort designs. The focus of the present review was on evidence from randomised controlled trials of screening children in the first four years of their life for OME to improve language and behavioural outcomes. Two types of study were sought: studies that screened a population of children and then randomised those with clinically important OME to treatment or control, and studies that compared outcomes for children randomised to be screened or not screened for OME (Barratt 1999). We identified and included seven studies of the first design; no studies of the second design were found.

The costs of screening are not presented in the included studies. However, data from Rovers and colleagues' study were used to determine the costs and cost-effectiveness of treatment with ventilation tubes compared to watchful waiting (Hartman 2001). They found that the mean cost per child during one year of follow up was 450 US dollars in the ventilation tube group and 120 US dollars in the watchful waiting group. The authors concluded that in the absence of difference in language development and given these higher costs, treatment with ventilation tubes should not be recommended in young children with persistent OME identified by population based screening.

A common problem in screening programmes is lead-time bias. It is possible that those who benefit most from treatment would soon have been identified through usual care in the absence of screening. The studies examined in this review did not reach conclusions about lead-time bias.

Although no benefit was found for screening children in the first four years of their life and treating those with clinically important OME, absence of demonstrated benefit does not mean no benefit exists. For example, outcome measures may not be sufficiently sensitive to detect clinically important differences and randomised controlled trials may introduce procedures that result in findings that are not necessarily applicable to pragmatic care situations. Rates of eligible children who were successfully followed up in these trials ranged from 41% to 68%. It is possible that the parents of children with more severe symptoms declined to be randomised in order to avoid the chance of being allocated to a control group, and sought treatment elsewhere. This would have reduced the chance of finding a clinically significant effect from screening and treatment. High rates of transfer between treatment arms can undermine the intention-to-treat analysis as a basis for extrapolating benefits from trials to practice. This is more likely if transfer occurs early in the follow-up period. About 38% of the children in the late treatment arm in the Paradise trial had ventilation tubes inserted before the age of five years, but most of these

occurred after 180 days post-randomisation, lessening the likelihood of an underestimation of efficacy. It is also possible that more children from families with higher socio-economic status consent to participate and are followed up; this again may lead to a sample that is less at-risk for impairment in language and other aspects of development. It is well recognised that home environment, intelligence and attendance at high-quality day care or schooling may influence language development. Small numbers of children randomised and followed up may lead to a Type II error; this constitutes another threat to detecting possible clinically significant differences that might exist. Zielhuis and colleagues screened children in their homes. Despite this, only 73% completed the screening programme. Rovers and colleagues screened and successfully followed up 88% of children. However, substantive numbers of children with OME did not attend ENT departments for follow up after failing screening (94 out of 288 in the Zielhuis study and 284 out of 1192 in the Rovers study). Paradise and colleagues successfully followed up 43% of children initially enrolled in their study for three or more years. In all of these studies, it is possible that some of those children most likely to benefit from screening did not complete the full screening process and/or did not attend for follow up at hospital ENT departments.

Screening is only useful when early detection is followed by referral and effective treatment leading to improved clinical outcome. This review of randomised controlled trials concludes that there is not an important benefit from screening the general population of asymptomatic children in the first four years of life for OME on language development and behaviour. This finding is consistent with earlier reviews of studies using mainly non-randomised designs (Butler 2001; Haggard 1991; Lous 1984; Roberts 1997). However, it should be noted that all trials were conducted in developed countries and the evidence is therefore not necessarily applicable to developing countries where OME may be more severe. Also, in two of the three trials we report (Zielhuis 1989 and Paradise 2001), the main purpose of the screening process was to identify suitable children to participate in a treatment trial. Such screening programmes may have identified children with milder disease than might be identified by a routinely established, service-delivery programme. If so, these trial results might be applicable to screening programmes that identify children with more severe disease. Effect sizes of treatment of children with more severe disease are likely to be greater than the effect sizes identified by the studies we included in this review.

AUTHORS' CONCLUSIONS

Implications for practice

The aim of population-based screening of asymptomatic children for OME is to discover children with clinically important OME

and to offer those children interventions to improve hearing and language development.

This systematic review of randomised controlled trials sought to assess the effect, on language development and behavioural outcomes, of screening and treating those children identified with clinically important OME in the first four years of life. Our findings suggest that screening a general population of these children for OME does not lead to better language and behavioural outcomes. However, these findings may not be applicable to developing countries. In addition, screening procedures that identify children with more severe disease may identify a subgroup of children who do receive meaningful benefit from early intervention.

