

Temporary hearing loss



A literature review by the National Deaf Children's Society

This literature review seeks to consider the following questions:

1. What impact does temporary hearing loss have - both in the short and long-term - on children's language development?
2. What clues does research give us around what good support – to children, families and other professionals – looks like?
3. What are the challenges, if any, that families of children experiencing temporary hearing loss face in accessing appropriate audiology or education services for children who are deaf?

1. Definition of temporary hearing loss

Temporary hearing loss in childhood is associated with otitis media (OM) - a group of diseases affecting the middle ear. There are two main types: otitis media with effusion (OME) and acute otitis media (AOM). OME is characterised by a build-up of fluid behind the eardrum and can easily be overlooked because there are few symptoms. AOM is an infection that occurs quickly and can be painful. A third type of OM, known as chronic suppurative otitis media (CSOM), is a middle ear infection that may result in discharge from the ear. All types of OM can cause temporary hearing loss (mild and moderate hearing loss which can be present for a few weeks or last several months) in one or both ears.

OM can be very common in early childhood, particularly in the first year of life. It is thought that approximately 80% of children experience OM by the age of four years.¹ Early onset of OM is linked to an increased probability of repeated episodes throughout childhood which may have long-term effects on a child's cognitive development and educational outcomes.

Most of the research conducted to date focuses on OME and this is reflected in this review. Common features of OME include: hearing difficulties (e.g. asking for things to be repeated, mishearing things), speech or language problems, behaviour problems (e.g. lack of concentration or attention), and poor progress at school. Other less common, features include clumsiness, balance problems, an intolerance of loud sounds, and tinnitus.

Although, OME is very common amongst those with cleft palate and Down's syndrome, this population is not included in this review.

2. A note on methodology

The 37 studies covered in this review do not provide strong evidence as to whether OME has a long-term effect on a child's cognitive and language development. It has been noted, however, that many papers tend to have issues with their research design (e.g. Rovers et al. 2000). These issues may have had an effect on a study's outcome and require us to be cautious when generalising the results to other populations. Some of these issues are listed below.

- Studies do not always make a distinction between length of time with OME (or number of episodes) and hearing loss. The degree of hearing loss experienced by children with OME can vary. Many studies argue that it is the degree of hearing loss rather than the presence of OME that predicts whether any negative effects can be observed (e.g. Zumach et al. 2011, Zumach et al. 2010).

¹www.mja.com.au/journal/2009/191/9/impact-otitis-media-cognitive-and-educational-outcomes

- Some studies do not take other factors into account. These factors might be socioeconomic status (often determined by referring to the mother's educational background), the home environment, how parents interact with their child, and the child's IQ.
- Some studies do not establish a baseline for their language development tests or include a control group (i.e. a group of children unaffected by OME) for comparison.
- The ability of some tests to detect a difference (e.g. language tests might be too broad) between groups can sometimes be questioned (Lous et al. 2005).
- The number of participants involved in these studies are sometimes too low for any significant findings to be meaningful.

Comparing findings across studies can also be difficult because studies focus on different age groups and may vary in the tests they use (e.g. tests looking at 'language' might focus specifically on speech production, receptive language ability, expressive language use or all of these aspects).

Studies that are considered good practice are those that have recruited a large sample from birth, tested this sample continuously for evidence of OME, and then tracked children throughout childhood while administering tests at regular intervals to determine whether OME causes problems in the long term. These longitudinal studies address some of the methodological shortcomings mentioned above and may be considered more reliable (particularly if they have also taken a range of social and environmental factors into account).

3. What are the short-term and long-term effects of OME?

Key points

- There appears to be a short-term effect of OME on understanding speech and sounds at an early age. In most cases, this effect is not present in older children with a history of OME. This suggests that these problems do not persist for the long term.
- In contrast, studies suggest that problems with listening ability can continue in the long term. These studies focus on the ability to switch from one ear to the other and filter out noise. Such studies suggest that children with a history of OME might find noisy environments challenging.
- Studies looking at other aspects of language (e.g. tests on pronunciation, vocabulary, and the length and complexity of sentences produced) and cognition suggest that temporary hearing loss caused by OM does not have a long-term effect on language and cognitive development.
- Instead, these studies frequently suggest that OME has an indirect effect. That is, it is the presence of other factors (e.g. socioeconomic status) combined with OME that predicts whether a child will do worse on specific outcomes.

