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Prevalence and Risk Factor of Cryptorchidism in Children between 0 - 5 Years in Two Hospitals in Kumba

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Abstract

Background: Cryptorchidism is a developmental defect in which a testis or both testes fail to descend from high in the abdomen to the bottom of the scrotum. It has a prevalence of 1.5%. The cause of cryptorchidism often can not be determined, making this a common but sporadic, idiopathic congenital defect. It is thought that genetics, combined with maternal and environmental factors, may disrupt hormones and physical changes that influence testicular development and descent; however, some factors, such as low birth weight and prematurity, have been reported as major risk factors. Cryptorchidism is one of the few known risk factors for testicular cancer; men with a history of cryptorchidism have a three- to four-fold increased risk of testicular cancer compared to those with no history of cryptorchidism. **Objective:** The aim of this study was to study the prevalence and risk factors of cryptorchidism in children between 0 - 5 years in 2 hospitals in Kumba. **Methods:** We conducted a hospital-based cross-sectional analytic study on children between 0 - 5 years coming for vaccinations at the Kumba Regional Hospital Annex and Presbyterian General Hospital Kumba, over a study period of 5 months. Scrotal examination was done on the children, and ANC and birth history were obtained from their mothers. Data analysis was done using SPSS version 26; categorical variables were described using numbers and percentages. Multivariate analysis using logistic regression was done to look for association between possible risk

factors and cryptorchidism, with a p-value < 0.05 considered statistically significant. **Results:** Our study included 112 children and their mothers, with mean maternal age of 27.93 (±6.12) years, and mean child age of 8.24 (±10.90) months. We discovered a prevalence of 9.8%. There was a significant association between self-employment and cryptorchidism, with an aOR of 10.689 (1.182; 96.657) and p-value of 0.035. **Conclusion:** From our study, we observed a high prevalence of cryptorchidism in this population and an association with self-employment.

Keywords

Cryptorchidism, Risk Factors, Prevalence

1. Introduction

Cryptorchidism or undescended testes (UDT) is a developmental defect in which a testis or both testes failed to descend from high in the abdomen to the bottom of the scrotum [1].

Described for the first time by John Hunter in 1786, cryptorchidism is a common congenital malformation of the male genital tract. It is characterized by the absence of one (unilateral cryptorchidism) or both (bilateral cryptorchidism) gonads in the scrotum [2]. Testicular descent is essential for normal spermatogenesis, which requires temperature lower than the body temperature.

Normally, the testes develop at 7 to 8 weeks of gestation and remain cephalad to the internal inguinal ring until about 28 weeks, when they begin their descent into the scrotum guided by condensed mesenchyme (the gubernaculum). Onset of descent is mediated by hormonal (androgens, Müllerian-inhibiting factor), physical (gubernacular regression, intra-abdominal pressure), and environmental (maternal exposure to estrogenic or antiandrogenic substances) factors [3].

The cause of cryptorchidism often cannot be determined, making this a common but sporadic, idiopathic congenital defect. It is thought that genetics, combined with maternal and environmental factors, may disrupt hormones and physical changes that influence testicular development and descent; however, some factors, such as low birth weight and prematurity, have been reported as major risk factors [4].

Cryptorchidism is more frequent in premature delivery with about 30% affected annually worldwide. An estimated 3% to 5% of full-term newborn babies are victims of cryptorchidism with predominance of the unilateral form [5]. A study carried out in Conakry over a 6-month period revealed a prevalence of 3.6% [6].

The main reasons for treatment of cryptorchidism include increased risks of progressive infertility, testicular malignancy, torsion, and/or associated inguinal hernia, and because of cosmetic concerns [7].

Cryptorchidism is one of the few known risk factors for testicular cancer; men with a history of cryptorchidism have a three to four-fold increased risk of testic-

ular cancer compared to those with no history of cryptorchidism. It is estimated that 5% - 9% of all men who develop testicular cancer have a history of persistent cryptorchidism.

Cryptorchidism is also a risk factor for sub-fertility: it is estimated that men with a history of cryptorchidism are twice as likely to be sub-fertile compared to those without cryptorchidism [8].

In Cameroon, studies on cryptorchidism are few. The aim of this study was to determine the prevalence and associated factors of cryptorchidism in Kumba, in the South West region of Cameroon, in order to improve awareness and prompt diagnosis.

