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Correlation of Fetal Dimensions with the Nutritional Status of Mother as Determined by History, Body Weight and Hemoglobin Estimation

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SUMMARY

Women having larger babies tend to have greater increases in their basal metabolic rate and lower rates of maternal energy storage. When intakes fall below the threshold, fetal growth and development is affected more than is maternal health. Studies of protein and energy metabolism illustrates the potential of adjusting the use of those nutrients to conserve a fetal supply. The purpose of this study was to find out any significant co-relation between fetal dimension i.e. Biparietal diameter and femur length and maternal nutrition status as determined by taking history about caloric intake per day, maternal weight and haemoglobin estimation. One hundred normal pregnant females attending antenatal clinic of Shaikh Zayed Hospital were examined irrespective of their age, parity and gestational age. Fetal dimensions were measured by ultrasound examination at 15 weeks, 24 weeks and 36 weeks of gestation. Maternal caloric intake per day was calculated by taking nutritional history. Maternal body weight was measured by doing general physical examination. Haemoglobin was measured by taking blood sample. Statistical analysis was done, which showed wide variation in caloric intake per day (1500-2700 cal/day). Maternal body weight ranges from 47-96kg with mean of 66.29 kg and having standard deviation of 10.55. Minimum maternal haemoglobin was 7.5gm/dl while 14.3 gm/dl was the maximum with mean of 11.3 gm/dl. Significant co-relation ($p<0.01$) was seen among fetal dimensions at 24 weeks and maternal caloric intake, body weight and haemoglobin. We concluded that the relationship between maternal nutrition and fetal growth was highly significant. Improved fetal outcome in developing countries need to address the problem of maternal health.

INTRODUCTION

Pregnancy consists of series of small continuous Physiologic adjustments that affects the metabolism of all nutrients. Changes in maternal food and physical activity, behaviour during gestation may augment the physiological adjustments[1]. Appropriate nutrient partitioning between the maternal body and gravid uterus is essential for optimal growth and neonatal survival [2].

In order to support optimal weight gain during pregnancy sufficient energy must be consumed. Energy is required for

1. The deposition of new tissue associate with pregnancy.
2. The increased metabolic expenditure to maintain the new tissue.
3. The increased energy needed to move the pregnant body around. If basal energy needs increase from 0.9–1.1 K cal/min, the increased energy needed for metabolism totals about 300 K cal per day.

Recommended energy intake between 15-50

years of pregnant females ranges from 1500–2700 K cal/day[3]. Pregnancy requires additional maternal absorption of iron. Severe anaemia (haemoglobin <80g/L) is associated with the birth of small babies (from both preterm labor and growth restriction).[4] The risk of fetal death is greatly increased with severe anemia, of Hb < 70 or 80 gm/L; there is little increased risk associated with mild or moderate anemia[5].

The gestational age of the fetus during pregnancy can be estimated using a wide variety of sonographic measurements. Historically Biparietal diameter (BPD) has been most widely used and has proved quite reliable.

The accuracy of Femur length (FL) measurement equals that of before 30 weeks and probably exceeds that of BPD near term. BPD ranges from 2.0–9.6 cm between 12–40 weeks FL ranges from 10–80 mm between the above said weeks[6]. The relationship between maternal nutritional and fetal growth (as determined by measuring fetal dimensions) is more complex than might be first assumed[7].

This paper examines the links between fetal dimensions that indicate fetal growth and maternal nutritional status which is determined by taking history about caloric intake / day, Physical examination and hemoglobin (Hb) level in the blood.

SUBJECTS AND METHODS

One hundred pregnant females attending the antenatal clinic of Shaikh Zayed Hospital were examined. All females were in the second trimester at the time of examination. Informed consent was obtained from each subject. Caloric intake per day was calculated by taking nutritional history. General physical examination was done. Height and weight were measured. Hemoglobin was measured in the Hematology Laboratory of the above-mentioned hospital. Pelvic ultrasound was done by the Radiology department of above mentioned hospital during the second and third trimester to see the fetal growth by measuring the BPD and FL. All females attending antenatal clinic were included, irrespective of their age, parity and gestational age. Females suffering from diabetes mellitus, pregnancy induced hypertension, Liver disease, ischaemic heart disease were not included.

RESULTS

A total of one hundred normal pregnant females attending antenatal clinic of Shaikh Zayed Hospital were examined. Nutritional history of the mothers showed a wide variation in caloric intake ranging from 1500--2700 kcal/day with mean of 2005.58kcal and standard deviation (288.61). Maternal body weight ranges from 47kg-96kg with mean of 66.29kg and standard deviation of 10.55.