Effects at the phonological level/listening ability

In this section, we focus on studies which report findings related to listening ability and speech perception. These studies suggest that OME has both a short-term and long-term effect on listening ability. Note, however, that each study differs in focus with some looking at how children respond to specific speech sounds as well as sounds in general. These studies also vary by language under focus (one study focuses on spoken Dutch).

There is some evidence to suggest that children who experience frequent episodes of OME might have problems understanding or producing sounds from an early age. Petinou et al. (2001) investigated whether 26-28 month old children (n = 16) with a history of OME could tell the difference between near-identical words pairs ending with either [s] or [z] (two very similar sounds). They measured whether children looked at the corresponding picture (when presented with a choice of two pictures) which matched the word

spoken to them. Children with no history of OME were more consistent in looking at the correct picture. Although this is a small study which only looks at one phonological pair, [s] and [z], this suggests that children who experience hearing loss as a consequence of OME may have difficulty in understanding speech from an early age.

This inability to tell the difference between similar speech sounds may continue for the long term. Zumach et al. (2011) investigated whether seven-year-old children (n = 54) affected by OME are able to tell the difference between speech sounds in Dutch that are very similar. Dutch children who had a higher degree of hearing loss found it harder to tell apart near-identical word pairs in spoken Dutch that differed in the first consonant (either [b] or [d]).

Other studies have looked at the impact of OME on listening ability over time. McKenna-Benoit et al. (2019) looked at the ability four and seven-year-old children (n = 34) in detecting differences in sounds. Although this study did not require children to listen to speech, the authors stress that being able to detect the type of sound changes in their study is important for understanding speech. Their results indicate that five-year-old children with a history of OME did worse than a control group in identifying sound changes. By contrast, this difference was not present when testing older children with OME (six-seven years). This suggests that children with OME catch up with their peers as they get older.

The findings from McKenna-Benoit et al. (2019) are supported by a larger study by Hall et al. (2007). In this study, 762 children at 31, 43, and 61 months had to discriminate between word pairs that sound similar at different volumes (e.g. *cup* and *duck*). In children without any hearing loss, the ability to recognise words at lower volumes improves over time (an average improvement of 5dB between 31 and 61 months). By contrast, children who have a history of OME at 31 months do worse at this task. Although this difference was stronger in those who had OME in both ears, those who had OME in one ear only, also lagged behind. However, this effect was not present at 61 months suggesting that OME does not have a long-term effect on the ability to recognise words at lower volumes.

Other studies have also found a relationship between OME and listening ability but they caution that this relationship is not straightforward. McCormick et al. (2001) is a longitudinal study looking at effects on language production and perception in five-year-olds (n = 294) with a history of OME. They found that children with a longer history have difficulty in identifying and producing some speech sounds. The same group also found it difficult to tell apart similar-sounding words (as in Hall et al. 2007) but this was more likely to be the case with children who had less stimulating home environments (measured by observing and rating how much a child interacted with their mother).

A follow-up study with the same group of children (n=179) at age seven (Johnson et al. 2008) again suggests that children generally catch up with their peers on speech perception and production. In this study, the ability to pronounce and segment words (e.g. say *meat*, now say it again with the *m*) was not found to differ when comparing seven-year-old children with and without a history of OME.

However, we must be cautious when assuming that children with a history of OME catch up with their peers. Some studies do suggest long-term effects of OME in other areas related to listening: the ability to switch focus to a specific ear in listening tasks. Asbjørnsen et al. (2005) and Klausen (2000) are studies investigating listening skills in nine-year-olds with a history of OME when compared to a control group (approximately 20 in each group). In these studies, children heard an English syllable in each ear and were asked to recall what they had heard. In other conditions, they were asked to attend to the syllable spoken in either the left or right ear. In general, there is a right ear advantage when listening to language. That is, we can expect more correct answers or responses from the right ear. In these two studies, both the control group and the OME-children demonstrate this advantage when asked to freely recall what they had heard and when asked to focus only on syllables they heard in their right ear. When asked to focus on words presented to their left

ear, however, OME-children were not as able to filter out syllables they heard in their right ear. Both studies did not consider the effect of socioeconomic status on their findings.

