Original Article

Atopy in HIV-Infected Children Attending the Pediatric Antiretroviral Clinic of LAUTECH Teaching Hospital, Osogbo

OA Oyedeji, AA Afolabi, AO Odeyemi, VO Kayode[1], E Agelebe[2]

Department of Paediatrics and Child Health, Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Osun State, [1]Paediatric Unit, Morning Star International Hospital, D/Line, Port Harcourt, [2]Department of Paediatrics and Child Health, Bowen Teaching Hospital, Ogbomoshoc, Nigeria

Received: 12-Jul-2019;
Revision: 20-Sep-2019;
Accepted: 28-Apr-2020;
Published: 12-Aug-2020

ABSTRACT

Background: Atopy is poorly researched in HIV children living in the developing countries. There is no previous report on this subject in Nigeria and this pioneering study is undertaken to create an awareness of the burden of this disease among health practitioners. **Aims:** The aim of this study was to document the atopic diseases present among HIV-infected children attending the antiretroviral (ARV) clinic of a Nigerian tertiary hospital. **Methods:** Information was obtained from consecutive consenting caregiver/HIV-infected child attending the pediatric ARV clinic, by the use of a proforma specifically designed for the study. The data obtained were analyzed using Statistical Package for the Social Sciences (SPSS) software program, version 16.0. **Results:** Seventy patients were studied and their ages ranged between 2 and 17 years. These 70 were constituted by 34 (48.6%) boys and 36 (51.4%) girls. Ten (14.3%) of the 70 studied, had atopic diseases. Nine (12.9%) patients had allergic conjunctivitis and 1 (1.4%) had allergic rhinitis. The single patient with allergic rhinitis also had bronchial asthma. No case of atopic eczema, or food allergy was recorded. Atopic disease conditions were more commonly recorded among the male sex and those whose parents have atopic diseases ($P < 0.05$). Atopic diseases were also more common among children without advanced HIV diseases and those with eosinophilia. Cosmetic and psychological embarrassment from eye discoloration and itching were the negative impacts on the quality of living. **Conclusion:** Allergic conjunctivitis is common in HIV-infected Nigerian children. Atopies are more common in boys and children with parental atopies.

KEYWORDS: *Allergy, familial, HIV-infections, pediatrics*

INTRODUCTION

Childhood HIV/AIDS disease continues to be a major source of morbidity and mortality in Africa. It is not surprising that the disease has been extensively researched along the lines of systemic affectation and opportunistic infections.[1-4] However, atopy has been under researched in both HIV-infected and uninfected Nigerian children, judging from the paucity of available studies in African children.

The global prevalence of allergic diseases seems to have increased with time in the last few decades.[5-7] Prevalence estimates of 7% and 8%, respectively, were obtained in a study of rural and urban Nigerian children for asthma in the year 2000; however, this is expected to be on the rise now.[7] Atopy is a personal or familial tendency to allergy arising from production of immunoglobulin E (IgE) antibodies in response to ordinary or potential allergens. It usually manifests with asthma, eczema, allergic rhinitis and conjunctivitis which has been observed to be the common allergic diseases in both HIV-infected and -uninfected children.[5,8,9]

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_359_19

Address for correspondence: Dr. OA Oyedeji, Department of Paediatrics and Child Health, Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Osun State, Nigeria.
E-mail: soltomoyedeji@yahoo.com

How to cite this article: Oyedeji OA, Afolabi AA, Odeyemi AO, Kayode VO, Agelebe E. Atopy in HIV-infected children attending the pediatric antiretroviral clinic of LAUTECH Teaching Hospital, Osogbo. Niger J Clin Pract 2020;23:1061-7.

Children infected with HIV usually have high levels of IgE.[10,11] Heightened chances or rates of atopic diseases are expected in the HIV-infected children with high IgE levels.

Surprisingly, the current prevalence estimate of atopy in HIV-infected Nigerian children and the association between atopy and HIV-infected Nigerian children is unknown. Furthermore, atopic diseases can also result in significant morbidity. They can impose constraints in affected individuals and account for school abseentism and constitute a drain on finances.[12,13] The desire to provide answers to the gaps in knowledge coupled with the ability of atopy to impact negatively on the quality of living in affected individuals, informed the desire to conduct this study. The aim of this study is to document the atopic diseases and its affectation of quality of life of HIV-infected children seen at Ladoke Akintola University of Technology (LAUTECH) Teaching hospital, Osogbo. It is hoped that the findings in this study should stimulate interest of other researchers to this relatively under researched field.

