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Research Article

Demographic Profile of Congenital Talipes Equinovarus in A New Clubfoot Program of a Nigerian Regional Hospital

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Abstract

Background: Evidence suggests that 80% of infants with congenital clubfoot live in developing countries, and the condition is said to be the commonest congenital musculoskeletal deformity in Nigeria, accounting for 52.8% of all malformations with live births incidence of 3.4/1000.

Study design: A 6-month observational study of demographic patterns of congenital talipes equinovarus at a Nigerian regional hospital is presented.

Results: Sixty seven children met the inclusion criteria. There was a slight preponderance of males over the females, at a ratio of 1.6: 1. The mean age of the population was 31.6 ± 23.64 months. The average age of the mothers and fathers at the conception of the children with clubfoot deformities was 25.58 ± 6.17 years and 32.34 ± 6.712 years respectively. In 45 (67.2%) children, the clubfoot was bilateral and unilateral in 22 (32.8%). Idiopathic clubfoot was the commonest variant at the rate of 70.1%.

Conclusion: Late presentation of clubfoot for treatment was common in this study. The risk of clubfoot was higher among firstborn children.

Keywords: Congenital talipes equinovarus; demographic patterns

Introduction

Congenital talipes equinovarus (CTEV, congenital clubfoot) is one of the most common structural congenital abnormalities affecting the lower limb, with a generally accepted incidence of one to two per 1000 live births.[1, 2] However, the incidence of CTEV has been reported to vary across the regions of the world from 0.6/1,000 individuals in Asia, 0.9/1,000 individuals in Australia to 6.9/1,000 individuals in Hawaii, Polynesia and Maori.[3, 4] Evidence suggests that 80% of infants with congenital clubfoot live in developing countries, [5, 6, 7] and the condition is said to be the commonest congenital musculoskeletal deformity in Nigeria, accounting for 52.8% of all malformations with live births incidence of 3.4/1000.[8 - 12] The incidence in males is reportedly higher than in females, with a male to female ratio of 4:1.[3] From a global perspective, it has been reported that approximately 100,000 children are born world-wide

each year with clubfoot. As already stated, about 80% of these children are believed to live in developing countries where many of them are deemed unable to receive the expected optimal treatment.[5 - 7, 13] When neglected, CTEV becomes a serious reason for physical, social, and psychological disability among the affected subjects.[13]

The anatomic deformity of CTEV is easily recognised. For descriptive purposes, clubfoot deformity has four constant features, namely, equinus, mid-foot cavus, fore-foot adduction and hind-foot varus. The deformity is both cosmetic and functional with associated hypoplasia of skin, muscles, bones, tendons, ligaments and neurovascular bundle on the medial side. The affected foot is smaller than the normal foot.[2, 14] Functional adaptation occasioned by these deformities in an untreated clubfoot results in additional local anatomical changes such as callosity of the lateral border of the foot due to weight bearing on this part, increasing deformation of the tarsal bones of the foot, skin and bone infections, stiffness of the foot, limitation in mobility, and inability to wear standard shoes.[2]

Although clubfoot may be associated with many other congenital abnormalities, it is more commonly an isolated idiopathic birth defect, which may affect either one foot or both feet. When it is associated with other congenital anomalies, it is referred to as syndromic clubfoot. When it is an isolated defect, it is referred to as idiopathic clubfoot.[15] About half of the infants with clubfoot have bilateral involvements, and unilateral deformity occurs more often on the right side.[3, 15] There is an associated posteromedial ankle and foot soft tissue contractures which deform and displace tarsal bones, giving rise to characteristic deformities of equinus, heel varus, mid-foot adductus and cavus.[15, 16] These deformities are responsible for the plantarflexed, inverted, and adducted position of the foot. The deformation of the normal anatomy of the affected foot is conspicuously obvious at birth.

The aetiology of CTEV is unknown but several theories have been advocated to explain it.[1, 2, 13] However, most infants who have congenital clubfoot have no identifiable genetic, syndromal, or extrinsic cause.[17] The reason for this study was to bridge the research data gap and paucity of literature on the subject matter of congenital clubfoot in the immediate study environment. Also, this work will contribute scientific data, from the perspective of the study environment, to the already existing national database on the subject of congenital clubfoot.

