

## by Johnson's Formula, Ultrasound and after Delivery

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## ABSTRACT

**Objective:** The ultimate objective of this study was to assess and validate the accuracy of fetal weight measurement by using Johnson's formula and its comparison with fetal weight estimated by using ultrasound.

**Study Design:** Cross sectional study

**Place and Duration of Study:** This study was conducted at the Obstetrics and Gynecology Department, Nishtar Hospital Multan from May 2016 to April 2017.

**Materials and Methods:** In this trial total number of 369 pregnant mothers were included and systematic random sampling was used for selection of mothers. First mother was selected randomly. All the data entered and analyzed by computer software SPSS 23.2. The value of  $P=0.005$  considered to be significant.

**Results:** A total number of 100% ( $n=369$ ) women were included in this study. The mean age, parity, height and weight of the patients was  $29.12\pm 4.02$  years,  $2.86\pm 1.5$  parity, and  $149.9\pm 3.94$  cm and  $51.86\pm 3.86$  kg respectively. The study population comprised of 60.4% ( $n=223$ ) illiterate and 39.6% ( $n=146$ ) literate women. The age distribution showed 62.3% ( $n=230$ ) women between 21-30 years 37.7% ( $n=139$ ) between 31-40 years. There were 54.2% ( $n=200$ ) women with height 140-150 cm and 45.8% ( $n=169$ ) between 151-160 cm. It was observed that there were 36% ( $n=133$ ) women had weight between 40-50 kg and 64% ( $n=236$ ) had weight between 51-60 kg. There were 66.1% ( $n=244$ ) women had parity between 1-3 and 33.9% ( $n=125$ ) had parity between 4-6.

The Johnson's formula was seen to over-estimate the fetal weight. To check the equality of means weight, one way ANOVA was applied, it was seen that all the variables i.e. Johnson's formula, ultrasound and actual weight had the different means with significant p-value i.e. 0.000 having F-value 18.08.

**Conclusion:** We can conclude from this study that the fetal weight estimated by Johnson's formula is overestimated while ultrasound estimation of fetal weight always is near to actual weight after delivery.

**Key Words:** Fetal weight, Clinical method, Johnson's formula, and Ultrasound.

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## INTRODUCTION

During pregnancy fetal weight estimation has great important aspect of intrapartum and prenatal care<sup>[1]</sup>. When pregnancy is going to an end, this estimation of fetal weight starts to become more and more important for making decision of mode of delivery. As we know in cases when fetal weight is higher or lower could result many perinatal complication during puerperium and labor so, birth weight of infant is very important for survival of newborn<sup>[2]</sup>. During routine examination the estimation of fetal weight could have great impact on the decision about the labor induction timing and mode of delivery. The abnormal fetal growth might be directly associated with maternal and perinatal risk so; the accurate estimations are very essential.

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Many delivery traumas and prolonged labor including injury of brachial plexus, intrapartum asphyxia, shoulder dystocia and many other maternal risks are also involved such as postpartum hemorrhage, injuries of birth canal and pelvic floor and, are directly related to the macrosomic fetal delivery along with increase risk of caesarean or operative vaginal delivery<sup>[3]</sup>. On the other hand, the identification of restricted growth and lower weight fetus is very necessary to prevent or reduce the perinatal risks such as neonatal morbidity and intrauterine fetal death. The fetal weight estimation is very useful for controlling the interval and time of delivery as well<sup>[4]</sup>.

The best perinatal management could be provided by obstetrician if they use such estimation method and technique which give an accurate fetal weight<sup>[5]</sup>. In these techniques ultra-sonographic and clinical method are most commonly used in the hospitals, in present time ultrasound technique is more preferable than clinical method, because it is easy to use and give accurate and precise estimation<sup>[6]</sup>. In this technique many parameters of fetus are used to predict the fetal weight. Though ultrasonic method need expensive equipments and is time consuming but it is considered accurate by investigators. Irrespective of its ease of use and precision, ultrasound estimation of fetal weight

could have variation in measurement up to 6-11%<sup>[7]</sup>. In many under developing countries the facility of ultrasound is not accessible than in clinics, different clinical methods is used to estimate fetal weight by the help of Johnson's formula principle, in which the clinical maternal measurements are obtained that guide to estimate the fetal weight. In 1954, Toshach and Johnson R.W. gave the principle name as Johnson formula principle that was simplified over the time in 1957 and followed by many studies<sup>[8]</sup>. It is still being used to estimate the fetal weight during intrauterine life. One thing very important; it is very simple, quick and easy clinical method<sup>[9]</sup>.

