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Journal of Otolaryngology Research

RESEARCH ARTICLE

ISSN: 2638-3616

Passive and Active Smoking, Ear-Nose-Throat Disorders, Chaotic Urbanization, Socio-Cultural Factors, and Mixed Hearing Loss among Schoolchildren – Adolescents from Kinshasa Province, DRC

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Citation: Sokolo Gedikondele J, Longo-Mbenza B, Matanda Nzanza R, Mvitu Muaka M, Mambueni Thamba C, et al. (2020) Passive and Active Smoking, Ear-Nose-Throat Disorders, Chaotic Urbanization, Socio-Cultural Factors, and Mixed Hearing Loss among Schoolchildren – Adolescents from Kinshasa Province, DRC. J Otolaryngol Res 2: 204

Abstract

Background and objectives: Passive and active smoking patterns are well associated with ear-nose-throat (ENT) complications worldwide in general and in Kinshasa school/DRC in particular. The study aimed to determine whether ENT disorders, degrees of urbanization sociocultural patterns, passive and active smoking patterns were related to mix hearing loss among schoolchildren-adolescents.

Methods: A cross-sectional survey was conducted between January 10th and November 20th, 2005 a cross randomly 5 schools from North, west East, South and centrum of Kinshasa town DRC. Participants were also a random multistage sample of from selected schoolchildren-adolescents evaluated using univariate and multivariate (logistic regression) analyses.

Results: Out of all participants (n=381 with 50.9% males vs. 49.1% females), 22.3% (n=85) leaners were diagnosed for co-existing mixed hearing loss-acute media otitis (coMHL-AOM). Catholic religion, youngest, oldest, East Tshangu Districts semi-urban noisy and chaotic residences, higher parental socioeconomic status, allergic rhinitis, chronic rhinitis, passive smoking, and chronic pharyngitis were identified as univariate and significant factors associated with coMHL-AOM. After adjustment for confounding univariate factors (age, religion, degrees of urbanization, and parental socioeconomic status); using multivariate logistic regression, only passive smoking (OR=12, 95%CI 4-36, p<0.0001), chronic rhinitis (OR=4, 95%CI 12-9, p<0.0001), and chronic pharyngitis (OR=3, 95%CI 2-7, p<0.01) were maintained as the most important independent and significant determinants of coMHL-AOM.

Conclusion: Parents, teachers, general practionners, policy leaders, and otolaryngologists are invited to work together for early prevention, diagnosis and treatment of coMHL-AOM epidemic prevalence and to tackle its independent determinants a cross elementary, primary and secondary schools from poor, polluted, noisy and chaotic semi-urban environment of Kinshasa Province; DRC.

Keywords: Passive Smoking; Acute Otitis Media; Mixed Hearing Loss; Pollutions; Central Africa

Introduction

Relevant information about environmental epidemiology of interaction of urbanization, exposure to tobacco smoke (Environmental tobacco smoke, ETS or passive smoking), noise active smoking, and ear-nose-throat (ENT) complications are known worldwide [1-6] in general and in developing countries such as Democratic Republic of Congo (DRC) in particular [7,8].

Indeed, ETS or passive smoking is recognized as a crucial issue among schoolchildren [9].

However and despite significant association of upper respiratory infection diseases, ENT disorders and hearing loss among children [10], there is a lack of clear policies and preventive approach for screaming and diagnosis of hearing loss related to upper respiratory tract infections (URTI) [11] and acute otitis media (AOM) infection [12] in the literature globally and in DRC.

Indeed, pathogenies and/or inflammatory and immune response, damage the middle ear in terms of AOM-hearing loss (AOMHL) [13-16].

A cross sectional survey demonstrated significant association between semi-urban peripheral areas, Catholic religion, elementary level, exposure to family tobacco smoke, history of ENT surgery, ENT disorders and chronic pharyngitis among schoolchildren-adolescents from Kinshasa town, DRC [17].

