Journal of Health Informatics in Developing Countries
http://www.jhidc.org/
Vol. 15 No. 1, 2021

Submitted: March 25th, 2021 Accepted: May 11th, 2021

The effect of Otitis media on the language acquisition among children: Findings from a systematic review

Abdullah AL Sagr *[1] , Nora AL Sagr[2]

[1] *King Abdullaziz Medical City of the National Guard, Health affairs, Riyadh,, Saudi Arabia.*
[2] *College of Applied Medical Sciences ,King Saud University Riyadh, Saudi Arabia.*

Abstract

Background: Otitis media (OM) is a widespread infection among children, which might hinder the acquisition of language. A myriad of individual studies has been found in the literature that reveals an inverse association between OM and language acquisition, however, the evidence from such studies is not reviewed and synthesized. Thus, we conducted a systematic review to integrate findings regarding the impact of OM on language acquisition among young children.

Methods: A wide range of electronic bibliographic databases such as PubMed, Embase, and ERIC was searched. Based on the eligibility criteria, all observational studies and one randomized controlled trial conducted from 2000 to 2020 were incorporated in the review. Following screening and assessing the abstracts, we ended up reviewing 11 articles, and data were extracted on important parameters such as country, sample size, study design, time of follow-up, and primary outcomes.

Results: Overall, the findings of the systematic review were mixed. However, the majority of the studies revealed a negative or inverse relationship between OM and various domains of language development among children. Generally, the eligible studies revealed that OM is negatively associated with language acquisition and can affect different domains such as receptive or expressive language. However, there were also some null findings from very limited studies.

Conclusion: The findings of this review may be considered imperative for the clinicians and physicians who treat children with OM because OM is mostly not severe and can be ignored. Given the effects of OM on various language domains, one needs to be vigilant while approaching the child with OM to prevent developing adverse effects of OM on language development.

Keywords: Otitis media; language development; Children; Systematic review.

[1]*Abdullah AL Sagr- King Abdullaziz Medical City of the National Guard, Health affairs, P.O.Box 22390, Riyadh 11426, Saudi Arabia; Email: Abdsag2004@yahoo.com.

1. Introduction

Otitis media (OM) is a widespread infection among children, and it is typified by the redness and infection of the middle ear[1]. This disease might be overlooked among children as it does not always cause severe symptoms[2]. There could be several risk factors of OM such as overcrowding, inadequate housing environments, passive smoking, undernutrition, and limited access to quality health care services[3, 4]. As a result, there could be adverse outcomes caused by OM such as hearing loss or effects on language development to just name a few[5]. For instance, hearing loss that happens in early childhood may lead to an irrevocable cascade of events that may be permanent, influencing the children's language, thereby social relations[6]. There is evidence that around 90% of kids had at minimum one event by the age of 10 years 10. Furthermore, 30 to 40% of children suffer periodic attacks[7]. The evidence from research studies on the age-specific occurrence of OM has found a bimodal arc regarding age and frequency of OM, displaying one noticeable zenith before 2 years of age and a tinier pinnacle at 5 to 7 years of age, the later apogee concurring with entry into primary school[6].

Primarily, research studies centered on assessing the adverse effect of hearing problems associated with OM on the occurrence of communication problems and academic accomplishment. Nevertheless, additional aspects disturb daily life, such as constant discharge from the ear, irritation, and disruption of balance interrupted sleep, and repeated physician appointments[8]. Likewise, there is also evidence that fluctuations in the hearing loss caused by OM might modify auditory processing and impede the development of language and speech. Hence, attention should also be put on invigorating speech and language while making treatment and therapeutic plans for the OM[8]. However, before making any plans to manage OM timely, there is a need for evidence about how OM can cause language development problems and to what extent language acquisition is affected by OM. There are individual studies in the literature that reveal an inverse association between OM and language acquisition, however, the evidence from such studies is not reviewed and synthesized. Thus, conducted a systematic review to synthesize findings regarding the impact of OM on the language acquisition among young children. Such findings will help clinicians and specialists in the ear, nose and throat field to screen and diagnose children for OM early in order to treat the infection in timely manner and avoid the development of adverse hearing and speech related outcomes.

2. Subjects and Methods

We performed a review systematically to evaluate, synthesize, and combine the existing evidence on the findings regarding the effect of OM on the acquisition of language among children. We used PRISMA guidelines to undertake this systematic review[9].