Implications for research

The methodological quality of the included studies was high and the trials involved screening of large numbers of children. However, the proportion of eligible children who actually participated in the trials of treatment was relatively low, and this raises the possibility of selection bias. Although different outcome measures were used, all these measures were identified and the results clearly presented. Further trials, in which general populations of children in the first four years of life are screened and those with OME randomised to treatment or control conditions, do not appear to be warranted, unless such trials raise the threshold of illness sever-

ity for treatment eligibility. However, despite small or negligible aggregate effect sizes from treatment in the studies we included in this review, many parents describe definite and sometimes dramatic improvements in their children after treatment for OME (Casby 2001). More in depth research needs to be done to achieve a better understanding of this phenomenon with the goal of identifying those children most likely to benefit from treatment. It is possible that the threshold for treatment was too low in the studies included in this review, and that beneficial effects may have been demonstrated if eligibility for treatment was limited to children with more severe OME. However, such children may be symptomatic and more easily identified through routine care, possibly undermining the case for screening asymptomatic children in the general population.

ACKNOWLEDGEMENTS

The authors would like to thank Drs Rovers, Paradise and Zielhuis for providing additional information. The Dutch Cochrane Centre helped with the EMBASE search in the original review, whilst Carolyn Doree and Gemma Sandberg at the Cochrane ENT Group provided much help with the literature searches for the updates.

REFERENCES

References to studies included in this review

Johnston 2004 *{published data only}*

Johnston LC, Feldman HM, Paradise JL, Bernard BS, Colborn DK, Casselbrant ML, et al. Tympanic membrane abnormalities and hearing levels at the ages of 5 and 6 years in relation to persistent otitis media and tympanostomy tube insertion in the first 3 years of life: a prospective study incorporating a randomised clinical trial. *Pediatrics* 2004; **114**:58–67.

Paradise 2001 *{published and unpublished data}*

* Paradise JL, Feldman HM, Campbell TF, Dollaghan CA, Colborn DK, Bernard BS, et al. Effect of early or delayed insertion of tympanostomy tubes for persistent otitis media on developmental outcomes at the age of three years. *New England Journal of Medicine* 2001;**344**:1179–87.

Paradise 2003 *{published data only}*

Paradise JL, Dollaghan CA, Campbell TF, Feldman HM, Bernard BS, Colborn DK, et al. Otitis media and tympanostomy tube insertion during the first three years of life: developmental outcomes at the age of four years. *Pediatrics* 2003;**112**:265–77.

Paradise 2005 *{published data only}*

Paradise JL, Campbell TF, Dollaghan CA, Feldman HM, Bernard BS, Colborn DK, et al. Developmental outcomes

after early or delayed insertion of tympanostomy tubes. *New England Journal of Medicine* 2005;**353**(6):576–86.

Paradise 2007 *{published data only}*

Paradise JL, Feldman HM, Campbell TF, Dollaghan CA, Rockette HE, Pitcairn DL, et al. Tympanostomy tubes and developmental outcomes at 9 to 11 years of age. *New England Journal of Medicine* 2007;**356**(3):248–61.

Rovers 2000a *{published and unpublished data}*

* Rovers MM, Straatman H, Ingels K, van der Wilt GJ, van den Broek P, Zielhuis GA. The effect of ventilation tubes on language development in infants with otitis media with effusion: a randomised trial. *Pediatrics* 2000;**106**:E42.

Zielhuis 1989 *{published data only}*

Zielhuis GA, Rach GH, van den Broek P. Screening for otitis media with effusion in preschool children. *Lancet* 1989;**1**:311–4.

References to studies excluded from this review

Friel-Patti 1990 *{published data only}*

Friel-Patti S, Finitzo T. Language learning in a prospective study of otitis media with effusion in the first two years of life. *Journal of Speech and Hearing Research* 1990;**33**(1): 188–94.

Marchisio 1998 *{published data only}*

Marchisio P, Principi N, Passali D, Salpietro DC, Boschi G, Chetri G. Epidemiology and treatment of otitis media with effusion in children in the first year of primary school. *Acta Otolaryngologica* 1998;**118**:557–62.

Maw 1999 *{published data only}*

Maw R, Wiks J, Harvey I, Peters TJ, Golding J. Early surgery compared with watchful waiting for glue ear and effect on language development in preschool children: a randomised trial. *Lancet* 1999;**353**:960–3.

Wright 1988 *{published data only}*

Wright PF, Sell SH, McConnel KB, Sitton AB, Thompson J, Vaughn WK, Bess FH. Impact of recurrent otitis media on middle ear function, hearing and language. *Journal of Pediatrics* 1988;**113**:581–7.

Additional references**Barratt 1999**

Barratt A, Irwig L, Glasziou P, Cumming RG, Raffle A, Hicks N, et al. User's guides to the medical literature: XVI. How to use guidelines and recommendations about screening. Evidence-Based Medicine Working Group. *JAMA* 1999;**281**(21):2029–34.

Bluestone 1988

Bluestone CD, Klein JO. *Otitis media in infants and children*. Philadelphia: W.B.Saunders Company, 1988.

Bluestone 2002

Bluestone CD, Gates GA, Klein JO, Lim DJ, Mogi G, Ogra PL, et al. Definitions, terminology, and classification of otitis media. *Annals of Otolaryngology, Rhinology and Laryngology* 2002;**Suppl 111**:8–18.