2. Materials and Methods

2.1. Study Design and Settings

This study was a hospital-based cross-sectional study carried out in the Kumba Regional Hospital Annex, and the Presbyterian General Hospital, South West Region of Cameroon from 1st January 2023 to 31st May 2023.

The vaccination unit of KRHA comprises of a unit head and 7 nurses. Vaccination is done following the EPI calendar. It receives about 120 children/month for BCG, and about 60 children/month for the other vaccines. It receives children across the Kumba Health District. The vaccination days are from Mondays to Fridays, but mainly Tuesdays and Thursdays.

The vaccination unit of the PGH comprises of a unit head and 4 nurses, and a supervisor from the health district. It covers children mainly from the southern part of the health district. Vaccination is done following the EPI calendar. The vaccination days are Tuesdays and Fridays. It receives about 60 children/month for vaccination.

During the days for vaccination, we started by giving a talk on cryptorchidism, laying emphasis on its complications and also assisted the nurses in the vaccination process. The ANC unit was beside the vaccination center, hence pregnant women also benefited from the health talk.

2.2. Study Population

The study population was children aged 0 - 5 years coming for vaccination in the Kumba Regional Hospital Annex and the Presbyterian General Hospital.

2.3. Inclusion and Exclusion Criteria

2.3.1. Inclusion Criteria

- Male children between 0 - 5 years whose guardians gave consent.

2.3.2. Exclusion Criteria

- Children whose guardians had <70% knowledge of the ANC and Birth history of the child.

Sample size determination

The sample size was calculated using the Cochran's formula.

$$n = \frac{Z^2 p(1-P)}{e^2}$$

where:

n = Minimum sample size;

Z = The standard normal variate at 95% confidence interval (Z-value = 1.96);

e = Error margin (5% or 0.05);

P = Expected prevalence of estimated population.

(Prevalence of cryptorchidism in Conakry) (Diallo *et al.*, 2020) [6].

Calculation

$$n = \frac{(1.96)\text{^}2(0.0365)(1-0.0365)}{(0.05)\text{^}2} = 53$$

Using a prevalence of 3.65% from a previous study carried out in Conakry (Diallo *et al.*, 2020) [6], we had a minimum sample size of 53 participants. However, we enrolled 112 participants for this study.

2.4. Study Procedure

Ethical approval was obtained from the institutional review board of the School of Health and Medical Sciences of CATUC, Bamenda. Administrative authorization was obtained from the provost of the School of Health and Medical Sciences of CATUC-Bamenda, and from the Directors of Kumba Regional Hospital Annex, and Presbyterian General Hospital Kumba. Following these approvals, we went to the vaccination units of these hospitals for introduction and to begin data collection.

2.5. Data Collection and Procedure

After obtaining ethical clearance from the School of Health and Medical Sciences of CATUC, Bamenda and the Directors of the various hospitals, women and their children were invited to take part in our study when they came for vaccination.

The mothers were thoroughly informed on the study, its aims, procedure, possible inconveniences, and confidentiality. Those who met the inclusion criteria and agreed to participate were then required to sign a consent form before being subjecting their children to our examination.

A questionnaire was used to record all the data and the following were of interest:

1) Socio-demographic data of the mother: Age, occupation and level of education.

2) Lifestyle during pregnancy:

Smoking (cigarettes/day), alcohol (drinks/week), and caffeine (mg/day).

3) Clinical parameters of the mother:

Height, weight, and parity before index pregnancy.

4) Clinical parameters of the child:

Age, birth weight, Gestational age at delivery, type of pregnancy, number of testes in the scrotum, and location of the left and right testes.

2.6. Determination of Study Variables

2.6.1. Identification

The date of the enrolment into the study was noted. Questionnaires were coded with numbers and the participants provided telephone numbers.

2.6.2. Socio-Demographic Information

Information such as maternal age at delivery was taken from mother's ID card. Information such as occupation and level of education was gotten verbally.

2.6.3. Life Style during Pregnancy

Information such as smoking (number of cigarettes smoked/day), alcohol (number of bottles of beers/week), and caffeine (type of coffee and the quantity taken/day).

The number of smoking was converted to pack/year's using the formula: (number of sticks of cigarettes smoked per day ÷ 20) × (number of years of smoking).

The quantity of alcohol consumed was converted to units/week using the formula (vol of alcohol in mls) × (% of alcohol) ÷ 1000.