2.1 Inclusion and Exclusion Criteria

To answer the study question, the eligibility of a study was contingent for inclusion if a research study evaluated the consequence of OM on the development and acquisition of language (any or all domains), published in English from 2000 to 2020 across different regions of the world. Additionally, only those studies which were quantitative were incorporated. Qualitative studies were excluded and studies without full texts were also excluded. All those studies that consisted of opinions, criticisms of older research studies, and editorials were not included.

2.2 Sources of information and strategy for searching the relevant articles

A systematic search of published articles was started and completed in 2021. We searched databases such as PubMed, Embase, and ERIC. We explored references of pertinent reviews along with the database searches. An independent search was carried out by two authors who also scanned the results for potentially appropriate studies followed by retrieving the full-text articles. The primary endpoint of the review was the language development that was either receptive or expressive following otitis media. We pre-piloted the search strategies without any restrictions by year of publication, geographic area, or other socio-demographic characteristics.

We identified a blend of Medical Subject Heading (MeSH) keywords and text words. We clustered these into four major groups based on the categories of population, intervention, outcome, and settings. The most prevalent search terms found in abstracts and titles comprised “Otitis media”, “chronic otitis media”, “acute otitis media”. Further, we consulted with a librarian to generate a search in four different parts. The first part was restricted to search terms particular to the primary endpoint such as “language development” or “language acquisition”. This was followed by combining these major concepts using combinations (AND, OR) relevant to the research question. Moreover, to detect more research articles, we also used truncation (*) with the same root word. We used truncation to make sure to retrieve all potential variants of search terms. We also applied search limits or filters on the language (English), however, and applied restrictions on publication period, age group, and type of studies to include eligible studies in the search.

2.3 Data abstraction

We imported all appropriate research studies into the reference manager software (EndnoteTM) file, where each study was reviewed, and we also screened titles for duplicates in this software. We did not consider the abstracts for further review, which did not explicitly explore the study objective. Finally, we obtained and examined the full-text articles of the remaining relevant articles. This was followed by abstracting and summarizing the articles that met the eligibility criteria using a standardized proforma.

Thus, after the process of removing duplicates, title, and abstract screening, we removed papers that were beyond the scope of this review as guided by inclusion criteria. Besides, the bibliography of the remaining studies was also verified and examined to evade missing any useful studies. This process of searching the articles was carried out independently by the reviewers, and their judgments and extracted summaries were matched to identify the differences and resolve these accordingly.

Independent reviewers filled a standardized data extraction sheet for the eligible research articles. The reviewers compared the data extraction tables to ensure including the imperative findings of the eligible studies and pilot tested the data extraction sheet before starting the process of data extraction. Besides, prevailing research articles on the chosen topic were reviewed to describe objects of the data extraction proforma. Any discrepancies between the two reviewers were solved by agreement between the two reviewers. The abstracted data comprised of the author, reference, year of publication, type of study design; total study size and population; average age with range for age, duration for follow-up, major study findings, and conclusion of the study.

3. Results

3.1. Findings of the search strategy

We screened the identified articles initially by titles, then by abstracts, and finally, we carried out a full-text articles assessment. Our initial search identified 5250 citations in different databases, however, 2505 articles were duplicates that were removed. Of the remaining 2745 unique studies, we reviewed titles and abstracts and found 1504 relevant abstracts. Upon reviewing abstracts, 1490 articles did not meet the eligibility criteria while reviewing the abstracts and 3 did not meet eligibility after reviewing full texts. Hence, we were able to retrieve full texts for 11 articles, which were incorporated in the review as shown in Figure 1.

3.2. Characteristics of the eligible studies

With respect to the study design, eight of the studies were prospective or longitudinal studies, two were matched case-control studies and there was one randomized controlled trial. The sample size of all included research studies varied between 9 to 22890 with a very wide range of the study participants included in different studies. The studies were conducted mostly in developed countries such as USA (n=3), Portugal (n=1), Spain(n=1), Netherlands (n=2), Australia (n=3), and one in the Saudi Arabia (n=1) (Table 1). Three studies were performed between 2016 to 2019, two between 2012 to 2013, two in 2010, and four were conducted between 2000 t0 2002 as illustrated in Table 1. As expected, the study was conducted among children with age range of 2 months to 10 years and these children underwent different assessments for language development with a wide range of follow up mostly for 3-4 years of follow up.