Note that in Asbjørnsen et al. (2005), these differences were present even though participants showed no signs of impaired language functions and normal cognitive abilities. Therefore, although no differences could be observed in how they used language, there may be subtle differences in how children with OME listen to sounds that we need to be considered. That is, the difficulty in switching from the right to left ear might mean that children with a history of repeated episodes of OME could have problems in noisy settings (e.g. a school classroom) and that these problems may continue to a late age.

Evidence from brain imaging studies appears to support the idea that young infants, with a history of OM, process sounds differently. Haapala et al. (2014) used brain imaging to measure how the brains of two-year-olds ($n = 40$) respond when listening to syllables in Finnish on a repeated cycle. These syllables sometimes varied unexpectedly in frequency or duration. Their results indicate that sounds are processed differently in children who have been affected by AOM and they suggest that this might have an effect on language development over the long term (although they do not look at this specifically).

Effects of OME on other aspects of language

The studies reported in the previous section have focused on listening ability and speech perception. Other studies have incorporated a wider range of tests which look at broader aspects of language. This might include tests on pronunciation, vocabulary, and the length and complexity of sentences produced.

Klausen (2000), mentioned in the previous section, also tested articulation, vocabulary knowledge, grammatical complexity, and expressive language use. Within their group of nine-year-old Norwegian children with a history of OME ($n = 19$), they found significantly lower scores in the articulation tests. One might then conclude that, other than articulation, there are no effects on language outcomes at the age of nine. Note, however, that this is a retrospective study (i.e. participants were not tracked from birth) with a low number of participants. Furthermore, no information on the socio-demographic factors is provided. These factors, if known, may alter the conclusions of this study.

In contrast, studies that have followed children throughout childhood generally indicate that short-term effects on language development tend not to be present as a child ages. These studies have also cautioned that any apparent negative effects on language outcomes might be attributed to other factors.

For example, Roberts et al. (2000) examined the effect of OME and hearing loss, from the first five years of life, on children's language skills during preschool years ($n = 85$). They also looked at their literary and maths skills prior to starting kindergarten. The children in this study were primarily from low-income families and were recruited from community-based childcare programmes. Although their findings indicate that children who have a longer history of OME tend to do worse on language assessments, this relationship between OME and language scores disappears once other factors (e.g., SES, maternal educational level, responsiveness and support of the home and childcare environment) were taken into account. Children with a history of OME also scored lower on literary and maths tests. However, as with other tests, this relationship disappeared once the quality of the home environment was taken into account (e.g. how parents interacted with their child, the provision of play materials, organisation of the environment). A later study indicates that these children eventually caught up in maths skills upon entering school and language skills by eight years old (Roberts et al. 2002).

Similar findings are reported in Zumach et al. (2010), Johnson et al. (2008), and Paradise et al. (2001). Zumach et al. (2010) evaluated language comprehension and production in Dutch children at two and seven years of age ($n = 65$). Their results suggest that two-year-old children with a history of OME might produce shorter

sentences. They also observed that language scores were better in children with highly-educated parents. This suggests that the short-term effects of OME can be mitigated in some environments. Furthermore, they found no clear effect of OME on language development at seven years of age.

Johnson et al. (2008) also found no effect of OME on language outcomes (e.g. scores on sentence length and structure, word structure) at age seven after controlling for socioeconomic status and home environment. Lastly, Paradise et al. (2000) looked at the relationship between OME on language perception and production in 241 three-year-old children. Although they found that children who had longer periods of OME did worse on receptive vocabulary (measured by using a picture-matching exercise) and verbal aspects of cognition (e.g. verbal memory and fluency), they found that this association was strongest among the most socioeconomically disadvantaged children.

