Original Article

Allergic Rhinitis: An Indicator of Otitis Media with Effusion in Children Seen at Aminu Kano Teaching Hospital, Kano

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Abstract

Background: Allergic rhinitis (AR) is a multifocal IgE-mediated type I hypersensitivity reaction involving nasal mucosa characterized by excessive sneezing, watery rhinorrhea, nasal itching, nasal stuffiness and eyes itching. Tympanometry is a simple, rapid and objective test that can be easily carried out. The use of tympanometry in clinical setting can improve detection of middle ear effusion and other middle ear abnormalities. AR has been found to be one of the predisposing factors to developing Otitis Media with Effusion (OME) in children. **Aim:** To determine the prevalence of Otitis Media with Effusion among children with allergic rhinitis seen at Aminu Kano Teaching Hospital. **Patients and Method:** A case control study was used to determine the prevalence of OME among children with allergic rhinitis as cases and those without allergy as controls. The study participants were children aged 4-12years with clinical diagnosis of AR attending Ear, Nose and Throat (ENT) clinics of Aminu Kano Teaching Hospital, while controls were children age 4-12years without history of allergic rhinitis, ear diseases or other respiratory system related ailments attending general outpatient clinics in Aminu Kano Teaching Hospital. An interviewer-administered score for allergic rhinitis (SFAR) questionnaire was filled out for all the participants, those with score of 6 and above were selected as cases. The two groups had complete ENT examination and tympanometry done, findings were recorded and analyzed using SPSS version 21. **Results:** The mean age of the cases was 6.8±2.1years while it was 7.5±2.6years for the controls. The mean difference was 0.7 and was not statistically significant (t=2.35, df=258, p-value =0.20). Type B tympanogram suggesting OME was found in 7.3% of subjects and in 2.8% of controls. Type C tympanogram suggesting negative middle ear pressure was found in 15.5% of subjects and in 4.6% of controls. Type A tympanogram suggesting normal middle ear pressure was found in 75% of subjects and in 90% of controls. Acoustic reflex was found to be absent in 29.6% of subjects and in 15.4% of controls and this found to be statistically significant ($\chi 2 = 7.77$, df = 1, p value = 0.001). The difference between type A, B and C tympanograms of subjects and that of controls was found to be statistically significant (Type A $\chi 2 = 14.62$, df = 4, p value = 0.01, Type B $\chi 2 = 14.06$, df = 4, p value = 0.01, Type C $\chi 2 = 17.01$, df = 6, p value = 0.01). Type B tympanogram was used as an indicator to suggest OME for the purpose of this study. **Conclusion:** Participants with allergic rhinitis

Introduction

Allergic rhinitis (AR) is a multifocal IgE-mediated type I hypersensitivity reaction involving nasal mucosa that may extend into paranasal sinuses

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were found to have more abnormalities of tympanometric parameters and higher prevalence of type B tympanogram suggesting OME than controls.

Keywords: *Allergic rhinitis, children, OME, prevalence, tympanometry*

characterized by excessive sneezing, watery rhinorrhea, nasal itching, nasal stuffiness, and eyes itching.[1] The diagnosis of AR is clinical, whereas measures that include skin prick test, nasal smear, and serum IgE assay among others are used for confirmation.[1] However, the use of symptoms score for AR (SFAR) in the diagnosis has been validated [Appendix 1].[2,3] SFAR has been found to be a simple and valid diagnostic tool in AR with sensitivity and specificity of 94.8% and 95.1%, respectively.[2] AR in children can manifest from the age of one, and the sensitivity of clinical diagnosis continues to increase as the child is getting older, by age of six, 62% of children with AR would have had symptoms.[4]

