

# Speech-Language Disorders in Children with Hearing Loss Connected with Otitis Media with Effusion

Broz Frajtag Jasenka\*

Department for Otolaryngology, University Clinical Hospital Center, Croatia

## Abstract

**Introduction:** Otitis media with effusion is accompanied with conductive hearing loss. The aim of the study is to find out effect of long term or recurrent conductive hearing loss on speech discrimination.

**Method:** Tonal audiometry tympanometry, speech audiometry (free sound field, head phone for left and right ear respectively) performed in 18 girls (mean age 8 years) and 27 boys (mean age 7 year). All of the children undergo speech/language screening tests.

**Results:** Results of speech recognition showed no ear side effect in girls and right ear advantage in boys. Girls showed earlier in age central auditory processing disorder. Boys showed lower scores in words discrimination while hearing through the head-phones on left ear. Poorer speech recognition at boys is accompanied with motorical immaturity, undeveloped articulation, poor vocabulary, lack of syntax in sentences, substitution of R and L, unable to focus on school task.

**Conclusion:** Children with conductive hearing loss associated to otitis media with effusion are pronounced auditory processing disorder and speech/language discrimination disturbance. Associative thinking and solving of abstract problems are more affected in females than males.

**Keywords:** Conductive hearing loss; Speech discrimination; Effusion; Otitis

## Introduction

Communication disorders are the most frequent health problem world-wide. Hearing loss is the most common birth defect and needs emergency audiologic intervention otherwise sequels have implications not only on speech and language and cognition development delay, but also social adaptation, academic skills, behavior, motoric skills, learning problems, communication in noise background is difficult. Central auditory processing disorder results from hearing developmental disorder because of long term central auditory processing disorder and lack of processing in some frequencies, especially speech frequencies. Most common symptom is difficulty of speech discrimination in the back-ground noise and balance in space, even when hearing level is normal. Hearing loss, during development, leads to central deficit that persists even after the restoration of peripheral function [1]. Although these effects are particularly severe following long period of auditory deprivation, even the temporary elevation of thresholds can disrupt auditory processing, the most frequent birth defect in humans. It can be difficult to recognize and often goes undetected until the child is older. Such children should be tested for hearing impairment as soon after birth as possible.

Otitis media with effusion is accompanied with conductive hearing loss. The aim of the study is to find out effect of long term or recurrent conductive hearing loss on speech discrimination. OME associated with conductive hearing loss is the most frequent disease in childhood with incidence of 80% until 3 years of age fluid in the middle ear and edema of the mucosa present in the otitis media with effusion disrupts transmission of the acoustic sound from the outside through the middle ear to the cochlea.

## Aims of Performed Study

Aims of performed study is to investigate influence of long term peripheral hearing loss on primary auditory cortical function, receptive

and expression language; possible gender, age and ear side influence and accordingly possible further sequels on cognition and behavior.

## Method

To find out capability of speech discrimination and central auditory processing we performed retrospective research study in group children suffer from hearing loss associated with otitis media with effusion. For testing of negative effect of fluid in the middle ear and possible effect to central auditory processing, receptive and expressive language, changing of behavior in the presence of the sound and cognition we carried out our research study based on results of audiologic testing and speech-pathologic testing (Speech Audiometry-We scored expressive speech and defend if exist differences between left ear, right ear and free field, *Clinical Evaluation of Language fundamentals*-evaluates understanding and use of language including word meaning (semantics), word and sentence structure (syntax) and retrieval of spoken language (auditory memory) of children, *Picture Vocabulary test*-picture naming, test which measures a child's naming (expressive vocabulary skills) of our patients who are in audiologic follow-up and permanent speech and language rehabilitation program.

Tonal audiometry tympanometry, speech audiometry (free sound field, head phone for left and right ear respectively) performed in 18

\*Corresponding author: Broz Frajtag Jasenka, Professor, Department for Otolaryngology, University Clinical Hospital Center, Zagreb, Rebro, Kišpatičeva 12, Croatia, Tel: 003-851-237-6357; E-mail: [brozfrajtag@gmail.com](mailto:brozfrajtag@gmail.com)

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girls (mean age 8 years) and 27 boys (mean age 7 year). Results were analyzed statistically with SPSS 7 program for Word.

