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RESEARCH ARTICLE

CHARACTERISTICS OF CHILDREN WITH HEART DISEASE AGED 0-12 YEARS IN KENYATTA NATIONAL HOSPITAL PAEDIATRIC WARDS, KENYA.

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Abstract

Background: Heart disease is a debilitating condition contributing to high morbidity and mortality rates as well as high disease burden among children. The aim of this study was to establish the characteristics of children with heart disease aged 0-12 years in Kenyatta National Hospital (KNH).
Methods: A descriptive cross-sectional study was conducted among 92 children with heart disease admitted in paediatric wards of KNH, Kenya. **Results:** Of the 92 children (54.3%) were infants and (52.2%) were males. Mean age was 2.4(±3.4) years. The mean age at diagnosis for congenital heart disease and acquired heart disease was 23 months and 6.09 years respectively. Most (79.3%) children had congenital heart defects; Ventricular septal defect (22.8%) being the most prevalent. Rheumatic heart disease and dilated cardiomyopathies were the most common (5.4%) acquired conditions. Forty nine (53.3%) children had heart failure.Characteristics with statistical significance were; slow weight gain [P=0.008], cyanosis [P=0.032], use of accessory muscles of respiration [P=0.007] and heart murmur [P=0.001] for children with congenital heart defects while weight loss [p≤ 0.001], dyspnoea [p≤ 0.001], abnormal pulsations [P=0.001], cardiac failure [p≤ 0.001], weakness/fatigue [p≤ 0.001] and polyarthritis [p≤ 0.001] were significant for children with acquired heart disease **Conclusion:** Congenital heart defects are the most common heart conditions in KNH commonly affecting infants and male children. There was a likely delayed diagnosis of congenital heart disease as about half the children presented already in heart failure on admission.

Introduction:-

Heart diseases are an important cause of an increased mortality and morbidity rates in children (Mohammad et al, 2014). The epidemiological patterns of heart disease differ greatly between developed nations and developing countries. Approximately 50 million children annually in Africa have heart disease; as many as 500 000 have CHD with an additional number of adolescents who survived in their earlier years of life (UNICEF, 2009). In Sub Saharan Africa rheumatic heart disease (RHD) still remains a serious health issue while children with congenital heart disease (CHD) present with poor health outcomes. Africa has the highest prevalence of heart diseases among young

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children, resulting from congenital heart diseases and rheumatic heart disease (Marijon, Maribel &Celermajer, 2012).

Children with heart disease present to the hospital for care with a variety of symptoms and different degrees of illness. Many children with congenital defects are asymptomatic and are normally identified in a routine physical examination. They may present with a history of tiredness during exercise, getting fatigued easily and recurrent respiratory infections (Kliegman et al, 2016). Presence of symptoms of heart murmur, cyanosis is an important reason for referral of children to paediatric cardiologists for diagnosis of CHD, as they indicate high possibility of a heart disease (Rivera et al, 2007). Delayed development is seen in children with congenital heart disease, with a different presentation between the children who have had surgical repair for the defects and those awaiting surgery (Mari, Cascudo, Alchieri, 2016).

An important factor in reducing childhood heart disease complications and mortality is early detection and prompt treatment by the local health professions (Mohammad et al, 2014). Despite previous research on heart diseases in children, complications resulting from the conditions in Kenya remain high. This necessitated the study to establish the characteristics of the children with heart disease in Kenyatta National Hospital. The information will contribute to a better understanding of the nature and characteristics of these children in our setting. The findings are hoped to be used by the health professionals in the lower level hospitals in Kenya who are generally the first contacts with sick children. Consequently, influence the screening of children especially those with clinical signs of a possible heart disease so that they can be promptly referred to a cardiologist for further evaluation and appropriate treatment initiated.

Objectives:-

The present study intended to establish the characteristics of children aged 0-12 years with heart disease in Kenyatta National Hospital, Kenya with an emphasis on the relationship between the type of heart disease and the clinical characteristics.