Subjects and Methods

The study was conducted at the Pediatric ARV out-patient clinic between June 1 and September 30, 2018. All principles governing ethics were complied with in the conduct of this research. Institutional ethical clearance was obtained with protocol number LTH/EC/2017/09/331. Informed consent was obtained from the parents of the studied subjects or from the subjects who were old enough to consent. Assent was obtained from the children in applicable cases. All consecutive consenting HIV-infected children attending the pediatric antiretroviral (ARV) clinic during the research period were studied. LAUTECH Teaching Hospital Ethical review board approval obtained on 20/02/2018.

Information was obtained by the use of a structured proforma specifically designed for the purpose of the study. Sociodemographic details obtained include age, sex, domicile of the subjects and their parents in addition to the occupation and their educational attainments of the parents. Additional information sought and recorded in the proforma include mode of delivery of the subjects, details of early infant feeding options (breastfeeding or formula feeds) and duration of the feeding option. Enquiries as to whether or not early feeding was exclusive for either breast or formula feed with the duration of feeding option.

The HIV clinical staging of the patients was based on the World Health Organization (WHO) HIV clinical staging classification.[14] Children with WHO clinical stages III and IV were classified as having advanced stages of HIV disease, whereas clinical stage I and II were regarded as non-advanced. Information on atopy in both the subjects and parents were obtained by incorporating the international study of Asthma and allergies in childhood (ISAAC) questionnaire into the specially designed proforma.[15]

Each patient was clerked, examined investigated and managed as indicated and the details of the information obtained were entered into the proforma. Results of the blood tests such as eosinophil and CD4 counts were obtained from the results of the statutory blood tests done as part of standard care for the patients on clinic visit days. Stools of those with eosinophilia were further examined by stool microscopy in affected patients to confirm helminthiases. Individuals found to have helminthic infestations were treated and excluded from the study.

The social classification of the children was based on Oyedeji's social classification system.[16] The occupation and education attainments of the parents studied were classified into five groups each based on Oyedeji's scoring system. Scores of 1–5 were assigned to each education or occupation category. The mean scores were approximated to the nearest whole number. Scores of 1 and 2 correspond to the upper socioeconomic classes, whereas a score of 3 is equivalent to the middle class and scores of 4 and 5 to the lower socioeconomic classes.

Data were entered into a personal computer analyzed using the Statistical Package for the Social Sciences (SPSS) software program, version 16.0 for Windows.[17] Continuous variables were expressed in proportions, ratios and percentages. Categorical variables were compared using the Chi-square (χ^2) test and risk ratio (RR) where appropriate. Statistical significance was set at $P < 0.05$.

Results

Population studied

A total of 70 HIV-infected children were studied. The corresponding caregivers were also studied.

Atopic diseases recorded in the population studied

Of the seventy studied patients, 10 (14.3%) had features of atopic disease, whereas 60 (85.7%) did not. Of the 70 patients 9 (12.9%) had features of allergic conjunctivitis and one patient had features of both allergic rhinitis and bronchial asthma. No case of food allergy or atopic dermatitis was recorded

Parental atopic disease

Three fathers had atopic diseases. Two (2.9%) had allergic rhinitis and the remaining 1 (1.4%) with atopic dermatitis. The 2 (2.9%) mothers with atopy had allergic conjunctivitis. Both mothers with atopic diseases were married to husbands with atopy, thus making the number of parents with atopy 3.

Age and sex distribution of the children with atopic disease

The age range of the children studied was between 2 and 17.0 years with a mean of 9.73 ± 3.92. There was a slight female preponderance with 36 (51.4%) girls and 34 (48.6%) boys, giving a female to male ratio of 1.05: 1.0. Of the 13 children aged less than 5 years 1 (7.7%) had atopic diseases, whereas 2 (7.7%) of the 26 children aged between 6 and 10 years and 6 (23.1%) of the 26 children aged between 11 and 15 children had atopic disease manifestation. One (20.0%) of the 5 children aged above 16 years had atopic disease. The age and sex distribution of the children studied are shown in Table 1.