Methods

Study area: This study was done at the clubfoot clinic of the Department of Orthopaedics and Traumatology, in a Nigerian university teaching hospital.

Study Design: This was a 6-month observational study of subjects with congenital clubfoot seen at the clubfoot clinic from June to November, 2021.

Sample Size Determination: The Cochrane formula[19] for minimum sample size calculation for a population more than 10,000 was used. The estimation of the minimum sample size was based on the formula $N = Z^2pq/d^2$, where Z = a constant, 1.96 (Standard normal deviation usually set at 1.96); p = proportion or prevalence rate of disease in decimal and refers to the number of cases which are present within the population at a particular point in time. The pooled estimate for clubfoot birth prevalence for Africa is 0.96, according to Smythe *et al.*[20] For the purpose of sample size calculation in this study, the prevalence rate of 0.96 was used; q = 1-p = 0.04; and d = degree of accuracy desired set at 0.05 (95% accuracy was desired).

$$\text{Therefore,} \quad N = \frac{1.96^2\ (0.96 \times 0.04)}{0.05^2}$$

$$N = 59$$

From the above formula, a minimum sample size of 59 was calculated for this study. However, the actual sample population recruited into this study was 67.

Sampling Technique: Convenience sampling technique was employed among clubfoot subjects seen at the clubfoot clinic.

Data Collection: Data was collected using pre-tested researcher-based proforma. This proforma was completed at the point of enrolment of the subjects into the clubfoot clinic. For the purpose of this manuscript, the demographic and epidemiological variables of the subjects were selected for study.

Ethical Clearance: Ethical approval for the study, with ethical approval reference AD/S/96/VOL.XXI/574, was obtained from the Ethical Review Board of the hospital. All information was explained to participants and their parents or guardians before evaluation.

Inclusion/Exclusion criteria: The following were the inclusion criteria for the study: Subjects with congenital clubfoot; subjects 18 years or less in age; must be enrolled at the Orthopaedic/clubfoot clinic; and guardian must be willing to give informed consent. The exclusion criteria were subjects above 18 years; presence of secondary clubfoot (e.g., post-traumatic clubfoot, post poliomyelitis related clubfoot, or clubfoot associated with cerebral palsy); and subjects that were not enrolled in the clinic.

Research Protocol:

Consecutive cases of researcher-diagnosed clubfoot subjects enrolled into the clubfoot clinic, and who met the inclusion criteria were

selected. Pre-tested researcher-based proforma was used as data collecting tool. The demographic information of the subjects, including the age, gender, birth order, birth weight, parents' age at birth of subjects, and parents' income were obtained and documented. Clinical assessment of the subjects' feet was done at first presentation, noting and documenting the specific patho-anatomic details of clubfoot (the affected foot, nature of clubfoot and clinical type) found in the subjects. The side involved was noted, and the clubfoot was categorized into intrinsic, extrinsic, idiopathic, syndromic, neuropathic or recurrent. The presence of hind foot varus, equinus, forefoot adduction, callosity, and other associated congenital anomalies were noted and documented. The details of deformity severity assessment, treatment and outcome are beyond the scope defined for this manuscript.

Data Analysis: Data generated was subjected to descriptive statistical analysis using the statistical package for social science (IBM SPSS for windows version 20). Tables were expressed in numbers of observation (frequency) with prevalence in percentages, and showing mean and standard deviation. The association between continuous variable was done using Pearson product correlation. Statistically significant associations and mean differences were considered at p-value less than less than 0.05 ($p < 0.05$).

Results

Demographic Characteristics of the Children with Clubfoot

A total of one hundred and twelve feet in 67 children with congenital talipes equinovarus (congenital clubfoot) deformities who met the inclusion criteria were seen and recruited into the study. There was a slight preponderance of males over the females, with a male to female ratio of 1.6: 1. There were 41 (61.2 %) males and 26 (38.8%) females. The mean age of the children was 31.6 ± 23.64 months. Seventeen (25.4%) of the children with clubfoot deformities were brought for treatment within the first year of life (0 - 12months). Thirty seven (55.3%) of these children were brought for treatment in the second and third years of life (13 - 36months), while 13 (19.4%) came for treatment after the age of three years. The highest prevalence (46.3%) of the clubfoot was seen in the firstborn children. Prevalence in subsequent births was lower, dropping to 5 (7.5%) in the fourth births and above. The mean birth weight of the children with clubfoot in this study was 3.14 ± 0.65 Kg (Table 1)