Methods:-

Study design

A descriptive cross sectional study was carried out within paediatric wards at Kenyatta National Hospital, Nairobi, Kenya. Kenyatta National Hospital is a 2000 bed capacity Tertiary Referral Hospital located in Nairobi, the country's capital city. It offers both preventative and curative services for a variety of illnesses to patients from all over Kenya. It is the primary teaching Hospital of the University of Nairobi, Kenya.

Sample size

The study participants consisted of children aged 0-12 years admitted with heart disease and their parents who gave consent. A sample size of 92 participants was selected from the total 120 children admitted with heart disease during the study period of four months. The sample size was calculated using the formula of Fishers et al. (1998):
$n=Z^2_{\alpha/2} P (1 - P)/d^2 = (1.96)^2 (0.5) (0.5)/ (0.05)^2 = 385$

Where Z = standard normal distribution curve value for 95 % CI which is 1.96
P = proportion of heart disease during admission was taken as 50%
d = absolute precision (0.05)

However, sample size adjustment was made since the target population was <10,000 using the following formula: $nf = n/ (1+n/N) = 385/ (1+385/120) =92$

Where: nf = the desired sample size for population <10,000; N = Total population (number of children admitted to K.N.H paediatric wards per month with heart disease is about 30); n= the calculated sample size (92).

Therefore, the minimum sample size of the study was 92 participants.

Sampling technique

A total of 92 participants were included into the study. The inclusion criteria involved children aged 0-12 years with a confirmed diagnosis of heart disease admitted at K.N.H. paediatrics medical wards whose parents consented to

participate in the study. Children without confirmed diagnosis of heart disease, children whose parents declined to give a written consent and children aged above 12 years were excluded from the study.

Systematic sampling method was used in which every alternative participant was selected for inclusion into the study. The first study participant was selected by simple random sampling among children aged between 0-12 years presenting with a diagnosis of heart disease and their parents who accompanied them. The parents were allowed to pick a folded numbered paper from a basket. The participant who picked the paper numbered 001 was the first respondent. Thereafter every alternate child whose parent gave consent was included in the study sample.

Data collection

Data collection was conducted over a period of four months between March and June 2017.A pretested semi structured questionnaire was used to collect information on the child's socio demographic characteristics and clinical presentations. Review of the patients file was done to collect more information on the child's diagnosis and their clinical presentations at the time of admission.

Data analysis

Data collected was entered into a Microsoft excel spread sheet and analysed using Statistical Package for Social Sciences (SPSS) version 20.0(IBM Corporation, Armonk, NY, USA). Pearson's chi-square test was used to establish the association between the clinical characteristics and the type of heart disease. Binary logistic regression analysis was performed to determine the relationship between the child's clinical characteristics and type of heart disease at a significant level of $P \leq 0.05$.

Ethical Considerations

Study approval was sought from the Kenyatta National Hospital/ University of Nairobi Ethics and Research committee (KNH/UON-ERC).Written informed consent was sought from all study participants after they were given participant information and before they were interviewed. Participation was purely on voluntary basis. Privacy and confidentiality were maintained while handling participants' information.

Results:-

Socio demographic characteristics of the children

Table 1 shows the description of children by socio-demographic characteristics. Their age ranged from < 1month to 12 years, with a mean age of 2.4 years. Most children (54.3%) were infants. The mean age at diagnosis was 2.1 years, with the highest (30.4 %) percentage of children diagnosed with heart disease at the age of between 1 to 6 months. There were more males 52.2% than females.

Table 1:-Socio demographic characteristics of the children

Characteristics	**Frequency (n=92)**	**Percent (%)**
Age		
< 1 year	50	54.3
1 to 2 years	22	23.9
3 to 5 years	5	5.4
6 to 12 years	15	16.3
Mean age (±Std deviation) = 2.4(±3.4)		
Age at diagnosis of heart disease		
< 1 month	9	9.8
1 to 6 months	28	30.4
7 to 11 months	16	17.4
1 to 2 years	20	21.7
3 to 5 years	4	4.3
> 5 years	15	16.3
Mean age (±Std deviation) = 2.1(±3.1)		
Gender		
Male	48	52.2
Female	44	47.8

Type of heart diseases

Out of the 92 children with heart disease, majority (79.3%) had congenital heart disease while 20.7% had acquired heart disease. Ventricular septal defect (VSD) was the most common (22.8%) congenital heart defect (Table 2).