At birth weights less than 3kg, the fetal weight is overestimated by using Johnson's formula, but still there is almost correlation of results with the birth weight<sup>[10]</sup>. The difference is observed to be statistically insignificant ( $P=0.602$ ). between actual birth weight and the fetal weight found by using Johnson's formula. The estimation of fetal weight using Johnson's formula is as accurate as USG. It can be used as an important tool for the estimation of fetal weight in the absence of USG. Johnson's formula is easy to use and there is no need of special skill. A good correlation is found by a South African study between birth weight ( $r=0.56$ ) and intrapartum SFH, but authors concluded that the formula which was derived was not good enough to be clinically useful. The basic problem in the estimation of fetal weight is that at extremes of birth weight all the methods are less accurate. It is difficult to predict macrosomic (birth weight of 4000 grams and above)<sup>[11]</sup>. The previous studies show that Johnson's formula gives as accurate estimation of fetal weight as ultrasound. We want to find the accuracy of fetal weight estimation on local level by using Johnson's formula especially for those under developed areas where USG technique is deficient so that we have designed this study.

## MATERIALS AND METHODS

With the ethical approval of ethics committee of the institute, this prospective cross sectional comparative study was conducted in Obstetrics and Gynecology Department, Nishtar Teaching Hospital Multan. This study took 12 months, May 2016 to April 2017 and informed consent was taken from all the patients under trial. Patients were also informed about their inclusion in study, its purpose and the procedure of the study. A total number of 100% ( $n=369$ ) were include in this study, sample size was calculated by WHO calculator. The mothers with the singleton term pregnancy admitted either for normal vaginal delivery, induction labor or elective caesarean section were include in this study. Preterm labor, abnormal lie and presentation, ruptured membrane, polyhydramnios, unbooked women, multiple pregnancies, ante partum hemorrhage and eclampsia, oligohydramnios, anteriorly

inserted placenta, poor visualization of fetal parts and uterine fibroids are included in exclusion criteria.

Systematic random sampling was used for selection of mothers. First mother was selected randomly and when each mother met the inclusion criteria was automatically selected in the study. 72 hours are the time interval between ultrasound and clinical estimation of fetal weight in-utero and babies delivery. All the information regarding the last menstrual cycle, age, parity and gestation age was collected from participant directly or from the files of the patient that was submitted before the delivery.

**Fetal Weight estimation by clinical method:** To estimate the fetal weight by abdominal palpation, there were four examiners: a consultant having 15 years professional experience (E4), a consultant having experience of 25 years (E5), a midwife with experience more than 10 years (E6) and a resident in 4<sup>th</sup> year of residency (E7). Leopold's maneuvers were used by all the examiners.

By using adult weighing scale with minimal clothing and recorded the maternal weight was measured. The flexible tape measure calibrated in centimeter was used in labor ward to carry out the in-utero clinical estimation of fetal weight. Before the symphysis fundal height measurement we must ask the woman to completely empty her bladder and after this, command her to lie in supine position and her legs should be extended properly. Before starting the measurement, the fundus of the patient was well defined by putting the ulnar border of the left hand against the upper border of uterus. The measurement of symphysis fundal height (SFH) was calculated from midpoint of upper border of maternal symphysis pubis to highest point of uterine fundus. After this non elastic was taken and was put on the upper border of the pubic symphysis and it was also stretched in very gentle way on the midline of the abdomen. In this way, the height of fundus was calculated in centimeters (cm).

The clinical fetal weight in(grams) was calculated by Johnson's formula principle  
 (Fetal weight (g) = Symphysis fundal height in (cm) –n)  
 multiply by 155 and also the maternal obesity and the fetal head engagements are very important for further adjustments in that formula.

$n= 13$ , if the presenting part is at +1.

$n= 12$ , if the presenting part is at station 0.

$n= 11$ , if the presenting part is at station -1.

If the patient has weight, near to 91 kg then 1 cm should be subtracted from the total fundal height calculated.