Caffeine was reported in mg/day, depending on the type of caffeine consumed. The one most commonly asked was Nescafe.

2.6.4. Clinical Parameters of the Mother

The weight and height were taken from the ANC records during the 3rd trimester.

The BMI was calculated using the formula: weight (kg)/height (m^2).

The parity before the index pregnancy was asked verbally and also checked in the ANC records.

2.6.5. Clinical Parameters of the Child

The age of the child, birth weight, Gestational age at delivery and type of pregnancy were taken from the children's vaccination cards.

The number of testes in the scrotum and the location of the left and right testis were gotten during our physical examinations, with the children lying in the supine position naked.

2.7. Data Management and Analysis

The data was coded, and the questionnaire was double-checked for completeness and consistency. The data was entered into Microsoft Excel 2016 and then imported to SPSS version 26 for analysis. Exploratory data analysis was done to check missing values and outliers.

Results were represented on tables and figures (pie charts) to ease organization and comprehension.

2.7.1. To Check for Association between Socio-Demographic Factors and Cryptorchidism

Bivariate analyses were done using chi-square test to determine independent factors that were significantly associated with cryptorchidism (maternal age at delivery, occupation, level of education).

2.7.2. To Determine the Prevalence of Cryptorchidism in Kumba

$$\frac{\text{Number of children with Cryptorchidism}}{\text{Total number of children examined}} \times 100$$

2.7.3. To Determine the Risk Factors of Cryptorchidism

The risk factors were assessed using Stepwise multivariate logistic regression analysis and adopting odds ratio (OR) estimates and confidence interval (95% CI) with p-values < 0.05, which was significant. 122 children coming for vaccination were recruited (Figure 1) of which 10 were excluded because their guardians had <70% knowledge of the ANC and birth history of the children.

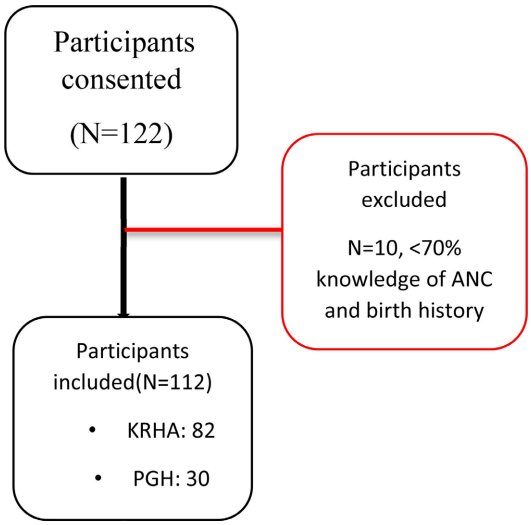

Figure 1. Enrollment flow chart.

2.8. Socio-Demographic Characteristics

A total of 112 children and their mothers were recruited. As shown in Table 1, 58.0% (n = 65) of the mothers were aged between 20 and 30 years, of which 43.7% (n = 50) were self-employed and 60.7% (n = 68) attended of the 112 children recruited, 53.6% (n = 60) where less than 6 months of age, of the 112 children recruited, 53.6% (n = 60) where less than 6 months of age, of which 3 were cryptorchid.

Table 1. Socio-demographic characteristics of study participants.

Variable	Frequency	Percentage (%)
Age category of mother (years)		
<20	10	8.9
20 - 30	65	58
>30	37	33
Total	112	100
Occupation of mother		

Continued

Employed	29	25.9
Self-employed	49	43.7
Unemployed	34	30.4
Total	112	100
Educational level		
Primary	17	15.2
Secondary	68	60.7
Tertiary	27	24.1
Total	112	100
Age of child category		
<6 months	60	53.6
>12 months	20	17.9
6 - 12 months	32	28.6
Total	112	100
Alcohol unit		
Non-drinker	66	58.9
Low-risk drinking	46	41.1
Total	112	100
Caffeine (mg/days)		
No	111	99.1
Yes	1	0.9
Total	**112**	**100**

2.9. Clinical Characteristics

The majority of the mothers were overweight in the 3rd trimester, *i.e.* 42% (n = 47) and about 15% (n = 15) didn't know their weight and or height in the 3rd trimester of pregnancy secondary education. Age of delivery of mother was 27.93 ± 6.116 (Table 2).

Most of the women, 57.1% (n = 64) had a parity of less than 1 before the children recruited and about 7.1% (n = 8) had a parity of greater than or equal to 4 of the 38 children whose mothers were obese, 6 of them were cryptorchid.