Table 2:-Type of heart diseases

Heart diseases		**Frequency (N=92)**	**Percent (%)**
Type of heart disease			
Congenital		73	79.3
Acquired		19	20.7
Types of congenital defects			
VSD		21	22.8
PDA		14	15.2
TOF		6	6.5
Other congenital defects (Combination)		32	34.8
Acquired heart conditions			
RHD		5	5.4
Dilated Cardiomyopathy		5	5.4
Other acquired conditions		9	9.8

Relationship between the children socio-demographic characteristics and type of heart disease

Age at diagnosis had a significant relationship with type of heart disease. Children aged more than 5 years at diagnosis were significantly more (63.2%) diagnosed with acquired heart disease compared to those with congenital heart disease (4.1%)*($p \leq 0.001$)*.Among children less than one month old none had acquired heart disease. The highest (37.0%) numbers of children were diagnosed to have a congenital heart disease at the age of 1 to 6 months *($p \leq 0.001$)* (Table 3).

Table 3: Relationship between the children socio-demographic characteristics and type of heart disease

Characteristics	**Acquired (N=19)**		**Congenital, (N=73)**		**Chi square value**	**df**	**P value ***
	n	**%**	**n**	**%**			
Age							
< 1 year	3	15.8%	47	64.4 %	39.35	2	≤ **0.001**
1 to 5 years	4	21.1%	23	31.5 %			
6 to 12 years	12	63.2%	3	4.1%			
Age at diagnosis of heart disease							
< 1 month	0	0.0%	9	12.3 %	40.65	5	≤ **0.001**
1 to 6 months	1	5.3%	27	37.0 %			
7 to 11 months	2	10.5%	14	19.2 %			
1 to 2 years	3	15.8%	17	23.3 %			
3 to 5 years	1	5.3%	3	4.1%			
> 5 years	12	63.2%	3	4.1%			
Gender							
Male	12	63.2%	36	49.3 %	1.16	1	0.282
Female	7	36.8%	37	50.7 %			

* Significant at p≤ 0.05 bolded; df = degree of freedom

Comparison of mean age at diagnosis and type of heart disease

The mean age at diagnosis was significantly more among those with acquired heart disease (6.09 years) compared to those with congenital heart disease (1.11 years) (P ≤ 0.001) (Table 4).

Table 4:-Comparison of mean age at diagnosis and type of heart disease

Heart disease	Mean	Std deviation	Mean Difference	95% Confidence Interval of the Difference		t test, p value
				Lower	Upper	
Congenital, (N=73)	1.11	1.85	-4.98	-6.21	-3.75	**P ≤ 0.001**
Acquired, (N=19)	6.09	3.92	-4.98	-6.91	-3.05	
Overall (92)	2.13	3.14				

Nutritional status of the children stratified by type of heart disease

Slow weight gain was significantly more common (49.3%) among children diagnosed with congenital heart disease than those with acquired heart disease (15.8%) *(p=0.008).*However, children with acquired heart disease significantly presented with weight loss (57.9%) compared to those who had congenital heart disease (16.4%) *(P ≤ 0.001)* (Table 5)