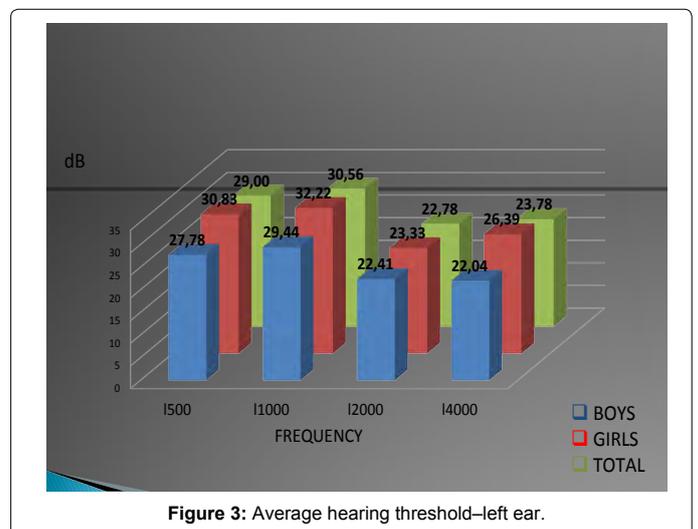
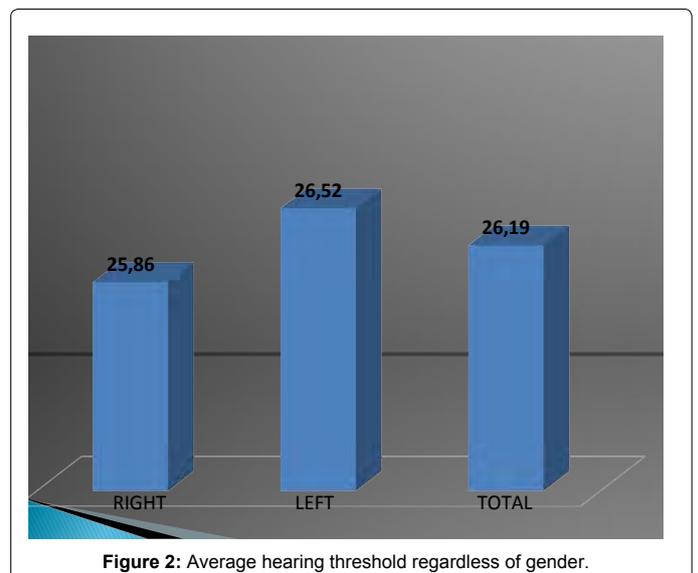
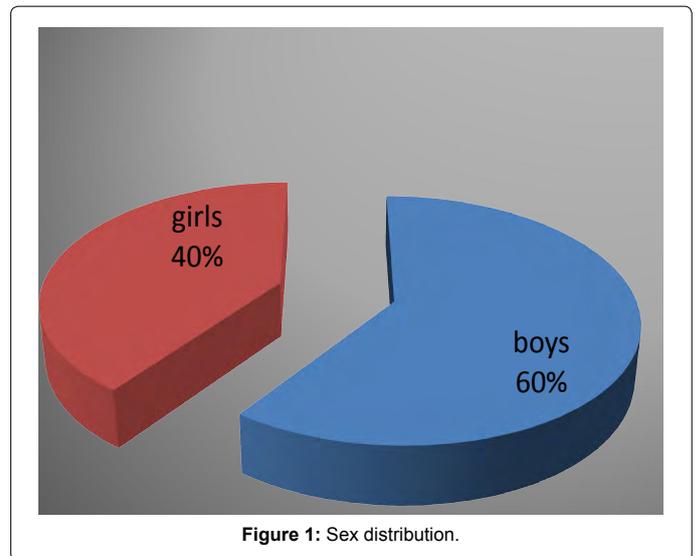
## Results

Preliminary results of our study showed that characteristics of conductive hearing loss associated with otitis media with effusion according to gender, age and ear side have different damage of speech understanding and different level of developmental development of cognition and fine motor development of hand. Secondary effects and disorders which came out as results of unrecognized conductive hearing loss associated with otitis media with effusion are clinically more complicated for treatment and rehabilitation and can last even for 2 years after peripheral hearing loss which have been restored. Incidence of boys (60%) in this random study was higher than in girls (40%) (Figure 1).