Butler 2001

Butler CC, MacMillan H. Does early detection of otitis media with effusion prevent delayed language development? *Archives of Disease in Childhood* 2001;**85**:96–103.

Casby 2001

Casby MW. Otitis media and language development: a meta-analysis. *American Journal of Speech-Language Pathology* 2001;**10**:65–80.

Casselbrant 1985

Casselbrant ML, Brostoff LM, Cantekin EI. Otitis media with effusion in preschool children. *Laryngoscope* 1985;**95**:428–36.

Casselbrant 1995

Casselbrant ML, Mandel EM, Kurs-Larsky M, Rockette HE, Bluestone CD. Otitis media in a population of black American and white American infants, 0-2 years of age. *International Journal of Pediatric Otolaryngology* 1995;**33**:1–16.

Dempster 1991

Dempster JH, Mackenzie K. Tympanometry in the detection of hearing impairments associated with otitis media with effusion. *Clinical Otolaryngology* 1991;**16**:157–9.

Fiellau 1977

Fiellau-Nikolasjen M, Lous J, Vang Pedersen S, Schousboe HH. Tympanometry in three-year-old children. *Scandinavian Audiology* 1977;**6**:199–204.

Fiellau 1979

Fiellau-Nikolasjen M, Lous J. Prospective tympanometry in three-year-old children. A study of the spontaneous course of tympanometry tubes in a nonselected population. *Archives of Otolaryngology* 1979;**105**:461–6.

Fiellau 1983

Fiellau-Nikolasjen M. Tympanometry and secretory otitis media. Observations on diagnosis, epidemiology, treatment and prevention in prospective cohort studies of three-year-old children [thesis]. *Acta Otolaryngologica Stockholm Supplement* 1983;**394**:1–73.

Fria 1985

Fria TJ, Cantekin EI, Eichler JA. Hearing acuity of children with otitis media with effusion. *Archives of Otolaryngology* 1985;**111**:10–6.

Grievink 1993

Grievink EH, Peters SAF, Van Bon WHJ, Schilder AGM. The effects of early bilateral otitis media with effusion on language ability: a prospective cohort study. *Journal of Speech and Hearing Research* 1993;**36**:1004–12.

Griffin 2006

Griffin GH, Flynn C, Bailey RE, Schultz JK. Antihistamines and/or decongestants for otitis media with effusion (OME) in children. *Cochrane Database of Systematic Reviews* 2006, Issue 4. [Art. No.: CD003423. DOI: 10.1002/14651858.CD003423]

Haggard 1991

Haggard M, Hughes E. *Screening children's hearing: a review of the literature and the implications for otitis media*. HMSO, 1991.

Handbook 2008

Higgins JPT, Green S, editors. *Cochrane Handbook for Systematic Reviews of Interventions 5.0.0* [updated February 2008]. The Cochrane Collaboration, 2008. Available from www.cochrane-handbook.org.

Hartman 2001

Hartman M, Rovers MM, Ingels K, Zielhuis GA, Severns JL, van der Wilt GJ. Economic evaluation of ventilation tubes in otitis media with effusion. *Archives of Otolaryngology, Head and Neck Surgery* 2001;**127**(12):1471–6.

Heikkinen 1999

Heikkinen T, Thint M, Chonmaitree T. Prevalence of various respiratory viruses in the middle ear during acute otitis media. *New England Journal of Medicine* 1999;**340**:260–4.

Hogan 1997

Hogan SC, Stratford KJ, Moore DR. Duration and recurrence of otitis media with effusion in children from birth to 3 years: prospective study using monthly otoscopy and tympanometry. *BMJ* 1997;**314**:350–5.

Jerger 1970

Jerger J. Clinical experience with impedance audiometry. *Archives of Otolaryngology* 1970;**92**:311–24.

Kzanas 1994

Kzanas SG, Maw R. Tympanometry, stapedius reflex and hearing impairment in children with otitis media with effusion. *Acta Otolaryngologica (Stockholm)* 1994;**114**: 410–4.

Lous 1981

Lous J, Fiellau-Nikolajsen M. Epidemiology of middle ear effusion and tubal dysfunction: a one-year prospective study compromising monthly tympanometry in 387 non-selected 7-year-old children. *International Journal of Pediatric Otorhinolaryngology* 1981;**3**:303–17.

Lous 1984

Lous J, Fiellau-Nikolajsen M. A 5-year prospective case-control study of the influence of early otitis media with effusion on reading achievement. *International Journal of Pediatric Otorhinolaryngology* 1984;**8**(1):19–30.

Lous 1995

Lous J. Secretory otitis media in schoolchildren. Is screening for secretory otitis media advisable?. *Danish Medical Bulletin* 1995;**42**:71–99.