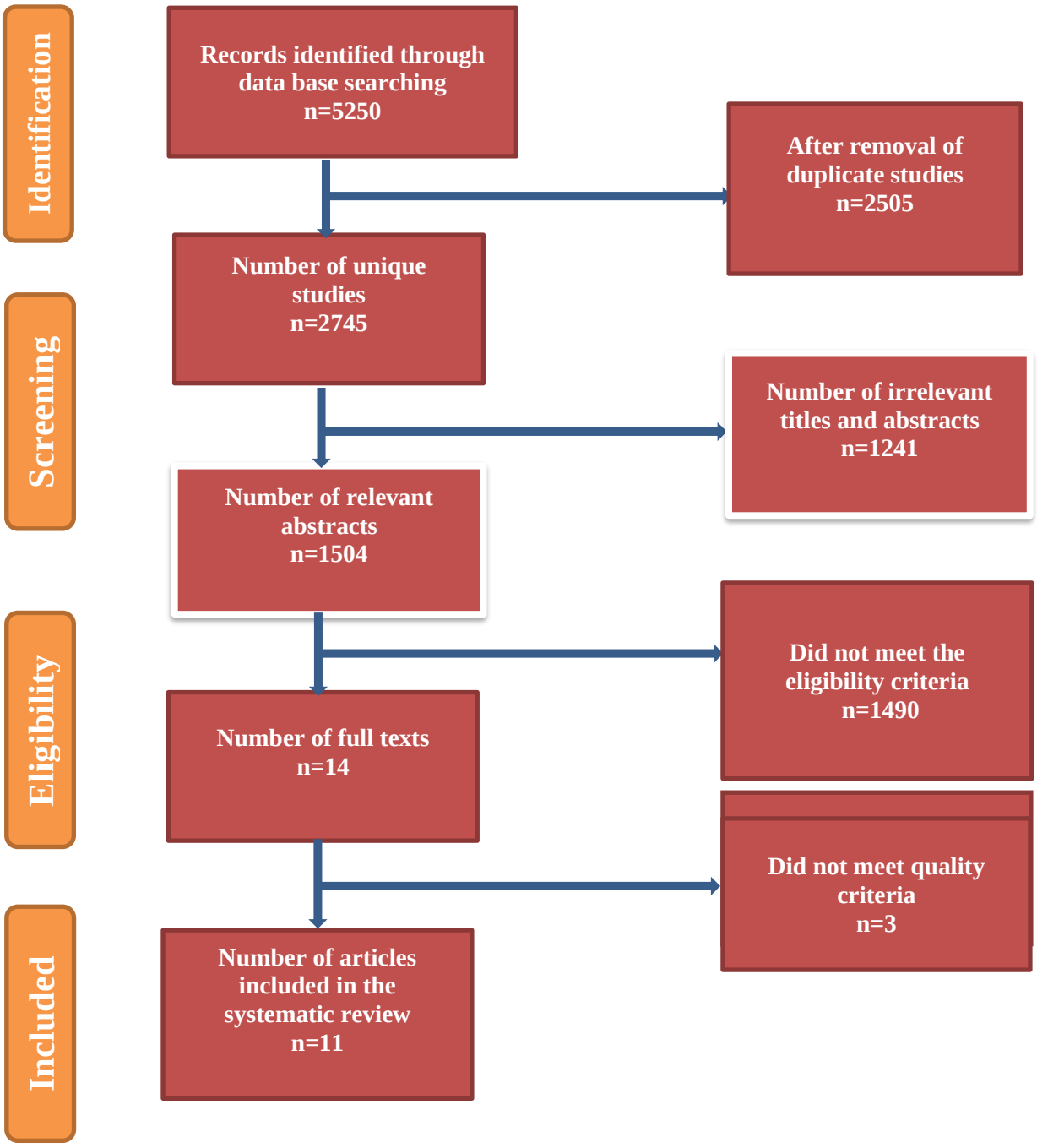

Figure 1: Flow chart summarizing the identification and selection of randomized controlledtrials for systematic