Boys were older than girls for mean age of 2-5 years. Girls displayed central auditory processing disorders continuously from earlier age than boys. Frequency increases and reaches peak around 5 years of age, decreases from age of 6 years to the older ages but maintained equalized and permanent up to adolescence [2]. Boys started to display central auditory processing disorders at 7 years of age and maintains permanent but not equalized frequency with relapsed that matched with relapses of the otitis media (Table 1). Tonal audiometry showed in male and female groups a higher level of hearing loss for lower frequencies (500 Hz, 1000 Hz) than for high frequencies (2000 Hz, 4000 Hz) ( $p=0.008$ ) (Table 2).

Frequency of 1000 Hz has the highest level of hearing loss in both genders. Females displayed on both ears for 4000 Hz higher level of hearing loss than males do average hearing threshold for speech frequencies in tested groups of ears do not exceeds 27 dB for left and 26 dB for right ears (Figures 2 and 3). Females shows for both ear side higher average of hearing loss at speech frequencies than males ( $p=0.0052$ ). Speech audiometry shows no significant difference in females between speech discrimination threshold in free sound field and each ear separately when tested by the help of earphones ( $p=0.891$ ). There was also no ear side advantage (Table 2). Females, if compared with males, have a higher level of speech discrimination threshold in free sound field and for right ( $p=0.016$ ) and left ear separately, when tested by the help of earphones. In males, right ears when tested by the help of earphones, showed better speech discrimination threshold than their left ears and threshold in free sound filed. Right ears in males showed advantage when reaching 100% in speech discrimination test if compared with left ears of males ( $p=0.016$ ) and both side of ears in females ( $p=0.012$ ,  $p=0.008$ ).

Girls showed earlier in age central auditory processing disorder. Boys showed lower scores in words discrimination while hearing through the head-phones on left ear. Poorer speech recognition at boys is accompanied with motorical immaturity, undeveloped articulation, poor vocabulary, lack of syntax in sentences, substitution of "R and L", unable to focus on school tusk. Handzic and all showed ear side related differences of hearing loss in OME children with orofacial clefts and out of malformations. Previous studies indicated that CHL (conductive hearing loss) profoundly affects short term synaptic depression and spike adaptation, increases synaptic latencies and evoked postsynaptic potentials were longer and more variable [3]. Females have advantage in process of hearing, it was not described if there exist gender differences in sensitivity for hearing loss in case of prolonged presence of conductive hearing loss to the central auditory processing. Impact of milder forms of conductive hearing loss on the auditory cortex is still



Age/Year	3	4	5	6	7	8	9	10	11	12	13	14	Min	Max	Average	N
Boys	0	0	0	7	4	2	3	2	1	1	2	1	6	14	8.52	23
Girls	1	3	5	2	0	2	0	1	0	1	1	0	3	13	6.44	16
Total	1	3	5	9	4	4	3	3	1	2	3	1	3	14	7.69	39

Table 1: Distribution of boys and girls longitudinally according to aging.

Gender	Speech audiometry Free sound field 10 words list Speech discrimination threshold dB	Speech audiometry Free sound field 10 words list 100% words discrimination threshold dB	Speech audiometry Headphones right ear 10 words list Speech discrimination threshold dB	Speech audiometry Headphones left ear 10 words list Speech discrimination threshold dB	One-way ANOVA p-level	Speech audiometry right ear 10 words list 100% words discrimination dB	Speech audiometry left ear 10 words list 100% words discrimination dB	One-way ANOVA p-level
Male	17.04	42.96	12.41	15.74	0.169	36.11	42.78	0.016
SD	8.80	10.94	8.13	9.38	-	9.94	9.74	-
Female	20.83	44.72	20.00	20.56	0.891	45.56	46.67	0.799
SD	9.12	11.18	12.25	11.87	-	14.13	11.76	-
One-way ANOVA p-level	0.169	0.603	0.016	0.137	-	0.012	0.234	-
Total	28.11	29.44	22.67	29.00	0.029	23.22	30.56	0.008
SD	12.85	15.75	12.14	11.71	-	16.38	13.02	-

Table 2: Speech audiometry testing-results for free sound field and headphones for each ear separately, thresholds and 100% discrimination.

undefined. Children with otitis media with effusion they have difficulties in pronunciation dyslalila. Damage in pronunciation become in profile of omission, substitution and distortion, almost always mistake in frikatives and afrikates, poor vocabular of children in social less environment, disorders in perception and behavior (hyperactivity) (Figure 4).