Descriptive Statistics of the Parents' Demographic Characteristics

Table 2 shows the descriptive statistics of the characteristics of parents of the subjects. The average age of the mothers and fathers at the conception of the children with clubfoot deformities was 25.58 ± 6.17 years and 32.34 ± 6.712 years respectively. The average monthly income in Nigerian Naira (NGN) assessed in 36 mothers and 53 fathers was 18055.56 ± 20387.59 and 36377.36 ± 42629.09 naira respectively. This is approximately equivalent to forty three United States dollars (USD 43) and USD 88 respectively as at the time of this study, according to a currency conversion chart.[24] Parity measured the number of viable pregnancies by the mothers of the children with clubfoot as at the time of this study. The mean of viable pregnancies was 2.21 $\pm$ 1.23.

The Association between Age (in months) at presentation of the Subjects and Demographic Characteristics of the Parents of the Subjects

The result of the association between age (in months) at presentation of clubfoot subjects and the parents' demographic characteristics is presented (Table 3). The Pearson correlation coefficient (R) showed low negative correlations of subjects' age at presentation with parents' age at conception and fathers' income. This low negative correlation was not statistically significant.

Patho-anatomic Profile of Children with Clubfoot (Classification/subtypes of Clubfoot seen in the Sample Population)

Forty five (67.2%) children had bilateral clubfoot, while 22 (32.8%) had unilateral clubfoot. In the unilateral affectation, there was equal involvement of the right and left sides. Intrinsic clubfoot was found in 39 (58.2%), while extrinsic clubfoot occurred in 28 (41.8%) of the cases. Based on the clinical subtype, there were 47 (70.1%) idiopathic, 12 (17.9%) syndromic, 7 (10.4%) recurrent and 1 (1.5%) neuropathic cases among the sample population.

Patho-anatomic Profile (Distribution of Identifiable Deformities of Clubfoot Among the Sample Population)

The identifiable deformities of clubfoot among the sample population are as presented. Forefoot adduction was present in all of the sample population. Hind-foot varus was present in 63 (94.0%), equinus deformity in 64 (95.5%), and 27 (40.3%) had callosity of the lateral border of the foot. Tibial torsion was absent in all (Table 5).

Patho-anatomic Profile (Other Musculoskeletal Abnormalities Associated with Clubfoot in the Sample Population)

Eleven (16.4%) of the sample population had other congenital musculoskeletal anomalies apart from clubfoot. These included overlapping or overriding toe digits, big big toe, syndactyly, polydactyly and rudimentary digits. Big big toe accounted for 6 (9.0%) of the anomalies (Table 6).

Variables	Groups	Frequency	Percentage
Gender	Female	26	38.8
	Male	41	61.2
	Total	67	100
Age group (month)	0-12	17	25.4
	13-24	19	28.4
	25-36	18	26.9
	≥37	13	19.4
	Total	67	100
Position in the Family	1st	31	46.3
	2nd	11	16.4
	3rd	20	29.9
	≥4th	5	7.5
	Total	67	100

Table 1: Demographic characteristics of the children with clubfoot

Variables	Number	Mean ± SD
Mother' s Conception Age	67	25.58 ± 6.17
Father's Conception Age	67	32.34 ± 6.712
Mother's income	36	18055.56 ± 20387.59
Father's income	53	36377.36 ± 42629.09
Mother's Parity	67	2.21 ± 1.23

Table 2: Descriptive statistics of the parents' demographic characteristics

S/N Variables	Mean	SD	R
i. Age Months	31.6	23.64	1
ii. Mothers' age at conception	25.58	6.17	-0.2
iii. Fathers' age at conception	32.34	6.712	-0.078
iv. Mothers' income	18055.56	20387.59	0.104
v. Fathers' income	36377.36	42629.09	-0.049

Table 3: The association between age of subjects in months and demographic characteristics of the parents of the subjects