Therefore, the study aimed to determine whether ENT disorders, degrees of urbanization, noise, sociocultural patterns, passive and active smoking patterns were related to mixed hearing loss among schoolchildren-adolescents from Kinshasa Province DRC

Methods

This cross-sectional, descriptive and analytic survey was carried out between January 10th and November 20th, 2005, Kinshasa megacity DRC (Figure 1).

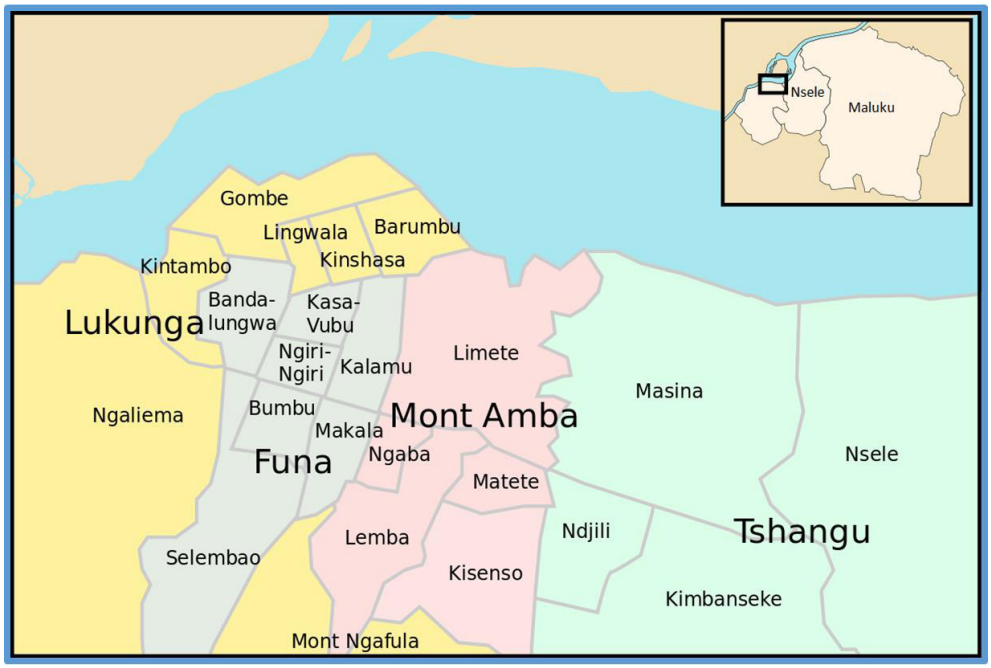

Figure 1: The administrative map of the Kinshasa megacity DRC

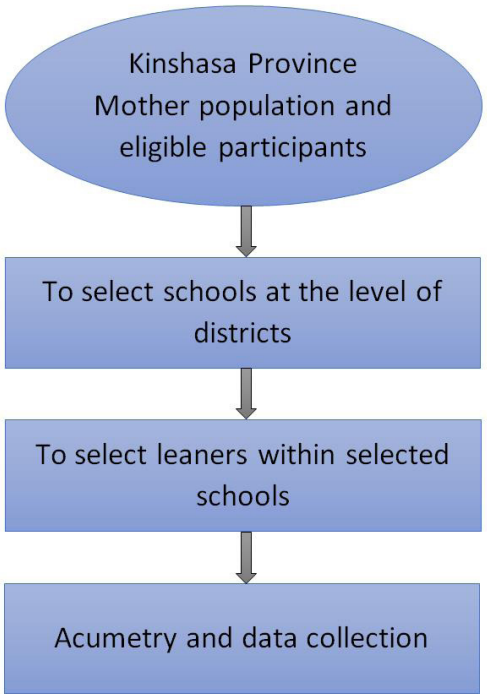

Figure 2: Logigram for the study

The promoter recommended a statistical multistage and stratified random sample model to select schools at districts, sub-districts and to select leaners within select schools of Kinshasa megacity respectively (Figure 2). The study was specifically and extensively designed to select representatives from a list of each strata according to inclusion (parental authorization and within consent of leaner) and exclusion (refusal of leaners to participant) criteria.

