

# Accuracy of Johnson-Toshack, Niswander and Risanto formulas to predict the estimated fetal weight based on symphysis-fundal height measurement

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## Abstract

Estimated fetal weight has a very important for planning whether the vaginal delivery is possible or not. There are various methods to determine the estimated fetal weight, ranging from conventional such using symphysis-fundal height and abdominal circumference measurements to more modern method such as using ultrasound examination. The estimated fetal weight can be calculated using several formulas such as the Johnson-Toshack, Niswander and Risanto formulas. The aim of this study was to compare the estimated fetal weight using the Johnson-Toshack, Niswander and Risanto formulas using simple symphysis-fundal height measurements. In this retrospective cross-sectional study, we assessed the medical records of 44 patients at Arifin Achmad Hospital of Indonesia from November 2020 to August 2021. The performance of the formulas was assessed using independent t-test. Our data suggested there was no significant difference between estimated fetal weight using Johnson formula ( $p=1.000$ ), Risanto formula ( $p=1.000$ ) and Niswander formulas compared to actual fetal birth weight ( $p=0.156$ ). In conclusion, Johnson-Toshack, Niswander and Risanto formula could be used by medical personnel to calculate the estimated fetal weight in order to plan the delivery methods. This is crucial in particular in areas with limited resources such as ultrasound to calculate fetal weight in Indonesia.

*Keywords:* Estimated fetal weight, Johnson-Toshack, Niswander, Risanto

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## 1. Introduction

Birth weight is strongly associated with fetal mortality and morbidity. In addition, birth weight is associated with diseases in adults such as cardiovascular disease and type 2 diabetes [1,2]. There are several factors that affect birth weight such as gestational age at delivery, gender of the fetus, hypertension, preeclampsia and uncontrolled type 2 diabetes [1,2]. The normal weight of a newborn ranges between 2500 and 4000 grams while low birth weight (LBW) is a newborn's weight which is less than 2500 grams. Babies weighing less than 2500 grams generally have a gestational age of less than 37 weeks and therefore the vital organs such as the brain, heart, lungs and kidneys are still not mature making the they will have difficulty adapting to the external environment. This will increase the morbidity and mortality of newborn [2].

Macrosomia is newborn's weight that exceeds 4000 grams. Macrosomia is commonly found in pregnant women with diabetes, post maturity and multipara. Complications of macrosomia are asphyxia during vaginal delivery because other parts are blocked and cephalopelvic disproportion often occurs making cesarean section often to be performed on macrosomia infants [4].

Measurement of symphysis-fundal height is generally performed after gestational age of more than 20 weeks to determine fetal well-being. The zero point on the measuring tape is placed on the upper edge of the pubic symphysis then the measuring tape is pulled across the midline of the abdomen until it reaches the top of the uterine fundus [5,6].

Estimated fetal weight is very important for to prepare the delivery methods (vaginal delivery or cesarean section). There are various ways to determine the estimated fetal weight, ranging from conventional approach such as symphysis-fundal height and abdominal circumference measurements to more modern method such as ultrasound. In some health facilities, in particular those located in remote areas, ultrasound is not available making the examination of estimated fetal weight through conventional method is the only important tool to determine the patient's delivery management plan. The estimated fetal weight can be calculated using conventional measurements by employing some formulas such as Johnson-Toshack, Niswander and Risanto formulas [5,7]. The aim of this

study was to determine the accuracy of estimated fetal weight using Johnson-Toshack, Niswander and Risanto formulas compared to the actual birth weight to predict the fetal birth weight at Arifin Achmad Hospital, Pekanbaru, Indonesia.

## 2. Methods

The cross-sectional study was conducted at Arifin Achmad Hospital, Pekanbaru. The population of this study was all pregnant women, both primiparous and multiparous, who were hospitalized on the Department of Obstetrics and Gynecology at Arifin Achmad Hospital, Pekanbaru, Indonesia from November 2020 to August 2021. The sample in this study was obstetric patients who met the inclusion criteria. The inclusion criteria in this study were 37-42-week gestation, single fetus, cephalic presentation. All pregnancies with premature rupture of membranes, hypertension in pregnancy and the presence of congenital abnormalities were excluded. The data used in this study was secondary data collected from medical records.

We recorded the results of symphysis-fundal height (SFH) and birth weight from the medical records. The results of measurement uterine fundal height were used for Johnson-Toshack, Niswander and Risanto formulas to estimate the estimated fetal weight.