AR affects 10–30% of the population worldwide with the greatest frequency found in children and adolescents.[1] The prevalence of AR was said to be increasing worldwide with western countries having the highest prevalence.[5] Similarly, the prevalence of AR was also found to be increasing even in developing countries, for example, a study conducted in Ibadan Nigeria revealed a prevalence of 11.3% among children 6–7 years of age.[6] AR has been found to negatively affect middle ear function with higher prevalence of abnormal tympanometric parameters and subsequent risk of developing OME. The prevalence of AR was higher in children with OME (28.4%) than control (20.1%).[7]

Tympanometry is a technique that is used to objectively analyze tympanic membrane compliance and estimating middle ear air pressure by means of electroacoustic and manometric measurements. It gives an information concerning status of middle ear transmission system.[8] Tympanometry provides useful information about the presence of fluid in the middle ear, compliance of middle ear system, eustachian tube function, and ear canal volume. Its use has been recommended in conjunction with more qualitative information (e.g., history and examination findings of the tympanic membrane) in the evaluation of middle ear conditions.[9]

The sensitivity of tympanometry (type B tympanogram) to detect ears with middle ear fluid was 70% and the specificity 98% with a positive predictive value of 93% and negative predictive value of 94%.[10] The sensitivity was somewhat lower in the younger age group 61%.[10] The high success rate in detecting middle ear effusion by tympanometry makes it a useful aid for assuring the correct diagnosis of middle ear diseases especially in children.[10,11] Tympanometry has been found to be as useful as otoscopy in detecting OME, simple otoscopy produced 84.4% agreement with tympanometry in detecting OME. The novelty of this study lies in the fact that findings obtained increases the suspicion of OME in children with AR especially in sub-Saharan Africa where the condition was earlier believed to be of low prevalence. This study has added to the quantum of literature on the prevalence of AR and OME among children in sub-Saharan Africa of which there is paucity of literature currently. The objective of this study was to determine the prevalence of OME among children with AR in sub-Saharan Africa.

Materials And Methods

This is a case–control study conducted among 130 cases and same number of controls. The cases were children aged 4–12 years with clinical diagnosis of AR attending ENT clinics of Aminu Kano Teaching Hospital, Kano, whereas controls were children attending general outpatient clinics in Aminu Kano Teaching Hospital Kano without history of AR, ear diseases, or respiratory system related ailments. Ethical approval was sought for and obtained from the Ethics Review Committee of Aminu Kano Teaching Hospital (protocol number: NHREC/21/08/2008/AKTH/EC/2166). Informed consent was obtained from caregivers of the participants. Sample size was calculated using Fisher's formula for descriptive studies: $n = Z^2pq/d^2$ and a sample size of 130 was arrived at. Modified SFAR questionnaire was used as the diagnostic criteria in selecting the subjects.[12] The questionnaire has a total score of 13 and score of 6 and above was considered diagnostic for the purpose of this study.[12] Subjects were consecutively chosen and those who satisfied the inclusion criteria were enrolled into the study. This study was conducted during a period of 6 months from February–July, 2019.

Detailed ENT examination was done on each participant and subsequently, each participant had tympanometry done using appropriate size probe of the tympanometer (Otopront Tymp, Serial No. 1521, 226 Hz, manufactured by Happersberger otopront, Germany, last calibration May, 2018) and results were printed out. Modified Jerger's nomenclature was used to classify the tympanograms into types A, As, Ad, B, and C. Type A was considered normal, types As and Ad were considered abnormal variants of Type A, whereas type B was used as indicator to suggest OME.

Acoustic reflexes were also recorded from the tympanometry machine by delivering a sound of 85 –105 dB to the test ear at 500, 1000, 2000, and 4000 Hz. Appearance of a well-defined amplitude in at least three of the test frequencies was considered normal and was denoted as "AR present," whereas appearance of the amplitude in only two of the test frequencies, or an absence of response following stimulation was considered an abnormal response and was denoted as "AR absent." All the variables used in this study were presented in form qualitative variables. Participants with tympanic membrane perforation, ventilation tube, history of ear surgeries, and craniofacial abnormalities were excluded from the study. Data obtained were analyzed using the Statistical Packages for Social Sciences (SPSS) Version 21.