Some studies have stressed the need to consider special populations which are more vulnerable to the effects of OME (Williams and Jacobs, 2009). For example, Australian Indigenous children, with a history of OME who speak Tiwi as a native language, are considered to be at a further disadvantage when learning English as a school language (Aithal et al. 2008). Since there are more speech sounds in English than in Tiwi, indigenous children may have more difficulty understanding English. Aithal et al. (2008) found that when asked to compare English syllables that sound similar, indigenous children with a history of OME did worse than indigenous children with no history of infection and non-indigenous children with OME. Although an Australian-based study, similar populations (e.g. children from a multilingual background who might have moved to the United Kingdom recently) may also be at a disadvantage when learning English as a second language. Such cases are likely to be small in number.

Other effects (cognitive and behavioural effects)

OM may also have an effect on aspects related to cognitive development, behaviour, and quality of life.

Brouwer et al. (2005) reviews 13 articles which measure health-related quality of life in children with OM to evaluate current instruments used to measure this outcome. The ages covered in this review were 0-13, although most reported an age of three or lower. The review indicates that children with AOM can experience distress in the form of physical suffering (e.g. pain, high fever), difficulties with hearing and speech, behavioural problems, emotional distress. Children with OME frequently experience hearing, speech, behavioural, and balance problems.

Brouwer et al. (2005) point out a number of issues in their review. Firstly, most quality of life measures are provided by the parents and may be a reflection of the parents' anxiety. They also question the reliability of the measures used. Secondly, they note that all the instruments reported in their review tested functional health status rather than health-related quality of life. In other words, they only reported observed physical symptoms and the functioning of the child as a consequence of these symptoms. They did not focus on questions exploring feelings or perceptions towards their health status. As a result, little is known of emotional and social symptoms and function in OM. Brouwer et al. (2005) conclude their study by recommending the instruments reported in Rosenfeld et al. (2000) as a test of functional health status. Their review also indicates that there may be little research in the effect of temporary hearing loss on children's emotional well-being.

Studies testing large populations for a range of cognitive outcomes (e.g. memory, verbal comprehension) also indicate that other factors are more important than a history of OME. For example, Johnson et al. (2000) is a longitudinal study of 698 children assessed at three (n = 379), 5 (n = 294), and seven years of age (n = 198). Their findings suggest that three-year-old children affected by OME are likely to score lower on cognitive tests of intelligence. However, no differences were observed in five or seven-year old-children (i.e. they had caught up), suggesting that OME only has a short-term effect on cognitive development.

Interestingly, they note that those who were more affected by OME were of a lower socioeconomic status and had home environments that were not as stimulating.

Few studies have looked at developmental outcomes after the age of 11. Bennet et al. (2001) investigates whether behavioural or cognitive effects from OME continue into late childhood and early teens (11-18 years). Using data from a large multidisciplinary study (1000 children born in New Zealand between 1972 and 1973), the relationship between OME and behaviour (rated by teachers and parents) and cognition (by looking at scores on academic tests) were compared. Their results suggest an effect on reading ability between 11-18 years. There was also an effect on parent-reported behaviour at 11, 13 and 15 years, and an effect on teacher-reported behaviour at age 13. Teenagers with a history of OME have worse scores in relation to inattention and antisocial behaviour. Note, however, although other factors, such as socioeconomic status, were controlled, this is a retrospective study covering a significant period of time. As a consequence, other unknown factors may also have had an effect on the result.

Summary

The studies reported in this section indicate that the effects of temporary hearing loss on language development is not straightforward. Often, it is not temporary hearing loss that causes issues in language development but other factors such as the home environment. In these cases, the negative effects of temporary hearing loss are made worse by the presence of these factors.

Feldman et al. (2003) highlights studies which have shown that the duration of OME is associated with lower socioeconomic status which, in turn, is associated with other factors (e.g. greater exposure to second hand smoke, and an increased likelihood of mixing with other kids in childcare). When we consider that children from lower socio-economic backgrounds are, in general, more likely to perform poorly on language and cognitive tests, these children, should they suffer from OME, will be a double disadvantage.

