Research Article

In Utero Ultrasonography Parameters as a Children Growth Prediction at Age 2 – 3

Parameter Ultrasonografi in Utero sebagai Prediksi Pertumbuhan Anak Usia 2-3 Tahun

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Abstract

Objective: To determine the relationship between ultrasound parameters during pregnancy and the growth of children aged 2 – 3 years.

Methods: This was an analytic observational study with a longitudinal approach using data from the first 1,000 days of life. Study conducted at the Faculty of Medicine, Diponegoro University. The research subjects were children aged 2 – 3 years old with good nutritional status and democratic parenting from 14 City Health Centers in Semarang. The ultrasound parameters obtained were Biparietal Diameter (BPD), Abdomen Circumference (AC), Head Circumference (HC), Femur Length (FL) at 20 – 24 weeks of gestation. Data were obtained during the second trimester. Data on the growth of children at the age of 2 years obtained are height, weight, and HC. Statistical test using Pearson correlation test, with p<0.1 is considered significant.

Results: The level of confidence used in this study was 90% and obtained 45 research subjects with a female gender of 26 children (57.8%) and 19 male children (42.2%). The Pearson test showed that there was no significant relationship between BPD and height (p=0.18; r=-0.20), AC and height (p=0.12; r=-0.23), and FL and height (p=0.17; r=-0.20). There was a significant relationship between HC and height (p=0.04; r=-0.29), BPD and weight (p=0.06; r=-0.28), HC and weight (p=0.01; r=-0,.5), AC and weight (p=0.08; r=-0.26), FL and weight (p=0.05; r=-0.29) and prenatal HC and postnatal HC (p=0.03; r=-0.32).

Conclusion: There is a significant relationship between ultrasound parameters during pregnancy and the growth of children aged 2 – 3 years.

Keywords: abdominal circumference, biparietal diameter, child growth, femur length, head circumference, pregnancy.

Abstrak

Tujuan: *Untuk mengetahui hubungan antara parameter ultrasonografi saat kehamilan dengan pertumbuhan anak usia 2-3 tahun.*

Metode: *Penelitian ini merupakan penelitian observasional analitik dengan pendekatan longitudinal menggunakan data penelitian 1.000 hari pertama kehidupan yang dilakukan di Fakultas Kedokteran Universitas Diponegoro. Subjek penelitian adalah anak usia 2 – 3 tahun dengan gizi baik dan pola asuh demokratis dari 14 Puskesmas Kota Semarang. Parameter USG yang diperoleh adalah diameter biparietal (BPD), lingkar abdomen (AC), lingkar kepala (HC), dan panjang femur (FL) pada usia kehamilan 20 – 24 minggu. Data diperoleh selama trimester kedua. Data tumbuh kembang anak usia 2 tahun yang diperoleh adalah tinggi badan, berat badan, dan lingkar kepala. Uji statistik menggunakan uji korelasi Pearson, dengan p<0,1 dianggap signifikan.*

Hasil: *Tingkat kepercayaan yang digunakan dalam penelitian ini adalah 90% dan diperoleh 45 subjek penelitian dengan jenis kelamin perempuan 26 anak (57,8%) dan 19 anak laki-laki (42,2%). Uji Pearson menunjukkan bahwa tidak ada hubungan yang signifikan antara BPD dengan tinggi badan (p=0,18; r=-0,20), AC dan tinggi badan (p=0,12; r=-0,23), dan FL dan tinggi (p=0,17; r=-0,20). Terdapat hubungan yang signifikan antara HC dengan tinggi badan (p=0,04; r=-0,29), BPD dan berat badan (p=0,06; r=-0,28), HC dengan berat badan (p=0, 01; r=-0,35), AC dan berat badan (p=0,08; r=-0,26), FL dan berat badan (p=0,05; r=-0,29) dan HC prenatal dan postnatal HC (p=0,03; r=-0,32).*

Kesimpulan: *Terdapat hubungan yang signifikan antara parameter ultrasonografi saat kehamilan dan pertumbuhan anak usia 2 – 3 tahun.*

Kata kunci: *diameter biparietal, kehamilan, lingkar abdomen, lingkar kepala, panjang femur, pertumbuhan anak.*

