Research Article

Serum Zinc Level at Term Pregnancy and Newborn Anthropometry

Kadar Zink Serum Ibu Hamil Aterm dengan Antropometri Bayi Baru Lahir

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Abstract

Objective: To determine the relationship between serum zinc level at term pregnancy and newborn anthropometry.

Methods: This study is an observational study with cross-sectional design. Serum zinc level at term pregnancy was measured and then anthropometric measurement was done to the newborn, including birth weight, birth length and head circumference at birth. The data were statistically analyzed using regression correlation test.

Results: Mean serum zinc level at term pregnancy is 36.01 μg/dl (SD=18.34 μg/dl), the average birth weight is 3158 gr (SD=480.4 gr), the average birth length is 48.42 cm (SD=1.75 cm) and the average head circumference at birth is 33.13 cm (SD=1.14 cm). There was no statistically significant relationship between serum zinc levels at term pregnancy and birth weight (p-value=0.152). Meanwhile, there are statistically significant relationships between serum zinc level at term pregnancy with birth length and head circumference with p-value 0.026 and 0.012, respectively.

Conclusion: Serum zinc level at term pregnancy is correlated with birth length and head circumference, but is not correlated with birth weight.

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Keywords: birth length, birth weight, head circumference at birth, serum zinc level, term pregnancy

Abstrak

Tujuan: *Untuk mengetahui hubungan kadar zink serum ibu hamil aterm dengan antropometri bayi baru lahir.*

Metode: *Penelitian ini merupakan penelitian observasional dengan desain potong lintang. Dilakukan pengukuran kadar zink serum pada ibu hamil aterm, kemudian dilakukan pengukuran antropometri bayi baru lahir yang meliputi berat badan, panjang badan dan lingkar kepala lahir. Data dianalisis menggunakan uji korelasi regresi.*

Hasil: *Rerata kadar zink serum ibu hamil aterm adalah 36,01 μg/dl (SD=18,34 μg/dl), rerata berat badan lahir adalah 3158 gram (SD=480,4 gram), rerata panjang badan lahir adalah 48,42 cm (SD=1,75 cm) dan rerata lingkar kepala lahir adalah 33,13 cm (SD=1,14 cm). Tidak terdapat hubungan antara kadar zink serum ibu hamil aterm dengan berat badan lahir dengan nilai p=0,152 (p>0,05), namun kadar zink serum ibu hamil aterm berhubungan dengan panjang badan lahir dan lingkar kepala lahir dengan nilai p masing-masing 0,026 dan 0,012 (p<0,05).*

Kesimpulan: *Kadar zink serum ibu hamil aterm berhubungan dengan panjang badan dan lingkar kepala lahir, namun tidak berhubungan dengan berat badan lahir.*

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Kata kunci: *berat badan lahir, kadar zink serum, kehamilan aterm, lingkar kepala lahir, panjang badan lahir*

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INTRODUCTION

Millennium Development Goals (MDGs) set their goal to decrease infant mortality by two-thirds within 1990-2015.[1] But data from WHO recorded that the number of infant mortality and neonatal mortality in 2013 were 37 and 22 per 1000 births, and it was still considered high. Data from the Indonesian Health and Demographics Survey shows that the number of infant mortality in Indonesia is still considered to be high; around 32 from 1000 births. It was far from the MDGs 2015 target, with the expectation to decrease the number of infant mortality to 23 per 1000 birth.[2]

Low Birth Weight (LBW) was one of the major risk factors that contribute to 60 to 80% of neonatal death. The world prevalence of LBW is around 15.5%; 96.5% of them coming from developing countries.[3] Data from Basic Health Research (Riskesdas) in 2013 mentioned that the Indonesian prevalence of LBW in 2013 was 10.2%. As for West Sumatra, the prevalence of LBW was 7.5%, which was higher than 2010 (6%).[4]

In developing countries, intrauterine growth restriction (IUGR) mainly occurs because of poor nutrition in expectant mothers during their pregnancy.[5] The prevalence of IUGR in developing countries is 40% higher compared to that of modern countries that ranged around 10%. IUGR tends to cause short-term effects such as the escalation of mortality during the fetal life, neonatal period and infantry. It also causes growth, immune and intellectual disorder. As for the long-term effects, the infants tended to have chronic diseases when they reached adulthood, such as heart attack and diabetes type 2.[6]

