

# **Original Research Article**

## **RELATIONSHIP BETWEEN MATERNAL HYDRONEPHROSIS AND ESTIMATED FOETAL WEIGHT IN BAYELSA STATE, SOUTH-SOUTH NIGERIA**

### **ABSTRACT**

**Background:** Hydronephrosis is the dilatation of the renal calyces and pelvis by urine, as a result of obstruction of the outflow of urine distal to the renal pelvis. It is a common finding in normal pregnancy, and usually physiological.

**Objective:** To determine the relationship between maternal hydronephrosis and estimated foetal weight in normal pregnancy.

**Materials and Methods:** This prospective study was conducted at the Obstetric Unit and Radiology Department of the two tertiary hospitals in Bayelsa State, Nigeria, over six months. Sonographic measurements of the renal pelvises and calyces of 400 consecutive normal pregnant women were done and compared with estimated foetal weights. Data were entered into a pre-designed proforma and analysed using Statistical Product and Service Solutions (SPSS) Windows® version 25, SPSS Inc.; Chicago, USA. Results were presented in frequencies and percentages for categorical variables; mean and standard deviation for continuous variables. Spearman correlation coefficient was used to determine the relationship between maternal hydronephrosis and estimated foetal weight.

**Results:** Four hundred pregnant women participated in this study. About 36% had hydronephrosis (27% with Grade 1 and 9% with Grade 2). While gestational age ( $\rho = 0.22$ ;  $p = 0.001$ ) and estimated foetal weight ( $\rho = 0.26$ ;  $p = 0.001$ ) were significantly related to hydronephrosis, maternal features including maternal age ( $\rho = 0.22$ ;  $p = 0.001$ ), maternal weight ( $\rho = 0.22$ ;  $p = 0.001$ ) and parity ( $\rho = 0.22$ ;  $p = 0.001$ ) were not related significantly.

**Conclusion:** Our study revealed that there was a relationship between maternal hydronephrosis and estimated foetal weight in normal pregnancy. The degree of pelvicalyceal dilatation also increased with gestational age.

**Keywords:** Hydronephrosis, Pregnancy, Pelvis, Calyx, Dilatation, Foetal weight.

### **INTRODUCTION**

Asymptomatic hydronephrosis occurs in 80 – 90% of pregnancies.[1,2] It is usually physiological, and uncommonly pathological. In pregnancy, physiological dilatation of the renal calyces, pelvises and upper ureters usually occurs due to the compression of the ureters by the pregnant uterus, and due to the smooth muscle relaxing effect of progesterone on the renal system. Hydronephrosis is more common in

the right kidney,[2–6] more in the primigravida, and usually starts in the second trimester of pregnancy. It resolves spontaneously six to twelve weeks after delivery. The plausible reason for hydronephrosis being more common in the right kidney may be due to the dextrorotation of the pregnant uterus to the right, leading to the compression of the right ureter, and partly sparing the left ureter.[5] Another reason is the crossing of the right ureter by the right iliac and ovarian vessels in the pelvic brim which increases the risk of pelvicalyceal dilatation.[5] The left ureter is also partly shielded from compression by the protective effect of the sigmoid colon.[5] Pathological dilatation of the renal calyces, pelvises and upper ureters occurs in 0.2 – 3% of pregnancies.[7,8]

Pregnancy is associated with many physiological changes which affect both the woman and the foetus.[9] The weight of the foetus is an important factor to consider when determining the outcome of pregnancy.[9] As the foetus grows larger, the larger the uterus becomes, and possibly the more the compression on the ureters. This may be evidenced by the more pelvicalyceal dilatation seen in patients with twin gestations and polyhydramnios.[10] This relationship between the foetus and dilatation of the renal system has not been well researched, as there is a paucity of published data on the subject matter. The objective of this study was to determine the relationship between maternal hydronephrosis and estimated foetal weight.

