

## Changes in the length of the fetal femoral percentile associated with giving zinc to pregnant women



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### ABSTRACT

**Background:** Pregnancy is a uniquely critical and sensitive period in a woman's life. The pregnancy conditions are determinants in the successful growth of the fetus and baby. Zinc is important in fetal bone growth (ossification) because zinc deficiency in pregnancy can interfere with fetal bone formation. Being short (stunted) at birth is associated with a high risk of shortness in childhood and adulthood. Several ultrasound parameters can assess the intrauterine growth and development of the fetus, one of which is the length of the femur: the measurement of the length of the femur can detect intrauterine stunting early. The objective of this study was to investigate the average length of fetal femurs in pregnant women given zinc tablets and assess differences in the percentile changes in fetal femoral length between pregnant women given zinc tablets and those not given zinc tablets.

**Methods:** This prospective design observational analytic study was conducted at Universitas Sumatera Utara Hospital and other hospitals from June to November 2019. Eligible subjects were pregnant women who met the inclusion criteria and were collected with consecutive sampling techniques.

**Results:** Fetal femur length was examined using ultrasonography on 31 subjects given zinc tablets and 31 who were not. The average fetal femur length prior to treatment was 61.97 mm (SD=8.13 mm) and 58.84 mm (SD=9.37 mm), respectively. There was no significant difference in the mean length of fetal femurs ( $p=0,110$ ) prior to treatment. Fetal femur length increase in subjects given zinc tablets was 27.74 mm (SD=5.32 mm), whereas in subjects not given zinc tablets was 23.08 mm (SD=2.81 mm).

**Conclusion:** There were significant fetal femoral length percentile changes in pregnant women given zinc tablets.

**Keywords:** fetal femur length, zinc, pregnant women.

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## INTRODUCTION

Nutrition significantly influences growth, especially in the first year of life in the womb. Inadequate food quality during pregnancy is one of the causes of fetal growth disorders. Macronutrients and micronutrients are crucial to maintaining the optimal growth of fetuses and infants.<sup>1</sup> Zinc is an important micronutrient in growth. Eighty-two percent of pregnant women worldwide suffer from zinc deficiency, caused by increased demand, food containing only small amounts of zinc, and food that may inhibit zinc absorption.<sup>2</sup>

Zinc is a nutrient that plays an important role in many bodily functions, such as cell growth, cell division, body metabolism, immune function, and development. Zinc supplementation has a significant positive

effect on weight gain and height and can increase linear growth.<sup>3</sup> Several ultrasound parameters can assess fetal growth and development in the womb. One is the measurement of femur bone length, which can detect intrauterine stunting early.<sup>4</sup> A maternal nutritional condition during pregnancy is known to affect intrauterine fetal growth and development: this can be seen from changes in the length of the femur at each gestational age.<sup>5</sup> This study aimed to investigate the average length of fetal femurs in pregnant women and assess differences in the percentile changes in fetal femoral length between pregnant women given zinc tablets and those not given zinc tablets.<sup>6</sup>

## METHOD

This was an observational analytic study of a prospective design. The study was

conducted at Universitas Sumatera Utara hospital and other hospitals from June to November 2019. Subjects were pregnant women who fulfilled the inclusion criteria. Subjects were collected with consecutive sampling techniques. Pregnant women whose nutritional status was poor, who were pregnant with twins or whose fetuses were known to have congenital anomalies were excluded.

Basic data collection was achieved through interviews with the research subjects. Ultrasound examination was performed on the research subjects by measuring the fetal femur length. Zinc tablets at a dosage rate of 20 mg/day were given to the treatment group for 12 weeks, while in the control group, no zinc tablets were given. After 12 weeks, ultrasound examination in the treatment and control groups measured the fetal femur length.