These studies also highlight how we must ensure that a range of factors is considered when determining the validity of each study's results. Williams and Jacobs (2009) stress that the extent to which each factor plays a role will vary between individual children (i.e. individual children may experience different combinations of factors with differing individual outcomes). Children who experience more factors associated with high risk (e.g., earlier onset of OME, longer periods of infections, poor access to medical management, and degree of hearing loss) require greater surveillance to minimise the negative effects of OM on language development.

4. Effects of grommets insertion – act now or wait?

There have also been several studies investigating whether it is better for a child's development to proceed quickly with surgery to treat OME or to wait at least three months to see if the condition resolves itself. This surgery involves the insertion of ventilation tubes (known as grommets) into the eardrum to allow air to pass through into the middle ear. Several studies have investigated whether children who receive this surgery quickly have better language and developmental outcomes later in life.

The key points arising from these studies are as follows:

- There is no clear benefit of early surgery for a child's language and cognitive outcomes in the long-term.
- The only observable benefit is a reduction in time with OME.
- Other factors (socioeconomic status, home environment) significantly interact with the results of language and cognitive tests.
- A period of watchful waiting instead of surgery is the recommended course of action.

One group of papers focused on the same group of children at three, four, six, and 9-11 years of age (Paradise et al. 2001, 2003, Paradise et al. 2003, Paradise et al. 2005, Paradise et al., 2007). In these studies, 429 children, with OME before the age of three, were divided into two groups at random: one group received surgery quickly and the second group were assigned to a 'watchful waiting' group. Children in both groups were assessed regularly when they reached a certain age. These tests involved:

- Standardised tests measuring cognitive and receptive language skills (e.g. matching spoken words to pictures).
- Assessments of children's productive language skills (e.g. pronunciation, range of words produced, length of sentences).
- Parental ratings of their child's behavioural and emotional health. From six years of age onwards, behavioural ratings were also collected from teachers.
- In the later studies (9-11 years), additional tests investigating literacy, attention, social skills, and intelligence were also used.

In general, the Paradise papers suggest that there is no clear benefit to receiving surgery promptly on developmental and language outcomes at three, four, six, and 9-11 years of age. The only observable benefit, they report, is that the time with OME is shorter in those who receive surgery promptly (Paradise et al. 2001). Additionally, no clear differences were found even when looking at specific subgroups of children (e.g. children who only had an infection in one or both ears and those with continuous and discontinuous infections) (Paradise et al. 2003).

The Paradise papers represent a widely cited study in this area. Other studies which are similar in design have also reported similar findings. These studies vary in methodology (e.g., in the number and type of tests used). Rovers et al. (2000) randomly divided 187 young infants (aged one) with OME into two groups (either surgery or watchful waiting) and assessed expressive and receptive language ability at the time of randomisation and six and 12 months later. No clear differences were found. Instead, the authors suggest that other factors such as the child's IQ and the mother's educational background may have an influence on their findings.

Hall et al. (2009) randomly divided 182 children with OME into the same two groups and assessed language development at four and 7-8 years of age. At four, there were some benefits to having early surgery: children in the watchful waiting group had poorer scores on some measures of language and writing (as assessed by the teacher). However, this difference was not present at 7-8 years. Instead, at this age there were more emotional problems within the watchful waiting group (as reported by the teacher). This study suggests that there might be minor benefits at four years of age but these benefits are not apparent at 7-8 years.

Lous et al. (2005) and Browning et al. (2010) review a number of papers published between 1971-2001 describing the effect of early or late surgery on long-term developmental outcomes (including some of the Paradise papers and Rovers et al.). These reviews suggest the main benefits of early surgery are a reduction in time spent with OME and a short-term improvement in hearing. The improvement in hearing is only a short-term benefit since children in the watchful waiting group are likely to 'catch up' when their infection has resolved. In contrast, no clear and consistent long-term effect was found for language development or for behaviour, cognitive, or quality of life outcomes across the range of studies reviewed.