The sample size (n_i) of children was calculated according to the following formula: ni = ($K \times Z^2 \times P \times Q/D^2$), P= prevalence of passive smoking in Kinshasa (Longo-Mbenza, unpublished data) equal 17% or 0.17, Q= 1-0.17, parameter related to error risk of 5% = 1.96, K= cluster factor =2, and D= accuracy level of 0.05.

Thus, 433 schoolchildren-adolescents were eligible for the study mother population.

The Ministry of Public Health, The Ministry of Education, the school principal and the parents gave permissions to conduct this study respectively. Ethical approval was given by the institutional review board of National Committee, DRC according to Helsinki Declaration II visions.

Data collection

All parents of children received an anonymous pre-school health history questionnaire including items on various early childhood health problems in general and on ENT and upper respiratory diseases in particular. The structured, anonymous and standardized questionnaire was pre-tested with 30 families to avoid ambiguous or incomprehensible questions. The modified Dillman techniques [20] were used to implement the survey questionnaire. The questionnaire ascertained demographic factors (sex, gender), district of residence, exposure to cigarette smoking, education attainment (elementary, primary, and secondary/high school), exposure to noise and pollution medical history of ENT, socioeconomic status (SES: high vs. low), history of allergies, upper and lower respiratory tract infections.

Comprehensive oto-rhino-laryngological evaluation demonstrated the presence or otherwise of acute otitis media (AOM), allergic rhinitis, pharyngitis, and hearing loss.

Definitions

Passive smoking or ETS was defined as the particulate and gas-phase compounds released into the air from burning tobacco product such as cigarettes, cigars and pipe tobacco.

AOM was defined by the rapid occurrence of one or more signs or inflammatory responses (symptoms) within the middle ear in with earache, tugging at the ear fever and /or irritability accompanied by middle-ear effusing [21].

Mixed hearing loss was defined by the combination of sensorineural hearing loss from possible causes exposure to loud noise and passive smoking [22,23] and conductive hearing loss from possible causes (ear infection, allergies, and presence of a foreign body) [24,25] using acumetry [26].

Statistical analysis

Data were presented as means ± standard deviation for continuous variables and proportions (%) for qualitative variables. The Chi-square tests were used to test for significance of observed univariate associations between independent variables (coMHL-AOM) and existing dependent variables.

For these univariate associations, the Cochran-Mantzel - Haenszel statistic and the estimates of Odds ratios (OR) were calculated with their 95% confidence intervals (CI).

The multivariate regression logistic model was used with OR with 95%CI after adjusting for confounding factors to identify significant and independent determinants of acute coMHL-AOM. A value of $p<0.05$ was considered significant for differences. All data analyses were performed using SPSS software for Windows version 25 (SPSS Inc, Chicago, IL, USA).

Results

A total of 381 schoolchildren adolescents (response rate of 88%), aged 4-20 years (mean age=10±4 years) with 194 males (50.9%) and 187 females (49.1%): sex ratio of 1 male: 1 female, were evaluated in the study population.

The prevalence of co-existing mixed hearing loss and acute media otitis (coMHL-AMO) was estimated 22.3% (n=85) in the study population. There was not significant ($P>0.05$) association between sex, active smoking and coMHL-AMO respectively (results not presented). However, there was significant and positive univariate association between Catholic religion, poor, crowded, and polluted semi-urban Tshangu District, oldest age≥12 year, youngest age≤6 years, higher parental socio-economic status, allergic rhinitis, chronic rhinitis, passive smoking, chronic pharyngitis, and coMHL-AMO respectively (Table 1) (Figures 3, 4 & 5).