Table 2. Clinical and medical characteristics of study participants.

Variable	Frequency	Percentage (%)
Parity		
≤1	64	57.1
≥4	8	7.1
2 - 3	40	35.7
Total	112	100

Continued

Birth weight		
<2500	14	12.5
2500 - 4000	90	80.4
>4000	8	7.1
Total	112	100
ARV month before pregnancy		
>12 months with AGRV	5	4.5
Nil	107	95.5
Total	112	100
BMI classification (3rd trimester)		
Normal	12	10.7
Obese	38	33.9
Overweight	47	42
Total	97	86.6
Type of pregnancy		
Multiple	5	4.5
Singleton	107	95.5
Total	112	100
Number of testes in scrotum		
0	4	3.6
1	7	6.3
2	101	90.2
Total	112	100
Cryptorchidism		
No	101	90.2
Yes	11	9.8
Total	112	100

2.10. Socio-Demographic vs Cryptorchidism

Several socio-demographic factors were analyzed in relation to cryptorchidism as seen in Table 3 below, with a focus on identifying significant associations based on a p-value threshold of less than 0.2. The level of education of the mother emerged as a significant factor, with a p-value of 0.03, indicating that the educational background may influence the occurrence of cryptorchidism. Other factors, such as the age of the child category, alcohol consumption and occupation of the mother with p-values of 0.124, 0.104, and 0.152 respectively suggest a potential association that could be explored in future studies.

Table 3. Socio-demographic vs cryptorchidism.

Variable	Category	Cryptorchidism			Chi-square	p-value
		No	Yes	Total		
Age category of mother	<20	10 (9.9)	0 (0.0)	10 (8.90)	1.665	0.435
	20 - 30	57 (56.4)	8 (72.7)	65 (58.0)		
	>30	34 (33.7)	3 (27.3)	37 (33.0)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Level of education of mother	Primary	17 (16.80)	0 (0.0)	17 (15.2)	7.007	**0.03**
	Secondary	63 (62.4)	5 (45.5)	68 (60.7)		
	University	21 (20.8)	6 (54.5)	27 (24.1)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Occupation	Employed	24 (23.8)	5 (45.5)	29 (25.9)	3.77	**0.152**
	Self-employed	47 (46.5)	2 (18.2)	49 (43.8)		
	Unemployed	30 (29.7)	4 (36.4)	34 (30.4)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Age of child category	<6 months	57 (56.40)	3 (27.3)	60 (53.6)	4.174	**0.124**
	>12 months	16 (15.8)	4 (36.4)	20 (17.9)		
	6 - 12 months	28 (27.7)	4 (36.4)	32 (28.6)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Alcohol unit cat	Non-drinkers	57 (56.4)	9 (81.8)	66 (58.9)	2.641	**0.104**
	low risk drinking	44 (43.6)	2 (18.2)	46 (41.1)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Caffeine (mg/day)	No	100 (99.0)	11 (100.0)	111 (99.1)	0.11	0.74
	Yes	1 (1.0)	0 (0.0)	1 (0.9)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		

2.11. Maternal and Child Factor vs Cryptorchidism

For the maternal and child factor related to cryptorchidism, as shown in Table 4 below, the number of testes in the scrotum shows a highly significant association with a p-value of less than 0.001. This indicates a strong relationship between the presence of testes in the scrotum and the occurrence of cryptorchidism. This stark contrast highlights the critical role of testicular presence in the scrotum as a determinant factor for cryptorchidism, suggesting that the absence of one or both testes is a significant risk factor for this condition. Other variables, such as BMI classification in the third trimester, demonstrate significant associations with cryptorchidism, as their p-values (0.165) were less than 0.2 and could be explored.

Table 4. Maternal and child factor vs cryptorchidism.