## **MATERIALS AND METHODS**

This research was conducted at the Obstetric Unit and Radiology Department of the Federal Medical Centre, Yenagoa and the Niger Delta University Teaching Hospital, Okolobiri, over six months, from July to December 2021. These are the two tertiary hospitals in Bayelsa State, Nigeria, and they render service, training and research, and serve as referral centres for hospitals in Bayelsa State and neighbouring Delta and Rivers States. This survey was a prospective, descriptive, cross-sectional study.

The sample size for this study was calculated using the formula:

$$n = z^2 pq/d^2 \quad [11]$$

### **Where:**

n = minimum sample size

z = normal standard deviation set at 95% confidence limit = 1.96

p = prevalence (63% = 0.63) of hydronephrosis from a previous study.[12]

q = 1 – p (complementary probability).

d = margin of error = 5% = 0.05

### **Calculation:**

$$n = (1.96)^2 \times 0.63 \times 0.37 / (0.05)^2$$

$$n = 3.8416 \times 0.63 \times 0.37 / 0.0025$$

$$n = 0.8955 / 0.0025$$

$$n = 358.2$$

considering attrition = 10% of 358.2 = 35.82

therefore:

$n = 358.2 + 35.82$

$n = 394.02$

'n' was adjusted to 400

The estimated foetal weight and the dimensions of the renal pelvis and calyx were measured for 400 consecutive normal pregnant women in our Centres. Pregnant women without any known renal or cardiovascular diseases were included in the study. Women with known medical condition(s) in pregnancy or renal pathology were excluded from the study. Women who met the inclusion criteria for the study from the antenatal clinic were counselled, and after obtaining written informed consent, were enrolled in the research. They were referred to the Radiology Department for a routine obstetric ultrasound scan. The age parity, gestational age, and blood pressure of the women were obtained and documented. Urinalysis was done with the use of a dipstick before ultrasound scan evaluation, to rule out proteinuria and glycosuria.

A real-time, greyscale, ultrasound examination was carried out with the use of the 2012 Philips HD11 machine, fitted with a 3.5 MHz curvilinear transducer, with electronic callipers to measure the length, width and thickness of each of the kidneys. An ultrasound scan was performed in the semi-prone position in order not to put pressure on the pregnant uterus. All patients were required to empty their urinary bladder before scanning.

All scans were performed posteriorly through the back. The real-time greyscale images were frozen following clear identification of the inferior and superior renal poles in the longitudinal plane. The renal length (L) was taken as the longest distance between the poles using an electronic calliper while the anteroposterior (AP) diameter (thickness) was measured from the anterior wall to the posterior wall of the kidney at its mid portion. The renal width (W) was measured on a transverse scan and the maximum transverse diameter was taken at the level of the hilum as the renal width. The unit of measurement was in centimetres (cm). Using the formula,  $\text{volume} = \text{length} \times \text{width} \times \text{breadth} \times 0.523$ , the renal volume was calculated. The pelvicalyceal diameter was measured, and an assessment of the degree of pelvicalyceal dilatation was made and documented.

The degree of hydronephrosis was graded with the Society for Foetal Urology (SFU) grading system[13] as follows (Figure 1):

**Grade 0**

- no dilatation, calyceal walls are apposed to each other.

**Grade 1 (mild)**

- dilatation of the renal pelvis without dilatation of the calyces (can also occur in the extrarenal pelvis).

- no parenchymal atrophy.

**Grade 2 (mild)**

- dilatation of the renal pelvis (mild) and calyces (pelvicalyceal pattern is retained)

- no parenchymal atrophy.

**Grade 3 (moderate)**

- moderate dilatation of the renal pelvis and calyces.

- blunting of fornices and flattening of papillae.

- mild cortical thinning may be seen.

**Grade 4 (severe)**

- gross dilatation of the renal pelvis and calyces, which appear ballooned.

- loss of borders between the renal pelvis and calyces.

- renal atrophy seen as cortical thinning.