Table 5:-Nutritional status of the children stratified by type of heart disease

Characteristics	Acquired, (N=19)		Congenital, (N=73)		Chi square	Df	p value*
	n	%	n	%			
Gaining weight adequately							
Yes	1	5.3%	12	16.4%	1.55	1	0.213
No	18	94.7%	61	83.6%			
Stagnant weight (not gained weight)							
Yes	4	21.1%	12	16.4%	0.22	1	0.636
No	15	78.9%	61	83.6%			
Slow weight gain							
Yes	3	15.8%	36	49.3%	6.94	1	**0.008**
No	16	84.2%	37	50.7%			
Has lost weight							
Yes	11	57.9%	12	16.4%	13.82	1	**≤ 0.001**
No	8	42.1%	61	83.6%			
Has rickets/malnutrition							
Yes	11	57.9%	44	60.3%	0.03	1	0.851
No	8	42.1%	29	39.7%			
* Significant at p≤ 0.05 bolded; df = degree of freedom							

Relationship between the clinical presentations consistent with chest and respiratory problems and the type heart disease

Children with acquired heart disease significantly presented with dyspnea (73.7%) compared to children with congenital heart defects (27.4%) *(p≤ 0.001).*However, cyanosis was significantly more (28.8%) among children with congenital heart disease *(p=0.032).*Use of accessory muscles of respiration was higher (89.0%) among children with congenital heart disease compared to those with acquired heart disease (63.2%) *(p=0.007).* Though 16.4% children had pigeon chest there was no significant association between chest deformities and type of heart disease (Table 6).

Table 6:-Relationship between the clinical presentations consistent with chest and respiratory problems and the type heart disease

Characteristics	Acquired, (N=19)		Congenital, (N=73)		Chi square	df	p value*
	n	%	n	%			
Presence of pigeon chest							
Yes	3	15.8%	12	16.4%	0.01	1	0.946
No	16	84.2%	61	83.6%			
Tachypnea							
Yes	19	100.0%	71	97.3%	0.53	1	0.466
No	0	0.0%	2	2.7%			
Dyspnea							
Yes	14	73.7%	20	27.4%	13.86	1	**≤ 0.001**
No	5	26.3%	53	72.6%			
Cyanosis							
Yes	1	5.3%	21	28.8%	4.58	1	**0.032**
No	18	94.7%	52	71.2%			
Use of respiratory accessory muscles							
Yes	12	63.2%	65	89.0%	7.40	1	**0.007**
No	7	36.8%	8	11.0%			
* Significant at p ≤ 0.05 bolded; df = degree of freedom							

Cardiovascular clinical presentation stratified by the type heart disease

There was significantly an increased (57.9%) proportion of abnormal pulsations among children with acquired heart disease compared to those with congenital heart diseases (20.5%) *(p= 0.001).* However, heart murmur was significantly more common (91.8%) among children with congenital heart disease *(p=0.001).*Thrills 42.1% *(p= 0.016),* facial edema 89.5% *(p≤ 0.001)* generalized edema 47.4% *(p≤ 0.001)* and cardiac failure 89.5% *(p≤ 0.001)* were significantly higher among children diagnosed with acquired heart disease than in children with congenital heart diseases(16.4%), (35.6%), (6.8%) and (43.8%) respectively (Table 7).

Table 7:-Cardiovascular clinical presentation stratified by the type heart disease

Characteristics	Acquired, (N=19)		Congenital, (N=73)		Chi square value	df	p value*
	n	%	n	%			
Abnormal pulsations							
Yes	11	57.9%	15	20.5%	10.37	1	**0.001**
No	8	42.1%	58	79.5%			
Tachycardia							
Yes	17	89.5%	63	86.3%	0.13	1	0.715
No	2	10.5%	10	13.7%			
Heart murmur							
Yes	11	57.9%	67	91.8%	13.42	1	**0.001**
No	8	42.1%	6	8.2%			
Thrills							
Yes	8	42.1%	12	16.4%	5.84	1	**0.016**
No	11	57.9%	61	83.6%			
Pallor							
Yes	8	42.1%	26	35.6%	0.27	1	0.602
No	11	57.9%	47	64.4%			
Facial edema							
Yes	17	89.5%	26	35.6%	17.57	1	**≤ 0.001**
No	2	10.5%	47	64.4%			
Generalized edema							
Yes	9	47.4%	5	6.8%	19.19	1	**≤ 0.001**
No	10	52.6%	68	93.2%			
Cardiac failure							

