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The Insler And Johnson Formulas For Determining Estimated Fetal Weight To Baby's Birth Weight

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ABSTRACT

Fetal weight has a very important meaning for planning midwifery care. Deviations found can be corrected immediately both during pregnancy and childbirth so that treatment is carried out on time. Clinical decisions made include the choice of type of delivery. This is expected to improve pregnancy outcomes for the welfare of the mother and fetus. The purpose of this study was to determine the difference in estimated fetal weight using the Insler Formula and the Johnson Formula compared to the baby's birth weight. This study used a cross sectional design. Sample taken by consecutive sampling. The criteria selected were third trimester pregnant women > 37-42 weeks pregnant, do a pregnancy check until giving birth at the Garuda and Ibrahim Aji Public Health Centers in Bandung City from July to November 2022. Estimated fetal weight was measured during antenatal checks using the Insler and Johnson formulas. The estimated fetal weight is compared with the actual weight of the newborn. Based on the results of a study that compared the estimated fetal weight with the baby's birth weight, it was found that there was no significant difference between the use of the Insler and Johnson formulas to measure the estimated fetal weight and birth weight p value > 0.05. The Johnson and Insler formula can be applied by student midwives or midwife practitioners when conducting antenatal care in the third trimester (gestational age > 37-42 weeks). This formula is a simple detection method, using simple tools, easy to obtain and can be used anytime and anywhere, namely a measuring tape. In addition, the measurement guidelines and calculation formulas are simple and easy to apply.

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INTRODUCTION

A midwife as a provider of midwifery care and decision making must be in accordance with the authority and rules that apply within the scope of midwifery practice. Midwives have duties and roles in providing maternal health services, one of which is midwifery care during normal pregnancy and delivery, early detection of risk cases and complications.[1]

Very small or very large baby weight is one of the complications of pregnancy and childbirth that can endanger the health of newborns. Fetal weight has a very important meaning for further planning so that there is no delay in handling both during pregnancy

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and childbirth, including in making decisions about the type of vaginal delivery or cesarean section. Estimated fetal weight is the predicted weight of the fetus while still in the uterus. By knowing the estimated fetal weight, the growth of the fetus in the uterus can be identified and monitored, so that if abnormal fetal growth is found, it can be detected immediately.[2]

The prevalence of low birth weight babies (LBW) in the world according to WHO is 15.5% or around 20 million babies born each year, and developing countries account for 96.5% of LBW babies. Based on the 2019 Indonesian Health Demographic Survey (IDHS) the incidence of Low Birth Weight (LBW) in Indonesia reached 35.3%.[3.] Macrosomia or birth weight of babies over 4000 kg in Indonesia based on the 2017 IDHS has decreased by 0.5% compared to the previous 5 years, but the death rate for macrosomia babies has increased by 0.1%. Meanwhile, birth complications experienced by mothers increased from 35% to 41%.[4] The prevalence of macrosomia in the United States is 8.23%.[5] 75.9% of the index of symphysis-fundal height and abdominal circumference (ISFHAC) also predicted macrosomia in the GDM group, whereas in the normal pregnancy group it was estimated that 81.3% of cases of macrosomia were predicted from ISFHAC.[6]

WHO recommends carrying out a fetal assessment including fetal movement, fundal height measurement at each antenatal examination, antenatal cardiotocography (CTG), ultrasound scan, fetal heart rate examination with Doppler. In addition, health services for pregnant women by providing pregnancy services at least eight times contact, five contacts in the third trimester, one contact in the first trimester, and two contacts in the second trimester. [7] Integrated and comprehensive antenatal care is carried out at least six times during pregnancy, twice at 0-12 weeks of pregnancy (first trimester), the third contacts at 12-24 years of gestation (second trimester), the fourth to the six contact at 28 weeks of gestation - birth (third trimester). Antenatal visits can be more than 6 (six) times according to needs and if any complaints, illnesses or pregnancy disorders.[8]

Calculation of estimated fetal weight has several formulas, including the Insler Formula, Johnson Formula and Hadlock formula using ultrasound. The results of the study stated that the Insler formula had better predictive results in measuring estimated fetal weight compared to actual birth weight. [9] These three formulas are used to estimate fetal weight (EFW) in grams. Insler's formula by measuring abdominal circumference (cm) and symphysiofundal height (cm).[9] Johnson's formula uses the measurement of symphysio fundal heights (cm) minus the presentation of the fetus in the uterus multiplied by 155 cm. The fetal presentation settings use the subtraction number 13 when the presentation part is not active, 12 when the presentation part is at station 0 and 11 when the presentation part is at station +1.[10] Hadlock's formula which combines the parameters of head circumference (HC), abdominal circumference (AC) and bones thigh length (FL) through ultrasound examination.[11]