In this study, Grade 0 corresponded to no dilatation; Grade 1 & 2 corresponded to mild dilatation; Grade 3 corresponded to moderate dilatation; Grade 4 corresponded to severe dilatation.

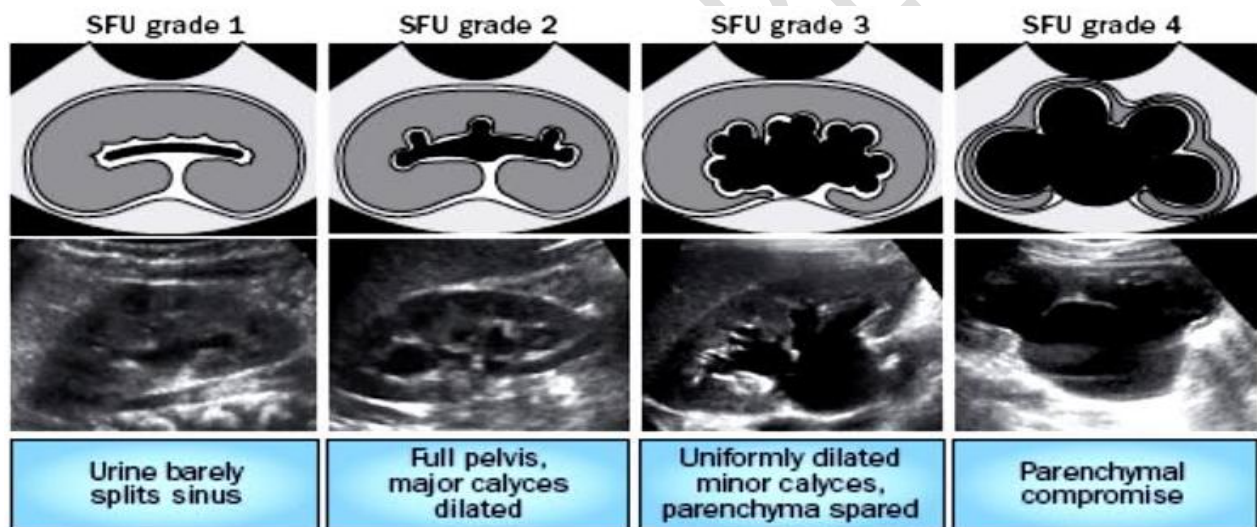


Figure 1: Diagram showing Society for Foetal Urology (SFU) grading system for hydronephrosis.[14]

**Data analysis**

Data were entered into a pre-designed proforma and were analysed using Statistical Product and Service Solutions for Windows® version 25, SPSS Inc.; Chicago, USA. Results were presented in frequencies and percentages for categorical variables; mean and standard deviation for continuous variables. Spearman correlation coefficient was used to determine the relationship between maternal hydronephrosis and estimated foetal weight.

**RESULTS**

Four hundred pregnant women participated in this study. The mean age was  $28.7 \pm 6.0$  years (Table 1). The modal age group (30.0%) was between 25 – 29 years, while a quarter (25.0%) was aged 30 – 34 years. Most (39.0%) of the women were nulliparous and in the second trimester (56.0%) of pregnancy. About 36.0% had hydronephrosis (27.0% with Grade 1 and 9.0% with Grade 2) (Table 1). The mean maternal weight was  $70.6 \pm 13.6$  years and the mean estimated foetal weight was  $1.6 \pm 0.9$ kg (Table 1).

While gestational age ( $p = 0.22$ ;  $p - 0.001$ ) and estimated foetal weight ( $p = 0.26$ ;  $p - 0.001$ ) were significantly related with hydronephrosis, maternal features including maternal age ( $p = 0.22$ ;  $p - 0.001$ ), maternal weight ( $p = 0.22$ ;  $p - 0.001$ ) and parity ( $p = 0.22$ ;  $p - 0.001$ ) were not related significantly (Table 2). The gestational age ( $F = 5.25$ ;  $p - 0.006$ ) and estimated foetal weight ( $F = 5.79$ ;  $p - 0.004$ ) were significantly higher among women with Grade 1 and Grade 2 hydronephrosis than those without hydronephrosis (Table 3; Figure 2). However, maternal age, maternal weight and parity did not show significant difference between the study groups (Table 3). Figure 3 shows normal right and left pelvicalyceal systems.