3.3. Main findings of the included studies

A recent study conducted by Brenan et al in 2020 followed children for 4 years in a prospective study where authors found a mixed finding regarding the relationship between otitis media and language development that was dependent upon different aspects for language development[10]. Authors found a substantial decrease in the degree of receptive vocabulary growth at the age of ten years for kids with otitis media of both ears at the age of ($\beta = -3.17$ [−6.04, −0.31], P-value = .030), but not for the joint unilateral or bilateral otitis media group ($\beta = -1.83$ [−4.04, 0.39], P-value = .106) [10]. The authors concluded that children with otitis media had mean language development scores in the typical array at six and ten years. Nevertheless, there a tiny but statistically substantial decrease was found in the percentage of receptive vocabulary growth at age of ten years of age among children with otitis media on both sides at the age of six years after controlling for an array of common causes of OM and language development such as socioeconomic status or housing conditions[10].

Another study was conducted in 2019 by Baptisa in Portugal found a negative relationship between OM and the development of language. Authors found that kids with OM during the earliest year of life showed a deficit in language development[11]. Lexical knowledge was the only non-affected domain among children with OM during the 1st year of life. A mild and intermittent hearing loss was identified among children with otitis media regardless of the age when they developed the same and no loss in the hearing was identified in the control arm [11]. According to the authors, early Otitis media episodes cause an adverse impact on the development of language and need to be diagnosed on time to prevent adverse outcomes[11]. Likewise, in 2016 Bell et al conducted a prospective cohort study in Australia to assess the effect of OM on the overall development including language components[12]. Authors found that kids with persistent otitis media had an enhanced probability of being categorized as developmentally susceptible on all domains including domains as opposed to kids without a persistent OM (20 percent–35 percent higher risk) [12]. No enhanced hazard for children with various persistent disease diagnoses as compared to those with a solo diagnosis (P-value $> .05$) [12].

Badran et al conducted prospective case series in Saudi Arabia and followed children for four years to assess the effect of OM on the development of language [13]. Authors found that persistent infections of the ear among kids played a crucial role to cause delays in the development of language[13]. Substantial setbacks were noted in language development among children with persistent infections of the middle ear (Table 2). The average of all aspects of language (receptive, expressive, and total language) age was improved and greater among kids of the study without a history of recurring infections of the middle ear as opposed to the study participants with persistent infections of the middle ear[13].

Table (1): Characteristics of the included studies with their settings and types of groups (n=11)

Study	Year	Country or Study Site	Study Design	Sample size	Age
Brenan et al(10)	2020	Australia	Longitudinal pregnancy cohort	1344	6 years
Baptisa(11)	2019	Portugal	Prospective case series	9	4 to 7 years
Bell et al(12)	2016	Western Australia	Prospective cohort study	22890	(mean age, 5.5 years; SD = 0.29
Badran et al(13)	2013	Jeddah, Saudi Arabia	Prospective case series	30	4 to 10 years
Alonso et al (14)	2012	Spain	Matched case control study	35	3 to 7 years
Winskel et al(16).	2010	Sydney Australia	Matched case control study	43 cases and 43 control	6 to 8 years old
Zumach et al (15)	2010	Netherlands	prospective study	65	6.6 to 7.10 years
Feagons et al (17)	2002	USA	prospective study	41	One year
Paradise et al (18)	2000	USA	prospective study	6350	2 months
Rovers et al(19)	2000	Eastern Netherlands	Randomized controlled trial embedded in a cohort	30,099	9 months
Shriberg et al(20)	2000	USA	prospective study	70	12 to 18 months

Analogously, Alonso et al conducted a matched case-control study in Spain where authors found that linguistic tests revealed substantial discrepancies between cases of OM and controls in different scores (phonetic, phonological, and syntax) [14]. However, there were no differences found in the semantics in the same study between cases and controls [14] (Table 2). These findings underscore the effect of persistent OM of the right ear and reveal that it primarily worsens phonetic and phonological coding of sounds, which might have consequences for prophylactic treatment of those kids at the risk[14]. Zumach et al conducted a prospective study in Nether lands[15]. The authors observed that while examining the association between early life OM-related auditory and problems of language at 27 months, a statistically substantial correlation was found between these two[15]. Similarly, there was a robust correlation between scores of languages at 27 months and 7 years. Conversely, a substantial correlation was found between early life OM and its auditory and language skills at school age was present[15]. Otitis Media in the early life affected neither language production nor comprehension scores were affected by otitis media[15].

