



## INSULIN CORTISOL RATIO IN ADULTS WITH LOW BIRTH WEIGHT

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### ABSTRACT

**Objective:** A prospective case -control study was conducted to correlate serum insulin and cortisol levels with the birth weights of the subjects of the study. **Materials and Methods:** 50 normal adults of age group 17-25 were selected for the study. Detailed protocol and record were developed for each subject and relevant data were recorded.

Depending on their birth weights, they were grouped into 2; group I with normal birth weights (2.5Kg and above) and group II with low birth weights (less than 2.5Kg). Fasting serum insulin and 8 AM serum cortisol were measured by direct immune enzymatic method. Statistical analysis was done. **Results:** Serum insulin level was found to be significantly decreased in low birth weight group. Serum cortisol was significantly higher in low birth weight adults. **Conclusion:** The present study shows that the insulin cortisol ratio is lower in adults who were born as low birth weight babies. So the determination of insulin cortisol ratio can be used as an index to find out the risk of development of diabetes in later life.

**KEYWORDS:** Diabetes Mellitus, low birth weight, insulin cortisol ratio.

### INTRODUCTION

In humans, blood glucose is stringently regulated by various mechanisms and maintained within a narrow range. A rise in the blood glucose level stimulates the secretion of insulin by  $\beta$  cells of islets of Langerhans of the pancreas. The uptake of glucose by most extra -hepatic

tissues, except brain is dependent on insulin. Insulin also influences the peripheral utilization as well as storage of glucose as glycogen or as fat. The effect of hormones like glucagon, epinephrine and glucocorticoids on glycogenolysis and gluconeogenesis are the major factors that keep the blood glucose level from falling. The hypothalamic-pituitary-adrenal (HPA) axis, the mediator of cortisol, plays a central role in the homeostatic processes that maintain normal range of blood glucose.

It has been already proved that there is a definite relationship between low birth weight and future development of diabetes.<sup>[1]</sup> The small size at birth is significantly associated with increased rates of occurrence of the metabolic syndrome (glucose intolerance, high blood pressure, and dyslipidemia) and related disorders like the cardiovascular disease in adult life.<sup>[1,2]</sup> Programming of hormonal systems in response to an unfavorable fetal environment may be one of the mechanisms fundamental to these long- term consequences. Especially, alterations in the neuroendocrine response to stress may play an important role.<sup>[3]</sup> It has also been suggested that increased adreno cortical and symphatho adrenal responses are associated with small size at birth.<sup>[4]</sup> Evidence from epidemiological studies shows that even subtle alterations in these neuro endocrine systems may have an influential role on the levels of cardiovascular risk factors including plasma glucose and lipid concentrations and blood pressure.<sup>[5]</sup>

It is well established that prenatal and postnatal environmental conditions may imprint the rodent HPAA, resulting in permanent modification of the neuroendocrine response to stress throughout life. Increased HPAA activity is seen in low birth weight, which leads to raised fasting plasma cortisol concentrations. Apart from these, patients with glucose intolerance have an apparently high cortisol secretion.

So there is a definite relationship between low birth weight and diabetes. Low birth weight babies are very common in our country. In the present study, we are trying to correlate the plasma insulin cortisol ratio with the birth weight of the subjects of study.

## **MATERIALS AND METHODS**

The subjects included a total of 50 students from MBBS and BDS courses studying in the Medical College. Subjects were normal healthy adults without any known disease. Age and body mass index were comparable. Blood glucose levels and Serum Albumin levels were measured which may influence the Serum insulin and cortisol levels. The subjects were

grouped into two according to their birth weight. Low birth weight group had a birth weight less than 2.5 Kg (group I) and normal birth weight group had a birth weight more than 2.5 (group II). Data regarding birth weight obtained from their parents. Informed consent obtained from all the subjects. 5ml of fasting blood sample was collected for investigation by venepuncture under aseptic precaution.

The parameters measured included the following; Blood glucose, serum albumin, serum insulin and serum cortisol.

## RESULTS

Statistical comparison of demographic and biochemical features between groups was done. The results were analyzed statistically using paired T-test and Mann-Whitney test. There were 27 males and 23 females. Group wise details of demographic features shown in Table I.