### Conclusion

Children with conductive hearing loss associated to otitis media with effusion are pronounced auditory processing disorder and speech/language discrimination disturbance. Associative thinking and solving of abstract problems are more affected in females than males. Prevention of hearing loss and secondary effects with irreversible sequels is one of the most important goals because of its high incidence in early childhood and orofacial malformations. Preschool and school preventive testing would be performed and children with disorders or disbalances would be included in program creating to their needs. Males at age of 8.5 years and females at age 6.5 years do not show lateralization of the peripheral hearing loss for the average hearing loss on speech frequencies

In both gender lower frequencies of 500 Hz and 1000 Hz displayed higher level of hearing loss, male shows improvement of hearing level on 2000 Hz and 4000 Hz, females showed higher level of hearing loss at 2000 Hz and 4000 Hz than males with no improvement with aging.

In female's development of receptive and expressive language started from the early childhood, earlier than in males became developmental priority, reaches peak at the age of 5 years when dominate cognitive disorder and after that frequency keeps continuing through the adolescence. Males displayed later than females disorders of receptive and expressive language as results of central auditory processing disorder which starts and reach peaks at the age of 6 years, then frequency keeps continuing through the adolescence with tendency of relapsing at the ages which matches with ages when hearing loss associated with OME relapses. In males at earlier age dominant symptoms of central auditory disorder are behavioral problems and spatial disorientation, males displayed later than females receptive and expressive language

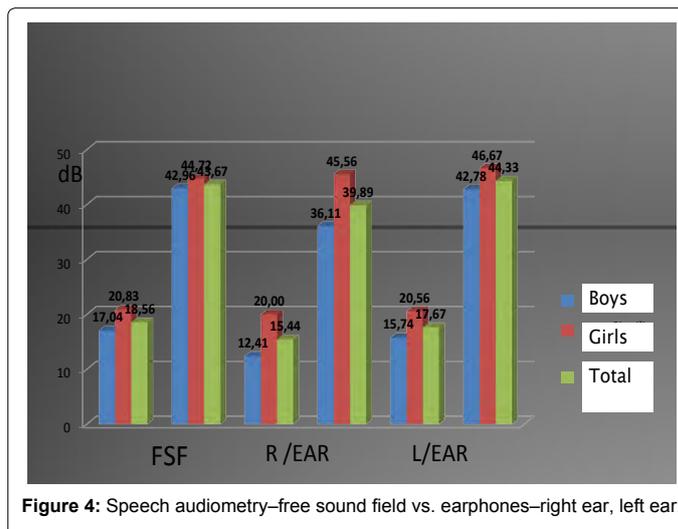


Figure 4: Speech audiometry-free sound field vs. earphones-right ear, left ear.

disturbance which are mostly overlooked until preschool age when verbal skills, syntax of sentences and articulation started to be important. Females display diffuse central auditory processing damage, both intra-hemisphere and inter-hemisphere auditory processing damage which influence to the quality of solving math and spoken language skills in the school and displayed no laterality. Males display central auditory processing disorder laterality with domination of left intra-hemispheric processing damage and females displayed no laterality. Central processing disorder in females mostly affect cognition while in boys affect more behavior than cognition.

### Summary

Males and females show central auditory processing and left hemispheric processing differences in quality according to the advantage of the right ear in the males and no ear advantage in the females. Aging have negative effects in girls if exist speech-language disorders. Girls have more problems with solving mathematics problems while boys have more problems in classes of spelling and reading of maternal

language. Both groups have problems with syntax of sequences and speech articulation particularly fricatives. Some of them have problems in behavior and have delay in learning if compare with counterparts with no hearing problems.

Both groups male and female children, which is also described in literature, have had deficit of attention, motor skills, untidy handwriting, missed information's in school because children are unable to be focus on the problem, misbehavior and low rate of social adaptation. Deficit of attention and hyperkinetic behavior in such children are not entity per se but sign of developmental motor delay. Most of children in early childhood, preschool and school age have communication problems

which are not recognized and need urgent audiologic rehabilitation-habilitation to prevent permanent sequel in cognition, behavior, spatial orientation social adaptation and academic skills.

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