From research conducted in India, the results of calculating estimated birth weight using the Insler formula are closest to the actual birth weight (P=0.060) compared to using the Johnson formula (P=0.000) and the Hadlock formula (P=0.000).[9] Research on fetal weight estimation in Indonesia uses the Johnson formula a lot, while the Insler formula is not used, even though the Insler formula is very easy to use by midwives and especially in areas where ultrasound is not available. Estimation of fetal weight using the Insler method is a method that is simple, easy, cost effective and universally applicable to determine estimated birth weight and has a role in decision making and management of labor.[10] Previous research compared EFW using ultrasound and other formulas in hospitals. This study used a formula that can be used by midwives at community health centers where they were the main detectors whose role was to determine the state of pregnancy. The aim of this research is to analyze differences in estimated fetal weight using the Insler Formula and the Johnson Formula.

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METHOD

The design of this study used a cross-sectional study to measure estimated fetal weight using the Insler formula and the Johnson formula at the antenatal visit followed until delivery compared to the baby's birth weight. The subjects of this study were third trimester pregnant women with gestational age > 37-42 weeks with inclusion criteria of BMI 18.5–25 kg/m2, single pregnancy, head presentation and willing to be respondents. The exclusion criteria for the last menstrual period were unknown, had pregnancy complications including antepartum bleeding, polyhydramnios or oligohydramnios, diabetes mellitus, hypertension/preeclampsia/eclampsia, fetal/uterine malformations, adnexal/fibroid masses. Sampling using consecutive technique as many as 97 respondents. The research was conducted from August to November 2022 at the Ibrahim Aji Health Center and the Garuda City Health Center in Bandung City, followed by childbirth at the two Poned Health Centers in the city of Bandung. The data for this study were taken from the two puskesmas because according to the inclusion criteria set, pregnant and giving birth women used were physiological. Considering the feasibility aspect of obtaining data according to the amount set for the available time periods, the Community Health Center with PONED is the choice. The city of Bandung is the chosen location because the city of Bandung provides an overview of the urban area profile. Urban areas have a tendency to have people with a low quality of life. In addition, the 2021 Bandung City Maternal and Child Health Profile data shows that the prevalence of neonatal deaths due to LBW is 23%.

Selected samples or pregnant women who carry out pregnancy checks and meet the sample criteria are measured for the height of the uterine fundus from the upper edge of the symphysis to the uterine fundus using a non-elastic measuring tape. The Insler formula measures the estimated fetal weight obtained from the height of the uterine fundus x abdominal circumference. Before taking the measurement, the patient was asked to empty the bladder, lying on his back by straightening his legs, measurements were taken. After examining the height of the uterine fundus, it is followed by measuring the abdominal circumference. For abdominal circumference measurements, the measuring tape is repositioned to wrap around the pregnant woman's waist at the level of the umbilicus without applying undue pressure to tighten the tape around the abdomen.

Measurements were made with a Strip Seca tape measure (made in Germany) to the nearest 1 mm. Uterine Fundus Height measurement starts from the zero point in the area above the edge of the symphysis pubis then the measuring tape is stretched across the midline of the uterus until the top of the uterus is touched by the finger. Meanwhile, to measure the circumference of the mother's abdomen, position the measuring tape at the umbilicus past the abdomen and behind the mother. Appropriate examination results are recorded in centimeters.[12]

For the Johnson Formula, uterine fundal height was measured as before, descent of the lowest part of the fetus was measured by examination of the abdominal fifths. Limit 2/5 is a sign of engaged fetus. Estimated fetal weight is measured using the following formula: Before engaging = (uterine fundal height -12) x 155, if engaged / Passing engaged = (uterine fundal height -11) x 155. Each respondent was asked to return for a pregnancy check-up to the enumerator with an agreed time, each visit carried out the same examination until the time of delivery.

During delivery, the baby's weight was measured using standard manual baby scales. The data that has been collected is then processed, analyzed and made a discussion of the results of measurements of estimated fetal weight compared to actual birth weight. Before testing the differences, the data collected was tested for normality of the data using the Kolmogorov Smirnov. If the data is normally distributed, proceed with a statistical test to

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measure the difference in estimated fetal weight and birth weight in both groups using the Independent T-Test. Data analysis was performed using the Statistical Package for Social Science (SPSS) version 20 for windows. This research has received ethical clearance recommendations from the Health Research Ethics Committee of the Health Polytechnic of the Bandung Ministry of Health, with ethical approval or "ethical approval" No.10/KEPK/EC/VIII2022.

