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Paediatric Osteomyelitis in a Tertiary Hospital in South-South Nigeria; Clinical Experience at Federal Medical Centre Asaba

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Authors' contributions

This work was carried out in collaboration among all authors. Author NKE designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors GOO, HIOO, SEE, NKE, OCA, ODE and AU managed the literature searches. Authors ODE and AU managed the retrieval of data. Authors ODE and OCA managed the analysis of the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: The incidence of Osteomyelitis is disproportionately higher in low-income countries (43-200 per 100,000 children) compared to high-income countries (1.94-13 per 100,000 children).These infections remains a significant threat to proper growth and development of children in low-income countries, and this is partly due to late presentation to the hospital coupled with wanton unorthodox pre-hospital intervention by traditional healers.
Aim: To determine the clinical and microbiological profile of paediatric osteomyelitis at Federal Medical Centre Asaba.
Methods: This is a 4year single centre retrospective study of all paediatric osteomyelitis managed in this hospital from January 2014 to December 2018. Important data such as type (acute, subacute and chronic) of osteomyelitis, bone involved, bone sites (epiphyseal, metaphyseal or diaphyseal) affected, microbiological culture results (implicated microorganisms), and genotype, treatment and outcome of treatment were expressed as frequencies and mean ± standard

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deviations, and Pearson's Chi square test was used to measure associations. P values < .05 were considered statistically significant.
Results: Forty (40) out of 3657 children had osteomyelitis, 17 (42.5%), 4(10%) and 19 (47.5%) were diagnosed with acute, subacute and chronic osteomyelitis respectively. The prevalence of osteomyelitis in this study was 1%. The children were between the ages of 6 months to 17 years with a mean age of 8.1 ± 4.23 years and spent an average of 19 ± 14 days on admission. Low and middle socioeconomic status were significantly associated with the risk of infection (P = .04). Tibia (47.5%) and femur (25%) were the commonest bones involved. *Staphylococcus aureus* accounted for 52.5% of cases and the metaphysis was the commonest site involved. The sickle cell heamoglobin to normal heamoglobin genotype ratio is 1:3. Out-come was favourable 87.5% of the cases.
Conclusion: Low socioeconomic class is a risk factor for paediatric osteomyelitis in our locality. Early diagnosis and prompt treatment are vital in ensuring favourable outcome.

Keywords: Paediatric; bone infections; osteomyelitis.

1. INTRODUCTION

Paediatric bone infections (PBI), also called osteomyelitis, is characterized by the inflammation of bone and its marrow, secondary to microbial invasion of the bone [1]. The invading organisms can reach the bone via the haematogenous route (the commonest route in children), by contiguous spread from a nearby septic focus, or direct traumatic inoculation (or iatrogenic infection) [1-3]. This infection is classified, arbitrarily based on the time frame of clinical manifestations, into acute (less than 2 weeks) subacute (2-6 weeks) or chronic (greater than 6 weeks) osteomyelitis [3]. Acute osteomyelitis (AOM) is characterized by local and systemic features of acute inflammation (which distinguish it from subacute osteomyelitis which presents insidiously with only mild local inflammation and pus formation; Brodie's abscess), while the hallmark of chronic osteomyelitis (COM) is the presence of infected dead bone (sequestrum) and an attempt at healing as evidenced by formation of new sclerosed bone (involucrum) [2,3]. Though the profile of likely causative organisms may vary with the age of the child, [4] *Staphylococcus aureus* remains the commonest implicated causative organism among all age groups.It is present in as much as 65-80% of all positive culture cases as reported in some studies [5-10]. Other organisms of aetiological significance are *Streptococcus pyogenes*, *Streptococcus pneumonia*, *Neisseria species* (in neonates and in developing countries), and *Haemophilus influenzae* type b which is relatively rare in developed countries possibly due to incorporation of *Haemophilus influenza* vaccination in their Childhood immunization programmes [11]. *Salmonella* Osteomyelitis though rare in the general population is relatively more common among patients with Sickle cell anaemia [12,13]. Furthermore, some studies suggests an increasing incidence of osteomyelitis caused by *Kingella kingae*, [14,15] possibly partly due to availability of new technologically advanced methods of diagnosis like polymerase chain reaction(PCR) [16-18].