Lous 2005

Lous J, Burton MJ, Felding JU, Ovesen T, Rovers MM, Williamson I. Grommets (ventilation tubes) for hearing loss associated with otitis media with effusion in children. *Cochrane Database of Systematic Reviews* 2005, Issue 1. [Art. No.: CD001801. DOI: 10.1002/14651858.CD001801]

MRC 1999

MRC Multi-Centre Otitis Media Study Group. Sensitivity, specificity and predictive value of tympanometry in predicting a hearing impairment in otitis media with effusion. *Clinical Otolaryngology* 1999;**24**:284–300.

Paradise 1979

Paradise JL, Smith CG. Impedance screening for preschool children. State of the art. *Annals of Otology, Rhinology and Laryngology* 1979;**88**:56–65.

Paradise 1999

Paradise JL, Feldman HM, Colborn DK, Campbell TF, Dollaghan CA, Rockette HE, et al. Parental stress and parent-rated child behaviour in relation to otitis media in the first three years of life. *Pediatrics* 1999;**104**(6):1264–73.

Paradise 2000

Paradise JL, Dollaghan CA, Campbell TF, Feldman HM, Bernard BS, Colborn DK, et al. Language, speech, sound production and cognition in three-year-old children in relation to otitis media in their first three years of life. *Pediatrics* 2000;**105**(5):1119–30.

Perera 2006

Perera R, Haynes J, Glasziou P, Heneghan CJ. Autoinflation for hearing loss associated with otitis media with effusion.

Cochrane Database of Systematic Reviews 2006, Issue 4. [Art. No.: CD006285. DOI: 10.1002/14651858]

Roberts 1997

Roberts JE, Wallace IF. Language and otitis media. In: Roberts JE, Wallace IF, Henderson FW editor(s). *Otitis media in young children: medical, developmental and educational considerations*. Baltimore: Paul H Brookes Co, 1997:133–61.

Rovers 2000b

Rovers MM. *Otitis media with effusion in infants: the effects of ventilation tubes [Thesis]*. Nijmegen: Nijmegen University, 2000.

Stephenson 1991

Stephenson JS, Martin LM, Kardatzke D, Bluestone CD. Prevalence of bacteria in middle ear effusions for the 1980's. In: Lim DJ, Bluestone CD, Klein JO, Nelson JD, Ogra PL editor(s). *Recent advances in otitis media*. Philadelphia: BC Decker Inc, 1991:389–92.

Teele 1989

Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in children in greater Boston: a prospective, cohort study. *Journal of Infectious Diseases* 1989;**160**:83–94.

Thomas 2006

Thomas CL, Simpson S, Butler CC, van der Voort JH. Oral or topical nasal steroids for hearing loss associated with otitis media with effusion in children. *Cochrane Database of Systematic Reviews* 2006, Issue 3. [Art. No.: CD001935. DOI: 10.1002/14651858.CD001935]

Wilson 1968

Wilson JHG, Jungner G. *Principles and practice of screening for disease*. Geneva: World Health Organization, 1968.

Zielhuis 1990a

Zielhuis GA, Rach GH, van den Broek P. The prevalence of otitis media with effusion: a critical review of the literature. *Clinical Otolaryngology* 1990;**15**(3):283–8.

Zielhuis 1990b

Zielhuis GA, Rach GH, van den Broek P. The natural course of otitis media with effusion in preschool children. *European Archives of Oto-Rhino-Laryngology* 1990;**247**(4): 215–21.

References to other published versions of this review**Butler 2003**

Butler CC, van der Linden MK, MacMillan H, van der Wouden JC. Screening children in the first four years of life to undergo early treatment for otitis media with effusion. *Cochrane Database of Systematic Reviews* 2003, Issue 2. [Art. No.: CD004163. DOI: 10.1002/14651858.CD004163]

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Johnston 2004

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening 6350 healthy infants aged 2 to 61 days in Pittsburgh, USA between June 1991 and December 1995 Treatment trial: 588 eligible, 429 (73%) underwent randomisation to early and late treatment. 309 underwent both otomicroscopic examination at age 5 years and audiometric testing at age 6 years
Interventions	Screening: pneumatic otoscopy plus tympanometry (in most cases), at least monthly until 3 years of age Audiometric testing: both before and after randomisation and at 6 years of age Treatment: ventilation tube insertion
Outcomes	Developmental testing at 6 years of age (see Paradise 2000, 2003) Audiometric testing: in conjunction with pneumatic otoscopic examination and tympanometric testing at 6 years Otomicroscopic examination: to detect tympanic membrane abnormalities at 5 years of age
Notes	Only 281 (65.5%) of the randomised children and 200 (83%) of the non-trial children in the original trial (Paradise 2001, 2003) were found to be free of MEE in both ears when evaluated at 5 and 6 years and thus could be included in this analysis

Risk of bias

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Paradise 2001

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening: 6350 healthy infants aged between 2 and 61 days in the Pittsburgh area (Children's Hospital of Pittsburgh, Mercy Hospital of Pittsburgh and 2 small-town and rural and 4 suburban private paediatric group practices) from May 1991 to December 1995. Of the 6350 children, 5121 (81%) were followed until age 1 year or longer, 4048 (64%) were followed until age 2 years or longer and 2735 (43%) until age 3 years or longer (Paradise 2000) Treatment trial: 588 eligible, 429 enrolled (73%), 402 followed up (68%). A higher proportion of the 159 children whose parents declined randomisation were seen at urban study sites (65% versus 50%, $P = 0.02$) and a lower proportion were seen at facilities in small or rural towns (23% versus 35%), $P = 0.005$)