Generally, the results of the present study recommend that long-term effects of initial life OM and its underlying loss of hearing might not be applicable for overall comprehension of linguistic and production skills[15].

Similarly, Winskel et al conducted a matched case-control study in Sydney Australia [16]. Authors found a typical propensity for kids with OM to attain lesser scores on reading, rhyme and non-word reading, semantic abilities of expressive vocabulary, phonological understanding skills of alliteration, and word definitions when compared to kids with no OM[16] (Table 2). These results underscore the possible challenges associated with otitis media might have on school-going kid's later development of language and literacy[16]. Another study conducted by Feagans et al in the USA found an inverse relationship between Otitis media and language development [17]. More specifically, authors observed that children with chronic otitis media and were in low-quality care uttered ½ as many words and diverse words while reading the book, responded less abstract queries appropriately, and were regarded more ill on language usage by their educators than the remaining 3 groups of kids[17]. Likewise, Paradise et al conducted a prospective study in the USA [18]. Authors did not find any substantial associations between time with MEE during predecessor intervals and children's scores on measures of impulsive expressive language, speech sound production, or additional measured traits of cognition. Conversely, scores on all measures were steadily greatest among the most kids belonging to poor socioeconomic status and lowest among the poorest kids[18]. Another study was conducted by Rovers et al in Eastern Netherlands [19]. No significant variations were noticed in expressive or comprehensive language between the 2 groupings after controlling for maternal education status, IQ of the kid, and differences at the baseline [19]. There was no significant effect of ventilation tubes on the development of language among children with OM [19].

There was an improvement in the thorough language of the kids who did not have effusion during the follow-up, which was more than that of the kids who had constant effusion during the whole follow-up. There were no variations found for the development of the expressive aspect of language. Shriberg et al conducted a prospective study in the USA[20]. Authors noticed that levels of hearing at twelve to eighteen months were substantially related to delay in speech and outcomes related to the language at a low level at the age of three years (Table 2). The probability for the subclinical or clinical delay in a speech at three years of age was 2 percent for kids with <20 dB mean hearing levels at twelve to eighteen months and 33 percent for those with > 20 dB mean hearing levels at 12-18 months [20].

Table (2) Summary of main findings regarding effect of otitis media on the acquisition of language (n=10)

Study	Year	Follow up and assessments	Main Findings	Conclusion
Brenan et al[10]	2020	4 years	No substantial association was found between bilateral otitis media and language ability at six years of age (β = −0.56 [−3.78, 2.66], P-value = .732). A substantial reduction was found in the rate of receptive vocabulary growth at ten years of age (PPVT-R) for kids with bilateral otitis media at six years of age (β = −3.17 [−6.04, −0.31], P-value = .030), but not for the joint unilateral or bilateral otitis media group (β = −1.83 [−4.04, 0.39], P-value = .106	Children with otitis media had mean language development scores within the normal range at six and ten years of age. Nevertheless, there was a tiny but statistically substantial decrease in the rate of receptive vocabulary growth at age of ten years of age in children who had bilateral otitis media at six years of age after controlling for a array of sociodemographic aspects.
Baptisa[11]	2019	3 different assessments	Children with Otitis media during the first year of life showed a deficit in language development. Children who developed Otitis media after three years matches the control group. Lexical knowledge was the only non-affected domain among children with Otitis media during the first year of life. A mild and intermittent hearing loss was identified among children with otitis media regardless of the age when they developed the same and no hearing loss was identified in the control group.	Early Otitis media episodes cause negative effect on language development and need to be diagnosed on time to prevent the adverse outcomes.
Bell et al[12]	2016	4 to 5 years	Kids with a chronic otitis media had an enhanced risk of being categorized as developmentally susceptible on social, emotional, language, cognitive, and physical domains as opposed to kids without a chronic otitis media	Irrespective of the total situations, chronic otitis media in young kids is a risk factor for decreased school willingness. These impacts were seen for health conditions not usually believed harmful to school