On the basis of these findings, these studies all suggest that watchful waiting for a specified length of time (depending on whether one or both ears are infected) is the preferred management option. In most cases, the infection is likely to heal within three months when left untreated. Again, since other social and environmental factors are important in predicting language outcomes later in life, targeted intervention that improves the quality of care/interaction with the child may be more important than surgical intervention.

5. Bone conduction headsets

Holland Brown et al. (2019) offers a possible solution to the watchful waiting period in the form of bone-conduction headsets, which have been developed by the leisure industry for the transmission of speech or music. These headsets are much cheaper than bone conduction hearing aids which are relatively expensive and not widely available via health services. Additionally, they are advantageous since behind-the-ear hearing aids are not always considered appropriate for temporary hearing loss. Holland Brown et al. (2019) assessed whether 3-6-year olds ($n = 19$) who were in a period of watchful waiting could discriminate between words that sound similar (plate vs. plane) in quiet and noisy conditions when using a bone conduction headset paired with a remote microphone. Results indicate that the use of headset significantly improved the children's ability to do this. The authors suggest that the headset could be used in the short-term to assist the child in difficult listening environments such as the school classroom.

6. Studies looking at parents and educational settings

Key points

- How parents interact with their child and the quality of the home environment are important. Children with more frequent hearing loss also tend to have less responsive or stimulating home environments.
- Parents tend to interact differently with children who have a history of OME. This may have an effect on how language develops in these children.
- Parents perceive a positive improvement in their child's language/behaviour following grommets surgery
- Parents and professionals (teachers and ENT surgeons) assign different levels of importance to the effects of OM on children. Understanding these differences may be important when trying to improve how they communicate with one another.
- Childcare settings which are more interactive and have a higher child to staff ratio can also have an effect on language and developmental outcomes; this is regardless of socioeconomic status.

Parent-child interaction effects

Studies mentioned in previous sections have highlighted the importance of the relationship between the parent and child. These include Johnson et al. (2000), who found that children affected by OME with lower scores in cognitive tests of intelligence were also of a lower socioeconomic status and had home environments that were not as stimulating, and Zumach et al. (2010) who found that language scores in two-year-old children were better in those who had parents who were highly educated.

Similarly, longitudinal studies which look at the long-term impact of OME suggest that parents play an important role in predicting outcomes; more so than the severity and duration of OME itself. Roberts et al. (1995) focuses on parenting styles and the home environment in 61 infants attending a community-based child-care programme. Participants were assessed for language and cognitive skills at one year of age (e.g. receptive and expressive language skills, and social and affective abilities). Although a small association was found between hearing loss linked to OME and receptive language ability, the mother's interactive style and the quality of the home environment were more important (e.g. how the parent interacted with the child, the frequency of these interactions, and the provision of play materials). In other words, children with more frequent hearing loss tended to have less responsive mothers and home environments.

In some cases, it is the hearing loss associated with OME that could affect the quality of interaction between mother and child. One study indicates that this might be the case. Yont et al. (2003) investigated the

frequency of two types of interactions between parents and children with chronic (lasting a long time) or non-chronic OME:

- **Joint attentional discussions:** when parents will coordinate their attention with the child so that both are focused on the same object (e.g. talking about a bucket of toys that the child, the mother, and the father are all focused on).
- **Attention-directed intents:** directing a child to look at something that they are not focused on (e.g. telling a child to look at a phone when the child is currently looking at a box).

Yont et al. (2003) suggest that parents of children with chronic OME produce more attention-directed intents and engage in fewer joint attentional discussions when compared to parents of non-chronic OME children. The authors argue that that joint-attentional discussions are important for language development and that parents have a central role in facilitating this type of interaction. Attention-directed intents, which draw a child's attention away from something, are considered to be problematic for language development. They argue that attention-directed intents are more frequent with children with chronic OME because they are less likely to respond to sounds around them.

In other words, mild hearing loss causes children with OME to appear unresponsive and this, in turn, means that parents do not receive the necessary cues to establish a more interactive style. Consequently, this might have a negative effect on long-term development. Note however, that Yont et al. (2003) and Roberts et al. (1995) only focused on 12-month-old children, so it's not clear if this pattern continues with older children (parents might learn to adjust their interaction styles over time) and the study does not provide any evidence indicating that parental interactions have a direct impact on language development.