**Table 1: - Demographic data**

		<b>GROUP I</b>	<b>GROUP II</b>
Age in years	Mean	18.3	18.9
	Range	18 - 20	18 - 25
Sex (%)	Male	64	44
	Female	36	56
Weight in Kg	Mean	60.2	58.5
	Range	42 – 89	43 - 88
Body mass index	Mean	23.8	22.6

The mean values of investigation results summarized below

**Table 2: - Laboratory data**

	<b>GROUP I</b>	<b>GROUP II</b>
Blood Glucose (mg/dl)	76.5	76.4
Serum albumin (g/dl)	3.3	3.6
Serum cortisol (ng/ml)	234	137
Serum insulin ( $\mu$ U/ml)	10.1	13.2
Insulin cortisol ratio	0.108	0.266

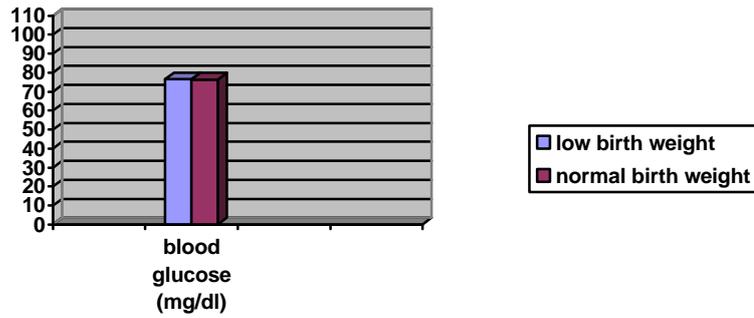


Figure 1: - Blood glucose (mg/dl)

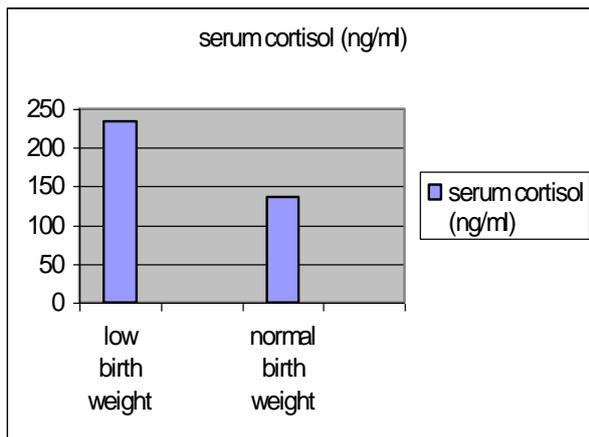


Figure 2:-Serum Cortisol(ng/ml)

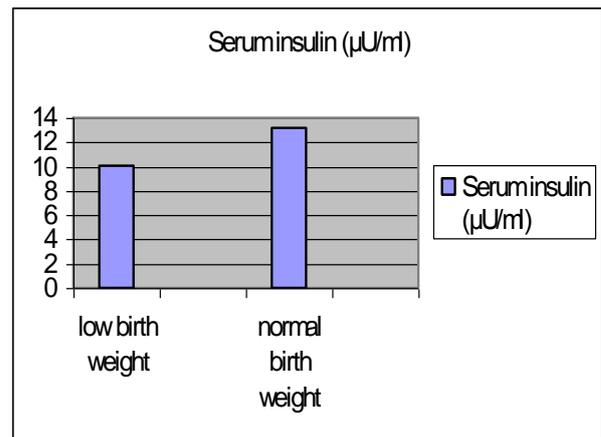


Figure 3:-Serum insulin(µU/ml)

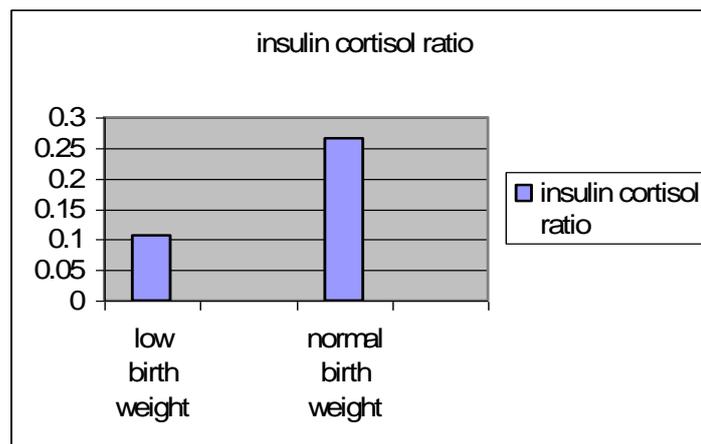


Figure 4:- Insulin Cortisol Ratio

Table 3: - Test Statistics

	S. Insulin	S. Cortisol	Insulin cortisol ratio
Mean difference	-3.0856	96.4800	-.1578
P value	.046	.000	0.000

The p-value is significant if less than .05 level.