			(20%–35% increase in risk). There was no increased risk for children with multiple chronic illness diagnoses over those with a single diagnosis (all P-value > .05). No indication of a disease-specific effect making such risk.	readiness, such as chronic otitis media.
Badran et al[13]	2013	4 years	The persistent infections of the ear among kids played a crucial role to cause delays in the development of language. The average of receptive, expressive, and total language age was improved and greater among kids of the study without a history of recurring middle ear infections as opposed to the study participants with persistent infections of middle ear.	Substantial setbacks in language development among children with persistent infections of middle ear.
Alonso et al [14]	2012	NA	Linguistic tests revealed substantial discrepancies between cases of otitis media and controls in phonetic, phonological, and syntax scores. However, there were no differences found in the semantics.	These findings underscore the causative effect of chronic otitis media of the right ear and reveal that it mainly worsens phonetic and phonological coding of sounds, which may have consequences for prophylactic treatment of those kids at the risk.
Zumach et al [15]	2010	Three monthly visits in the first two years of life	When examining the association between early life otitis media related auditory and language problems at 27 months, a statistically substantial correlation was found between these two. Similarly, there was a robust correlation between scores of languages at 27 month and 7 years. Conversely, substantial correlation was found between early life otitis media and its auditory and language skills at school age was present. Otitis Media in the early life affected neither language production	Generally, the results of the present study suggest that long-term effects of early life otitis media and its underlying hearing loss might not be applicable for overall comprehension of language and production skills.

			nor comprehension scores were affected by otitis media.	
Winskel et al[16]	2010	NA	There was a typical propensity for kids with a history of otitis media to achieve lesser scores on phonological awareness skills of alliteration, rhyme and non-word reading, semantic skills of expressive vocabulary and word definitions and reading than kids with no otitis media.	These results underscore the possible challenges associated with otitis media might have on school going kid's later development of language and literacy.
Feagons et al [17]	2002	4 years	Children with chronic otitis media and were in low-quality care spoke ½ as many words and different words while reading the book, responded fewer abstract questions appropriately, and were rated more poorly on language use by their teachers than the other 3 groups of kids.	An inverse relationship was found between Otitis media and language development.
Paradise et al [18]	2000	3 years	No substantial correlations were found in the study population as a whole or in any subgroup between time with MEE during antecedent periods and children's scores on measures of spontaneous expressive language, speech sound production, or other measured aspects of cognition. Conversely, scores on all measures were steadily greatest among the most kids belonging to poor socioeconomic status and lowest among the poorest kids.	The results indicate that constant early-life MEE actually causes later small, circumscribed deficiencies of receptive language and verbal aspects of cognition in some groups of kids.
Rovers et al[19]	2000	One year	No significant variations were found in expressive or comprehensive language between the 2 groups after controlling for maternal education status, IQ of the kid, and baseline differences. There was an improvement in the comprehensive language of	There was no significant effect of ventilation tubes on language development among children with otitis media.

			the children who were effusion-free during the follow-up more than that of the children who had persistent effusion during the entire follow-up. There were no differences found for development of expressive language.	
Shriberg et al[20]	2000	3 years	Hearing levels at 12-18 months were substantially related to speech delay and low outcomes related to the language at the age of three years. The probability for subclinical or clinical speech delay at three years of age was 2 percent for kids with <20 dB average hearing levels at 12-18 months and 33 percent for those with > 20 dB average hearing levels at 12-18 months.	Substantial impacts of hearing levels at twelve to eighteen months on speech status at three years were considerably mediated by language status at three years.

4. Discussion

There persists to be substantial argument around whether a history of OM during the initial and critical duration of life leads to problems with speech and difficulties in language development. We undertook this systematic review to answer the research to quantify the causal effect of OM on the development of language. The main purpose of this research was to identify what we can see from the data of available studies to make causal inferences about what we can not see that is a causal effect of OM on language development. The results of the eleven eligible studies were synthesized and analyzed to address the research question of interest. Overall, the findings of the review were found to be consistent without implied hypothesized and theory that we contended for the effect of OM on language acquisition. More specifically, except few mixed findings from some studies, most of the studies supported the hypothesis of having an inverse relationship between OM and language acquisition.