Of the 34 boys studied 8 had atopic disease, whereas 2 of the 36 girl studied had atopic symptoms. This difference was statistically significant $\chi^2 = 4.613$ $P = 0.03$ RR = 0.19

95% CI = 0.04–0.98

Table 1: Sociodemographic and clinical characteristics of the patient studied

Age and sex distribution		
	Male	Female
>1 month-5 years	7	6
> 5 years-10 years	10	16
>10-15 years	15	11
>15-<18 years	2	3
Age groups and children with atopy in each age group		
>1 month-5 years	13	1 (7.7%)
> 5 years-10 years	26	2 (7.7%)
>10-15 years	26	6 (23.1%)
>15-<18 years	5	1 (20.0%)

Age distribution of the parents

The ages of the fathers ranged from 30 to 72 years with a mean of 48.0 ± 9.8. Ten of the fathers were aged between 30 and 40 years, whereas 40 were aged between 41 and 50 years, 16 between 51 and 60 years and 4 between the ages 61 and 76 years. The mothers' ages ranged from 25-58 with a mean of 39.81 ± 6.45 years. Seven mothers were aged between 25 and 30 years, 34 were aged between 31 and 40 years, 27 were aged 41–50 years and 2 between 51 and 58 years.

Occupation and educational attainments of the parent

Most of the parents were junior public servants and this group constituted more than a third of the working class occupation. More than half of the parents had at least completed secondary school education. All fathers had some formal education, whereas only one mother did not attend school at all. The details of the occupation and educational attainments of the parents are shown in Table 2.

Relationship between social class and atopy

Most of the children studied were from social class II. There were 11, 36, 20, and 3 children from social classes I, II, III, and IV, respectively. There were no children in social class V. Of the 11 children in Social class I, 2 (18.2) had atopic diseases, whereas 3 (8.3%) of the 36 children in social class II had atopy, 4 (20.0%) of the 20 children in social class III had atopic disease and 1 (33.3%) of the 3 children in social class IV had atopic disease.

Mode of acquisition of HIV and delivery

Mode of acquisition of HIV was presumed to be vertical in 64 (91.4%) and horizontal in 6 (8.6%). The six

Table 2: Educational attainments and occupation of parents

Occupation	Fathers *n*=70	Mothers *n*=70	Education	Fathers *n*=70	Mothers *n*=70
Senior public servants, professionals, managers, contractors and businessmen	3 (4.3%)	4 (5.7%)	University and postgraduate certificate equivalent	19 (27.1%)	9 (12.9%)
Intermediate grade public servants and senior school teachers and equivalents	6 (8.6%)	5 (7.1%)	Higher and Ordinary National diploma, completed school of nursing equivalents	12 (7.1%)	14 (20.0%)
Junior public servants, junior school teachers, drivers and artisans	34 (48.6%)	38 (54.3%)	Secondary school completed, technical and teacher training school s equivalents	29 (41.4%)	29 (41.4%)
Petty traders, laborers, messengers and similar grades	27 (38.6%)	20 (28.6%)	Primary school completed equivalents	10 (14.3%)	17 (24.3%)
The unemployed, students and subsistence farmers	0	3 (4.3%)	No formal school attended	0	1 (1.4%)

children who got infected horizontally all gave a history of receiving unscreened red blood cell transfusion.

Five of the children studied were delivered by caesarean section and the remaining 65 was by normal vaginal delivery. Of the five patients delivered by caesarean section, two had atopic manifestations, and three did not; while of the 65 born by normal vaginal delivery 8 had atopic disease manifestation and 57 did not. The association between mode of delivery and presence or absence of atopic manifestation was not significant (χ^2 = 2.91, P = 0.09 RR = 0.31 CI = 0.11–1.99 [95%]).

WHO Clinical staging of HIV of the children studied

World Health organization HIV clinical staging of the children showed that most of the children had non-advanced HIV disease. Of the 70 studied 11 (15.7%) had Stage I disease, 49 (70.0%) had stage II disease, 8 (11.4%) had stage III disease, and 2 (2.9%) had stage 4 disease or AIDS. Thus, 60 had non advanced HIV disease and 10 advanced HIV disease.

Of the 70 patients studied, atopic disease manifestation was not seen among children with advanced disease and all patients with atopy were identified in WHO classes stages I and II. Details of this association are seen in Table 3.

Early infant feeding

Of the 70 studied patients, 59 (84.3%) were breast fed exclusively for the first 4–6 months, whereas 11 (15.7%) received formula feeds. Of the total 70 studied, 11 were fed on infant formula, 8 (11.4%) of the children fed on formula from birth to 3 months, whereas 2 (2.8%) were fed on formula for 4 months and the remaining 1 (1.4%) child was fed with infant formula for 6 months. There was no case of pre-lacteal feeding with infant formula.