INTRODUCTION

Intrauterine life is one of the determinants of the quality of child development. Growth is an increase in the number, size, dimensions at the level of cells, organs, and individuals. Physical growth is typically assessed using weight, height (length), head circumference, arm circumference, and skin folds. Weight is used as a parameter to assess the nutritional status of children, while head circumference is used to monitor children's brain growth and development.[1,2]

Infants experience rapid growth in the first 1000 days of life. The first 1000 days of life is a very important phase in documenting the growth of children to detect abnormalities as early as possible. The process of child growth takes place regularly, interrelated, and continuously starting from conception to adulthood. The stages of child growth are divided into two, namely the prenatal and postnatal periods, each of which has its characteristics and differences in anatomy, physiology, biochemistry, and character.[3,4]

Growth and development disorders can occur if there are both or either genetic and environmental factors. For example, stunting is a condition in which children under five experience limited or reduced growth and development. This condition is caused by chronic malnutrition so that children are too short for their age. Malnutrition can occur in the womb and can only be seen when the child turns 2 years old. Stunting has a negative impact on nutritional problems in Indonesia because in the future it will affect the physical and functional aspects of the body and will increase child morbidity. Basic Health Research (Riskesdas) showed the prevalence of stunting in Indonesia reached 37.2% in 2013 and decreased to 30.8% in 2018. However, this figure is still far from the target of the World Health Organization (WHO), namely 20%.[4–6]

Health services for pregnant women or Antenatal Care (ANC) are carried out during the mother's gestational age range which is grouped according to gestational age and is divided into three categories: the first trimester; second trimester; and third trimester. This service is carried out to monitor the pregnancy process to ensure the health of the mother and the growth of the fetus is good, to find out whether there are pregnancy complications that may occur during early pregnancy, and to improve and maintain the health of the mother and fetus. The health services provided for pregnant women include fetal examination, one of which is through ultrasound examination.[7] Ultrasound examination is a diagnostic method that uses ultrasonic waves that are non-invasive, safe, practical, and can provide information on fetal growth.[8] Fetal growth assessments such as biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) were used to measure the assessment of the estimated fetal weight (EFW).[9]

Based on the description above, pregnant women need to carry out ANC examinations, especially ultrasound, to find out pregnancy complications and detect the disturbances in the growth and development of children later because the process is continuous from conception to adulthood. One example of a child's growth and development disorders is stunting which can only be seen at the age of 2 years.[5,9] Therefore, it is necessary to research to determine the relationship between ultrasound parameters during pregnancy and the growth of children aged 2 years.

METHODS

This research was done within both the Obstetrics and Gynecology Department, and Pediatrics Department. The study was conducted at 14 City Health Centers in Semarang from April to September 2021. This research has received permission from the Health Research Ethics Commission (KEPK) Faculty of Medicine, Universitas Diponegoro, Semarang with number 227/EC/KEPK/FK-UNDIP/VII/2021.

This research was an analytic observational study with longitudinal approach. The population of the subjects in this study was children aged 2 - 3 years old in 14 Semarang City Health Centers who met the inclusion and exclusion criteria of the study. The inclusion criteria in this study were children aged 2 - 3 years old, domiciled in Semarang, good child nutrition, democratic parenting, have complete ultrasound records, and ultrasound examination performed by Obstetrics and Gynecologists who are a certified basic ultrasound examiners. Meanwhile, the exclusion criteria were children with congenital abnormalities and mothers who have comorbidities during pregnancy. In the ultrasound examination, no kappa test was carried out, but those who did the examination were Obstetrics and Gynecology specialists who had a certificate of basic ultrasound standardization where to get

the certificate, they had to undergo training in which there was conformity with the results of the ultrasound examination.

The ultrasound parameters obtained were Biparietal Diameter (BPD), Head Circumference (HC), Abdomen Circumference (AC), and Femur Length (FL) at 20-24 weeks of gestation. Data were obtained in the second trimester. The child growth data obtained were height, weight, and HC.

The data obtained were analyzed statistically using the Shapiro Wilk test on data with a normal distribution (p>0.1) using the Pearson correlation test. The level of confidence in this study was 90% because from the existing data, not all of them have a complete ultrasound.