Independent variables	Statistics of dependent variables coMHL-AMO OR (95% CI)	P
Passive smoking		
Yes	54(22.4-156)	<0.0001
No	1	
Chronic rhinitis		
Yes	26(14-50)	<0.0001
No	1	
Chronic pharyngitis		
Yes	22(12-41)	<0.0001
No	1	
Parental SES		
High	2.5(1.2-5.5)	<0.01
Low	1	
Allergic rhinitis		
Yes	1.7(1.1-2.9)	<0.05
No	1	

Table 1: Univariate significant associated factors of coMHL-AMO

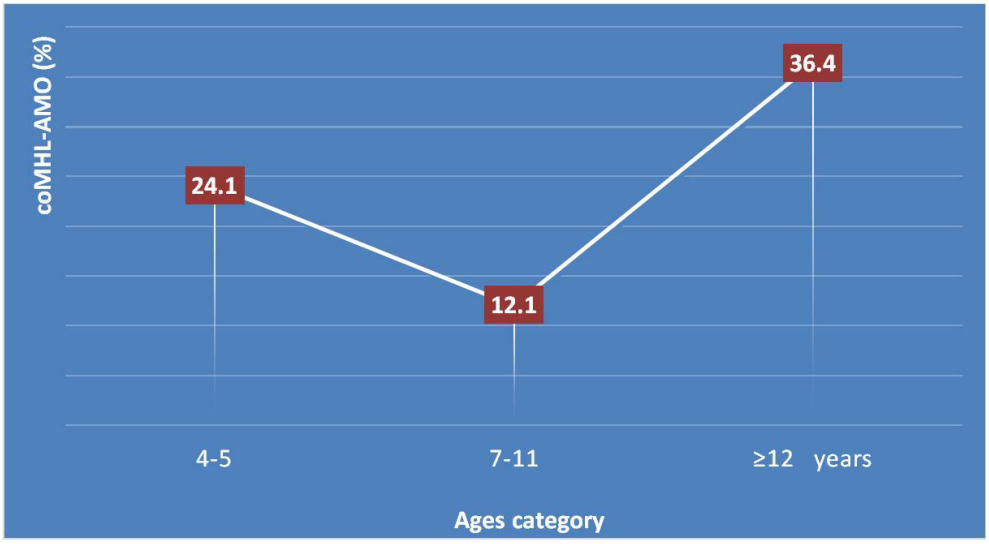

Figure 3: Inequal but significant variations of proportions of coMHL-AMO between ages category