The results presented in Table 3 show that the serum insulin, serum cortisol and insulin cortisol ratio differ significantly between low birth weight and normal birth weight adults.

## DISCUSSION

Serum insulin and serum cortisol levels are important parameters in assessing the glucose homeostasis in the body. Various studies report a link between birth weights of the subjects with the levels of these hormones.

Philips.D.I.W. *et. al.* examined the relations among size at birth, plasma cortisol concentrations, and components of the metabolic syndrome in a sample of healthy men aged 59-70 yrs. They measured 0900 h fasting plasma cortisol levels in 370 men who were born in Hertfordshire, UK, during the period 1920-1930 and whose birth weights were recorded. Fasting plasma cortisol levels varied from 112-702 nmol/L and related to fasting plasma glucose concentrations and insulin resistance ( $P = 0.006$ ). Plasma cortisol concentrations fell progressively ( $P = 0.007$ ) from 408 nmol/L in men whose birth weights were 2.50 kg or less to 309 nmol /L among those whose birth weights were 4.31 kg or more, a trend independent of age and body mass index. These findings suggest that plasma concentrations of cortisol within the normal range have an important effect on glucose tolerance.<sup>[6]</sup>

Fall. C.H.D. *et.al.* studied 24-h serum cortisol profiles in 83 healthy elderly men and women whose birth weight and infant weight are recorded. It was not related to birth weight, weight at 1 yr, or change in weight. Inconsistent with other studies, 0730-0900 h cortisol concentrations were higher in men and women of lower birth weight, even though this was not statistically significant ( $P 0.08$ ). These findings do not support the hypothesis that reduced intrauterine and infant growths are associated with continuously raised cortisol concentrations in old age.<sup>[7]</sup>

Chaoyang *et al.* examined the effects of low birth weight on the components of insulin resistance syndrome in Caucasian and African-American children aged 4-14 years. According to their study, LBW was significantly associated with increased fasting insulin concentration and visceral fat mass, and  $\beta$ -cell function among African-American children. Among children with LBW, there were noteworthy differences in fasting insulin, insulin sensitivity, and acute insulin response, between Caucasians and African- Americans. The hyperbolic function between insulin sensitivity and  $\beta$  cell function was retarded among

children with LBW. Also, there was a significant interaction between LBW and ethnicity in relation to fasting insulin and visceral fat.<sup>[8]</sup>

Naomi *et al.* measured glucose tolerance and anthropometry among twenty-year-old, South Africans with low birth weights [underweight for age] and normal birth weights [appropriate for gestational age]. In a subset, 0900 h plasma cortisol concentrations were measured. Although the UFA group was smaller and lighter, with a lower body mass index, they had higher fasting plasma glucose levels, and a greater proportion demonstrated glucose intolerance. Plasma cortisol levels determined at 0900 h were higher in the UFA group.<sup>[9]</sup>

In the present study, it was found that serum cortisol is significantly high in low birth weight individuals as compared to the group II. Serum insulin (p .046) and insulin cortisol ratio (0.000) were significantly low in low birth weight group.

According to Philips. D. I. W. *et al.* the fasting plasma cortisol concentrations were inversely related to birth weight (p .007). Results of our study agree with this finding.

In the study conducted by Fall. C.H.D. *et al.* the serum cortisol concentrations were higher in low birth weight group, but not statistically significant (p .08).

Chaoyang *et al.* reported that among African- American and Caucasian children LBW was significantly associated with higher fasting insulin. (p< .05). But our study shows low fasting insulin level in low birth weight group (p .046). This finding may be due to the difference in ethnicity.

Naomi *et al.* showed that fasting glucose and plasma cortisol levels are higher in low birth weight group. But both the groups in the present study have no significant difference in fasting blood glucose level but serum cortisol levels were high in low birth weight group.

So the present study shows that there are significant variations in serum insulin and serum cortisol levels depending on birth weight of the individual. Hence, insulin cortisol ratio can be used as a tool to assess the changes in glucose homeostasis. In the present study, insulin cortisol ratio is less than 0.15 in low birth weight group. In normal birth weight group, it is around 0.25.

## CONCLUSION

In the present study, insulin cortisol ratio is lower in low birth weight adults compared to normal birth weight adults. As low birth weight persons have a higher chance of developing diabetes in future, low insulin cortisol ratio may have a link with the development of diabetes. So measuring insulin cortisol ratio of young people will help to find out persons who are at risk of developing diabetes. So, preventive measures can be started early.

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