Variables/classification criteria	Groups	Frequency	Percentage
Affected foot	Bilateral	45	67.2
	Unilateral Left	11	16.4
	Right	11	16.4
	Total	67	100
Nature	Extrinsic	28	41.8
	Intrinsic	39	58.2
	Total	67	100
Clinical types	Idiopathic	47	70.1
	Neuropathic	1	1.5
	Recurrent	7	10.4
	Syndromic	12	17.9
	Total	67	100

Table 4: Classification/subtypes of clubfoot seen in the sample population

Variables	Groups	Frequency	Percentage
Forefoot adduction	yes	67	100
Hind-foot varus	No	4	6
	yes	63	94
Equinus deformity	No	3	4.5
	yes	64	95.5
Cavus	No	8	11.9
	yes	59	88.1
Callosity	No	40	59.7
	yes	27	40.3
Tibial torsion	No	67	100
Palpable head talus	No	2	3
	yes	65	97
Spindle legs	No	53	79.1
	Yes	14	20.9

Table 5: Distribution of identifiable deformities of clubfoot among the sample Population

		Clubfoot	Control
Variables	**Groups**	**Frequency (%)**	**Frequency (%)**
Over-lapping toe digits	No	66 (98.1)	40 (100)
	Yes	1 (1.5)	0 (0)
	Total	67 (100)	40 (100)
Big big toes	No	61 (91)	40 (100)
	Yes	6 (6)	0 (0)
	Total	67 (100)	40 (0)
Syndactyly (toes)	No	66 (98.5)	40 (100)
	Yes	1 (1.5)	0 (0)
	Total	67 (100)	40 (100)
Syndactyl (fingers)	No	65 (97)	40 (100)
	Yes	2 (3)	0 (0)
	Total	67 (100)	40 (100)
Polydactyly (fingers and toes)	No	67 (100)	40 (100)
Rudimentry toe(s)	No	67 (100)	40 (100)
Rudimentary finger(s)	No	66 (98.5)	40 (100)
	Yes	1 (1.5)	0 (0)
	Total	67 (100)	40 (100)

Table 6: Other musculoskeletal abnormalities associated with clubfoot in the sample Population

Discussion

This is a prospective observational study aimed at investigating the demographic patterns of congenital talipes equinovarus (CTEV) deformity, more commonly known as congenital clubfoot deformity, as seen at a Nigerian regional hospital. Notably, CTEV is reportedly the commonest congenital musculoskeletal deformity in Nigeria,[8, 9, 11, 12] and a leading cause of disability world over,[27] with over 80% of cases believed to be domiciled in developing countries, where clubfoot is adjudged a major disease burden in low-resource settings.[5, 7, 13, 27-29] In the course of this study, the overall burden of CTEV relative to other paediatric disorders in the study centre was estimated at 3.04%. If left untreated, CTEV can become a severe disability and deformity that remains with the child into adulthood.[30, 31] The basic pathological anatomy of clubfoot, as manifested at birth, shows that the foot is turned downwards and rotated internally at the ankle, in varying degrees of severity. There is a twisting of the foot out of shape on account of a co-existing shortening of the Achilles tendon as well as other contiguous soft tissue compromise, giving rise to a club-shaped foot. Such a deformed foot is incapable of normal functions, including weight-bearing, ambulation and wearing of normal shoes.[6, 12,]

The overall prevalence of CTEV varies across geographic regions. Large series from the United States, Europe and elsewhere around the world gave a global prevalence of 1 - 2/1000 live births,[7, 32-36] but the pooled estimate for clubfoot birth prevalence for Africa according to Smythe *et al.,*[20] was given as 0.96. The aim of this study was to investigate the demographic patterns of congenital talipes equinovarus at the study centre.

Various reports[7, 11, 12, 15, 20, 32, 34, 35, 37-40] show that clubfoot deformities are commoner in the males than in females with a ratio varying from 1: 1.6 to 2: 1. This present study is also in agreement with the aforementioned data, with a slight male preponderance over the females in a ratio of 1.6: 1. It is not clear why there is this sort of consistent discrepancy in the gender distribution pattern of clubfoot. According to Kruse *et al.,*[38] it is due to inherent difference, occasioned by genetic factors, in the susceptibility to the deformity. In order to inherit clubfoot, it is propounded that females ought to have a greater number of susceptibility genes than males. Females are thought to be more likely to transmit the disease to their children and more likely to have siblings with clubfoot. This phenomenon is known as the Carter effect, and the presence of such an effect supports a multifactorial threshold model of inheritance.[38] In a study performed at Washington University School of Medicine and