Univariate and bivariate analyzes were performed on the data in this study. Univariate analysis was performed to obtain the distribution of characteristics of research subjects. Bivariate analysis was performed to assess changes in fetal femoral display percentiles following the zinc administration. The analysis was performed using the SPSS software, version 20.0. Statistical significance was considered at a p-value <0.05 with a 95% confidence interval. This study was approved by the Health Research Ethical Committee, Faculty of Medicine, Universitas Sumatera Utara (No.249/TGL/KEPK FK USU-RSUP HAM/2019).

## RESULTS

From June to November 2019, 62 research subjects were collected. The research subjects were divided into two groups: pregnant women who were given zinc tablets (the treatment group) and pregnant women who were not given zinc tablets (the control group). Each group comprised 31 subjects. Table 1 shows the study subjects' characteristics.

A slight majority of the subjects in the two groups were 25-29 years. There were no differences in the characteristics of the two groups' subjects based on age. Most of the subjects in the two groups weighed 50-60 kg. There were no differences in the characteristics of the two groups' subjects based on maternal weight. Most of the subjects in the two groups were 150-160 cm tall. There were no differences in the characteristics of the two groups' subjects based on maternal height. Most subjects in the two groups had an upper arm circumference of 20-25 cm. There were no differences in the characteristics of the two groups' subjects based on maternal upper arm circumference. A majority of the subjects in the two groups were secundigravid. There were no differences in the characteristics of the two groups' subjects based on maternal parity.

Table 2 describes the results of femur length measurements, including mean values, SD, shortest size, longest size, and 10, 25, 50, 75, and 90 percentiles in the maternal group given zinc and in the control group before and after treatment. Before treatment, there were no differences in the mean length of fetal femurs between

**Table 1. Characteristics of the subjects.**

Characteristics	Treatment (n = 31)	Control (n = 31)	P
Maternal age (years)			
20-24	5 (16,1)	4 (12,9)	0,730 <sup>a</sup>
25-29	14 (45,2)	14 (45,2)	
30-35	12 (38,7)	13 (41,9)	
Maternal weight (kg)			
50-60	21 (67,7)	20 (64,5)	0,813 <sup>a</sup>
61-71	7 (22,6)	8 (25,8)	
>71	3 (9,7)	3 (9,7)	
Maternal height (cm)			
150 – 160	24 (77,4)	27 (87,1)	0,319 <sup>b</sup>
161 – 171	7 (22,6)	4 (12,9)	
Upper arm circumference (cm)			
20 – 25 cm	20 (64,5)	20 (64,5)	1,000 <sup>b</sup>
26 – 31 cm	11 (35,5)	11 (35,5)	
Parity status			
Primigravida	8 (25,8)	8 (25,8)	0,956 <sup>b</sup>
Secundigravida	14 (45,2)	13 (41,9)	
Multigravida	9 (29)	10 (32,3)	

<sup>a</sup>Kruskal Wallis, <sup>b</sup>Chi Square

**Table 2. Descriptive statistics of fetal femur length before and after treatment.**

	Treatment (n = 31)	Control (n = 31)	p*
<b>Pre</b>			
Mean	34,23	35,16	0,683
SD	8,88	10,28	
Min – Max	20 – 51	20 – 52	
Percentile			
10	22	21,2	
25	25	25	
50	36	35	
75	42	46	
90	45	49	
<b>Post</b>			
Mean	61,97	58,84	0,110
SD	8,13	9,37	
Min – Max	44 – 76	47 – 74	
10	50	48,2	
25	55	51	
50	63	57	
75	67	69	
90	73,6	73	