Paradise 2001 (Continued)

Interventions	Screening: tympanometry, pneumatic otoscopy every month (in most cases) Audiometric testing in all children who had unilateral or bilateral middle-ear effusions continuously for 8 weeks Treatment: ventilation tube insertion
Outcomes	Developmental testing of the children in the treatment trial as soon as possible after their third birthday and in any case within two months afterwards. Tests were: the Number of Different Words Test; the Percentage of Consonants Correct-Revised test; the General Cognitive Index of Mc-Carthy Scales of Children's Abilities; measure of receptive language; sentence length; grammatical complexity; parent-child stress and behaviour Audiometric examinations before randomisation and after randomisation. Otoscopy every month Follow-up period: 3 years
Notes	There were differences in the duration of effusion before the treatment started. By the age of 3 years, 169 children in the early treatment group (82%) and 66 children in the late treatment group (34%) had received tympanostomy tubes

Risk of bias

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Paradise 2003

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening: 6350 healthy infants aged between 2 and 61 days in the Pittsburgh area (Children's Hospital of Pittsburgh, Mercy Hospital of Pittsburgh and 2 small-town and rural and 4 suburban private paediatric group practices) from May 1991 to December 1995 Treatment trial: 588 eligible, 429 (73%) underwent randomisation to early and late treatment, and 402 (93.7%) received developmental testing at the age of 3 years. 397 (67.5%) underwent developmental testing at the age of 4 years. 241 children who failed to meet criteria for the treatment trial were randomly selected to form a socio-demographically representative sample of the study population and underwent developmental testing at 3 years of age. 234 of these children were tested again at age 4 years
Interventions	Screening: pneumatic otoscopy plus tympanometry (in most cases) at least monthly until 3 years of age Audiometric testing in all children who had unilateral or bilateral middle-ear effusions continuously for 8 weeks Treatment: ventilation tube insertion
Outcomes	Developmental testing of the children in the treatment trial as soon as possible after their 4th birthday and in any case within 2 months thereafter. Methods of developmental assessment: formal tests, samples of conversation and parent-reported inventories regarding parent-child stress and children's behaviour. In addition to outcome measures at 3 years (see Paradise 2000), at the age of 4 years a nonsense word repetition task was also conducted Audiometric testing: in all children who were about to undergo developmental testing and in any child

Paradise 2003 (Continued)

	in whom a parent or clinician suspected hearing loss Follow-up period: 4 years
Notes	Of the 204 children assigned to the early-treatment group, who were followed up at 4 years, 34 did not receive ventilation tubes. Of those assigned to late treatment, 117 of the 193 children tested at 4 years did not receive ventilation tubes

Risk of bias **Risk of bias**

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Paradise 2005

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening: 6350 healthy infants aged between 2 and 61 days in the Pittsburgh area (Children's Hospital of Pittsburgh, Mercy Hospital of Pittsburgh and 2 small-town and rural and 4 suburban private paediatric group practices) from May 1991 to December 1995. Of the 6350 children, 5121 (81%) were followed until age 1 year or longer, 4048 (64%) were followed until age 2 years or longer and 2735 (43%) until age 3 years or longer (Paradise 2000) Treatment trial: 588 eligible, 429 enrolled (73%), 402 followed up (68%). A higher proportion of the 159 children whose parents declined randomisation were seen at urban study sites (65% versus 50%, $P = 0.02$) and a lower proportion were seen at facilities in small or rural towns (23% versus 35%), $P = 0.005$)
Interventions	Screening: tympanometry, pneumatic otoscopy every month (in most cases) Audiometric testing in all children who had unilateral or bilateral middle-ear effusions continuously for 8 weeks Treatment: ventilation tube insertion
Outcomes	Developmental testing of the children in the treatment trial as soon as possible after their 6th birthday. Methods of developmental assessment included formal tests, samples of conversation and parent-reported inventories regarding parent-child stress and children's behaviour In addition to those tests used at age 4 (see Paradise 2003), children were also tested using the Wechsler Intelligence Scale for Children, the SCAN test which is a test of deficits in central auditory processing and a teachers rating of behaviour Follow-up period: 6 years
Notes	-