**Table 1: Maternal and foetal features**

Characteristics	Frequency N = 400	Percent (%)
<b>Maternal age (years)</b>		
> 20	28	7.0
20 – 24	76	19.0
25 – 29	120	30.0
30 – 34	100	25.0
> 35	76	19.0
<b>Mean maternal age <math>\pm</math> SD in years</b>		$28.7 \pm 6.0$
<b>Parity</b>		
Nulliparous (0)	156	39.0
Primiparous (1)	92	23.0
Multiparous (2 – 4)	132	33.0
Grand-multiparous ( $\geq 5$ )	20	5.0
<b>Median parity (range)</b>		1 (0 – 6)
<b>Trimester of pregnancy</b>		
First	24	7.0
Second	224	56.0
Third	148	37.0
<b>Mean gestational age <math>\pm</math> SD (in weeks)</b>		$25.9 \pm 6.8$
<b>Grade of hydronephrosis (calyceal dilatation)</b>		
None	256	64.0
Grade 1	108	27.0
Grade 2	36	9.0
<b>Maternal weight <math>\pm</math> SD (kg)</b>		$70.6 \pm 13.6$
<b>Estimated foetal weight <math>\pm</math> SD (kg)</b>		$1.6 \pm 0.9$

**Table 2: Relationship between hydronephrosis and maternal/foetal variables**

Variables	rho (p-Value)
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Grade of hydronephrosis and maternal age (years)	0.05 (0.523)
Grade of hydronephrosis and maternal weight (kg)	0.01 (0.935)
Grade of hydronephrosis and gestational age (weeks)	0.22 (0.001*)
Grade of hydronephrosis and estimated foetal weight (kg)	0.26 (0.001*)
Grade of hydronephrosis and parity	0.06 (0.368)