Shriners Hospital for Children, St. Louis, Missouri, involving 97 multiplex families with more than one individual with idiopathic clubfoot, Kruse *et al.*,[38] calculated the rates of transmission by the affected fathers and affected mothers, and the prevalence among siblings was determined in the nuclear families of affected persons. They found that the prevalence of clubfoot was lowest in daughters of affected fathers and highest in sons of affected mothers. The affected mothers transmitted clubfoot to 59% of their children, whereas affected fathers transmitted idiopathic clubfoot to 37% of their children, and this occurrence was found statistically significant[38] at $p = 0.04$. They also found that siblings of an affected female had a significantly higher prevalence of clubfoot than those of an affected male. This phenomenon whereby the offspring of an affected female has a higher chance of suffering from clubfoot than that of an affected male is known as the Carter effect. This effect, which has also been demonstrated in congenital pyloric stenosis, is thought to be due to a polygenic inheritance, whereby females require a greater genetic load to be affected by the disease.[38, 41] In this present study, however, none of the parents of the children with clubfoot was found to have the disease. It may well be that our comparatively smaller sample size, coupled with the duration of this study did not allow such an observation to be registered.

The average age of the children encountered in this study was 31.6 ± 23.64 months. This is very different from the findings by some authors in different locations in Nigeria.[11, 12] About 17 (25.4%) children in this study were within the age of one year, while 37 (55.3%) of these children were brought for treatment in the second and third years of life (13 - 36months). The sample populations studied by Mejabi *et al.*,[11] and Ugorji *et al.*,[12] were much younger than the sample population of this study. This is probably because clubfoot clinic service is relatively young in the study centre. The initial clubfoot patients seen in the study centre comprised neglected and abandoned cases living with the deformity within the various communities across the State. These cases came to the study centre following community awareness and sensitization programmes by the clubfoot team of the hospital. To the best of our knowledge, this work is the first scientific documentation of clubfoot within the locality of this study, following an organized treatment programme for the disease in the State. Therefore, it is not surprising that the initial cases managed under the programme comprised a lot of older children, who hitherto lived with the disease in the communities. It is expected that, by the time the older children population with clubfoot is mopped up by the on-going treatment programme, a younger children population in their infancy and neonatal period will become more prevalent, as is the situation elsewhere,[11, 12] where there are much older clubfoot treatment programmes than what obtains in the present study centre. The activities of unorthodox practitioners such as traditional bone setters (TBS) may have contributed in diverting the attention of some parents of the children in this study from seeking proper care of the clubfoot at early stages. Asuquo *et al.*,[42] have reported cases as old as nine years at first presentation to the hospital.

The highest prevalence (46.3%) of clubfoot in this study was seen among firstborn children, while the prevalence in subsequent births was lower, dropping to 5 (7.5%) in the fourth births and above (Table 1). The relationship between birth order and clubfoot in this study was statistically significant at $p < 0.001$. From point of view of both descriptive and inferential statistics of this data, it was observed that as the birth order increased, the rate of clubfoot decreased. This finding is corroborated by similar findings by some other authorities,[20, 30, 40, 42, 43] who have also documented that clubfoot is commoner among firstborn children. The association between birth order and occurrence of clubfoot is difficult to explain. Werler *et al.*,[43] have postulated the impact of medication use in pregnancy in relation to the risk of isolated clubfoot in offspring. In their study, they found that the use of certain specific medications in early pregnancy can increase the risk of clubfoot. Such medications include opioids, antiviral drugs, diphenhydramine, non-steroidal anti-inflammatory drugs, antimicrobials, antiemetic drugs and fertility drugs. For instance, it is thought that non-steroidal anti-inflammatory drugs may be vasoactive in the developing foetus due to prostaglandin inhibition, and this may provide some evidence in support of vascular disruption pathogenesis.[43] Some of these drugs listed here are often available over the counter, and are commonly taken as treatment for the constitutional symptoms of early pregnancy. These constitutional symptomatic upsets occur as part of early morning sickness of pregnancy, which is often accentuated in some primigravid women. Access to these drugs either through formal prescriptions or by self-medication practices can be adduced as additional factor to strengthen the opinion by Werler *et al*.[43] Since the possibility of taking these drugs is higher with the primigravid women, the result may be an increase in the clubfoot risk of the firstborn children.