RESULTS

Table 1. Distribution of Research Subject Characteristics

Variables	n	%	Mean ± SD
Maternal Age			
14 – 19	2	4.4	
20 – 29	24	53.3	
30 – 39	18	40	28.36 ± 5.48
40 – 49	1	2.2	
Child's Gender			
Girl	26	57.8	
Boy	19	42.2	
USG Parameter			
BPD			5.51 ± 1.35
HC			19.63 ± 2.71
AC			17.45 ± 2.72
FL			3.79 ± 0.64
Child's Growth			
Height			83.48 ± 2.61
Weight			10.81 ± 1.35
HC			47.12 ± 1.19

The research subjects consisted of 45 mothers and children. Maternal age was categorized into four, the results obtained are 2 (4.4%) mothers categorized for 14 – 19 years, 24 (53.3%) mothers categorized for 20 – 29 years, 18 (40%) mothers categorized for 30 – 39 years , and 1 (2.2%) mother categorized for 40 – 49 years. The mean value for maternal age was 28.36 ± 5.48 years. In children, 26 (57.8%) children were girls and 19 (42.2%) were boys. On the results of ultrasound parameters, the mean BPD value was 5.51 ± 1.35 mm. The mean value for HC was 19.63 ± 2.71 mm. The mean value for AC was 17.45 ± 2.72 mm. The mean value for FL was 3.79 ± 0.64 mm. In the results of child growth, the mean value of height was 83.48 ± 2.61 cm, the mean value of weight was 10.81± 1.35 kg, and the mean value of HC was 47.12 ± 1.19 cm.

Table 2. Correlation between BPD, HC, AC, and FL with Height

Variables	Height	
	p-value	*r*
BPD	0.18	-0.20
HC	0.04*	-0.29
AC	0,12	-0.23
FL	0.17	-0. 20

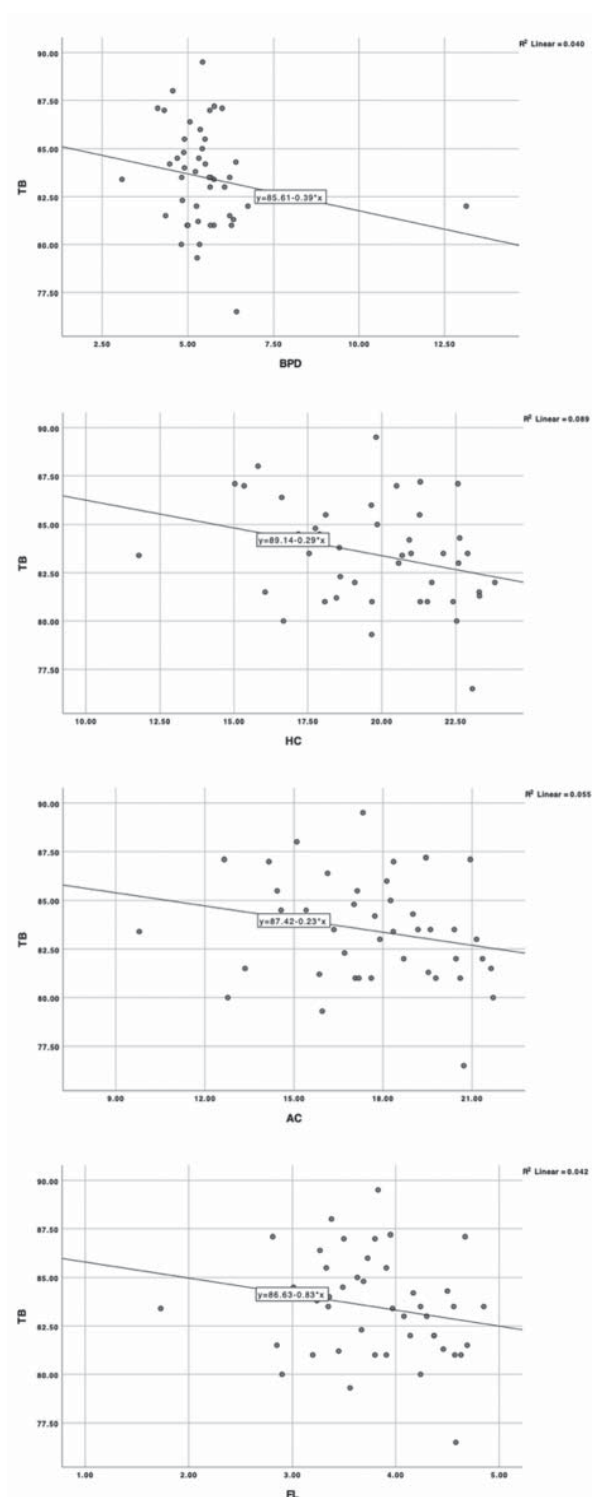Description: Pearson Correlation Test ($p<0,1$)