Estimated fetal weight according to the Johnson-Toshack formula ( $EFW_J = (SFH - n) \times 155$ ), where  $n$  is the descent of the lower part of the fetus in which  $n = 11$  if the fetal head has passed the sciatic spine (Hodge III),  $n = 12$  if the fetal head has entered the pelvic inlet and  $n = 13$  if the fetal head has not yet entered the pelvic inlet. The estimated fetal weight using the Niswander formula ( $EFW_N = 1.2 (SFH - 7.7) \times 100$ ), in grams, while the estimated fetal weight using the Risanto formula ( $EFW_R = (125 \times SFH) - 880$ ), in grams.

The results of the measurement of the estimated fetal weight using the Johnson-Toshack, Niswander, Risanto formula and birth weight were tested for normality using the Saphiro-Wilk test. If the data normally distributed, the independent Student t-test will be used otherwise the Mann-Whitney was carried out. The significance was assessed at 5%.

## 3. Results and Discussion

There were 44 pregnant women who met the criteria to be included in this study. Table 1 provides the estimated fetal weight using the Johnson-Toshack, Niswander and Risanto formula and the actual birth weight of the newborn. The mean actual birth weight was 3061.43 grams. Our data found that the mean estimated fetal weight using the Johnson-Toshack, Niswander and Risanto formula were 3050.98 grams, 2877.82 grams and 3080.23 grams, respectively (Table 1). This suggested that Niswander has the most least accurate to predict the birth weight.

Table 1 Analysis of mean differences of estimated fetal weight using Johnson-Toshack, Niswander, Risanto formulas compared to the actual birth weight using student t-test

(I) Formula	Mean $\pm$ SD (gram)	(J) Formula	Mean difference (I-J)	p-value
Johnson-Toshack	3050.98 $\pm$ 427.48	Niswander	173.159	0.214
		Risanto	-29.250	1.000
		Actual birth weight	-10.455	1.000
Niswander	2877.82 $\pm$ 337.20	Johnson-Toshack	-173.159	0.214
		Risanto	-202.409	0.086
		Actual birth weight	-183.614	0.156
Risanto	3080.23 $\pm$ 351.25	Johnson-Toshack	29.250	1.000
		Niswander	202.409	0.086
		Actual birth weight	18.795	1.000
Birth weight	3061.43 $\pm$ 410.28	Johnson-Toshack	10.455	1.000
		Risanto	-18.795	1.000
		Niswander	183.614	0.156

Our data found that there was no significant different between estimated fetal weight using Johnson-Toshack formula compared to actual birth weight (3050.98 $\pm$ 427.48 grams vs. 3061.43 $\pm$ 410.28 grams,  $p=1.000$ ), Niswander formula compared to actual birth weight (2877.82 $\pm$ 337.20 gram vs. 3061.43 $\pm$ 410.28 grams,  $p=0.156$ ) and Risanto formula compared to actual birth weight (3080.23 $\pm$ 351.25 gram vs. 3061.43 $\pm$ 410.28 grams,  $p=1.000$ ).

There was also no significant difference between formulas. For example, the mean estimated fetal weight of Johnson-Toshack formula was not different compared to Niswander formula with  $p=0.214$ ; there was no different of the mean estimated fetal weight of Niswander formula compared to Risanto formula with  $p=0.086$ ; and the mean estimated fetal weight Johnson-Toshack formula was not significantly different with that calculated using Risanto formula with  $p=0.001$ .

The results of this study are similar with a study conducted by Gayatri in 2004 who stated there was no significant difference between Niswander formula ( $p=0.205$ ) with actual birth weight. In the recent study, Simanjuntak in 2020 also found that there was no significant different in estimated fetal weight using the Johnson-Toshack formula ( $p=0.070$ ) and Risanto formula ( $p=0.863$ ) with actual birth weight. Altogether, these provide the prove that those three formulas can be used in reliable tool in measuring fetal weight in order to assist in planning the delivery management of the pregnancies, in particular for babies with low birth weight or macrosomia [8,9].

#### 4. Conclusion

There is no significant difference between the estimated fetal weight using the Johnson-Toshack, Niswander and Risanto formula compared to the actual birth weight. Measurement of the estimated fetal weight using these three formulas could be used by medical personnel to plan the next delivery, especially medical personnel in remote areas with limited resources where the ultrasound to calculate fetal weight is not available.

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