Our findings are consistent with the similar type of studies conducted almost two decades ago by Roberts et al, where authors demonstrated a range of effects from null association to a very weak association between OM and language development among children[21]. The consistency between the meta-analysis conducted by Roberts et al and the current systematic review was slightly lower than the

expectation[21]. This could be because the reason that studies included in the meta-analysis did not control for the common causes of OM and language acquisition. However, this reason for weaker association might be implausible because of the positive confounding due to common causes of OM and language development. Controlling for such positive confounding will in turn have provided an estimate towards the null, thereby weakening the association further. Such control for positive confounders will have falsified the hypothesis further and would have refuted the theory for the effect of OM on language development. However, if it is assumed that the non-exchangeability between the group of children with and without OM is due to negative confounders, controlling for such confounders will have supported the hypothesis further. Other systematic reviews were conducted two decades before supporting the findings of the meta-analysis conducted by Roberts et al[21, 22].

The causal explanation for the effect of OM on the acquisition of language could be explained by some mediational mechanisms invoked by hearing loss. This is further supported by the evidence from the literature, which states that OM results in mild to moderate hearing problems[23]. These hearing problems in turn can be theorized to interfere with the language process, thereby the child is not able to encode the information efficiently and accurately[23]. This further affects the child's ability to learn vocabulary or grammar in case of recurrent OM and associated loss of hearing during the creative time of language and learning. Although the possible mechanism through which OM affects language development has been explored in the literature to some extent for assessing the construct validity of OM, there is still a need of exploring the effect modification too. It might be possible that it is the hearing loss that fully mediates the relationship between OM and language development, or the responsiveness of the childcare environment may play a role of effect modifier. In the former situation, researchers need to explore the construct validity of the ingredients of OM that affects language acquisition, while in the later, it is the external validity that will be assessed to see how the effect of MO is modified by different causal partners in different settings.

4.1.Strengths and Limitations

This review has endorsed the findings regarding the effect of OM on the acquisition of language development among infants and young children. The systematic review is strengthened due to robust evidence from both observational studies and randomized controlled trials, which is considered as the superior and gold standard in the hierarchy of study designs. We also found diverse studies from across the globe that gave us confidence that findings can be transportable to other settings. However, we need to be careful about the prevalence of causal partners that might vary from one to another setting and such prevalence of causal partners will affect the magnitude of the estimate. We found a considerable

consistency in the primary outcomes for included studies as most of the studies assessed identical outcomes. However, the length of follow-up varied across the studies with lengthier follow-up for about 4 years. One of the major limitations of the eligible studies was the inability to measure and control all the common causes of exposure and outcome, which might have provided an overestimated effect of OM on the language development in the individual studies. Given the nature of observational studies, one can not measure all confounders, therefore, one needs to make assumptions of no unmeasured confounding and no model miss-specification while interpreting the causal effect of the OM on language development. Secondly, the non-exchangeability due to selection bias or measurement error in either OM or language development using different scales or tests could also introduce bias in the individual studies. For example, loss to follow-up is a great threat to internal validity in the case of observational studies and such selection bias might have resulted in the underestimation of the effect if we assume that those who were lost to follow-up were more exposed and more likely to develop the outcome. Therefore, the findings of eligible studies need to be interpreted cautiously under these caveats.

5. Conclusion

We found mixed to positive findings regarding the effect of OM on the development of language among children in this systematic review. Generally, the eligible studies revealed that OM is negatively associated with language acquisition and can affect different domains such as receptive or expressive language. However, there were also some null findings from very limited studies. The findings of this review may be considered imperative for the clinicians and physicians who treat children with OM because OM is mostly not severe and can be ignored. Given the effects of OM on various language domains, one needs to be vigilant while approaching the child with OM. Additionally, there is a need to introduce some screening programs for children in the communities that could screen children for OM because not all children show up in the clinics due to several reasons such as lack of access to care, absence of symptoms, or lack of awareness. Therefore, children in the communities need to be screened on time to prevent them from developing adverse effects of OM on language development.

6. Declarations

6.1 Conflict of Interest Statement

The authors have no conflict of interests to declare.