Association between early infant feeding and atopy

Among the 60 children with absence of atopic features, 50 were exclusively breastfed and 10 were exclusively fed with infant formula. Of the 10 children with atopy, 9 were exclusively breastfed, whereas the remainder one fed exclusively on infant formula feeds. The differences across both groups is not significant (χ^2 = 0.288, P = 0.59).

Association between patient allergy and Parental atopy

Three parents had atopy among the 10 children identified with atopy. No atopy was recorded among all the parents of the 60 children without atopy. This association between child and parental atopy is statistically significant (χ^2 = 18.81, P < 0.01).

Provoking factors for atopy

The provoking factors for allergy could not be elicited in all the children, as the specific allergens needed for testing were not available.

Effect of atopy on quality of life

Of the 10 children with atopy, three complained that the atopy constitute a psychological disturbance to their health as a result of the recurrent nasal and eye itchiness, whereas two complained of cosmetic embarrassment as a result of eye discoloration and itchy nose and the remaining one person of the cost of care affecting the financing of the patient and care giver.

Mean CD4 count and eosinophil of patients with and without atopy

The 10 patients with atopic symptoms had a mean CD4 count of 543.2 cells/μL, whereas those without

Table 3: Association between atopic diseases in HIV-infected patient and HIV clinical staging, gender, parental atopic disease and infant feeding

			RR	χ^2	P	95% CI
HIV staging and atopic diseases						
	Presence of atopy symptoms	Absence of atopy symptoms				
Stages I & II	10	50	0.00	1.94	0.16	00-0.00
Stages III & IV	0	10				
Gender and atopic disease						
Boys	8	26	4.24	4.61	0.03	0.92-28.39
Girls	2	34				
Association between eosinophilia and atopic disease manifestation						
Eosinophilia present	10	51	0.82	1.72	0.19	0.75-0.93
Normal eosinophil count	0	9				
Association between parental and child atopic disease						
Presence of parental atopy	3	60	0.05	39.21*	<0.01	0.05-0.15
No parental atopy	7	0				

atopy had a mean count 679.0 cells/μL. The mean eosinophil percentage among children with atopy was 14.26% ± 6.77% and 12.07% ± 8.32%. Eosinophilia was regarded as an eosinophil count equal to or greater the 1500 cells/ml or differential eosinophil percentage >7%. Of the 70 patients studied 61 had eosinophilia, whereas 9 had a normal eosinophil count. The association between eosinophil count and atopic diseases in the patients studied is shown in Table 3.

Discussion

This study's finding of 14.3% prevalence of atopic diseases in HIV-infected subjects is similar to the South African prevalence of 10%. However, disparities were recorded in the estimates and types of atopies identified for the South African study which reported prevalence rates above 60% for both allergic rhinitis and atopic eczema.[11] Thus, this study suggests that allergic rhinitis is less common in our setting. Atopic dermatitis and food allergies were also not discovered in this study. Perhaps our exposure to food and other precipitants of allergy is lessened by our rather conservative habits. The prevalence of 65% obtained for allergies in the study conducted at Brazil is however much higher than what was obtained in this study.[8] The disparities in estimates in this and both South African and Brazilian studies may be due to racial and geographical location differences.

Previous reports on atopies in Nigerian children suggest that allergic rhinitis and atopic eczema are uncommon in the general population. They record estimates ranging between 5.12%–8.6% in studies conducted in the last decade.[18,19] Bronchial asthma and allergic conjunctivitis were reported more commonly with prevalence estimates of 12.5% and 18.2%, respectively.[20,21] However, there are no available reports on food allergies in Nigerian children and a previous report has expressed a concern for the need for comprehensive data and study on food allergy[22]

The mean age in this study population was high and differed from previous studies,[8,11] where the maximum age studied was 12 years compared with 7 years in this study. The male predilection for atopy in the present case series was also not consistent with previous reports. The study conducted in Brazil included only subjects matched for age and sex, so that age and gender-based comparisons with this study would not be appropriate because of the differences in subject recruitment.