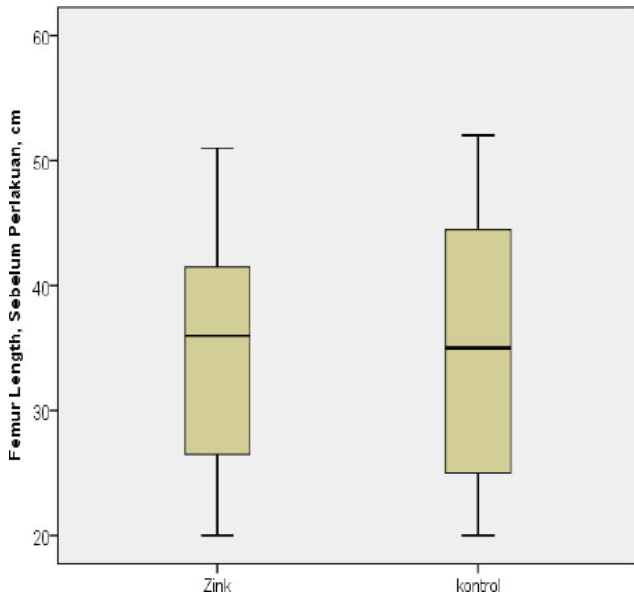
\*Mann-Whitney test

the two study groups after being tested with the Mann-Whitney test.

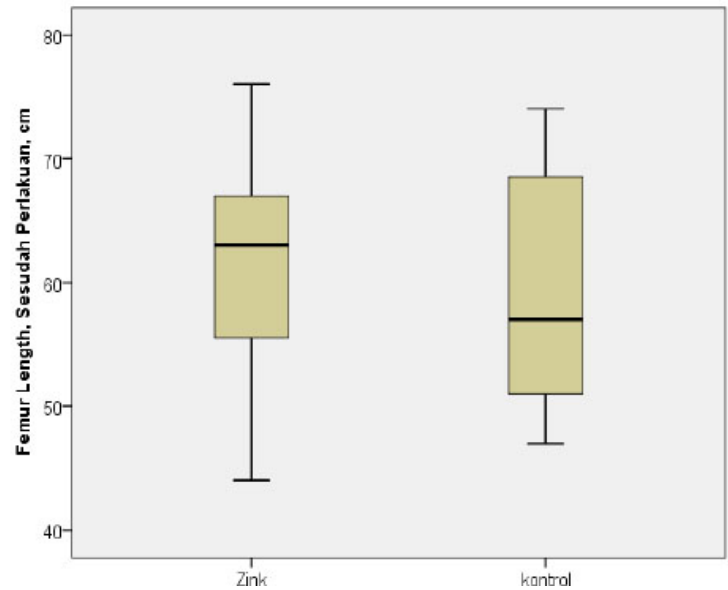
After treatment, the fetal femurs in the maternal group given zinc appear to be longer, with an average length of 61.97 mm, while the average length of the fetal femurs in the control group is 58 mm. However, after treatment, the Mann-Whitney test showed no significant mean

differences in fetal femur length between the zinc and control groups.

Table 3 shows the change in fetal femoral length after treatment. The study's results showed that the length of the fetal femur in the group given zinc was greater than the control group. Femur length increase in the group given zinc was 27 mm, while in the group not given zinc,



**Figure 1.** Boxplot chart displaying the length of the fetal femur before treatment in the maternal group given zinc and the control group.



**Figure 2.** Boxplot chart displaying the length of the fetal femur after treatment in the group given zinc and the control group

**Table 3. Differences in changes in femur length between the maternal group given zinc and the control group.**

	Zinc (n = 31)	Control (n = 31)	P
Change in length of the femur			
Mean	27,74	23,68	<0,001
SD	5,32	2,81	
Median	28	23	
Min – Max	3 – 33	18 – 29	

length increased by 23 mm. The analysis using the Mann-Whitney test concluded a significant difference in the increase in fetal femur length between the maternal group given zinc and the control group.