Parental ratings and perceptions

Some studies have focused exclusively on parents and their perception of different aspects of temporary hearing loss. For example, Karakanevatos and Lesser (1998) asked 107 parents to complete a questionnaire prior to and 12 months after surgery for grommets. The questionnaire asked parents to assess their child's ability to hear and understand speech in different conditions, to produce speech clearly, and their behaviour and whether they noticed an improvement following grommet insertion. Generally, parents reported a (perceived) improvement; particularly in behaviour, language, and social skills when compared to hearing. This perceived improvement varies depending on the child's age. For example, an improvement in hearing is reported for children over three while an improvement in speech is reported for children aged one to eight. The authors note that children who have an elder sibling who also received surgery for OME are more likely to have surgery themselves. They suggest that pressure from parents, acting on this perceived improvement, may be one reason why this happens.

Studies have also measured whether parental ratings of language use are related to the duration of OME. For example, Feldman et al. (2003) looked at this association in 621 children of one, two and three years. Generally, there was no association at one, a weak correlation at two, and a stronger correlation at three. That is, at three years, lower language scores were associated with children who had OME for longer. Although this implies that longer durations of OME at an early age are associated with worsening scores, the authors suggest that this pattern might be attributed to an as yet unknown confounding variable. Support for this comes from the various longitudinal studies of randomised control trials (e.g. Paradise papers) which show no relationship between length of time with OME and language measures. Additionally, the study also included maternal education as a factor and found that the more highly educated the mother, the higher a child did on language scores.

Comparing parents and professionals

One UK-based study suggests that policy makers should also be mindful of how parents and professionals discuss and prioritise aspects of OME. Higson and Haggard (2005) asked 118 teachers, 154 parents, and 178 ENT surgeons to respond to a questionnaire which covered areas such as presentation of illness, hearing, behaviour, concentration, and speech and language. Each question presented a scenario (e.g. child does not hear you unless face-to-face or a loud voice is used) and participants were asked to rate how often the scenario happens and how concerned they are when it happens. Responses were compared across four domains to determine which domain parents, teachers, and surgeon consider to be important: language and education, hearing, behaviour, balance.

The results indicate that teachers assign more weight to language and education, much more so than parents who consider hearing as being most important. ENT surgeons did not consider hearing to be as important by comparison. Behaviour and balance problems showed the least difference overall. Higson and Haggard suggest that the difference between teachers and parents with respect to the impact of language and education may be attributed to the fact that teachers are formally taught that language is crucial for education and that they can compare children in classroom against each other. ENT surgeons may assign low importance to hearing because hearing level is not always a characteristic of OME given its variability across children.

The authors suggest that it is important to understand the level of importance (measured as a combined score of frequency and concern) assigned to each value in order to facilitate communication between groups. For example, the child's health care system assumes that teachers can make valid referrals for hearing checks to school nurses for OME. However, if the problem is defined solely in terms of hearing then the paper suggests that teachers' awareness is probably insufficient for systematic referral of this type (since they will likely be more responsive to cues relating to language). Appeals for greater awareness of hearing may not be playing to their strength. However, teachers are in an appropriate setting to observe impact on language/education and behaviour and therefore could provide expert information on this to parents and professionals.

Quality of childcare

Research looking at the effect of educational settings have also indicated that OME can have an effect. Vernon-Feagans et al. (2007) looked at spontaneously produced language samples from 60 children in three childcare settings at three intervals (18, 24, 36 months). Half were in settings classed as high quality and the other half were in a low quality setting. The quality of childcare was assessed by looking at the number of children in childcare, the number of staff/caregivers, and the child-to-caregiver ratio. Results showed that children in higher quality of care with OME were more advanced on most of the measures of language (e.g. frequency of question words, sentence length, and vocabulary range), esp. at 24 and 36 months of age. Children in lower quality got progressively worse on language measures across time. Interestingly, there was no effect of OME. Similar findings were also found in studies using standardised language tests (e.g. Vernon-Feagans and Manlove, 2005; Vernon-Feagans et al. 2002). Interestingly, this study also controlled for socio-economic background: children from higher socioeconomic background were present in both care settings so the difference in language outcomes could not be attributed to SES alone but to the quality of the childcare setting.