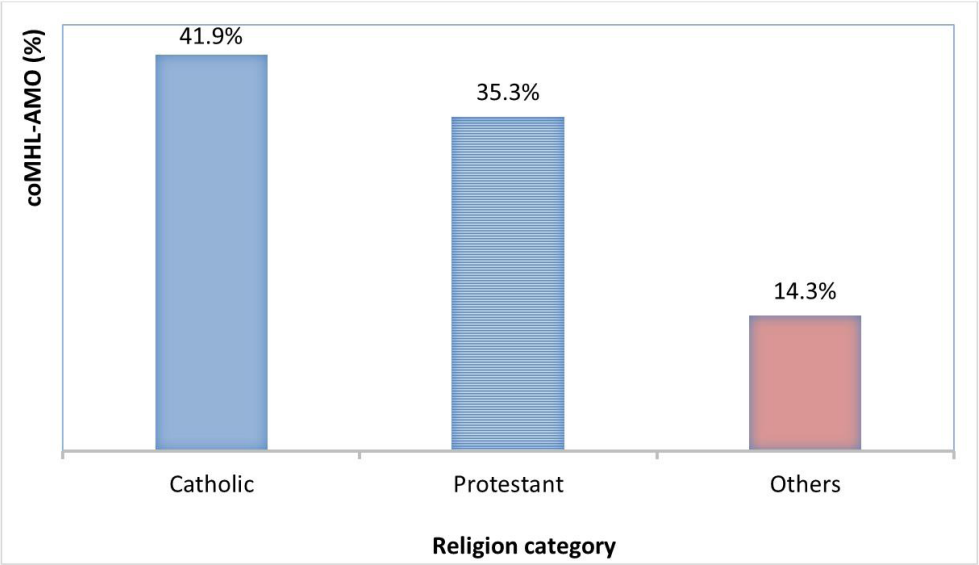

Figure 4: Signification variations of coMHL-AMO a cross religion groups

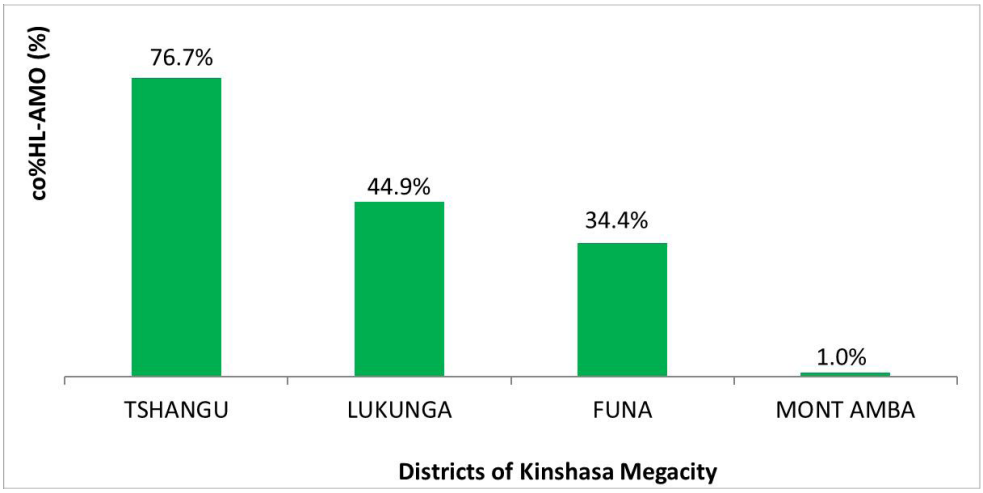

Figure 5: Distribution of proportions of coMHL-AMO between different Districts of Kinshasa Megacity

After adjusting for confounding factors (age, socioeconomic status, residence, religion and active smoking), using multivariate logistic regression, only passive, chronic rhinitis, and chronic pharyngitis were maintained as most important independent and significant determinant of coMHL-AMO (Table 2).

Independent determinants	Multivariate adjusted OR(95% CI) of coMHL-AMO	P
Passive smoking		
Yes	12(4-36)	<0.0001
No	1	
Chronic rhinitis		
Yes	4(2-9)	<0.0001
No	1	
Chronic pharyngitis		
Yes	3(2-7)	<0.01
No	1	

Table 2: Independent determinants of coMHL-AMO after multivariate logistic regression

Discussion

The present survey revealed a high prevalence of coMHL-AMO among schoolchildren/adolescent from Kinshasa megacity, DRC. Indeed, 22.3% of schoolchildren/adolescents were suffering from hearing loss in these Bantu Central Africans, in terms of a mass public problem as reported worldwide within the interval 0.88%-46.4% [27]. This large and wide interval of hearing loss prevalence varies according to economic level, developing countries vs. rich countries, geography setting, heterogeneity methods and normality criteria diagnosed by authors [27]. However, hearing loss estimated 22.3% in the present DR Congolese study was similar to that estimated 22.2% in the North-African-Egyptian City study [28] but higher than those 8%-15% reported by other developing Pakistan and Kenya [29,30].

Pathophysiology and mechanisms of hearing loss as reported by other authors working in infants, children, and adolescents [28,31,32], the present study obviously characterized both sensorineural and conductive lesions for mixed bilateral hearing loss. Both univariate associated factors and independent determinants of coMHL-AMO from the present study at explaining the Environmental epidemiology and the pathophysiology of hearing loss.

The present DR Congolese study, the Egyptian study [28] and a previous English study [28] have shown that there was no influence of sex on mixed hearing loss. There is significant association between active smoking and hearing loss in the literature [33,34], whereas the present study did not have any effect of active smoking on coMHL-AMO.