Variable	Category	Cryptorchidism			Chi-square	p-value
		No	Yes	Total		
Parity cat	≤1	57 (56.4)	7 (63.6)	64 (57.1)	0.398	0.819
	≥4	7 (6.9)	1 (9.1)	8 (7.1)		
	2 - 3	37 (36.6)	3 (27.3)	40 (35.7)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
ARV month before pregnancy	>12 months with AGRV	4 (4.0)	1 (9.1)	5 (4.5)	0.612	0.434
	Nil	97 (96.0)	10 (90.9)	107 (95.5)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Birth weight Category	<2500	12 (11.9)	2 (18.2)	14 (12.5)	0.468	0.791
	2500 - 4000	82 (81.2)	8 (72.7)	90 (80.4)		
	>4000	7 (6.9)	1 (9.1)	8 (7.1)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
GAD cat	<37weeks	18 (17.8)	2 (18.2)	20 (17.9)	0.003	0.999
	>40 weeks	19 (18.8)	2 (18.2)	21 (18.8)		
	37 - 40 weeks	64 (63.4)	7 (63.6)	71 (63.4)		
	Total	101 (100.0)	11 (100.0)	112(100.0)		
BMI classification (3rd trimester)	Normal	12 (13.6)	0 (0.0)	12 (12.4)	3.609	0.165
	Obese	32 (36.4)	6 (66.7)	38 (39.2)		
	Overweight	44 (50.0)	3 (33.3)	47 (48.5)		
	Total	88 (100.0)	9 (100.0)	97 (100.0)		
Type of pregnancy	Multiple	4 (4.0)	1 (9.1)	5 (4.5)	0.612	0.434
	Singleton	97 (96.0)	10 (90.9)	107 (95.5)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Number of testes in scrotum	0	0 (0.0)	4 (36.4)	4 (3.6)	112	<0.001
	1	0 (0.0)	7 (63.6)	7 (6.3)		
	2	101 (100.0)	0 (0.0)	101 (90.2)		
	Total	101 (100.0)	11 (100.0)	112 (100.0)		

2.12. Prevalence of Cryptorchidism

Cryptorchidism is the condition where one or both testicles fail to descend into the scrotum. As shown in Figure 2 below, the frequency of non-cryptorchid individuals is 101, representing 90% of the sample, while those with cryptorchidism account for 11 individuals, or 10%. This indicates that cryptorchidism affects a significant minority of the population, highlighting the importance of awareness and early detection. The condition can lead to various complications, including infertility and increased risk of testicular cancer, making it crucial for healthcare providers to monitor and manage cases effectively.

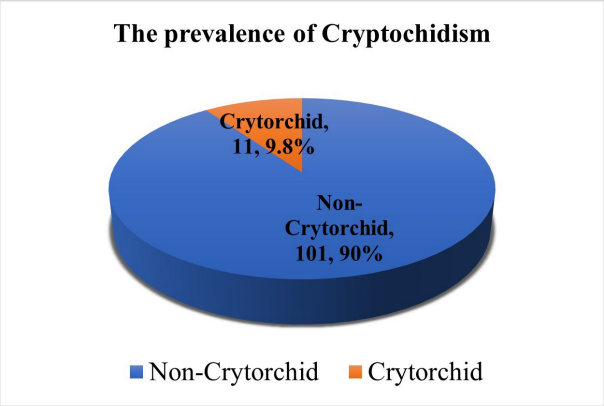

Figure 2. The prevalence of cryptorchidism.

2.13. Location of the Testes

2.13.1. Right Testes Location

Figure 3 below presents the distribution of various locations of the right testes. The majority of the observations, accounting for 87.5% (98 cases), are categorized under scrotum, indicating that the right testes are predominantly located within the scrotal sac. A smaller proportion of cases are noted in other categories: high scrotal locations represent 5.4% (6 cases), while external orifice and nonpalpable locations account for 2.7% (3 cases) and 3.6% (4 cases), respectively. Additionally, there is one case (0.9%) classified as internal orifice. This data suggests that while most right testes are found in the expected scrotal position, there are a few instances of atypical locations, which may warrant further clinical investigation.

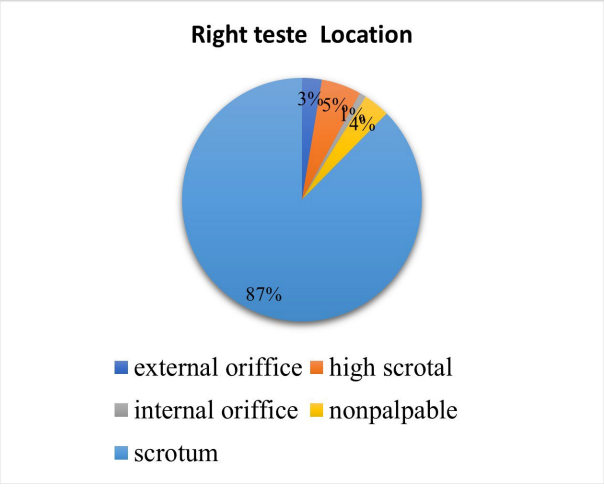

Figure 3. Anatomical location of the right testes.