Childcare settings play an important role in language development since so many young children spend much of their day in these settings without their parents. However, this kind of environment can be noisy with a high level of background noise, which can make it a challenge to hear and understand speech; particularly for children with OME. Vernon-Feagans et al. note that 'OM may have its greatest effect in the presence of poor quality environment that is both noisy and where the child may not engage in frequent verbal/adult interactions'. The authors conclude that policy makers and educators should take seriously teacher/child ratios in childcare settings and promote more adult/child interactions in these settings.

Similar comments have been made with regard to school classrooms although they have not been subject to research in the same manner. Classrooms can also be noisy environments and teachers do not often make sufficient accommodation for children to hear the teacher's voice and other children. Higson and Haggard (2005) note that they have been unable to find policy literature linking problems of ambient/background noise with OME or promoting awareness of OME amongst teachers. This paper indicates that management strategies of children with OME in the classroom is an understudied area.

7. Conclusion

In this section, we revisit the questions put forth at the beginning of this review.

What impact does temporary hearing loss have - both in the short and long-term - on children's language development?

- There is some evidence of a short-term effect in understanding speech and sounds. However, this effect does not appear to be long-lasting.
- These effects are present even when the hearing loss is unilateral (in only one ear).
- Additionally, there do not appear to be long-term effects in language and cognitive development as a consequence of OM.
- Listening ability appears to be affected. Children may have difficulty attending to and filtering out sounds in the surrounding environment. This difficulty is present even when language scores appear to be normal.
- The effects of OM may be lessened by other factors. Children with more responsive parents and more stimulating home environments do not appear to be as negatively affected by OM.
- There are no clear benefits of earlier insertion of grommets. Papers in this review suggest watchful waiting as the preferred management option.

What clues does research give us around what good support – to children, families and other professionals – looks like?

- Parents need to be made aware that even unilateral OME can have a negative effect on a child's ability to hear and discriminate between words (e.g. Hall et al., 2007)
- It is important to highlight good listening habits. The studies included in this review do indicate that OME might cause problems with understanding speech, which may be challenging when in a noisy environment such as a classroom. Classrooms need to be adapted and teachers need to be made aware of what adjustments need to be made.
- It is important to highlight that the degree and quality of interaction that a primary caregiver produces with their child may assist with overcoming the negative effects of OME.
- Highlights more interactive styles between parents and children (see Yont et al. 2003). The types of interactive styles favoured by Yont et al., which are not as frequent between parents and children with OME, are considered important for language development.
- Notes that, since other social and environmental factors are important in predicting language outcomes later in life, interventions that improve the quality of care/interaction with the child may be more important than surgical intervention.
- Targeted support for families from lower socio-economic backgrounds in particular may be necessary.
- Bone conduction headsets (see Holland Brown et al. 2019) may provide an inexpensive solution to the watchful waiting period.

What are the challenges, if any, that families of children experiencing temporary hearing loss face in accessing appropriate audiology or education services for children who are deaf?

- There is very little research on accessing appropriate audiology or education services for children with temporary hearing loss.
- One key issue is how parents and professionals discuss and prioritise aspects of OME (Higson and Haggard, 2005). For example, parents place more importance on hearing than ENT surgeons, while teachers assign more value to language. In order to facilitate communication between these groups, these differences need to be highlighted. Parents may feel that ENT surgeons have dismissed their concerns because they do not consider hearing to be as important.
- Since listening ability is affected, adjustments need to be made at school for children with temporary hearing loss. Teachers need to be reminded of good communication habits (e.g. making eye-contact before speaking, speaking at the appropriate volume).
- Quality of childcare can have a further effect on children with OME. Childcare settings with a high number of children and fewer adults to children are likely to have a further detrimental effect on language development.
- Children from multilingual backgrounds may find educational settings a challenge. Particularly if they are learning English as a school language.

8. References

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