All the examiners involved in this study were not informed about the weight estimations made by other examiners. They were only aware of parity and gestation age before examination. Same weighing scale (seca), calibrated on regular basis were used to measure the weight of newborn baby within 30 min after

delivery. All the record of mother like parity, BMI, gestation age and maternal age similarly neonatal information like delivery date and birth weight were properly recorded.

**Fetal weight estimation by ultrasound:**

There the ultrasound weight estimation was done after the clinical method .Real time having the abdominal sector 3.5 MHZ transducer, that was ultrasound machine used for ultra-sonographic estimation of fetal weight. Hadlock formula was basically used as 85 ultrasound machine formula to estimate fetal weight. Similarly, this Hadlock formula was devised on the basis of femur length (FL), Fronto-occipital diameter and Biparietal diameter(BPD)are used to measure the head circumference and sagittal diameter, abdominal transverse(AT) are used to measure the abdominal circumference. All the estimations of fetal weight that were done by both ultrasound and clinical methods were recorded in the chart .A standard analogue Way master (England) scale corrected for zero error was employed to calculate the birth weight of baby immediately after delivery . It is very important that birth weight was measured within 30 minute after delivery. Three examiners are used to estimate fetal weight by ultrasound. The first examiner with more than 10 years experience was ultrasound specialist. The second and third examiners were trainee. First examiner (E1) trained E2 in ultrasound skills for about six months, on other hand E3 learned only basic skills of this technique in ten days but he got experience by observation before the study, but the trainee were in their second year. All the important data that was collected during the whole study period was entered properly in specific data from which was designed specifically for this study.

All the data was entered and analyzed by computer software SPSS version 23.2. Descriptive variable like age and onset of action were presented as mean and SD. To see the significance among groups statistical test ANOVA was applied and for continuous stats among groups were analyzed by applying Chi square test. P value 0.005 was considered as significant.

**RESULTS**

A total number of 100% (n=369) women were included in this study. The mean age, parity, height and weight of the patients was 29.12±4.02 years, 2.86±1.5 parity, and 149.9±3.94 cm and 51.86±3.86 kg respectively. The study population comprised of 60.4% (n=223) illiterate and 39.6% (n=146) literate women. The age distribution showed 62.3% (n=230) women between 21-30 years 37.7% (n=139) between 31-40 years. There were 54.2% (n=200) women with height 140-150 cm and 45.8% (n=169) between 151-160 cm. It was observed that there were 36% (n=133) women had weight between 40-50 kg and 64% (n=236) had weight between 51-60 kg. There were 66.1% (n=244) women

had parity between 1-3 and 33.9% (n=125) had parity between 4-6. (Table 1).

The Johnson’s formula was seen to over-estimate the fetal weight (Table 3).To check the equality of means weight, one way ANOVA was applied, it was seen that all the variables i.e. Johnson’s formula, ultrasound and actual weight had the different means with significant p-value i.e. 0.000 having F-value 18.08 (Table 4).

**Table No. 1: Demographic Variables (n=369)**

Characteristics	Frequency	Percentage (%)
<b>Education Status</b>		
Literate	146	39.6
Illiterate	223	60.4
<b>Total</b>	<b>369</b>	<b>100.0</b>
<b>Stratified Age</b>		
21-30 years	230	62.3
31-40 years	139	37.7
<b>Total</b>	<b>369</b>	<b>100.0</b>
<b>Stratified Weight</b>		
40-50 kg	133	36.0
51-60 kg	236	64.0
<b>Total</b>	<b>369</b>	<b>100.0</b>
<b>Stratified Height</b>		
140-150 cm	200	54.2
151-160 cm	169	45.8
<b>Total</b>	<b>369</b>	<b>100.0</b>
<b>Stratified Parity</b>		
1-3 Parity	244	61.1
4-6 Parity	125	33.9
<b>Total</b>	<b>369</b>	<b>100.0</b>
<b>Descriptive Statistics</b>		
<b>Variable</b>	<b>Mean±S.D</b>	
Age	29.12±4.02 years	
Parity	2.86±1.50 parity	
Height	149.9±3.94 cm	
Weight	51.86±3.86 kg	

**Table No.2: The Estimated Fetal Weight (EFW) calculated by different methods (n=369)**

Methods	Mean±S.D	95% C.I
<b>Johnson’s formula</b>	3399±143.79 gm	(3381.63, 3418.03 )
<b>USG</b>	3323.9±193.2 gm	( 3305.7, 3342.1)
<b>Actual birth weight</b>	3343.3±192.9 gm	(3325.1, 3361.5)