Yes	17	89.5%	32	43.8%	12.61	1	**≤ 0.001**
No	2	10.5%	41	56.2%			
* Significant at p ≤ 0.05 bolded; df = degree of freedom							

Intestinal and musculoskeletal clinical presentation stratified by the type heart disease

Although the proportion of hepatomegally was higher among children with acquired heart disease(68.4%) than in children with congenital heart disease (46.6%), it was not significant *(p = 0.090).* There was a strong significant association between being fatigue and type of heart disease where fatigue was significantly more (84.2%) in children with acquired heart disease compared to those children with congenital heart disease (34.2%) *(p≤0.001).* Similarly, children with acquired heart disease had significantly increased (26.3%) proportion of polyarthritis *(p≤ 0.001)* (Table 8).

Table 8:-Intestinal and musculoskeletal clinical presentation stratified by the type heart disease

Characteristics	**Acquired, (N=19)**		**Congenital, (N=73)**		**Chi square value**	**df**	**p value***
	n	**%**	**n**	**%**			
Hepatomegaly							
Yes	13	68.4%	34	46.6%	2.88	1	0.090
No	6	31.6%	39	53.4%			
Spleenomegaly							
Yes	2	10.5%	3	4.1%	1.21	1	0.272
No	17	89.5%	70	95.9%			
Ascites							
Yes	2	10.5%	6	8.2%	0.10	1	0.751
No	17	89.5%	67	91.8%			
Fatigue/weakness							
Yes	16	84.2%	25	34.2%	15.23	1	**≤0.001**
No	3	15.8%	48	65.8%			
Polyarthritis							
Yes	5	26.3%	0	0.0%	20.32	1	**≤0.001**
No	14	73.7%	73	100.0%			
* Significant at p ≤ 0.05 bolded; df = degree of freedom							

Discussion:-

Findings from this study show that majority (79.3%) of the children had congenital heart disease; VSD being the most common type of congenital heart lesion. This is comparable to other epidemiological studies in Kenya and Pakistan where VSD was the most diagnosed CHD among children (Mohammad et al, 2014, Awori &Ogengo, 2013).

In the current study, the age of the children ranged between < 1month to 12 years with a mean age of 2.4 years . Majority (54.3%) were aged less than one year. This was as expected since children with congenital heart defects show symptoms in their first year of life (Massin&Dessy, 2006). Age at confirmation of diagnosis of a congenital defect is an important determinant of the child's clinical characteristics and the overall health status. In this study the mean age at diagnosis of a heart disease was 2.1 years. However, the mean age at diagnosis for congenital heart disease was 23 months. According to paediatric cardiology standards, children with cyanotic heart disease who are diagnosed following discharge from hospital after birth or those with acyanotic heart disease diagnosed at the age when they should have already undergone corrective surgery or children whose hemodynamic state is deranged and requires immediate treatment are termed to have delayed diagnosis (Rashid et al,2016). The findings from the current study show that there was a likely delayed diagnosis in children with congenital heart defects as about thirty two (43.8%) children presented already in heart failure on admission to hospital. Similarly, the diagnosis of CHD was made at an older median age of 24 months in Pakistan (Ammouri&Ayoub, 2016). It is evidenced that 40-50% of the newborns, the diagnosis is made by the first week while in 50-60% by one month (Massin&Dessy, 2006). This situation of late diagnosis is seen in most developing countries and it could be attributed to lack of diagnostic equipments and skilled personnel especially paediatric cardiologists at the lower level health facilities in Kenya.

Although the presence of malnutrition was not statistically significant in this study majority of the children had some form of malnutrition, in 60.3% and 57.9 % children diagnosed with congenital and acquired heart conditions respectively. However,children diagnosed with congenital heart disease had slow weight gain while as weight loss was common among children with acquired heart disease. This is similar with a Syrian study where majority of the children diagnosed with heart disease presented with failure to thrive (Ammouri and Aqoub, 2016).