Risk of bias **Risk of bias**

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Paradise 2007

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening: 6350 healthy infants aged between 2 and 61 days in the Pittsburgh area (Children's Hospital of Pittsburgh, Mercy Hospital of Pittsburgh and 2 small-town and rural and 4 suburban private paediatric group practices) from May 1991 to December 1995. Of the 6350 children, 5121 (81%) were followed until age 1 year or longer, 4048 (64%) were followed until age 2 years or longer and 2735 (43%) until age 3 years or longer (Paradise 2000) Treatment trial: 588 eligible, 429 enrolled (73%), 402 followed up (68%). A higher proportion of the 159 children whose parents declined randomisation were seen at urban study sites (65% versus 50%, $P = 0.02$) and a lower proportion were seen at facilities in small or rural towns (23% versus 35%), $P = 0.005$)
Interventions	Screening: tympanometry, pneumatic otoscopy every month (in most cases) Audiometric testing in all children who had unilateral or bilateral middle-ear effusions continuously for 8 weeks Treatment: ventilation tube insertion
Outcomes	Developmental testing of the children in the treatment trial between their 9th and 12th birthdays. Methods of developmental assessment included the Woodcock Reading Mastery Tests, for reading progress; an oral reading fluency test, the Woodcock-Johnson III test of achievement (writing, calculation and spelling subtests); to assess phonological awareness, the Elision and Rapid Letter Naming Subtest of the Comprehensive Test of Phonological Processing; the Hearing in Noise Test, to assess auditory processing ability; the Disruptive Behaviour Disorder Rating Scale; the Child Behaviour Checklist; the Impairment Rating Scales; the Social Skills Scale of the Social Skills Rating System (completed separately by parents and teachers); visual and auditory continuous performance tests and the Wechsler Abbreviated Scale of Intelligence Follow-up period: 9 to 11 years
Notes	-

Risk of bias***Risk of bias***

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Rovers 2000a

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: no
Participants	Screening: 30,099 healthy children aged 9 months born in the Eastern part of the Netherlands between 1 January 1996 and 1 April 1997. 26,450 completed screening and were followed up (Rovers 2000b). 1365 failed the population-based screening and 1081 of these visited an ENT department. 201 were lost to follow up Treatment trial: 386 eligible, 187 enrolled (48%). 19 withdrew immediately after randomisation and a further 11 withdrew during the trial (8 from the watchful waiting group and 3 from the ventilation tube group). However, the authors state 158 children were successfully followed up, 78 in the watchful waiting group and 80 in the ventilation tube group, giving a follow-up rate of 41%. The parents of 199 children

Rovers 2000a (Continued)

	did not agree to randomisation and 66 of these did not agree to any further participation in the study. However, 133 of those declining to be randomised did provide information about the treatment they agreed to undergo; 97 opted for watchful waiting and 36 opted for ventilation tubes (Rovers 2001)
Interventions	Screening: routine hearing screening (Ewing test) Otoscopy and tympanometry by the ENT surgeon when a child failed 3 successive tests Treatment: ventilation tube insertion
Outcomes	Hearing tests at randomisation and at 3, 6 and 12 months of follow up Language development assessment (Reynell test was used to measure comprehensive language development and the Schlichting test and the Lexi test were used for the expressive language development) at randomisation and at 6 and 12 months of follow up Tympanometry and otoscopy were performed every 3 months Follow-up period: 12 months
Notes	Follow-up period was 1 year. 10 children in the watchful waiting group had ventilation tubes inserted

Risk of bias

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Zielhuis 1989

Methods	Randomised controlled trial of treatment for OME in a population identified through screening Blinding of outcome assessment: yes
Participants	Screening: 1249 healthy children living in Nijmegen (Holland) aged 24 months old from 1984 to 1987. 1050 (73%) completed the screening programme. Only 194 of children with persisting OME attended their GPs after referral by the study team. Of these, 152 were referred to an ENT clinic, 144 were seen, 84 eligible, and consent for the trial was obtained for 51 children Treatment trial: 84 eligible, 52 enrolled (62%) and 43 followed up (51%)
Interventions	Screening: tympanometry was done every 3 months. Otoscopy was done when the tympanogram was flat Treatment: ventilation tube insertion
Outcomes	Language development tests by means of a standard Reynell test both before group allocation and 6 months afterwards Follow-up period: 2 years
Notes	The number of children in both groups was small. The follow-up period was short

Risk of bias

Risk of bias

Bias	Authors' judgement	Support for judgement
------	--------------------	-----------------------

Zielhuis 1989 (Continued)

Allocation concealment?	Low risk	A - Adequate
-------------------------	----------	--------------

MEE = middle ear effusion

OME = otitis media in effusion

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Friel-Patti 1990	ALLOCATION: Not a randomised controlled trial The children were not treated after the screening procedure
Marchisio 1998	ALLOCATION: Randomised PARTICIPANTS: The children who participated in the trial were between 5 and 7 years old
Maw 1999	ALLOCATION: Randomised PARTICIPANTS: The participants were children with OME, but they were recruited by means of referral because of suffering from persistent OME
Wright 1988	ALLOCATION: Not a randomised controlled trial