Results

About 130 subjects were recruited in this study and matched with equal number of controls. A total of 520 ears were evaluated. The age range of the subjects was between 4 and 12 years with mean age of 6.8 ± 2.1 years. The mean age of controls was 7.5 ± 2.6 years and was not statistically significant (t = 2.35, df = 258, *P* value = 0.20).

About 59% of subjects were males and 41% were females. About 61% of controls were males, whereas 39% were females. There was no statistically significant difference between the gender of the participants (χ^2 = 0.08, df = 1, *P* value = 0.77).

Hausa-Fulani being a predominant tribe where the study was carried out accounted for 65% of subjects and 72% of controls, Yoruba ethnic group constituted 19% of subjects and 15% of controls, participants of Igbo extraction made up 12% of subjects and 8% of controls, and other tribes contributed 5% for subjects and controls each. There was no statistically significant difference in the occurrence of AR or OME among the participating ethnic groups.

Table 1 shows details of the demographic characteristics of the participants.

Participating ears were individually examined and their laterality was equally put into perspective. Type A tympanogram was found to be predominant with prevalence of 74% and 75% among subjects for the right and left ears, respectively, whereas prevalence of 92% and 90% was found among controls for the right and left ears, respectively. Type B tympanogram was found to be higher in both right and left ears among subjects with prevalence of 8% and 7% for right and left ears, respectively as against a lower prevalence of 2% and 3% among the controls in right and left ears, respectively.

Table 1: Socio-demographic Distribution among the Participants

Variables	Subjects (*n*=130)		Controls (*n*=130)	
Age (years) Mean±SD	6.8±2.1		7.5±2.6	
	(t=2.35, df=258, P=0.20)			
Gender	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Males	77	59	79	61
Females	53	41	51	39
	(χ^2=0.08, df=1, P=0.77)			
Tribe				
Hausa-Fulani	85	65.4	93	71.5
Yoruba	24	18.5	20	15.4
Igbo	15	11.5	10	7.7
Others	6	4.6	7	5.4

Table 2: Comparison of Tympanogram of the Right Ears between the two groups

Variables	Subjects (%) (*n*=130)	Controls (%) (*n*=130)
Type A	96 (73.8)	119 (91.5)
Type B	10 (7.7)	3 (2.4)
Type C	20 (15.5)	5 (3.8)
Type As	2 (1.5)	2 (1.5)
Type Ad	2 (1.5)	1 (0.8)

Table 3: Comparison of Tympanogram of the Left Ears between the two groups

Variables	Subjects (%) (*n*=130)	Controls (%) (*n*=130)
Type A	98 (75.4)	117 (90)
Type B	9 (6.9)	4 (3.1)
Type C	20 (15.4)	7 (5.4)
Type As	2 (1.5)	2 (1.5)
Type Ad	1 (0.8)	0 (0.0)

Table 4: Comparison of Tympanogram between the two groups

Variables	Subjects (*n*=130)	Controls (*n*=130)
Type A	74.6%	90.7%
Type B	7.3%	2.8%
Type C	15.5%	4.6%
Type As	1.5%	1.5%
Type Ad	1.1%	0.4%

Similarly, type C tympanogram was also found to be higher among the subjects with a prevalence of 16% and 15% among subjects compared to the prevalence of 4% and 5% among controls for the right and left ears, respectively [Tables 2 and 3]. There was no statistically significant difference in type As and Ad among subjects and controls [Table 4].

Overall, type B tympanogram was found in 7.3% of subjects that was higher than 2.8% found in controls. Type A

tympanogram was found in 75% of subjects that was lower than 90% in controls. The overall prevalence of type B tympanogram was found to be higher in subjects compared with controls and the difference was found to be statistically significant (Type B $\chi 2 = 14.06$, df = 4, *P* value = 0.01).