Figure 1. The scatter plot graph between BPD, HC, AC, and FL to Height

From the results of the bivariate analysis conducted with the Pearson correlation test on the relationship between BPD, HC, AC, and FL with height, the results showed no significant correlation (*p*> 0.1) between BPD and height (*p*=0.186; *r*=-0.201). There was a weak but significant negative relationship (*p*<0.1) between HC and height (*p*=0.046; *r*=-0.0299). There was no significant relationship (*p*>0.1) between AC and height (*p*=0.120; *r*=-0.235). There was no significant relationship (*p*>0.1) between FL and height (*p*=0.177; *r*=0.205).

Table 3. Correlation between BPD, HC, AC, and FL with Weight

Variables	Weight	
	p-value	*r*
BPD	0.06*	-0.28
HC	0.01*	-0.35
AC	0.08*	-0.26
FL	0.05*	-0.29

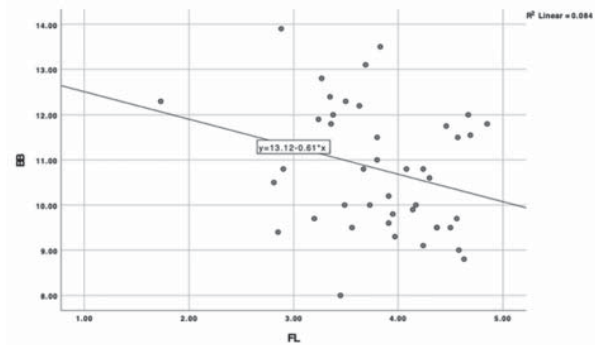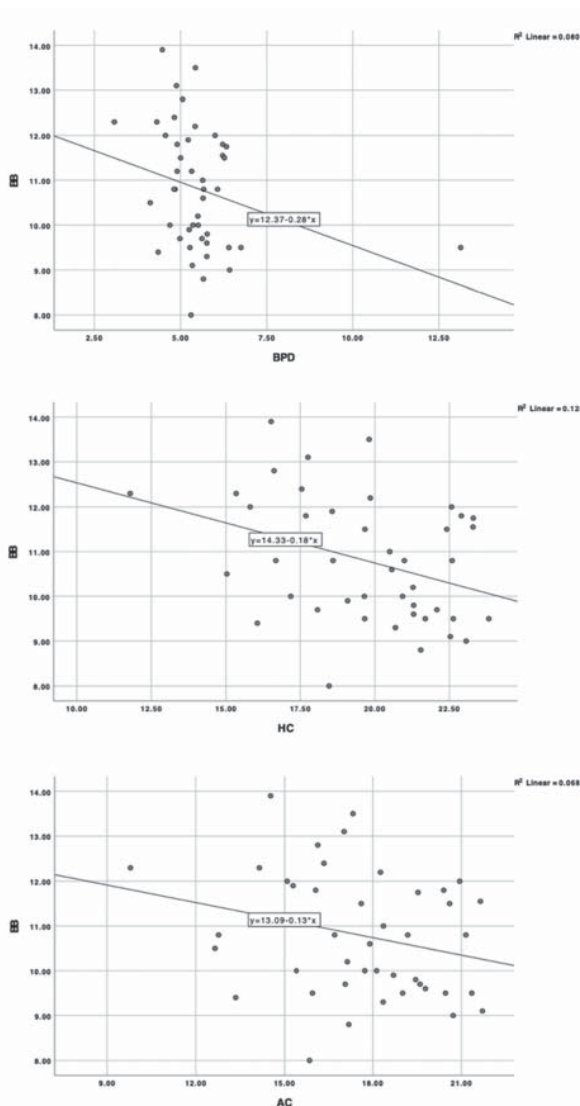Description: Pearson Correlation Test (*p*<0.1)

Figure 2. The scatter plot graph between BPD, HC, AC, and FL to Weight

Table 4. Correlation between prenatal HC and postnatal HC

Variables	Postnatal HC	
Prenatal HC	*p-value*	*r*
	0.03*	-0.32

Description: Pearson Correlation Test (*p*<0.1)

From the results of the bivariate analysis carried out with the Pearson correlation test on the relationship between prenatal HC and postnatal HC, the results showed that there was a weak but significant negative relationship (p<0.1) between prenatal HC and postnatal HC (p=0.03; r=-0.32).