There is evidence in literature that involvement by clubfoot is bilateral in about 30 - 50% or more of cases and patients with bilateral clubfoot are said to have a wider range of severity. In unilateral cases, the right side has been reported to be more commonly affected than the left.[11, 12, 15, 17, 27, 44, 45] This assertion finds corroboration in this study, where 45 (67.2%) of cases was bilateral. However, in the unilateral cases seen in this study, the right and left feet were equally affected (Table 4.4), and this is in disagreement with findings elsewhere,[12, 17, 27] but in agreement with the findings by some other authors.[11, 46] Although the rate of bilateral clubfoot, as already noted, has been quoted as 30 - 50% of cases, some authors[12, 47] have reported much higher rates to the tune of 75% for bilateral clubfoot. Although all the aforementioned authors[11, 12, 15, 17, 27, 45, 47] found higher rates of bilateral clubfoot in their studies, some authorities have, on the other hand, reported preponderance of unilateral clubfoot over bilateral.[9, 48, 49] Clubfoot generally impairs the normal ambulatory skills and speed of affected persons, compared with persons having normally developed feet. Persons with unilateral and bilateral clubfoot walk differently, but unilateral clubfoot presents more imbalances in gait biomechanical parameters compared with bilateral clubfoot.[45]

The majority of cases of clubfoot have been reported to occur in isolation and are referred to as idiopathic, meaning that the aetiology of such cases is not fully understood. In the idiopathic variant, clubfoot is the only congenital defect. This may further be sub-classified into familial and non-familial.[20, 32, 43, 50, 51] In some reports,[12, 31, 32, 51] the rate of idiopathic clubfoot has been reported in the range of 80 - 92%. Idiopathic clubfoot constituted 47 (70.1%) of the cases seen in this study, and this is in agreement with already existing evidence. Syndromic clubfoot was the second commonest variant of congenital clubfoot seen in this study, accounting for 12 (17.9%) cases (Table 4). Although the exact aetiological factors in idiopathic clubfoot are not known, several theories have been proposed, including uterine restriction in early pregnancy, disorders of endochondral ossification, connective tissue disorders and vascular disruption.[32, 52] The theory of uterine restriction by pressure was propounded by Hippocrates, and this theory assumes that clubfoot might be caused by an increased intrauterine pressure during pregnancy.[7, 53] However, this theory was disputed because of absence of association of clubfoot with most cases of overcrowded uterus such as cases of twins, large babies or polyhydramnios.[7, 54] Other factors that have been implicated include genetic factors, developmental arrest, male gender, maternal smoking, certain medications, maternal diabetes, maternal age, maternal parity and education level.

A multifactorial aetiologic model that involves both environmental and genetic factors has also been proposed, but the underlying pathogenesis for these factors remains a matter of scientific debate.[20, 33, 43, 55 - 62] Although 70.1% of cases in this study were idiopathic clubfoot, there was no record of such risk factors as maternal smoking, radiation exposure or maternal diabetes among the cohort. It is difficult to ascertain drug history in the study because self-medication and over the counter (OTC) purchase of medications are very common. Many people in this environment practice self-medication as a first line response to ill health, and this would most likely include women in early pregnancy. Such women may self-indulge in over the counter drugs in response to undiagnosed illnesses, which often are difficult to differentiate from symptoms of early pregnancy. So, it is probable that this practice, although anecdotal in evidence, may be at the root of aetiogenesis of congenital clubfoot in our environment. There is significant evidence to associate random use of medications in pregnancy to the risk of isolated clubfoot in offspring.[43] Also, there is strong evidence for a genetic basis for isolated or idiopathic clubfoot. According to some authors,[31, 63] approximately 25% of all isolated cases report a family history of clubfoot. However, there was no family history of clubfoot in the cohort reviewed by this study