The pattern of atopies discovered in the present appears to be consistent with those obtained in the general population from previous reports, with the exception that no case of atopic dermatitis was documented in this report.[18-22] Perhaps the absence of atopic dermatitis may have to do with the small sample size. Another hypothesis for the absence of atopic dermatitis in this study series may have to do with the immune suppression effect of the HIV, resulting in the inability of the subjects to express immune response to allergens responsible for eczema, among those genetically predisposed. Thus, HIV may have down played the expression of allergy in the skin probably in a similar fashion in which it gives rise to anergy to Tuberculoprotein skin sensitivity tests.[23]

Other factors that may be responsible for lower prevalence estimates of atopy among the studied group of HIV-infected patients may have to do with the lower rate of parental atopy. Parental atopy has been established to be predictive of atopy in offsprings.[24,25] The choice of early feeding may also have been contributory to the low prevalence of atopy obtained in the present case series as most of the mothers in this study practiced exclusive breastfeeding. The current treatment guideline for management of HIV-infected Nigerian children encourages exclusive breastfeeding for the first 4–6 months when and if possible in order to reduce mother to child transmission of HIV in infected mothers.[26] This recommendation does appear to be positively associated with the low prevalence of atopic diseases and should be encouraged.

There was no social class predilection for atopy in the present case series indicating that parental occupation and education probably did not have any association with development of atopy. However, atopies were more common among children without advanced HIV disease, although this association did not reach significant proportions. This finding is not unexpected as children without advanced disease are likely to mount stronger immune responses to allergens. However, the lower mean CD4 counts recorded in the nonadvanced HIV disease class is not consistent with the natural history.

Eosinophilia was more common among the HIV-infected children with atopy in the present case series; however, this finding did not reach statistically significance proportions. Eosinophilia is one of the hematological responses to allergy and this finding was consistent with other reports.[8,27] Specific conditions associated with eosinophilia in previous studies include atopic dermatitis, prurigo nodularis, eosinophilic folliculitis, parasitic infection, malignancy, allergy and adrenal insufficiency.[8,9,28]

A third of the children with atopies opined that the disease condition affected their quality of life. The cosmetic embarrassment resulting from brownish pigmented sclera, dyspigmentation from allergic conjunctivitis and the recurrent need to rub the eyes

or noses following itching affected their psychological outlook. Previous reports show that children with allergic conjunctivitis may suffer additional eye problems which may impact negatively on their finances. Furthermore, both allergic conjunctivitis and rhinitis can affect school attendance and performance either as a result of the disease or its treatment.[29,30]

Limitations

This study is a hospital-based study and furthermore the sample size was small. Thus the findings in this study may not be reflective of the general prevalence and pattern of atopies among HIV-infected Nigerian children.

Conclusion

It is concluded that atopic diseases in HIV-infected children are not uncommon and they are significantly associated with the male gender and presence of allergies in parents. Atopies are more commonly associated with eosinophilia, normal or high CD4 and non-advanced HIV clinical stages. Affected patients can suffer psychologically from cosmetic embarrassment and the disease can serve as a drain on their finances from the point of view of paying for care or treatment and drugs.

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.