There is considerable variations in the reported incidence of childhood osteomyelitis between the high income and the low-income countries [19-23]. With the exception of Australia which has a childhood osteomyelitis incidence rate of 82 per 100,000 children, [19] other high-income countries have a disproportionately lower incidence rate of 1.94 - 13 per 100,000 children compared to their counterparts in low-income countries with a reported incidence rate of 43 - 200 per 100,000 children [20-23]. Late presentation to hospital coupled with pre-hospital unorthodox intervention by traditional healers worsens the morbidity and increases the rate of complications like pathologic fracture, growth plate destruction and growth impairment with limb deformity in low-income countries like Nigeria [24-29]. There are no studies to the best of our knowledge that analyses this important childhood health challenge in Asaba and in our hospital (Federal Medical Centre Asaba) specifically. We therefore undertook this study with the main aim of determining the clinical (prevalence, clinical presentations and outcome) and microbiological profile of Paediatric osteomyelitis at the Federal Medical Centre Asaba, Nigeria.

2. MATERIALS AND METHODS

This was a 4 year single-centre retrospective study that included all paediatric (0 – 18 years of

age) osteomyelitis cases seen in our hospital from January 2014 to December 2018. We meticulously reviewed the databases of the Children Emergency unit admissions, in-patient admissions, out-patient clinic attendance as well as the operation theater database. We reviewed the clinical notes of all paediatric patients seen in the hospital during the study period. There was a total of 3,657 patient's clinical notes out of which 40 were cases of osteomyelitis and so, were included in the study. Of these 40 cases, 39 patients had complete clinical notes, while 1 patient had an incomplete clinical note. The inclusion criteria were (1) a documentation of a clinical diagnosis of osteomyelitis in the patient's file and (2) a confirmatory microbiological [2,3] and/or a radiological diagnosis of osteomyelitis. Late x-ray imaging done after the 14th day following onset of symptoms is considered the most valuable radiologic method in the diagnosis of osteomyelitis [30]. The exclusion criteria were (1) age greater than 18years and (2) the absence of both microbiological and radiological confirmatory diagnoses. From the patients' clinical notes, the following important data were retrieved: demographic data, socio-economic status of parents, duration of clinical features, site of infection, comorbidities, haemoglobin genotype, microbiological studies' results, radiological investigation report, treatment administered (medical and/or surgical), complications and outcome of treatment as well as length of hospital stay.

Data analysis was done using statistical package for the social sciences (SPSS) version 20. Bar-chart was used in the presentation of the data. Data were expressed as frequencies and mean ± standard deviations and Pearson's Chi square test of significance was used to measure associations. *P* values < .05 were considered statistically significant.

3. RESULTS

A total of 40 cases of PBI, out of a total patient population of 3657 patients, were seen during the study period, giving a prevalence of 1%. There were 21 of the male sex and 19 of the female sex giving a male to female ratio of 1.1:1. The children were aged between 6 months and 17 years with a mean age of 8.1 ± 4.23 years. The average length of hospital stay was 19 ± 14 days. Fig 1 shows the distribution of the type of osteomyelitis documented among the children while Table 1 shows the socio-demographic and genotype characteristics of the children. There was a significant association between socioeconomic status of the parents and osteomyelitis (*P* = 0.04). A total of 27 children had a normal hemoglobin genotype while 13 children were sickle cell patients (sickle cell genotype to normal hemoglobin genotype = 1:3). *Staphylococcus aureus* was isolated as the microbiological cause of PBI in 21 children (52.5%) while *E.coli* was cultured in 2 children (5%), 17 children(42.5%) had sterile cultures. A total of 12 (30%) of the children presented with fever, swelling and pain, 7 (17.5%) presented with only pain and swelling, 5 (12.5%) presented with either fever or swelling, 5 (12.5%) with fever and inability to move the affected limb, 5 (12.5%) with only inability to move the affected limb, 2 (5%) children had a discharging sinus at presentation, while 3 (7.5%) children presented with a chronic ulcer. The bones affected were the left tibia bone 12 (27.3%), right tibia 10(22.7%), right femur 5(11.4%), left femur 5(11.4%), calcaneum 3(6.8%), right humerus 3(6.8%), left humerus 4(9.1%) left radius 1(2.3%) and left ulna 1(2.3%). One child (2.5%) had multiple site osteomyelitis involving the bones of the upper and lower limbs (left humerus, left ulna, left radius, left and right Tibia) with an associated septic arthritis (right knee joint). The bone sites involved were metaphysis in 29 (65.9%) cases, diaphysis in 12 (27.3%) cases ,and epiphysis in 3 (6.8%) cases. The antibiotics used for treatment included ampicillin/cloxacillin and gentamycin combination in 17 children (42.5%), ceftriaxone, gentamycin, and clindamycin in 9 children (22.5%), ceftriaxone alone in 5 children (12.5%), ceftriaxone and gentamycin in 4 children (10.0%), ceftriaxone and metronidazole in 3 children (7.5%) and cefuroxime alone in one child (2.5%). A total of 35 (87.5%) children were discharged, 2 (5%) were referred on request, 3 (7.5%) children declined further treatment and were discharged against medical advice.