DISCUSSION

Child growth takes place regularly, interrelated, and continuously starting from conception to adulthood. The growth experienced a rapid increase at an early age, especially at first 1,000 days of life. The growth stage of children is divided into two, namely the prenatal period and the postnatal period. In the prenatal period, growth monitoring can be done through ultrasound examination using BPD, HC, AC, and FL parameters. Meanwhile, in the postnatal period, height and weight monitoring of children can be carried out.[3,4,9] In this cross-sectional study, the researchers discussed the relationship between ultrasound parameters during pregnancy and the growth of children at the age of 2 – 3 years.

The results of this study showed a relationship between ultrasound parameters and child growth. Children's growth is interrelated starting from conception to adulthood.[3] In theory, if the femur is too short, the child will not grow too long despite a severe delay in bone age. On the other hand, if the femur is long, the risk of short stature is very small.[10] Meanwhile, FL is also used to calculate in the Hadlock formula to measure

EFW.[9] In a study conducted that EFW can be used to predict a child's weight at the age of 3 years.[11] The results of the Pearson test in this study showed that the relationship between FL and height was not significant, while the relationship between FL and weight was significant. This is not in accordance with previous research which reported a relationship between FL and height in children.[10] Meanwhile, in the same study, a relationship between FL and weight in children was also reported.[10] This discrepancy could be caused by several factors, such as the limitation of the number of research subjects, wherein this study the height of the children was normal. Another factor that can influence is the supplements consumed by the mother during the third trimester, where in a study was found that it could also increase the growth of children in the early 5 years of life.[12]

This study shows that there was a significant relationship between HC and height, BPD and weight, and HC and weight. However, BPD and height did not show a significant relationship. BPD and HC are two parameters used to assess fetal brain size as found.[13] Fetal brain size can predict a child's brain development related to somatic growth.[14,15] This is in accordance with research who stated that children's brain development is related to children's weight. In the same study, it was stated that children's height was significantly associated with HC.[14] BPD and HC were also used to assess EFW using the Hadlock formula, where EFW could be used to predict a child's weight at the age of 3 years.[11,16]

This study showed a significant relationship between AC and weight but did not show a significant relationship between AC and height. AC is not an indicator of growth in height or weight.[10] However, together with BPD, HC, and FL, AC is a parameter used to assess EFW using the Hadlock formula, where EFW can be used to predict a child's weight at the age of 3 years.[11,16]

In this study, we found a significant relationship between HC in the prenatal period and HC in the postnatal period. HC is a picture of brain development in which during the prenatal period, the brain is very vulnerable so that brain development is not only determined by congenital factors but also pregnancy conditions and postnatal environmental factors.[2,17] HC at birth reflects HC in prenatal period which is associated with cognitive and motor development at 2 years of correction.[18]

The growth of children in the prenatal and postnatal period might be influenced by several factors. In another study, it was stated that genetics affects fetal growth.[19] Maternal factors that affect a child's weight are diabetes mellitus, smoking, and hypertension. Meanwhile, fetal factors that can influence, namely gender, also affect growth in the prenatal period.[19] In the research that has been done, it was found that children who live in urban areas have better weight compared to children who live in rural areas because more children living in rural areas suffer from infectious diseases, this can be influenced by the mother's education. Mother's education may be directly proportional to mother's knowledge about nutrition and also healthy lifestyle.[20]

The discrepancy obtained in this study with previous research is due to limitations in the study. Limitations of the study include the level of confidence in this research was 90%, therefore the number of subjects involved in this study is less than previous studies. If the number of subjects was more varied and the sampling method was different, it is possible to obtain different results from this study. This study also did not pay attention to the nutritional intake of mothers during pregnancy and in the children, and did not pay attention to the history of the disease in children.

CONCLUSIONS

Based on the results of the study, there is a relationship between ultrasound parameters during pregnancy and the growth of children aged 2 – 3 years. Further research can be done on ultrasound parameters in the first 1,000 days of life using cohort or case-control research methods. In future research, it is important to consider the history of the child's disease and the nutritional intake.

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