2.13.2. Left Teste Location

As seen Figure 4 below, majority of cases, accounting for 85.7% (96 instances), are classified as scrotum, indicating that the left testes are predominantly found in the scrotal position. A smaller proportion, 8% (9 instances), is identified as high scrotal, suggesting that these testes are located higher than the typical scrotal po-

sition. Additionally, 3.6% (4 instances) are categorized as nonpalpable, meaning these testes could not be felt during examination, while 2.7% (3 instances) are located at the internal orifice. This data highlights the prevalence of scrotal positioning for the left testes while also acknowledging the presence of cases with atypical locations.

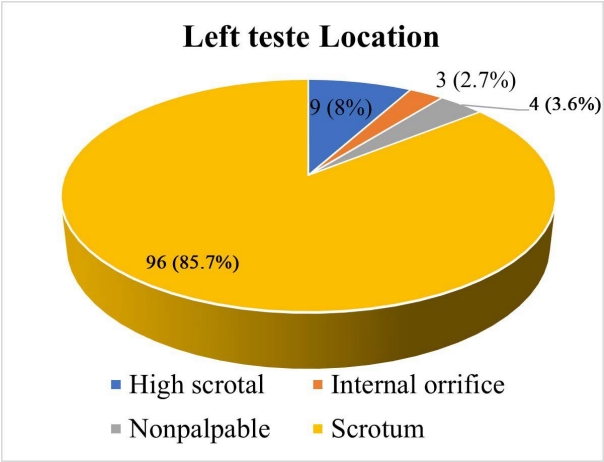

Figure 4. Anatomical location of the left testes.

2.14. Multivariate Analysis of the Factors Associated with Cryptorchidism

Further analysis was done using multiple logistic regression with the significant values < 0.05.

As seen in Table 5 below, occupation, more particularly self-employment, was associated with cryptorchidism with odds ratio of 10.689 (1.182; 96.65) and p-value of 0.035. The odds ratio of 10.689 suggests that self-employed individuals are over ten times more likely to have a child with cryptorchidism compared to those who are employed.

Table 5. Multiple logistic regression.

Variable	Category	Cryptorchidism			aOR	p-value
		No	Yes	Total		
occupation	Unemployed	30 (29.7)	4 (36.4)	34 (30.4)	1.831 (0.448; 7.489)	0.400
	Self-employed	47 (46.5)	2 (18.2)	49 (43.8)	10.689 (1.182; 9.665)	**0.035**
	Employed	24 (23.8)	5 (45.5)	29 (25.9)	1	
	Total	101 (100.0)	11 (100.0)	112 (100.0)		
Alcohol Unit	1 - 13	44 (43.6)	2 (18.2)	46 (41.1)	0.317 (0.056,1.806)	0.196
	0 unit	57 (56.4)	9 (81.8)	66 (58.9)	1	
	Total	101 (100.0)	11 (100.0)	112 (100.0)		

Continued

Age of child category	6 - 12 months	28 (27.7)	4 (36.4)	32 (28.6)	3.008 (0.535, 16.919)	0.211
	≥12 months	16 (15.8)	4 (36.4)	20 (17.9)	1.548 (0.205, 11.67)	0.671
	≤ 6 months	57 (56.40)	3 (27.3)	60 (53.6)	1	
	Total	101 (100.0)	11 (100.0)	112 (100.0)		

3. Discussion

Cryptorchidism is a developmental defect in which a testis or both testes fail to descend from high in the abdomen to the bottom of the scrotum. In the western world, about 2.5% of all boys undergo cryptorchidism surgery, thus it remains one of the most common surgical procedures performed in boys.

We sought to determine the prevalence of cryptorchidism, the relationship between socio-demographic factors and cryptorchidism and the possible risk factors of cryptorchidism. We found a high prevalence of 9.8% and an association between occupation and cryptorchidism.