Expectant nutrition is one of the determining factors during pregnancy; as it would help the infant to grow healthy inside their mother.[7] However, expectant mothers in developing countries consumes poor quantities of micro-nutrients during their gestation.[8] Around 82% of expecting mothers in developing countries have zinc deficiency;[9] and more than 80% of expecting mothers around the world consumes poor quantities of zincs.[10] In Indonesia, the prevalence of zinc deficiency in expecting mothers was found to be high. In East Nusa Tenggara (NTT), almost 71% of expecting mothers have zinc deficiency; and for Central Java it was around 70 until 90%.[11]

Zinc has been considered to be important throughout the gestation process, it is needed in the synthesis of both nucleic acid and proteins.[12] Zinc plays a significant role to support the function of several enzymes and growth hormones during pregnancy.[13] Zinc would regulate the growth hormones and Insulin-like Growth Factor-1 (IGF-1). This is the reason why zinc deficiency would lead to a decline in cell proliferation and protein synthesis that leads to infant growth disorder.[14]

METHODS

This research was conducted in the maternity section of RSUP Dr. M. Djamil Padang from February 6th until April 24th 2014. The samples for this research were taken from expecting mothers in RSUP Dr. M. Djamil Padang, West Sumatra who met the inclusion and exclusion criteria. Inclusion criteria involved expecting mothers with term singleton pregnancies, and living newborn. As for the exclusion criteria, it includes expecting mothers who were not willing to take part in the research, expecting mothers with infectious diseases during their gestation, expecting mothers with anemia, diabetes mellitus, hypertension, preeclampsia, and having a newborn with congenital disorder.

The level of serum zinc was measured using Zinc Colorimetric Assay Kit. The weight of the newborn baby was measured using GEA brand scale, and the length of the newborn baby was weighed using the measuring board; centimeter tape was used to measure the baby's head circumference.

Blood sample of the expecting mothers were taken before they delivered the baby. When the babies were born, anthropometric measurement was conducted to record the birth weight, birth length, and head circumference at birth on his/her first hour. The data were analyzed using regression correlation statistical tests.

RESULTS

From the observation, we included 38 expecting mothers with pregnancy at term, who fulfilled the inclusion and exclusion criteria.

Table 1. The Distribution of Maternal Serum Zinc Level, Birth Weight, Birth Length and Head Circumference at Birth of the Newborn Baby

	n	Mean	SD	%
Serum Zinc Level (μg/dl)	38	36.01	18.34	
≥ 56	4			10.5
< 56	34			89.5
Birth Weight (gram)	38	3158	480.4	
< 2500	2			5.3
2500-4000	35			92.1
> 4000	1			2.6
Birth Length (cm)	38	48.42	1.75	
48-52	28			73.7
< 48	10			26.3
Head Circumference at Birth (cm)	38	33.12	1.14	
33-37	27			71.1
< 33	11			28.9

Table 1 showed that maternal serum zinc level <56 μg/dl occurred in 34 term expecting mothers (89.5%), the average serum zinc level was 36.01 μg/dl (SD=18.34 μg/dl). From the anthropometric measurement, it was recorded that 39 babies (92.1%) weighed around 2500-4000 grams with average weight of 3158 grams (SD=480.4 gram). The length of 28 newborn babies (73.7%) was in the range of 48-52 cm with average length of 48.42

cm (SD=1.75 cm). In terms of the head circumference, 28 babies (71.1%) had their head circumference measured at the range of 33-37 cm, with the average head circumference at birth to be 33.13 cm (SD=1.14 cm).

Figure 2 showed a positive correlation between serum zinc level at term pregnancy and the birth length of the newborn baby. However, both of them have a weak relation (r=0.360), but it was found to be statistically significant (p=0.026).

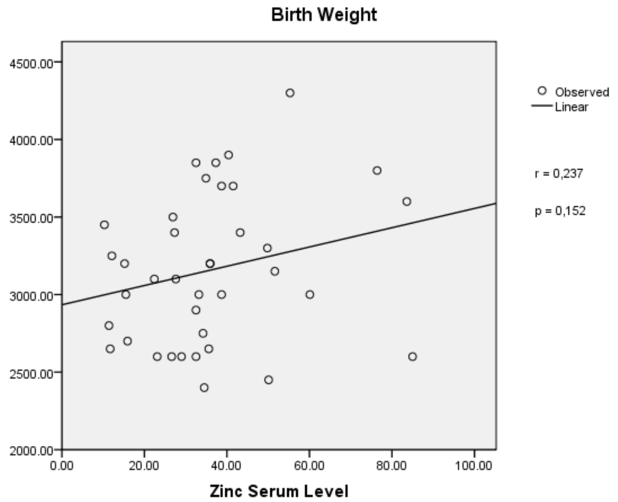

Figure 1. The Relationship between Serum Zinc Level in Term Pregnancy and Newborn Baby's Weight