Discussion

The age range of the subjects was between 4 and 12 years with mean age of 6.8 ± 2.1 years. This is similar to a study conducted by Pau *et al.*[13] that also used 4–12 years of age; however, slightly different from the age range of 2–12 years and mean age of 7.8 years that was reported by Kayhan *et al.*[13,14] This was matched with controls of the same age range, there was no statistically significant difference between the age range of subjects and that of controls.

AR affects both males and females with male preponderance.[14] This is in keeping with the boy/girl ratio of 1.4:1 that was found in this study. This is similar to boy/girl ratio of 1.4:1 found by Kayhan *et al.*[14] The male: female ratio of the controls was found to be 1.6:1 in this study. There was no statistically significant difference between gender of subjects and that of controls.

Participants of Hausa-Fulani extraction were found to be predominant in this study, this is due to the fact that the study was conducted in Kano which is a Hausa-Fulani dominated area.[15]

Type B and C tympanograms were found to be higher among the subjects compared with controls. This is similar to the findings in a study conducted by Fasunla *et al.*,[16] who found type B and C tympanograms to be higher in subjects with AR than in those without allergy. Gerardo *et al.*,[17] also found type B and C tympanogram to be higher in subjects with AR. Similarly, type A tympanogram was found to be lower in children with AR than in controls. This is similar to the findings of Adeyemo *et al.*,[18] who found type A tympanogram to be lower in subjects with AR than in those without allergy. The difference between type B and C tympanograms of subjects and those with controls was found to be statistically significant [Type B $\chi 2 = 14.06$, df = 4, *P* value = 0.01, Type C $\chi 2 = 17.01$, df = 6, *P* value = 0.01(statistically significant)].

In this study, only type B tympanogram was used as an indicator of OME and was found to be 7.3% in subjects with AR that was higher than 2.8% found in controls. Benjamin *et al.,* found a similar prevalence of 7.5% in subjects with AR and 1.6% in non-AR subjects in a study conducted in Honk Kong.[13] This is close to what was found by Fernandes *et al.*,[19] who found type B tympanogram in 10% of those with AR. However, this is much lower than 45.3% that was found in a study conducted by Fasunla *et al.*[16] This could be explained by the fact that a lower age range of 2–7 years with mean age of 3.8 ± 1.7 years was used as opposed to older children with age range of 4–12 years and mean age of 6.8 ± 2.1 years that was used in this study. In addition, the difference in the diagnostic criteria being used has contributed to the discrepancy in the prevalence found. Studies that used only type B tympanogram as indicator of OME found lower values.[20,21] Whereas studies that used both type B and C as indicators of OME found higher values.[22-24] Higher prevalence of OME has also been found more among the Caucasians than Africans.[24,25]

Limitations

This study was limited by relatively low sensitivity of tympanometry in the diagnosis of middle ear effusion especially in smaller children, also other compounding factors that might affect Eustachian tube function, such as adenoid hypertrophy, cleft palate, Down syndrome, among others were ruled out clinically. Recall bias from some caregivers on the symptoms of the participants was also another limitation encountered.

Conclusion

Patients with AR were found to have more abnormal tympanometric parameters than controls. The prevalence of type B tympanogram that was used as an indicator of OME in this study was found to be higher in children with AR than in controls. This implies that children with AR are more at risk of developing OME and routine screening of children with AR for OME can go a long way in early detection and treatment of the condition.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Appendix I: Modified Score For Allergic Rhinitis (Sfar) Questionnaire[3]

Symptoms	Score
Blocked nose	1
Runny nose	1
Excessive sneezing	1
Nasal symptoms+itchy-watery eyes (rhinoconjuctivitis)	2
Month of the year in which symptoms are more (Seasonal/Perenial)	1
Triggers (pollens, house dust, mite, epithelia-cats, dog)	2
Previous medical diagnosis of allergy	1
Previous positive test for allergy	2
Family history of allergy	2
Total	13

NB: Score of 6 and above was considered diagnostic