Maternal haemoglobin in the same pregnant females varies from 7.5gm/dl-14.3gm/dl. Maximum pregnant females had Hb value 11.324 gm/dl. Majority of the pregnant ladies were at the age of 25 years. Some females had age as less as 20 years while other had as more as 40 years.

Fetal dimensions i.e biparietal diameter (BPD) and femur length (FL) were measured at 15 weeks, 24 weeks and 36 weeks of gestation by ultrasound (Table 1).

Table 1: Calories, body weight, haemoglobin, age of mother and BPD and FL at 15, 24 and 36 weeks of gestation

	N	Mean	Std. Deviation
CALORIES/day	100	2005.58	288.61
Body weight (Kg)	100	66.29	10.55
Haemoglobin(gm)	100	11.324	1.289
BPD (15 wks)	100	4.545	1.281
BPD (24 wks)	100	6.742	.875
BPD (36 wks)	100	8.558	.502
FL (15 wks)	100	3.139	.765
FL (24 wks)	100	5.149	.839
FL (36 wks)	100	6.839	.503
AGE (years)	100	25.67	4.57
Valid N (listwise)	100		

Significant correlation ($p<0.01$) is seen between maternal caloric intake/day and biparietal diameter of the fetus at 24 weeks of gestation (Table 2). No significant co-relation was seen between maternal caloric intake/day and fetal femur length at 24 weeks of gestation.

Significant relationship was also observed between maternal body weight and fetal BPD and FL at 24 weeks of gestation (Table 4).

Table 2: Correlation between caloric intake and biparietal diameter and 24 weeks of gestation.

	Value	Df	Asym p Sig. (2-sided)
Pearson Chi-Square	644.563[a]	558	.006
Likelihood Ratio	274.695	558	1.000
Linear-by-Linear Association	.108	1	.742
N of Valid Cases	99		

a. 608 cells (100.0%) have expected count less than 5. The minimum expected count is .01

Table 3: Correlation between caloric intake and and femur length at 24 weeks of gestation.

	Value	Df	Asym p Sig. (2-sided)
Pearson Chi-Square	620.496[a]	576	.097
Likelihood Ratio	273.999	576	1.000
Linear-by-Linear Association	.741	1	.389
N of Valid Cases	99		

a. 627 cells (100.0%) have expected count less than 5. The minimum expected count is .01

Similarly significant correlation ($p<0.01$) was seen between maternal body weight and fetal FL at 24 weeks of gestation.

Table 5 showed significant correlation between maternal Hb and fetal FL at 24 weeks of gestation ($p<0.01$).

DISCUSSION

It is observed that there is a statistically significant co-relation between the incidence of intra uterine growth retardation and maternal weight of less than 45 kg, and with decreased value of hemoglobin[8]. In our study all indices of fetal growth showed significant relationship with maternal caloric intake, body weight and hemoglobin. Under weight women had a four fold higher risk of intra-uterine growth retardation[10].

The energy requirement of basal metabolism is influenced by maternal nutrition and by fetal size. If maternal energy reserves are low at conception the basal metabolic rate is down regulated to conserve energy[1].

Table 4: Correlation between biparietal diameter and body weight at 24 weeks of gestation.

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.[c]
BPD and Body weight					
Interval by Interval	Pearson's R	-.226	.098	-2.281	.025
Ordinal by Ordinal	Spearman Correlation	-.247	.091	-2.512	.014
N of Valid Cases		99			
Body weight and Femur length					
Interval by Interval	Pearson's R	-.258	.095	-2.635	.010
Ordinal by Ordinal	Spearman Correlation	-.278	.088	-2.850	.005
N of Valid Cases		99			

a. Not assuming null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Table 5: Correlation between haemoglobin and femur length at 24 weeks of gestation.

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.[c]
Interval by Interval	Pearson's R	.278	.096	2.855	.005
Ordinal by Ordinal	Spearman Correlation	.241	.106	2.447	.016
N of Valid Cases		99			

a. Not assuming null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Epidemiological studies have found association between high maternal hemoglobin concentration and increased risk of poor pregnancy out come. Accordingly higher than the normal hemoglobin concentration should be regarded as an indicator of possible pregnancy complication, not necessarily as a sign of adequate iron nutrition because supplement does not increase Hb higher than optimal concentration needed for O_2 delivery. An association between moderate anaemia and poor pregnancy outcomes has been found through epidemiologic studies.[9]

CONCLUSION

Reforms to achieve good maternal nutrition status pre-conception as well as through out the gestation best assure a good milieu for fetal growth and development.

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