RESULTS

The research test was carried out by testing the normality of the data using the Kolmogorov Smirnov. Data normality test results, obtained as follows:

Table 1. Data Normality Test

Characteristics	n	Mean±SD	p value
1. Age (years)			
Insler group	58	28,24±5,83	0.2
Johnson group	39	28.95±5,93	
2. Uterine Fundal Height (TFU)			
Insler group	58	31,14±0,16	0.081
Johnson group	39	31.95±2,27	

There was no significant difference in the results of the normality test for the age and fundal height variables in the Insler group and the Johnson group because the p value was > 0.05 so that the two groups could be said to be both statistically homogeneous.
Based on these data, the statistical test used to measure the difference in estimated fetal weight and birth weight in the two groups used the Independent T-Test.

Table 2. Estimated Fetal Weight (EFW) and Actual Birth Weight

Indicator	Mean (gram) ± SD		p value
	Insler (n=58)	Johnson (n=39)	
Estimated fetal weight (EFW)	3079,62±437,09	3215,26±355,09	0.11*
Actual birth weight	3005,81±345,76	3076,79±317,50	0.31*

Note: Independent T test

Table 2 shows the results of the statistical test that there was no significant difference between the estimated fetal weight in the Insler group and the Johnson group, with a p value > 0.05; there was no significant difference in birth weight between the Insler group and the Johnson group, with a p value > 0.05.

Table 3. Different Test of Estimated Fetal Weight and Birth Weight

Group	Mean (gram)		p value	r value
	EFW ± SD	Actual birth weight ± SD		
Insler	3079,62 ± 437,09	3005,81 ± 345,76	0.315*	0,508*
Johnson	3215,26 ± 355,09	3076,79 ± 317,50	0.073*	0,866*

p value: based on independent T test
r value: based on Pearson correlation

Table 3 shows that there was no significant difference in the statistical test results between estimated fetal weight and birth weight in the Insler and Johnson groups, with a p value > 0.05. These result show that between Insler and Johnson formula as accurate method for estimation of fetal weight in term singleton pregnancies. Correlation analysis of estimated fetal weight with the Insler formula (r=0,508) and Johnson formulas (r=0,866) using Pearson

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showed a positive correlation for both, but the Johnson formula showed a higher correlation than the Insler method.

DISCUSSION

The results of the average estimated fetal weight using the Insler method were 3079.62 grams. While the actual average birth weight was 3005.81 grams. This shows that the Insler formula can be used to measure the estimated fetal weight fairly accurately, it is proven that the measurement results with the Insler formula are not significantly different from birth weight.

The same as research on birth weight using the Insler method (SFH x AG) ± SD of 2967.79 ± 348.52 which is more accurate in estimating fetal body weight compared to actual birth weight ± SD of 2903 ± 460.02.[9] The study stated that examination using the Insler formula (96.33%) was very accurate in Low Birth Weight (LBW) and examination using the abdominal palpation method (91.09%) was more accurate in the normal weight group and macrosomia (94.72%). The formula for calculating the baby's birth weight using the Insler method with an error of up to 5% is able to estimate the fetal weight accurately for 86.64%. This means that the abdominal palpation method is a better predictor in estimating fetal weight.[13] Fundal height assessment is an inexpensive method to screen for fetal growth restriction.[14] Estimated fetal weight can determine whether the fetus is underweight or overweight. Several studies have different statements regarding the accuracy in determining LBW and macrosomia. The reasons for differences between one study and another may be related to examinations carried out by different people and differences in equipment.[13] Diagnostic capabilities may vary and depend on the size of the baby, as well as ethnicity and geographic origin.[15] The biological mechanism that causes this has not yet been discovered.