3.1. Association between Cryptorchidism and Socio-Demographic Factors

In our study, the mean age of the mothers was 27.95 ± 6.12, which presents the average age of peak fertility in women. This is consistent with the study carried out by Carbone *et al.* between 1998-2002 in Italy [9] and Hougaard *et al.* between 1988-1994 in Denmark [10]. We discovered there was no significant association between maternal age and cryptorchidism. These findings were similar to those reported by Hougaard *et al.* between 1988-1994 in Denmark [10] and Berkowitz *et al.* in 1990 in New York [11]. However, some authors like McGlynn *et al.* between 1959-1965 in USA [12] found an association between older women (>30 years) [13], between younger women (<20 years) and cryptorchidism respectively due to differences in circulating levels of estrogen, but this evidence didn't reach statistical significance.

According to our study, 44.6% of the mothers were self-employed and 25% were employed, which revealed an association between mothers who are self-employed and their sons having cryptorchidism with an aOR (10.689, p = 0.0350); which means Children born by mothers who are self-employed are 10times more likely to have cryptorchidism than children whose mothers are employed in Kumba. These findings were in line with those discovered by Berkowitz *et al.* [11] between 1980-1960 in Hungary, a lower maternal standard of living.

The most probable reason of this could be because the left testes start descending before the right and the left testes is usually lower than the right because of a force acting on which can result in intrauterine growth restriction, preterm deliveries.

However, these findings were different from those discovered by Damgaard *et al.* between 1997-2001 in Copenhagen and between 1997-1999 in Finland and Berkowitz *et al.* in 1996 in New York [11], which didn't show an association between

occupational class and cryptorchidism. These discrepancies could be explained by a smaller sample size and shorter duration of our study.

Majority of the mothers, 60.7% ended secondary education and 24.1% attended university education. In our study, we didn't find any association between level of education and cryptorchidism. These findings were in line with those reported by Li *et al.* between 1964-2010 in Sweden [14] and Berkowitz *et al.* in 1996 in New York [11].

3.2. Prevalence of Cryptorchidism

In our study, we found that the prevalence of cryptorchidism was 9.8%. This value was high when compared to the 3.5 cases/year reported by Mouafo *et al.* between 2008-2016 in Yaoundé [15], 3.6% by Diallo *et al.* in 2009 in Conakry [16], and 1.52% by Kumanov *et al.* in 2011 in Bulgaria [8]. This discrepancy could be explained by the fact more than half of our study population were children below 6 months, and there is a decrease in trend in prevalence as age increases, As described by Scorer in 1964 [17] (4.2%, 0.97%, 0.78%), John Radcliffe Hospital cryptorchidism group between 1986-1992 (5.01%, 1.78%) [18], and Berkowitz *et al.* (3.68%, 1.00%, 1.06%) [11] that there's a decreasing prevalence from birth, 3 months and 1 year respectively. As described by Scorer, congenital cryptorchidism resolves spontaneously and this descent occurs mostly during the first months of life, when the endogenous testosterone secretion briefly increases, thus a lower prevalence is usually reported from 3 to 12 months of life.

In our study, 2/3rd of the children with cryptorchidism were unilateral, of which 57% were on the right. These findings were similar to those reported by Barthold *et al.* between 2011-2016 in DR Congo, and Favorito *et al.* [19] between 1996-2013 in Brazil.

It is known that an increase in body weight and fat tissue is associated with several abnormalities of sex steroid hormone balance, particularly in women of reproductive within the abdomen during the development and movement of abdominal viscera. This force is a positive intra-abdominal pressure, the center of which is on the left side of the median plane. Hence, the left kidney and testis are pushed to a farther distance than that of the right kidney and testis. Since the center of this pressure is on the left of the median plane, it fails to push the right kidney and right testis to the same levels as their left counterparts [20].

Unfortunately, the definition of cryptorchidism is not uniform and therefore study results differ substantially even if the applied methodology is similar. There is no consensus among researchers on whether high scrotal testes should be counted as normally descended testes or abnormal.

3.3. Risk Factors of Cryptorchidism

3.3.1. Maternal Factors

In our study, majority of the women drank between 0 - 5 units of alcohol/week (1 - 3 bottles of beer/week). Alcohol consumption during pregnancy is suspected to

modify sex hormone levels in utero, which are essential for the descent of the testes, as described by Steven *et al.* in the USA (2005). However, our results didn't find an association between maternal alcohol consumption and cryptorchidism. Similar results were observed by Zhang *et al.*, a meta-analysis study in USA (2015) [21], Kjesgaard *et al.* between 1985-2012 in Denmark, Mongraw-Chaffin *et al.* between 1958-1967 in California. Damgaard *et al.* between 1997-2001 in Copenhagen and between 1997-1999 in Finland found an association between maternal alcohol consumption and cryptorchidism. This difference could be because Damgaard *et al.* considered only children less than 3 months in their study.