**Table No. 3: The mean weight calculated by all the 3 methods are compared (n=369)**

Methods	Mean±S.D	P-value by ANOVA test
<b>Johnson’s formula</b>	3399 ±143.79 gm	0.000
<b>Ultrasonography</b>	3323.9±193.2 gm	
<b>Actual birth weight</b>	3343.3±192.9 gm	

**Table No. 4: Analysis of Variance**

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	2	1147602	573801	18.08	0.000
Error	1104	35045349	31744		
Total	1106	36192951			

## DISCUSSION

It is very important to estimate the fetal weight accurately because in this way the decisions about the timing of labor induction and the mode of delivery can easily be made<sup>[12]</sup>. The results of current studies show that ultrasound is more accurate than Johnson's formula in estimation of fetal weight and it also shows that Johnson's formula overestimate the fetal weight estimation<sup>[13]</sup>. But many previous studies show that fetal estimation done by both ultrasound and Johnson's formula is always very poor when the fetus is macrosomic<sup>[14]</sup>.

The results of previous studies are very different in many ways, as some studies reporting that estimations of fetal weight made by ultrasound were more accurate, other studies concluding that the estimation of fetal weight made by Johnson's formula was near to actual weight of fetus<sup>[15]</sup>. The different approaches have been used in the previous studies, difference in examiners' skill and time between estimating the weight and actual birth.

Therefore in this study we want to find the accuracy of fetal weight estimation by using by ultrasound and Johnson's formula and their comparison. In this study, total number of 100 % (n=369) pregnant mothers were under trial and the result was concluded that Johnson's formula overestimates fetal weight while the ultrasound measures accurately<sup>[16]</sup>.

Similarly, a recent study was done by Rabei et al; in which total number of 100 % (n=100) pregnant mothers were included in it and 93 out of which 100 were multigravida and 7 primigravida patients. The weight range was 45kg-68kg and age group was 21-40 year. According to this study Johnson's formula overestimate the fetal weight at lower weights especially at the fetal weights with more than 3kg<sup>[17]</sup>.

According to the study performed by Ratwani et al; the estimation of fetal weight done by ultra-sonographic was more accurate in the birth weight between >1501- <4000g as compare to clinical method. But both methods were not correct in the estimation of fetal weight in Macrosomic fetus and IUGR. When there is IUGR case these methods overestimated birth weight but the ultrasonic method has smaller mean error. It was more accurate statistically<sup>[18]</sup>.

The result of the study done by Jan-Simon et al, indicates that the ultrasound is now more accurate in fetal weight estimation. It is notable that the recent studies show the high rate of accuracy of fetal weight estimated with the help of ultrasound as compare to

studies performed in 1990s or even earlier. This is because ultrasound technology has improved a lot in recent years<sup>[19]</sup>. Another study, 100 pregnant women were included and result shows that Johnson's formula underestimate the fetal weight while ultrasound overestimates the fetal weight<sup>[20]</sup>. On the other hand, study conducted by Ugwu et al, in May 2014, Johnson's formula and ultrasound fetal weights were estimated on 200 consecutive term pregnancies (37 completed weeks of gestation -41 weeks and 6 days)<sup>[21]</sup>. Conclusion was that ultrasound method is generally a better predictor of fetal weight than Johnson's formula. The study included the total number of 100% (n=200) pregnant women and result reveals that Johnson's formula overestimates while Ultrasound is very near to the actual weight of fetus<sup>[21]</sup>.

The above findings are very important for those areas where the modern technology of Ultrasonography is available in the hospital as well as the expert clinicians are present every time. In the end we can say that if ultrasound is accessible then it should be used to estimate the fetal weight because it is accurate in the fetal weight estimation as compare to Johnson's formula which is very simple in use an easily accessible but it overestimates the estimation of fetal weight.

## CONCLUSION

We can conclude from this study that the fetal weight estimated by Johnson's formula is overestimated while ultrasound estimation of fetal weight always is near to actual weight after delivery.

### Author's Contribution:

Concept & Design of Study:	Mahnoor Fatima Shah
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Data Analysis:	Saeed Ahmad
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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