Our results could be explained by the fact that active smokers had quit smoking before the survey was carried out. Data consistent with the Australian study which showed that the risk of hearing loss associated with smoking would decrease within five years of quitting smoking [35]. However, there was clear explanation for significant and positive association between identified univariate associated factors, multivariate independent determinants of coMHL-AMO in the present study. AMO might have an influence on the occurrence of sensorineural and mixed sensorineural and conductive hearing loss among Bantu children-adolescent from the present study as reported by several foreign studies [28,36-38]. Other ENT conditions such as allergic rhinitis, chronic rhinitis well associated with AMO in the same population previously published (17), were also identified as univariate associated factors of coMHL-AMO in the present study.

Furthermore, noisy and polluted semi-urban Tshangu District, passive smoking, AMO, rhinitis, and pharyngitis might have synergistic effect on mixed hearing loss in the present study as reported by other authors [39-44].

Indeed, the same significant univariate positive association between non-ENT conditions (poverty, passive smoking) [39-41] are related to ENT conditions among DR Congolese schoolchildren adolescents and associated with smoke Tobacco [17], Otologic disorders in the literature [27,45], and hearing loss [46,47]. The present study used the multivariate logistic regression to avoid confounding factors to consider only passive smoking chronic, rhinitis, and chronic pharyngitis as the most significant and important determinants of coMHL-AOM.

In the present Central African/DRC study as in European and other Sub-Saharan African studies, the most frequent cause of hearing loss is chronic and suppurative OMA [28,48-50].

The epidemiological profile of passive smoking is extensive among extreme (oldest and youngest) ages in the same DR Congolese population [17] as reported by other authors [51-54]. Literature reports that having a rich parent could be the cause of the passive smoking [55,56] as well as univariate-associated factor of coMHL-AMO in the present study. Passive smoking and other pollutants from high socioeconomic status and urban Kinshasa areas may determine allergic rhinitis and chronic pharyngitis also independent determinants of coMHL-AMO from the present study. Indeed, the impaired mucociliary clearance and irritation of adenoid tissue with elevated concentrations of histamine may induce allergic rhinitis and other upper respiratory tract infections [15,57].

Both chronic rhinitis and chronic pharyngitis, upper respiratory tract infections known to be associated with passive smoking [58-60], were also independent and significant determinants of coMHL-AMO in the present study.

Public Health, Practice and Research Perspectives

The present findings will impact on a range of implications whose major importance in terms of public health, prevention and policy, clinical practice, school environment, and research. Thus, the assessment of hearing loss is needed urgently in Kinshasa megacity with efficient interventions among parents, schoolchildren/adolescents, and practitioners. Audiometric screening, family and schools without noise neither passive smoking is recommended. A participatory approach will invite parents, teachers, general practitioners, policy leaders, otolaryngologists, and leaners (schoolchildren/adolescents) to work together to reduce high prevalence of coMHL-AMO in Kinshasa megacity, DRC.

Strength and Limitations of the Study

The strength of the present study might be reflected by its first comprehensive large and probabilistic community research in Central Africa. However, the present study had limitations to some degree such as its cross-sectional design, lack of some biomarkers such as cotinine, fibrinogen, and other inflammatory markers [61-63]. Moreover, acumetry without precision was used to diagnose hearing loss as a limitation of the present study. Indeed, the audiometric assessment of hearing loss is considered as the golden standard objective and reliable measure in different studies.

Conclusion

Parents, teachers, general practionners, policy leaders, and otolaryngologists are invited to work together for early prevention, diagnosis and treatment of coMHL-AOM epidemic prevalence and to tackle its independent determinants a cross elementary, primary and secondary schools from poor, polluted and chaotic semi-urban environment of Kinshasa Province; DRC.

Acknowledgement

We grateful all those who from far or near agreed to participate in this study; all the investigators, the children and ther father who willingly approved and supported within them the data collection.

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