OME = otitis media in effusion

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix I. Search strategies

CENTRAL	PubMed	EMBASE (Ovid)
#1 OTITIS MEDIA WITH EFFUSION single term (MeSH)	#1 "Otitis Media with Effusion"[Mesh] OR "Ear, Middle/secretion"[Mesh]	1 exp Mucooid Otitis Media/ 2 exp Secretory Otitis Media/
#2 EAR MIDDLE [se] single term (MeSH)	#2 ((glue[tiab] AND ear[tiab]) OR (oti- tis[tiab] AND media[tiab]) OR (mid- dle[tiab] AND ear[tiab] AND effu- sion*[tiab]) OR (otitis[tiab] AND ef- fusion*[tiab]) OR (nonsuppurative[tiab] AND otitis[tiab]) OR (non[tiab] AND suppurative[tiab] AND otitis[tiab]) OR tympanitis[tiab] OR (serous[tiab] AND otitis[tiab]) OR (secretory[tiab] AND oti- tis[tiab]) OR (mucooid*[tiab] AND oti- tis[tiab]) OR (mucous[tiab] AND oti- tis[tiab]) OR (seromuco*[tiab] AND oti- tis[tiab]) OR (sero[tiab] AND muco*[tiab] AND otitis[tiab]) OR (otitis[tiab] AND serosa[tiab]) OR (mucooid*[tiab] AND middle[tiab] AND ear*[tiab]) OR (mucous[tiab] AND middle[tiab] AND ear*[tiab]) OR (seromuc*[tiab] AND mid- dle[tiab] AND ear*[tiab]) OR (adhe- sive[tiab] AND otitis[tiab]) OR (ex- udative[tiab] AND otitis[tiab]) OR ((3 exp Serous Otitis Media 4 (GLUE adj EAR).tw. 5 ((OTITIS adj MEDIA) and EFFU- SION*).tw. 6 (TYMPANITIS or (SEROUS adj OTI- TIS) or (SECRETORY adj OTITIS) or (OTITIS adj SEROSA).tw. 7 ((MIDDLE adj EAR) and EFFUSION) .tw. 8 ((NONSUPPURATIVE adj OTITIS) or (NON adj SUPPURATIVE adj OTITIS)) .tw. 9 (((MUCOID and MIDDLE) adj EAR) or (((SERO adj MUC*) and MIDDLE) adj EAR) or ((SEROMUC* and MIDDLE) adj EAR)).tw. 10 ((ADHESIVE and OTITIS) or (EX- UDATIVE and OTITIS)).tw. 11 ((OME or SOM) and (OTITIS or EAR*)).tw. 12 1 or 11 or 7 or 2 or 10 or 5 or 4 or 8 or 3 or 6 or 9 13 exp screening/ 14 (screen* or test* or evaluat* or monitor* or examin* or detect*).tw. 15 (early OR delay*).ti. 16 exp Hearing Loss/pc, di [Prevention, Diagnosis] 17 exp postnatal development/ 18 exp Developmental Disorder/di, pc [Di- agnosis, Prevention] 19 exp Language Disability/pc, di [Preven- tion, Diagnosis]
#3 GLUE EAR	#3 #1 OR #2	
#4 OTITIS MEDIA near EFFUSION*	#4 Mass Screening [MeSH]	
#5 MIDDLE EAR near EFFUSION*	#5 screen* [tiab] OR test* [tiab] OR eval- uat* [tiab] OR monitor* [tiab] OR ex- amin* [tiab] OR detect* [tiab] OR identif* [tiab] OR early [ti] OR delay* [ti]	
#6 NONSUPPURATIVE OTITIS OR (NON SUPPURATIVE OTITIS)	#6 "Child Development/ complications"[Mesh]	
#7 TYMPANITIS OR SEROUS OTITIS OR SECRETORY OTITIS OR OTITIS Serosa	#7 "Developmental Disabilities/preven- tion and control"[Mesh]	
#8 (MUCOID near OTITIS) OR (SERO MUC* near OTITIS) OR (SEROMUC* near OTITIS)		
#9 (MUCOID near MIDDLE EAR) OR (SERO MUC* near MIDDLE EAR) OR (SEROMUC* near MIDDLE EAR)		
#10 (ADHESIVE near OTITIS) OR (EX- UDATIVE near OTITIS)		
#11 (OME OR SOM) AND (OTITIS OR EAR*)		
#12 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR # 11		
#13 MASS SCREENING explode all trees (MeSH)		
#14 screen* OR test* OR evaluat* OR monitor* OR examin* OR detect* OR de- lay*:ti OR early:ti		
#15 CHILD DEVELOPMENT explode all trees (MeSH)		
#16 DEVELOPMENTAL DISABILI- TIES single term (MeSH)		
#17 LANGUAGE DEVELOPMENT DISORDERS single term (MeSH)		

(Continued)