4. DISCUSSION

Paediatric bone infections (PBI) remains a significant cause of health challenge among growing children in low and middle income countries like Nigeria. The admission rate of 1% in this study is similar to results obtained from other studies on PBI across the world [31]. However, this is not consistent with the general notion that infection rates (PBI inclusive) are higher in LMICs. Nevertheless considering the fact that this study and indeed most of the studies from LMICs are hospital based retrospective studies, [5,6,24] there are chances

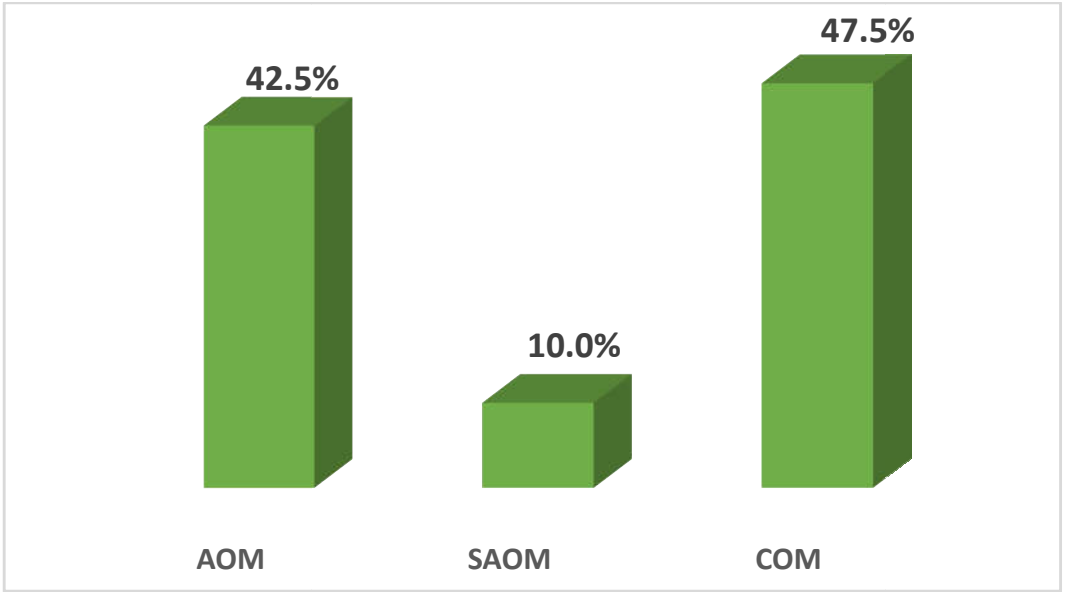

Fig. 1. shows the distribution of the type of osteomyelitis documented among the children
AOM: Acute osteomyelitis, SAOM: Subacute osteomyelitis, COM: Chronic osteomyelitis

Table 1. Socio-demographic and genotype characteristics of the children

Variables		Diagnosis				
Age		**AOM**	**SAOM**	**COM**	**χ2**	***P***
	0-4 years	3(33.3)	2(22.2)	4(44.4)	4.99	.54
	5-9 years	8(50.0)	0(0.0)	8(50.0)		
	10-14 years	4(33.3)	2(16.7)	6(50.0)		
	15-18 years	2(66.7)	0(0.0)	1(33.3)		
Gender	Male	8(38.1)	4(19.0)	9(42.9)	4.02	.13
	Female	9(47.4)	0(0.0)	10(52.6)		
Sec	Low	3(20.0)	3(20.0)	9(60.0)	9.89	.04*
	Mid	10(47.6)	1(4.8)	10(47.6)		
	High	4(100.0)	0(0.0)	0(0.0)		
Genotype	HbAA	7(41.2)	2(11.8)	8(47.1)	1.44	.84
	HbAS	3(30.0)	1(10.0)	6(60.0)		
	HbSS	7(53.8)	1(7.7)	5(38.5)		
Outcome	Discharged	13(37.1)	4(11.4)	18(51.4)	4.71	.32
	Referred	1(50.0)	1(50.0)	0(0.0)		
	Dama	3(100.0)	0(0.0)	0(0.0		