6.2 Funding Disclosure

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

7. References

[1] Bhutta MF, Monono ME, Johnson WD. Management of infective complications of otitis media in resource-constrained settings. Current opinion in otolaryngology head neck surgery. 2020;28(3):174-81

[2] Harmes KM, Blackwood RA, Burrows HL, Cooke JM, Harrison RV, Passamani PP. Otitis media: diagnosis and treatment. American family physician. 2013;88(7):435-40

[3] Hardani Sr AK, Esfandabadi FM, Delphi M, Samir MA, Abdollahi FZ. Risk Factors for Otitis Media in Children Referred to Abuzar Hospital in Ahvaz: A Case-Control Study. Cureus. 2020;12(8)

[4] Songu M, Islek A, Imre A, Aslan H, Aladag I, Pinar E, et al. Risk factors for otitis media with effusion in children with adenoid hypertrophy. Acta Otorhinolaryngologica Italica. 2020;40(2):133

[5] Luu K, Park J, Shaffer AD, Chi DH. Long-Term Otitis Media Outcomes in Infants With Early Tympanostomy Tubes. Otolaryngology–Head Neck Surgery. 2020;163(6):1258-63

[6] Cai T, McPherson B. Hearing loss in children with otitis media with effusion: a systematic review. International journal of audiology. 2017;56(2):65-76[10.1080/14992027.2016.1250960]

[7] Rosenfeld RM, Shin JJ, Schwartz SR, Coggins R, Gagnon L, Hackell JM, et al. Clinical Practice Guideline: Otitis Media with Effusion (Update). Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery. 2016;154(1 Suppl):S1-s41[10.1177/0194599815623467]

[8] Homøe P, Heidemann CH, Damoiseaux RA, Lailach S, Lieu JE, Phillips JS, et al. Panel 5: Impact of otitis media on quality of life and development. International journal of pediatric otorhinolaryngology. 2020;130:109837

[9] Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Int J Surg. 2010;8(5):336-41

[10] Brennan-Jones CG, Whitehouse AJO, Calder SD, Costa CD, Eikelboom RH, Swanepoel W, et al. Does Otitis Media Affect Later Language Ability? A Prospective Birth Cohort Study. Journal of speech, language, and hearing research : JSLHR. 2020;63(7):2441-52[10.1044/2020_jslhr-19-00005]

[11] Baptista A. Does early identification of children with otitis media with effusion can prevent difficulties in language development? European Journal of Public Health. 2019;29(Supplement_1):ckz034. 19

[12] Bell MF, Bayliss DM, Glauert R, Harrison A, Ohan JL. Chronic Illness and Developmental Vulnerability at School Entry. Pediatrics. 2016;137(5)[10.1542/peds.2015-2475]

[13] Badran HS, Abulnasr KM, Abd El Hameed Nasser S. Effect of recurrent otitis media on language profile in children with fragile x syndrome. Clinical medicine insights Ear, nose and throat. 2013;6:1-7.PMC3791953, [10.4137/cment.S11157]

[14] Uclés P, Alonso MF, Aznar E, Lapresta C. The Importance of Right Otitis Media in Childhood Language Disorders. International Journal of Otolaryngology. 2012;2012:818927[10.1155/2012/818927]

[15] Zumach A, Gerrits E, Chenault MN, Anteunis LJ. Long-term Consequences of Early life Otitis Media on Language Development.

[16] Winskel H. The effects of an early history of otitis media on children's language and literacy skill development. The British journal of educational psychology. 2006;76(Pt 4):727-44[10.1348/000709905x68312]

[17] Vernon-Feagans L, Hurley M, Yont K. The effect of otitis media and daycare quality on mother/child bookreading and language use at 48 months of age. Journal of Applied Developmental Psychology. 2002;23(2):113-33

[18] 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[10.1542/peds.105.5.1119]

[19] 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 randomized trial. Pediatrics. 2000;106(3):E42

[20] Shriberg LD, Friel-Patti S, Flipsen P, Jr., Brown RL. Otitis media, fluctuant hearing loss, and speech-language outcomes: a preliminary structural equation model. Journal of speech, language, and hearing research : JSLHR. 2000;43(1):100-20[10.1044/jslhr.4301.100]

[21] Casby MW. Otitis media and language development: A meta-analysis. 2001

[22] Shekelle P, Takata G, Chan LS, Mangione-Smith R, Corley PM, Morphew T, et al. Diagnosis,

natural history, and late effects of otitis media with effusion. Evidence report/technology assessment. 2002(55):1-5

[23] Roberts J, Gravel J, Rosenfeld R, Berman S, Haggard M, Hall J, et al., editors. Otitis media and language learning: Controversies and current research. Otitis Media and Language Learning Sequelae Conference, Arlington, VA; 2002.