<p>#18 HEARING LOSS/ prevention and control (MeSH) #19 #13 OR #14 OR #15 OR #16 OR #17 OR #18 #20 #12 AND #19</p>	<p>#8 "LANGUAGE DEVELOPMENT DISORDERS/prevention and control" [Mesh] #9 "hearing loss/prevention and control" [Mesh] #10 #4 OR #5 OR #6 OR #7 OR #8 OR #9 #11 #3 AND #10</p>	<p>20 ((language* or speech*) and (develop* or behav*)).tw. 21 18 or 19 or 16 or 13 or 17 or 20 or 15 (2588316) 22 21 and 12</p>
CINAHL (EBSCO)	Web of Science	BIOSIS Previews/CAB Abstracts (Ovid)
<p>S1 (MH "Otitis Media with Effusion") S2 TX (glue AND ear) or TX (otitis AND media) or TX (middle AND ear AND effusion*) S3 TX (nonsuppurative AND otitis) or TX (non AND suppurative AND otitis) S4 TX tympanitis or TX (serous AND otitis) or TX (secretory AND otitis) S5 TX (mucoid* AND otitis) or TX (mucous AND otitis) or TX (seromuco* AND otitis) S6 TX (sero AND muco* AND otitis) or TX (otitis AND serosa) S7 TX (mucoid* AND middle AND ear*) or TX (mucous AND middle AND ear*) or TX (seromuc* AND middle AND ear*) S8 TX (adhesive AND otitis) or TX (exudative AND otitis) S9 TX (OME OR SOM) and TX (otitis OR ear*) S10 s1 OR s2 OR s3 OR s4 OR s5 OR s6 OR s7 OR s8 OR s9 S11 (MH "Health Screening") S12 TX screen* OR test* OR evaluat* OR monitor* OR examin* or detect* or identifi* S13 (MH "Child Development Disorders/ DI/PC") S14 (MH "Developmental Disabilities/ DI/PC") S15 TX (language* OR speech*) and TX (behav* OR develop*) S16 TX (early OR delay*) S17 s11 or s12 or s13 or s14 or s15 or s16 S18 s10 and s17</p>	<p>#1 TS=ome #2 TS=((otitis OR ear) AND (effusion OR glue OR serous OR secretory)) #3 #2 OR #1 #4 TS=(screen* OR test* OR evaluat* OR monitor* OR examin* or detect* or identifi*) #5 TS=((language OR speech) AND (delay* OR development* OR behav*)) #6 TI=(early OR delay*) #7 #4 OR #5 OR #6 #8 #3 AND #7</p>	<p>1 (GLUE adj EAR).tw. 2 ((OTITIS adj MEDIA) and EFFUSION*).tw. 3 (TYMPANITIS or (SEROUS adj OTITIS) or (SECRETORY adj OTITIS) or (OTITIS adj SEROSA)).tw. 4 ((MIDDLE adj EAR) and EFFUSION).tw. 6 ((NONSUPPURATIVE adj OTITIS) or (NON adj SUPPURATIVE adj OTITIS)).tw. 7 (((MUCOID and MIDDLE) adj EAR) or (((SERO adj MUC*) and MIDDLE) adj EAR) or ((SEROMUC* and MIDDLE) adj EAR)).tw. 8 ((ADHESIVE and OTITIS) or (EXUDATIVE and OTITIS)).tw. 9 ((OME or SOM) and (OTITIS or EAR*)).tw. 10 1 or 7 or 2 or 5 or 4 or 8 or 3 or 6 or 9 11 (screen* or test* or evaluat* or monitor* or examin* or detect*).tw. 12 (early or delay*).ti. 13 ((language* or speech*) and (develop* or behav*)).tw. 14 11 OR 13 OR 14 OR 12 15 10 AND 14</p>

WHAT'S NEW

Last assessed as up-to-date: 29 June 2009.

Date	Event	Description
25 August 2009	New search has been performed	Two new studies included in the review, but conclusions remain the same

HISTORY

Review first published: Issue 2, 2003

Date	Event	Description
15 November 2006	New citation required and conclusions have changed	Substantive amendment. Two new studies were included in the review

CONTRIBUTIONS OF AUTHORS

Sharon A Simpson: searching for trials, quality assessment of trials, data extraction, data analysis and development of updated review. Corresponding author.

Chantal L Thomas: update of the original review including searching for trials, quality assessment of trials, data extraction, data analysis.

Chris Butler conceived of the study and participated in protocol development, searches, data extraction, analysis and report writing.

Mariska van der Linden participated in protocol development, searches, data extraction, analysis and report writing.

Harriet MacMillan participated in data extraction, analysis and report writing.

Hans van der Wouden participated in study design, analysis, searches and report writing.

DECLARATIONS OF INTEREST

None known.

NOTES

This review was substantively updated in November 2006 and updated again in August 2009.

The title was previously changed from 'Screening children in the first four years of life to undergo early treatment for otitis media with effusion' to 'Identification of children in the first four years of life for early treatment for otitis media with effusion'.

INDEX TERMS

Medical Subject Headings (MeSH)

*Hearing; *Language Development; *Mass Screening; Otitis Media with Effusion [*diagnosis; therapy]; Randomized Controlled Trials as Topic

MeSH check words

Child, Preschool; Humans; Infant