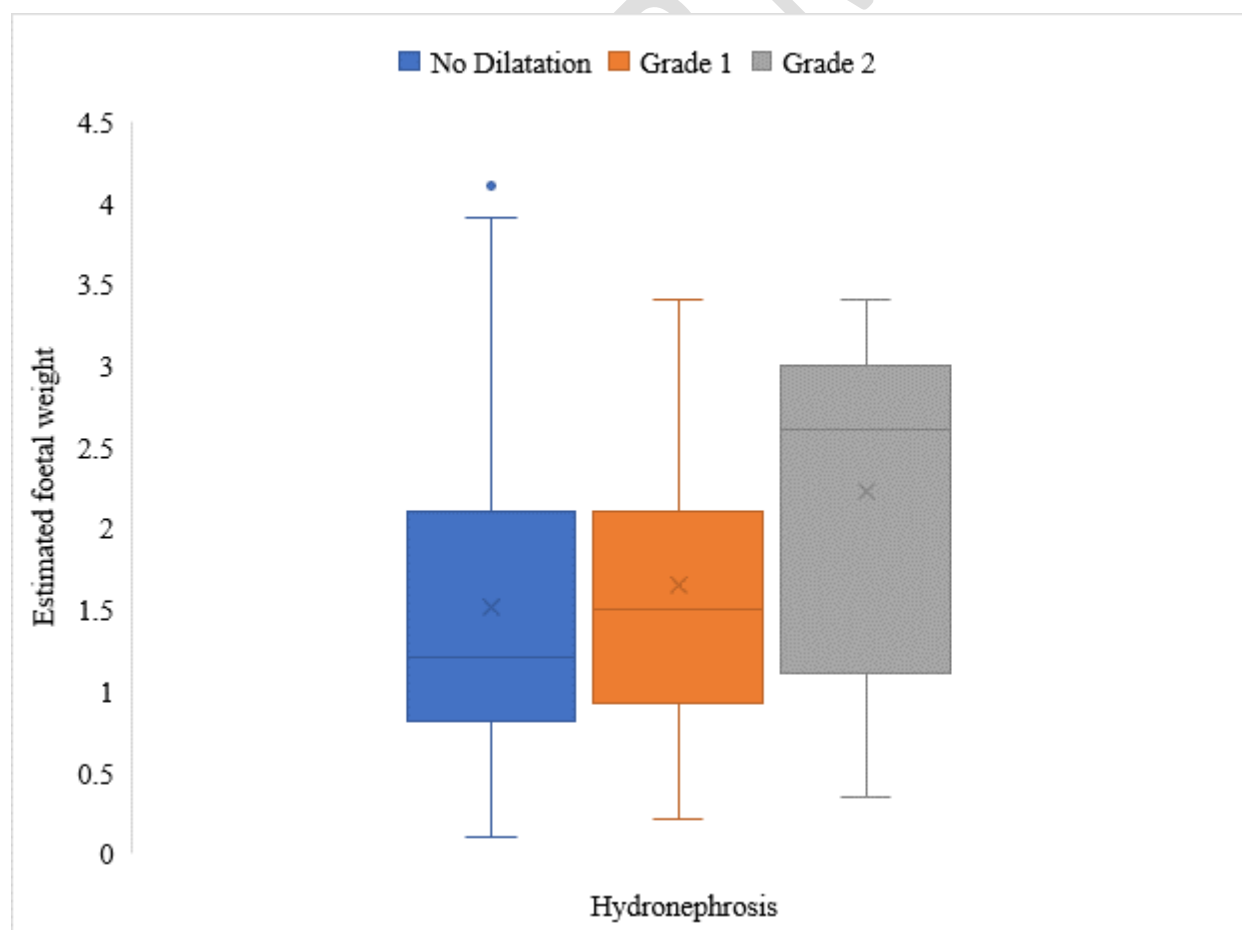
rho – Spearman correlation coefficient.

\*Statistically significant

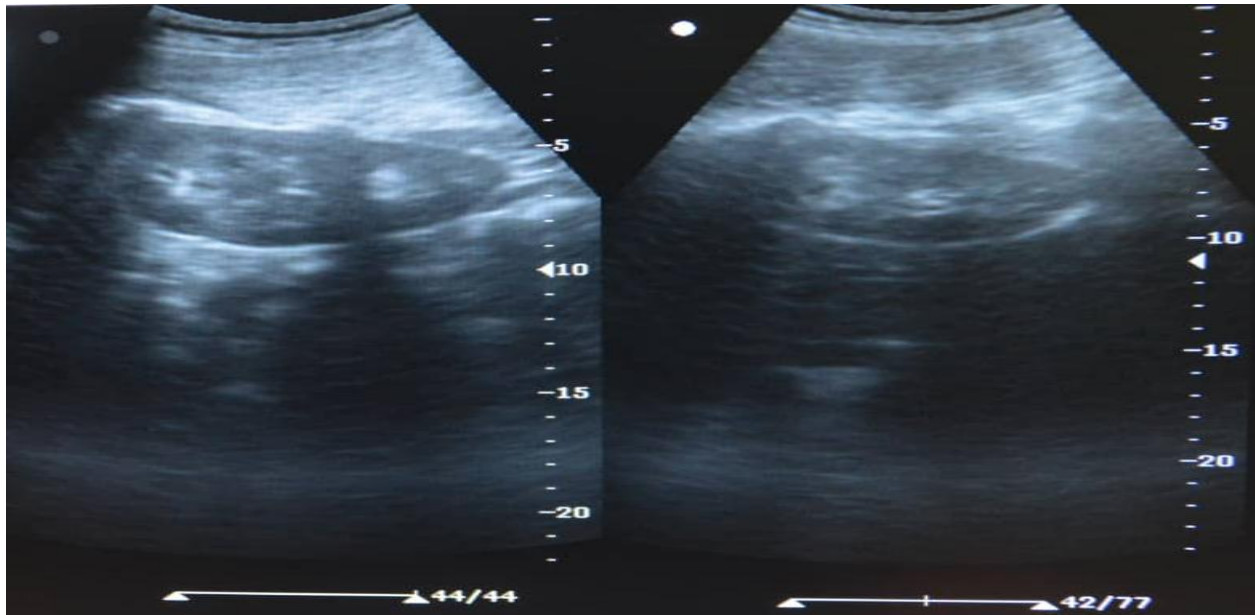
**Table 3: Comparison of maternal and foetal characteristics**