Acknowledgement

The contributions of Prof. Emmanuel at conception, statistical analysis, write up, and review are gratefully acknowledged. My appreciation also goes to Prof G.A Oyedeji emeritus for helping with the review of this manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Brown B, Oladokun RE, Odaibo GN, Olaleye DO, Osinusi K. Kanki, P. Clinical and immunological profile of pediatric HIV infection in Ibadan, Nigeria. J Int Assoc Physicians AIDS Care 2011;10:49-53.
2. Singh P, Hemal A, Agarwal S, Kumar D. Cardiac manifestations in HIV infected children. Indian J Pediatr 2015;82:230-4.
3. Endayehu Y, Mekasha A, Daba F. The pattern of mucocutaneous disorders in HIV infected children attending care and treatment in Tikur Anbesa specialized hospital, Addis Ababa, Ethiopia. BMC Dermatol 2013;13:12.
4. Fredrick F, Francis JM, Ruggajo PJ, Maro EE. Renal abnormalities among HIV infected children at Muhimbili National Hospital (MNH)-Dar es Salaam, Tanzania. BMC Nephrol 2016;17:30.
5. Linhar LS, Traebert J, Galato D, da Silva RM, Schuelter-Trevisol F, Rovaris NS, *et al*. Allergic diseases in subjects under 18 years living with HIV. Allergy Asthma Clin Immunol 2014;10:35.
6. Potter PC, Warner JO. Pawankar R. Recommendations for competency in allergy training for undergraduates qualifying as medical practitioner: A position paper of the World Allergy organization. World Allergy Org 2009;2:150-4.
7. El-Gamal YM, Hossny EM, El-Sayed ZA, Reda SM. Allergy and immunology in Africa: Challenges and unmet needs. J Allergy Clin Immnnol 2017;140:1240-3.
8. Cruz CR, Carvalho VO, Santos RV, Tahan TT, Rossoni AM, Lima HC. Laboratorial atopy markers in children with human immunodeficiency virus. Mem Inst Oswaldo Cruz 2010;105:293-8.
9. Da Silva L, Kweku Sagoe Amoah S, Da Silva J. Relationship between atopy, allergic diseases and total serum IgE levels among HIV-infected children. Eur Ann Allergy Clin Immunol 2013;45:155-9.
10. Bowser CS, Kaye J, Joks RO, Charlot CA, Moallem HJ. IgE and atopy in perinatally HIV-infected children. Pediatr Allergy Immunol 2007;18:298-303.
11. Masekela R, Moodley T, Mahlaba N, Wittenberg DF, Becker P, Kitchin O, *et al*. Atopy in HIV-infected children in Pretoria. S Afr Med J 2009;99:822-5.
12. Mbugi EV, Chilongola JO. Allergic disorders in Africa and Africans: Is it primarily a priority? World Allergy Organ J 2010;3:175-81.
13. Potter PC. Inaugural lecture: Allergy in Southern Africa. Curr Allergy Clin Immunol 2009;22:156-61.
14. WHO. Interim WHO clinical staging of HIV/AIDS and HIV/AIDS case definition for surveillance. African Region. Available from: https://www.who.int/hiv/pub/guidelines/clinicalstaging.pdf. [Last accessed on 2019 May 23].
15. International Studies on Asthma and Allergies in Childhood (Phase 3 Manual). Auckland, New Zealand: ISAAC International Data Center; 2000. Available from: http://isaac.auckland.ac.nz. [Last accessed 2019 Jul 07].
16. Oyedeji GA. Socioeconomic and cultural background of hospitalized children in Ilesa. Nig J Pediatr 1985;12:111-7.
17. SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc. Available from: https://www.ibm.com/support/pages/how-cite-ibm-spss-statistics-or-earlier-versions-spss. [Last accessed on 2020 Jul 18].
18. Adegbiji WA, Olajide GT, Olubi O, Olajuyin AO, Aluko AA, Olatoke F. Otorhinolaryngological manifestation of allergy in South Western Nigerian children. J Allergy Ther 2018;9:279. doi: 10.4172/21556121.1000279.
19. Nnoruka EN. Current epidemiology of atopic dermatitis in south-eastern Nigeria. Int J Dermatol 2004;43:739-44.
20. Akhiwu HO, Asani MO, Johnson AB, Ibrahim M. Epidemiology of pediatric asthma in a Nigerian population. J Health Res Rev 2017;4:130-6.
21. Duke RE, Odey F, De Smedt S. Vernal Keratoconjunctivitis in public primary school children in Nigeria: Prevalence and nomenclature. Epidemiology Research International 2016;2016:6. Article ID 9854062.

22. Boye JI. Food allergies in developing and emerging economies: Need for comprehensive data on prevalence rates. Clin Transl Allergy 2012;2:25.
23. Kirenga BJ, Worodria W, Massinga-Loembe M, Nalwoga T, Manabe YC, Kestens L, *et al*. Tuberculin skin test conversion among HIV patients on antiretroviral therapy in Uganda. Int J Tuberc Lung Dis 2013;17:336-41.
24. Arshad SH, Karmaus W, Raza A, Kurukulaaratchy RJ, Matthews SM, Holloway JW, *et al*. The effect of parental allergy on childhood allergic diseases depends on the sex of the child. J Allergy Clin Immunol 2012;130:427-34.e6.
25. Dold S, Wjst M, von Mutius E, Reitmeir P, Stiepel E. Genetic risk for asthma, allergic rhinitis and atopic dermatitis. Arch Dis Childhood 1992:67:1018-22.
26. Federal Ministry of Health. Nigeria National Guidelines for HIV Prevention, Treatment and Care. National AIDS and STI's control program. 2016. Available from: http://apps.who.int/medicinedocs/documents/s23252en/s23252en.pdf.
27. Bhowmik A, Banerjee P. Hematological manifestation in HIV infected children. J Coll Physicians Surg Pak 2015;25:119-23.
28. Skiest DJ, Keiser P. Clinical significance of eosinophilia in HIV-infected individuals. Am J Med 1997;102:449-53.
29. Meltzer EO. Quality of life in adults and children with allergic rhinitis. J Allergy Clin Immunol 2001;108:S45-53.
30. Pitt AD, Smith AF, Lindsell L, Voon LW, Rose PW, Bron AJ. Economic and quality-of-life impact of seasonal allergic conjunctivitis in Oxfordshire. Ophthalmic Epidemiol 2004;11:17-33.