## DISCUSSION

Zinc is important for pregnant women because it affects fetal development. It is essential to meet the needs of fetal intake and is related to the absorption rate of zinc micronutrients in the body.<sup>7</sup> The World Health Organization (WHO) says that zinc deficiency in pregnant women can harm fetal development and cause poor births.<sup>5</sup> Low zinc concentrations in plasma reduce placental zinc transport and can affect the supply of zinc to the fetus. A developing fetus will use zinc from its mother's food to convert protein into tissue and muscle growth.<sup>8</sup>

This study found significant changes in fetal femoral length in pregnant women

given zinc tablets. According to Idral Purnakarya from the faculty of medicine at Universitas Indonesia, it is not yet the case that the necessary zinc content has reached 100% of pregnant women in Indonesia.<sup>8,9</sup> Good zinc intake affects the development of the fetus: the baby will be born without having experienced growth disorders. This is because the formation of growth enzymes will have been sufficient.<sup>10,11</sup>

Low serum zinc levels in pregnant women can affect the growth and development of the fetus, causing hypogonadism, growth failure and low birth weight.<sup>12,13</sup> Zinc supplementation in pregnant women is necessary because zinc needs are increased during pregnancy: the condition requires about 20 mg of zinc per day. Several studies suggest that zinc supplementation can improve the state of pregnancy and its outcomes.<sup>14-16</sup> Zinc regulates calcitonin secretion from the thyroid gland and affects bone turnover. Zinc serves as an activator for bone

formation. Recent studies have shown how zinc regulates bone matrix calcification in osteoblasts.<sup>17</sup>

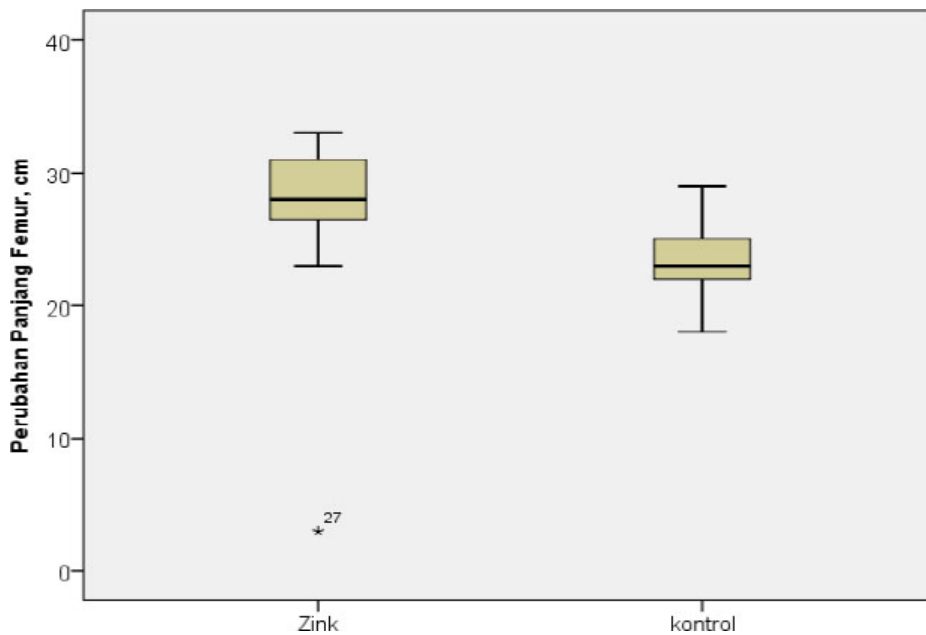
Several findings support the contention that zinc deprivation inhibits extracellular matrix calcification in osteoblasts through decreased synthesis and activation of protein matrices, type 1 collagen, alkaline phosphatase and decreased calcium and phosphorus buildup.<sup>18</sup> However, zinc deficiency can be considered a risk factor for poor extracellular matrix calcification.<sup>19,20</sup>

## CONCLUSION

In this study, no significant difference in the mean length of the fetal femur was found between the pregnant women given zinc tablets and the control group. Significant fetal femoral length percentile changes were found in pregnant women given zinc tablets.

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**Figure 3.** Boxplot chart displaying changes in fetal femur length increase in the group given zinc and the control group.

## AUTHOR CONTRIBUTION

All authors contributed equally in all aspects regarding the publication of this case report.

## CONFLICT OF INTEREST

None.

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