*AOM: Acute osteomyelitis, SAOM: Subacute osteomyelitis, COM: Chronic osteomyelitis, Hb: Heamoglobin, SEC: socioeconomic class. DAMA: Discharged Against Medical Advice, *significant P value*

that this incidence may not be a true reflection of the actual disease burden of PBI in LMICs. Retrospective studies often face the problem of loss of accurate data, particularly in LMICs where data archiving is very poor. However, this study revealed that there was a significant association between parent's socio-economic status and osteomyelitis. Osteomyelitis was disproportionately higher in children whose parents were in the low and middle socio-economic status compared to children from parents in the high socio-economic group. The association between poverty and malnutrition is an established fact [32-34] and could well explain this result. Children of parents in the low and middle socio-economic status are less likely to have the means to afford nutritionally balanced meals that will help to boost the immunity of these children. A progressive increase in the prevalence of osteomyelitis with age was noticed (from 5 to 14years of age), with a peak age prevalence in the 5-9 years age group which accounted for 16 (40%) of the children affected, followed closely by the 10-14 years age group

which accounted for 12 (30%) of cases. The less than 5years age group accounted for 9 (22.5%) followed by the 15-18 years age group which contributed the least number of cases 3 (7.5%). These results are similar to results obtained from a study in Ilorin Nigeria [5]. The male to female ratio of 1.1:1 showed that there was no much difference in sex distribution of patients with osteomyelitis which is at variance with results obtained from similar studies in Ilorin, Nigeria [5]. The reason for this difference, however, is not apparent. Acute Osteomyelitis accounted for 17 (42.5%) with a peak incidence in the first decade of life. In fact, 65% of AOM occurring in the combined age ranges of 0–4years and 5-9 years (within the first decade of life). Subacute osteomyelitis accounted for only 4(10%) cases. Most of the cases in this study were COM which accounted for 19 (47.5%) cases. The possible explanation for this is the poor health seeking behavior of patients in LMICs coupled with the very common practice of wanton unorthodox pre-hospital intervention by traditional bone healers which delays early presentation to the hospital, delays early accurate diagnosis and consequently leads to delayed antibiotic treatment [5,24,25,29]. Thus a significant number of AOM progresses into COM. Nevertheless, the peak incidence of COM occurring in the first decade of life as seen in this study is at variance with the reported peak incidence in the second decade of life as seen in other similar studies [5,35-37]. The reason for this discrepancy is not explicitly clear to the authors. *Staphylococcus aureus* accounted for more than half of all cases 21(52.5%) in this study making it the leading cause of osteomyelitis in all age groups. This finding is similar to the microbiological results obtained from other similar studies on osteomyelitis documented in the literature [5-10] *Escherichia coli* was isolated in 2(5%) cases (one AOM and one COM). However, in 17(42.5%) cases, no organism was isolated after 48hours of culture despite the fact that these patients had obvious clinical features of either AOM or COM with a confirmatory radiological evidence to support the same. Among these patients with negative culture results, 10(58.8%) and 7(41.2%) were COM and AOM respectively. Most of these patients had been on self-medication (for a considerable period of time), with various antibiotics they procured from road side drug sales outlet. Bacteria are significantly less frequently detected in culture based on microbiological test samples collected after a previous antibiotic exposure or ingestion by patients [38]. This posed a major challenge in the management of these patients as the choice of antibiotics was only based on empirical data. The outcome of treatment was quite favourable in 35 (87.5%) children; this figure comprised of 13 (37.1%), 18 (51.4%) and 4 (11.4%) children with AOM, COM and SAOM respectively. It is important to note that in this study a 100% discharge rate was recorded for the SAOM. All the patients with SAOM had a culture positive result which isolated *Staphylococcus aureus*, hence a definitive microbiological diagnosis was arrived at and all the SAOM patients got antibiotic therapy based strictly on sensitivity results. Furthermore, these patients also had surgical drainage of the associated brodies' abscess. One patient in the SAOM group underwent an arthrotomy and joint irrigation for an associated septic arthritis. On the other hand a discharge rate of 94.7% (18 out of a total of 19 children) was observed among patients treated for COM. It is important to note that this group of patients had the highest number of culture negative results (a total of 10 patients). Some of the latter patients were treated with empirical antibiotic regimen in conjunction with surgical curettage and sequestrectomy of dead infected bone tissue. However, those with culture positive microbiological results were treated with antibiotics based strictly on sensitivity results and those that had a sequestrum had sequestrectomy and curettage as an adjunct treatment. AOM recorded the least discharge rates of 76.5% (13 out of 17 children with AOM) possibly because 4 patients with AOM opted out of treatment (3 requested for discharge against medical advice due to financial challenges and 1 patient requested for referral to another hospital on account of proximity to family members).

5. CONCLUSION

Low socioeconomic class is a risk factor for paediatric osteomyelitis in our locality. Early diagnosis and prompt treatment are vital in ensuring favourable outcome.

6. LIMITATION TO THE STUDY

There were few missing information from the patients record which is peculiar with retrospective studies.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Data collection was done after due approval by the hospital's Research and Ethics Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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