In our study, majority of the women were overweight or obese, *i.e.* according to the WHO standard for classification of BMI, underweight: <18.5 kg/m^2, normal weight: 18.5 - 24.9 kg/m^2, overweight: 25 - 29.9 kg/m^2 and obese: ≥30 kg/m^2 [22].

Age as discovered by Pasquali *et al.* (2003) in Italy. Such alterations involve both androgens and estrogens and, overall, their carrier protein, sex hormone-binding globulin (SHBG), can affect testicular descent. However, in our study, we didn't find an association between maternal BMI and cryptorchidism. This was similar to the results observed by Arendt *et al.* between 1992-2012 in Sweden, Adams *et al.* between 1992-2008 in Washington. However, Li *et al.* between 1964-2010 in Sweden [14], and Berkowitz *et al.* in 1996in New York [11] found an association between maternal BMI and cryptorchidism, with children born by mothers with obesity during pregnancy likely to develop cryptorchidism. This difference could be explained by our small sample size and shorter study period, and we also relied on maternal information for obtaining weight during pregnancy and some turn to hide their real values.

It has been hypothesized that there is an association between parity before the index pregnancy and cryptorchidism, due to hormonal differences in nulliparous women compared with multiparous women [23]. Women in their first pregnancy have higher levels of free estradiol than in subsequent pregnancies, as described by Bernstein *et al.* in 1986, and mothers of cryptorchid boys have been found to have higher levels of free estradiol during the first trimester than mothers of boys with normal testicular descent, as described by Bernstein *et al.* in 1988. However, we didn't find an association between parity before index pregnancy and cryptorchidism. This was similar to the discoveries made by Mori *et al.* in 1992 in Japan, Weidner *et al.* between 1983-1992 in Denmark and Wagner-Mahler between 2002-2005 in France. Biggs *et al.* in 2002 in Washington found a weak association between nulliparity and cryptorchidism, but it wasn't statistically significant.

3.3.2. Child Factors

Low birth weight and gestational age at delivery have been reported by many authors as common risk factors of cryptorchidism. Testicular descent in humans is completed during the third trimester of pregnancy.

4. Conclusions

The trans-abdominal phase takes place between weeks 10 and 15 of gestation and

the androgen-dependent trans-inguinal phase occurs between weeks 26 and 35 (Hutson *et al.*, 1997) [24]. Thus, cryptorchidism is a common finding in premature boys as reported by many authors: Jensen *et al.* between 1980-2008 in Denmark, Mayr *et al.* in 1999 in Stockholm, Preiksa between 1996-1997 in Lithuania, Damgaard *et al.* between 1997-2001 in Denmark. However, in our study, we didn't find an association between gestational age at delivery, low birth weight and cryptorchidism. This discrepancy could be explained by the smaller sample size, shorter study periods and difference in study design, as most authors used a case-control study design.

In combination, these observations suggest that these could be risk factors for cryptorchidism; however, rather than being risk factors *per se*, birth weight and fetal growth restriction may either have a shared etiology with cryptorchidism or be on the causal pathway between causative factors and cryptorchidism. In this case, the true etiological factors would be exposures in the intrauterine environment that affect fetal development—likely reflecting a combination of the genetic and/or environmental exposures. Low birth weight, for example, may be the result of a multitude of maternal factors—such as smoking during pregnancy, nutrition, pre-pregnancy weight and age; thus, it is difficult to determine the true nature of the association between these markers of gestation and cryptorchidism as described by Kramer *et al.* in a meta-analysis in 1987, and Kayode *et al.* in a multilevel analyses in 2014.

5. Limitations

Majority of the data collected were given by the mothers, so there could be a tendency where the mothers under- or over-reported certain aspects, such as weight and quantity of alcohol intake.

6. Strengths

Confounders were accounted for during analysis of risk factors.

To the best of our knowledge, this is the first study on the prevalence and risk factors of cryptorchidism in our setting. Hence, it will serve as a platform for further exploration.

At the end of this study, in which we sought to determine the prevalence, risk factors and association between socio-demographic factors and cryptorchidism in children < 5 years, we observed a prevalence of 9.8%, and an association between self-employment and cryptorchidism.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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