Variables	No dilatation n = 256 (64.0%)	Grade 1 n = 108 (27.0%)	Grade 2 n = 36 (9.0%)	F-statistics (p-Value)
Maternal age (years)	28.59 ± 6.41	28.33 ± 5.41	30.66 ± 4.97	1.07 (0.344)
Maternal weight (kg)	70.75 ± 13.00	69.29 ± 15.00	74.44 ± 12.77	0.98 (0.378)
Gestational age (weeks)	24.87 ± 6.70	27.70 ± 6.48	28.55 ± 6.68	5.25 (0.006*)
Estimated foetal weight (kg)	0.88 ± 1.10	1.33 ± 1.11	1.68 ± 1.37	5.79 (0.004*)
Parity	1 (0 – 6)	1 (0 – 4)	2 (0 – 6)	3.94 (0.139)

\*Statistically significant



**Figure 2: Estimated foetal weight and maternal hydronephrosis**



**Figure 3: Normal right and left pelvic/renal systems**

#### **DISCUSSION**

Hydronephrosis is known to occur in pregnancy, and is predominantly asymptomatic in about 9 out of 10 pregnancies.[1,2,5] This study, is in agreement with the literature, as study participants had no symptoms suggestive of a renal compromise warranting any medical or surgical intervention. This, albeit, was in contrast to reports from Farr et al., in Austria,[15] and Bayrakta et al., in Turkey.[16] It was also interesting to note that none of the women in our cohort had grade 3 hydronephrosis. The reason for our finding is not clearly understood but we hypothesize variations in genetics may play a role.

In this study, we included only singleton pregnancies to enable us to appreciate the fact that uterine size only changed as a consequence of foetal growth. We found a positive correlation between estimated foetal weight (EFW) and the grade of hydronephrosis, and there was a statistically significant difference in EFW when compared to the severity of hydronephrosis. This is consistent with what has been previously reported in other studies by Bayraktar et al. and Coban et al., in Turkey.[16,17] Our findings suggests that pregnancy-induced hydronephrosis is physiological and its severity is in tandem with increasing foetal size with no adverse effect on foetal growth.

Consistent with the literature,[5,16–18] we found that hydronephrosis was diagnosed in the second trimester. We observed ultrasound changes between the 27th and 28th week of gestation and dilatation of the right kidney was more common than the left in our cohort. Also, we report that as calyceal dilatation worsened there was a corresponding increase in gestational age. Our findings are similar to reports from other studies.[16,17] Overall, our findings suggest pregnancy-induced hydronephrosis is physiological and its severity increases with increasing gestational age.

Our study's strength lies in the fact that it is the first study that has assessed the relationship between maternal hydronephrosis and estimated foetal weight in our region. This study is limited in that, mothers were not followed up longitudinally. However, studies in the literature suggest there is no significant adverse effect on birth weight.[16,17] Our study nonetheless was not aimed at estimating birth weight.

## CONCLUSION

Our study revealed that there was a relationship between maternal hydronephrosis and estimated foetal weight in normal pregnancy. The degree of pelvicalyceal dilatation also increased with gestational age.

## ETHICAL APPROVAL

This prospective, descriptive, cross-sectional study was examined and approved by the Research and Ethics Committees of the hospitals.

## COMPETING INTERESTS DISCLAIMER:

**Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.**

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