In contrast to the statement that detection of macrosomia through symphysis measurement of TFU has a sensitivity level of 20-70% and is a poor predictor, likewise the accuracy of ultrasound and physical examination is considered inconsistent in detecting macrosomia. Various other techniques and formulas do not help in accurately predicting macrosomia, so an accurate diagnosis of macrosomia can be made by weighing the newborn after birth.[16]

Based on the results of this study, the estimated fetal weight using the Insler formula for birth weight is equivalent in accuracy to the estimated birth weight using the Johnson formula. Therefore, from the two formulas studied, both Insler and Johnson can be used widely in the learning process and implementation in clinical practice because of the accurate measurement results with actual birth weight, low cost, and simple tools. This is different from the research results which state that there are significant differences between the Insler and Johnson formulas.[13]

The results of measurement of estimated fetal weight in women with BMI < 25 did not differ significantly between manual and ultrasonographic methods. In women with a BMI between 25 and 30 ultrasonography was better at estimating fetal weight than the manual method (94.4 versus 80.3% of cases). Women with a BMI of 30 showed a better estimate of fetal weight by ultrasound than by the manual method (91.8 versus 71.4% of cases).[17]

Palpation and the Johnson technique can be used as an alternative to ultrasound for fetal weight estimation, especially if the measurements are carried out by an experienced specialist. This finding has important implications for developing countries where there is still a shortage of advanced technology. The sensitivity of ultrasound for the estimation of LBW fetal weight and the sensitivity of the Johnson technique for the estimation of macrosomic fetal weight were higher than the sensitivity of other methods. However, the ultrasound and Johnson methods are less accurate for fetal weight estimation at very large or very small extreme fetal weights. [12]

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The results of the average estimated fetal weight using the Johnson method were 3215,26 grams. While the actual average birth weight was 3076.79 grams. This shows that the Johnson formula can be used to measure the estimated fetal weight fairly accurately, it is proven that the measurement results with the Johnson formula are not significantly different from birth weight. When comparing the two Insler and Johnson fetal weight estimation formulas with the baby's birth weight, the two formulas did not show a statistically significant difference.[12] Johnson's formula has been reported to be more sensitive than Insler's formula.[18] This means that the Insler and Johnson formulas are equally accurate when used to determine estimated fetal weight. The results of correlation analysis using Pearson showed a positive correlation, the estimated fetal weight using the Johnson formula (r=0.866) showed a higher correlation than the Insler formula (r=508). Both two formulas can be used clinically to calculate estimated fetal weight.[19] The results of the average estimated fetal weight using the Johnson method were 3215,26 grams. While the actual average birth weight was 3076.79 grams. This shows that the Johnson formula can be used to measure the estimated fetal weight fairly accurately, it is proven that the measurement results with the Johnson formula are not significantly different from birth weight. When comparing the two Insler and Johnson fetal weight estimation formulas with the baby's birth weight, the two formulas did not show a statistically significant difference.[12] Johnson's formula has been reported to be more sensitive than Insler's formula.[18] This means that the Insler and Johnson formulas are equally accurate when used to determine estimated fetal weight. The results of correlation analysis using Pearson showed a positive correlation, the estimated fetal weight using the Johnson formula (r=0.866) showed a higher correlation than the Insler formula (r=508). Both two formulas can be used clinically to calculate estimated fetal weight.[19]

Clinical and ultrasonographic methods are one way to predict birth weight in infants. The clinical method has advantages in terms of economy, in contrast to ultrasonography which is more expensive because it requires tools and trained personnel. Clinical method as an alternative that can be used in areas with limited resources because it can be carried out by health providers.[20] Clinical Methods can also be used in developing countries even in underdeveloped areas that do not have adequate facilities. [13]

The accuracy in the implementation of obstetric and perinatal management is decided by an obstetrician, one of which is based on the estimated fetal weight factor, because it is the thing that determines the survival of the fetus. Pregnancy care that applies the relationship between estimated fetal weight and gestational age, will help identify wrong estimated dates, intrauterine growth disorders, thereby reducing the number of premature perinatal deaths. [21]

Accurate estimation of fetal weight is essential in the management of labor and delivery. Measurement of estimated fetal weight is a vital part of the prenatal phase and predicts the survival of the baby outside the womb. Techniques for estimating fetal weight, the most common of which are clinical and ultrasonographic techniques. Clinical methods used to estimate fetal weight include abdominal palpation, Johnson's formula, and Insler's formula. Inaccurate estimation of fetal weight can lead to an increased risk of intrauterine growth disorders and macrosomia. [13]

CONCLUSION

Both the Johnson and Insler formulas can be used by midwifery students and midwives as an alternative to simple formulas of appropriate technology that are sufficiently accurate to determine estimated fetal weight.

AUTHOR CREDIT STATEMENT

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There are limitations in this research. The research subjects involved were limited to two PONED health centers. For a broader generalization of results in the future, more health centers from several regions can be involved and a larger number of samples.

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DECLARATION OF COMPETING INTEREST

More extensive research is needed and a larger number of respondents so that the results of this study can be used as the basis for further research using the cohort method.

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