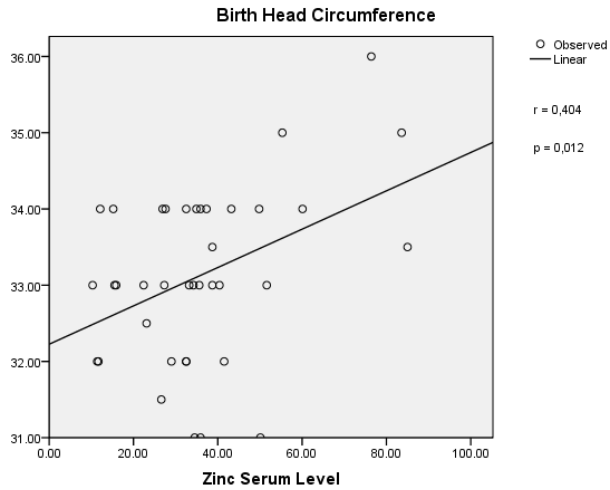

Figure 3. The Relationship between Serum Zinc Level in Term Pregnancy and Newborn Baby's Head Circumference

Figure 1 showed that serum zinc level and newborn baby's weight had a positive correlation. But the correlation between those two factors was only weak (r=0.237), and it showed no statistical significance (p=0.152).

Figure 3 showed that serum zinc at term pregnancy and baby's head circumference at birth had a medium positive correlation (r=0.404), which was found to be statistically significant around (p=0.012).

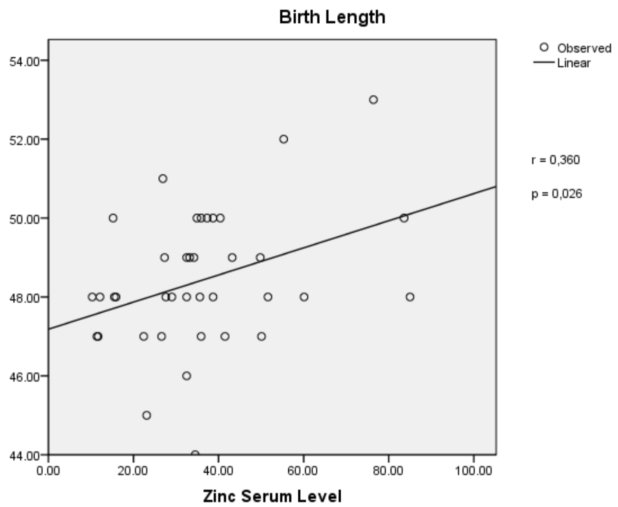

Figure 2. The Relationship between Serum Zinc in Term Pregnancy and the Newborn Baby's Length.

DISCUSSION

From the observation during the research, 89.5% of expecting mothers with term pregnancy had zinc deficiency. The prevalence of zinc deficiency in expecting mothers during the research observation was higher than Widagdo's observation in 2006 in Jakarta that recorded 48% of expecting mothers had zinc deficiency.[15] In 1996, both in East Nusa Tenggara (NTT) and in Central Java; the prevalence of zinc deficiency has been previously observed. The percentages are high; both of them showing the prevalence to be around 71% and 70-90%.[11]

Countries around Asia also showed high prevalence of zinc deficiency in expecting mothers. As much as 45% of Chinese expecting mothers experienced zinc deficiency during their third trimester, Bangladesh recorded 55% expecting mothers had zinc deficiency during the gestation period, while India recorded 65% of this condition.[16]

From the observation, it was also seen that from 38 babies; 2 of them were born with birth weight less than 2500 gram. It was lower than that in Widagdo's observation in 2006 that recorded 9.3% of newborn baby weighing less than 2500 gram. Ten babies (26.3%) from 38 babies had body length less than 48 cm, 11 babies (28.9%) were born with head circumference less than 33 cm. However, the average for weight, length and head circumference were still within the normal range.

This research was quite similar to the previous research by Widagdo in 2006 in Jakarta. It recorded that the average measurement of newborn babies weighed around 3064 gram (SD=450 gram), length measuring 48 cm (SD=2 cm), and head circumference of 33 cm (SD=2 cm).[15] Meanwhile, Dehkordi's observation in India (2013) recorded that the average birth weight, length, and head circumference on babies from their sample of expectant mothers with normal zinc level were successively 3229 gram, 50.32 cm and 34.73 cm. The weight, length, and head circumference of the newborn babies from the expectant mothers with low zinc level is ranged around 3092 gram, 50.10 cm and 34.48 cm. It showed a significant difference in weight, length, and head circumference that occurred in babies from mothers with normal and low zinc level.[17]

The result from the correlation regression statistical test showed that zinc serum level on term expectant mothers was not corresponding to the weight of the baby ($p>0.05$). It showed that the increasing serum zinc level in expecting mothers would not increase the birthweight of the baby. Even if both of them had a positive correlation; but it carries no significance in increasing the baby's weight.