Syndromic clubfoot was the second most common variant in this study, at the rate of 17.9%. In the literature, syndromic clubfoot is said to account for the remaining 20% (after the estimated 80% from idiopathic clubfoot) of cases of congenital clubfoot, and are due to associated malformations, chromosomal abnormalities and known genetic syndromes, such as distal arthrogryposis and myleomeningocele.[31, 64] In this study, the commonest cause of syndromic clubfoot was arthrogryposis multiplex congenita (AMC), followed by tibia hemimelia. This study sought to make a subtle distinction between syndromic clubfoot in 12 (17.9%) of the sample population, and clubfoot associated with other musculoskeletal congenital malformations in another small sample population of 11 (16.4%) cases (Table 6). These other associated musculoskeletal malformations include overlapping or overriding toe digits, big big toe, syndactyly, polydactyly and rudimentary digits. Big big toe accounted for 6 (9.0%) of the associated anomalies. These other associated malformations do not provide the background of difficulty in the management of clubfoot as would be the case with defined syndromic clubfoot, occasioned by such intercurrent malformations as arthrogryposis multiplex congenita (AMC) or tibia hemimelia. So, the clubfoot associated with AMC is more difficult to manage than that associated with rudimentary digits.[64] This study, therefore, sought to make a distinction between these two categories of musculoskeletal malformations associated with clubfoot in order to draw attention to their differing pathological anatomy.

This study considered the descriptive statistics of some characteristics of the parents of the children recruited into the sample population (Table 2). The average age of the mothers and fathers at the conception of the children with clubfoot deformities was 25.58 ± 6.17 years and 32.34 ± 6.712 years, respectively. The average monthly income in Nigerian naira (NGN) assessed in 36 mothers and 53 fathers were 18055.56 ± 20387.59 and 36377.36 ± 42629.09 naira, respectively. This is approximately equivalent to forty three United States dollars (USD 43) and eighty eight United States dollars (USD 88), respectively, as at the time of the study, according to Investopedia.[24] The result of the association between patients' age in months and the parents' demographic characteristics (Table 3) according to Pearson correlation coefficient (R) showed no statistically significant negative or inverse correlations with parents' age at conception and fathers' income. This statistical relationship suggests that the low level of fathers' income did not sufficiently explain the delayed or late presentation of the subjects to hospital for treatment. Notwithstanding, it remains a fact that ours is a poor and low income environment, where the average total family income, as projected from this study, is one hundred and thirty one United States dollars (USD 131). It has already been established that clubfoot is commoner in low income countries, and that 80% of cases are believed to be domiciled in developing countries, where clubfoot is adjudged a major disease burden in poor and low-resource settings.[5, 7, 13, 27 - 29]

The pathological anatomy of clubfoot has been described in literature, detailing the fundamental parts of the deformity, based on clinical examination of the involved foot.[1, 13, 65 - 67] The hind-foot is held in a firm position of equinus, with a tight Achilles tendon (tight heel cord), and this was documented in 64 (95.5%) of cases in the present study. The gastrosoleus muscles show varying degrees of retraction and atrophy, leading to spindle shaped legs, which was documented in 14 (20.9%) of cases in the study. The calcaneus is

inverted in varus position, and the forefoot is held in adduction and supination, producing a cavus deformity on the medial surface of the foot as well as a medial and a posterior skin crease. Abnormal kinematics is apparent upon palpation of the deformed foot. There is limited subtalar motion because of severe shortening of the medial and posterior tarsal ligaments and the tightness of the tibialis posterior and gastrosoleus muscles. The head of the talus is unduly prominent and easily palpated, being uncovered by the navicular, which is medially positioned, close to the medial malleolus.[13, 65] These different patho-anatomic changes of clubfoot were demonstrated in varying degrees among the sample population in this study (Table 5). The biological aberration in the clubfoot suggests an excessive pull of the tibialis posterior, aided by the gastrosoleus and the long toe flexors. The ligaments of the posteromedial aspects of the ankle and foot are very thick and taut. There is evidence that excessive collagen synthesis occurs in the ligaments, tendons and muscles around the foot and ankle, and this may persist until the child is three or four years, and is thought to be the reason for relapses in the affected children.[1, 67]

Conclusion

This study showed that late presentation of clubfoot for treatment was common. The risk of clubfoot was higher among firstborn children, but parental age at conception did not affect the risk of clubfoot in the child. Bilateral clubfoot was commoner than unilateral and idiopathic clubfoot was more prevalent.

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