Similar to other studies this study demonstrated a considerable number of children presented with respiratory problems. A study conducted in Pakistan reported that 80% of the children with heart disease presented with respiratory distress, cough and recurrent chest infection (Mohammad et al, 2014). More often, symptoms of respiratory problems in children can be indicator of an underlying cardiac disease. It results from pulmonary congestion due to left to right shunt which predisposes the child to frequent chest infections (Kliegman et al, 2016). Children with a cyanotic congenital heart defects that cause increased pulmonary blood flow are frequently misdiagnosed and are managed for pneumonia until the diagnosis of CHD is established (Ammouri&Ayoub, 2016). This calls for more thorough examination among the children who present to hospital with repeated chest infections.

In the present study pigeon chest was the most common chest deformity accounting to 16.4% of children with CHD. Presence of a chest deformity can result from a long standing respiratory compromise in children with cardiac disease. Pigeon chest has been associated to congenital cardiac anomalies and it results from an abnormal chest cartilage growth (Sultan & Yang, 2014). The proportion of the children with this deformity in this study could be explained by the fact that most children with CHD were relatively diagnosed at a mean age of 23 months.

This study revealed an alarming prevalence of heart failure (53.3%) among the children at the time of admission. There was heart failure in 34.8% and 18.5% children who were diagnosed with congenital and acquired heart conditions respectively. It is evidenced that children who have a delayed diagnosis of cardiac disease most often end up getting heart failure (Massin& Dessy,2006).This may be attributed to either the children were not diagnosed or treated early enough for cardiac condition before complications set in. This figure indicates that there is need to explore ways of mitigating the factors contributing to heart failure among the children. Furthermore, bivariate analyses showed that cardiac failure was significantly more $(P \leq 0.001)$ among children diagnosed with acquired heart disease as compared to those who had congenital defects. Previous studies have reported congenital heart defects and acquired heart diseases among the main causes of heart failure among children (Ogengo et al, 2013).

In this study, it was further observed that (51.1%) of the children had an enlarged liver although it was not significant. However, hepatomegally was most common among the children diagnosed with acquired heart disease. This presentation of hepatomegally may be explained by the findings that majority of the children were admitted when they were already in heart failure. In children with cardiac disease, hepatomegally due to systemic congestion can be an indicator of heart failure (Kliegman et al, 2016).

Regarding musculoskeletal presentations, 44.6% children presented with weakness/fatigue. Fatigue was significantly higher in children diagnosed with acquired heart disease $(P \leq 0.001)$.Evidence has shown that children in heart failure may present with a history getting fatigued easily especially during exercise or feeding (Kliegman et al,2016). Weakness and or fatigue can only be elicited in active children who will mostly take a rest during an activity. This is supported by the fact that in this study cardiac failure was significantly high among the children with acquired heart disease who were mostly above 5 years of age. Polyarthritis $(P \leq 0.001)$ was significantly higher in children diagnosed with acquired heart disease. This could be attributed to the study findings that the most common acquired heart disease was RHD as polyarthritis can be a presentation in children with rheumatic disease. Most children with RHD present with features involving several organs to include the skin and the joints (Massin & Dessy , 2006).

Conclusion:-

Congenital heart disease was the most common heart condition among the children admitted at Kenyatta National Hospital. There was a likely delayed diagnosis for children with congenital heart disease as almost a half presented already in heart failure on admission. This necessitates the need for adequate screening of children presenting in Kenyan hospitals for care and treatment.This will improve early identification of children with a likely heart disease and enhance prompt medical/ surgical treatment.

Recommendations:-

The study recommends improvement of the health care system locally in order to achieve timely screening, diagnosis and corrective treatment of the children with heart defects before heart failure sets in. Thus, reduce long term complications and mortality resulting from the heart disease in children.

Abbreviations

CHD- congenital heart disease
KNH- Kenyatta National Hospital
RHD- rheumatic heart disease

Competing interests:-

The authors declare that they have no competing interests.

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