Osendarp's research result in 2000 noted that consuming zinc supplement around 30 mg/day during the last trimester would not be significant in increasing the baby's weight. The average baby's weight from expecting mothers that consumed zinc supplement and expecting mothers as comparator were 2513 (SD=390) and 2554 (SD=393) gram.[18] Norrozi's research in 2012 that took place in Iran also showed that consuming zinc supplement for 25 mg/day did not increase the baby's weight compared to expectant mothers who did not consume the supplement. The baby's weight on both arms were found to be around 3142 (SD=452) and 3230 (SD=527) gram.[19]

On the other side, India's researcher Dehkordi observed a significant relationship between zinc level in expecting mothers and the baby's weight ($p=0.007$). The average birth weight from expectant mothers with normal zinc level was higher than babies from expectant mothers with abnormal zinc level. Mojgan et al who conducted the research in Iran in 2012 also recorded that serum zinc level in expectant mothers were significant to the baby's weight. Expectant mothers with low zinc level tended to give birth to the baby with low average weight compared to expectant mothers with normal zinc level. Their risks to give birth to low weight baby were found to be 12 times higher.[20]

There are several factors that explained the inconsistency in the results of the research focusing on serum zinc level in correlation to the baby's weight. It could happen because of a low index of accuracy in the expectant mother's zinc level, small number of samples, the time and duration in consuming zinc supplements, expectant mother's weight, digestive illnesses, and dietary factors that have a great influence on zinc bioavailability.[21]

The result of regression statistic test showed a significant relationship between serum zinc level on term expectant mothers and the length of the newborn baby ($p<0.05$). The result showed that high serum zinc level on expectant mothers was usually followed by the increase of the newborn baby's length. It showed a positive relationship between both variables, so from the statistical point it could be said that the increasing zinc level on expectant mothers had a significant influence to the increasing baby's body length.

Merialdi's research in Peru (2004) observed a positive effect between prenatal zinc supplementation with a dose of 25 mg/days and the baby's femur length. Expectant mothers who consumed zinc supplements tended to have a baby with longer femur length compared to expectant mothers who did not consume zinc supplements. Prawirohartono et al in their research in Central Java, Indonesia (2013) also recorded that consuming zinc supplements yields a higher length in the newborn baby (48.8 cm) compared to the babies born from the control group (48.5 cm).[22]

Zinc plays an important role in bone metabolism, as shown on animal trials. Zinc stimulates bone metabolism, bone protein synthesis, and bone formation on tissue engineering, by increasing the main enzyme activities such as alkaline phosphatase. Zinc was also important to increase the anabolic effect of IGF-1 on osteoblasts. It is important to shape and mineralize bone's extracellular matrix during endochondral ossification. Zinc also plays an essential role in obstructing osteoclastic activities, which is responsible for bone resorption.[23]

From the result of correlation regression statistical test, there was a significant relationship between the level of serum zinc on expectant mothers and the baby's head circumference ($p<0.05$). Both aspects showed a significant relationship since the increase of zinc level in expectant mothers would be followed by the increase of the baby's head circumference.

Surkan's research in Nepal in 2012 was focused on the consumption of zinc supplement as micronutrient support and its relation to baby's head circumference. It recorded that consuming zinc supplements brought benefit to the baby's brain growth.[24] Tamura in his research that took place in USA in 2003 recorded that expectant mothers who consumed zinc supplements have a propensity to give birth to babies with a head circumference 0.4 cm larger than the babies from the comparator group. The escalation of baby's head circumference indicated a healthy brain growth.[25] Zinc is important for the baby's brain growth, and zinc deficiencies lead to a decrease of DNA synthesis on brain tissue that would result in declining brain tissue growth.[26] Zinc is an enzymatic cofactor that governed both protein and DNA biochemistry. Zinc deficiency would degrade the DNA, RNA, and brain protein system in infants. Zinc also controls both IGF-1 and the expression of gene receptor on baby's growth hormone that influence the infant's brain growth. Natural neurotropic factors had its own role in producing cell proliferation and differentiation during the normal brain growth and maturity.[27]

CONCLUSION

There is a relationship between zinc level in expectant mothers with newborn baby's body length and head circumference, but it showed no significant relationship to newborn baby's weight.

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