5.0 SUMMARY

Good maternal nutrition is important for the health and reproductive performance of women and their health, survival and development of their foetus and infant from a clinical, etiologic or prognostic perspective. In developing countries, the health and nutrition of the female is affected by complex and highly inter-related biological, socio economic, cultural and health care related factors. In industrialized countries, the rapid economic development accompanied by modernization in lifestyles led to several problems similar to those of developing countries. Since, India is not clearly categorized as developed or developing country, the problem is still complicated. However, the situation is not dire. Epidemiologists believe that improved understanding of the biological mechanisms and socio-economic knowledge on practical aspects would provide a better reform to “Healthy India” investment rather than introducing piece meal policies like providing nutrition, tablets, injection, etc to provide a solid basis for health policy matters.

In the present study, an attempt has been made to assess the maternal serum, urine, hair elements and umbilical cord serum elements maternal and infant anthropometry in the high (n=198), middle (n=196) and low (n=190) income pregnant women (n=584) belonging to rural (n=196), urban (n=201) and metropolitan (n=183) by means of descriptive statistics and ‘t’ test. Multiple Linear Regression (MLR) models has also been adopted to analyze the correlation of Maternal socio economic status - education, type of delivery, income, type of marriage, sex of the infant, birth order Maternal anthropometry - height, weight, age, age square, maternal serum and umbilical cord elements - Zn, Cu, Li, Ca, Mg, Fe, TIBC, P, Na and K infant anthropometry - head circumference, chest circumference, crown heel length height
and mid upper arm circumference and infant birth weight in the three levels of
economy of the above said three populations. The influence of the maternal
anthropometry and socio-economic status on the health (Hypertension – Pregnancy
induced) condition of the pregnant women has been assessed by applying logistic
model. Factor Analysis was applied for the maternal serum, urine Zn, Li, Ca, Na, &
K, hair Zn, Cu, Cr, Cd & Mn and umbilical cord serum Zn, Cu, Li, Ca, Mg, Fe, TIBC,
P, Na & K elements to have a picture on the level of importance and impact of the
elements on maternal pregnancy.

The results obtained from the study have been summarized as follows:
A. The first section of the study shows the picture on the mean values of the maternal
serum, urine, hair and umbilical cord serum elements for high middle and low-
income group of rural urban and metropolitan populations.

1. In the case of maternal serum elements, in rural population when
compared to the HI, and MI groups LI group shows the lower value of Zn,
Cu, Ca, Mg, Fe, TIBC, P, Na & K, which are vital for the betterment of the
pregnancy and its outcome.

2. In urban population, when compared to HI and MI group Zn, Ca, Fe, TIBC
and P and K are the major elements found to be low in the LI group.

3. In metropolitan population Zn, Cu, Ca, Fe, TIBC and Na are found to be
less in LI group when compared to that of HI of MI groups.

4. Urine elemental analysis gives the view that the excretory levels of the
elements in the HI, MI and LI group of rural, urban and metropolitan
population is not uniform and moreover the maternal serum elemental
level and the urinary excretory level is also not uniform. The reason may be due to various pregnancies induced physiological changes occurring in the maternal system. At this juncture it may be recommended to throw attention on the above-mentioned area to study the relationship between maternal serum and urinary elements during pregnancy period.

5. Regarding maternal hair elements, none of the elements show higher values in the rural population. However, Zn and Cd values are higher in the urban population. Cu, Cr and Mn values are higher in the metropolitan population. It is surprising to note that the hair Zn, Cu, Cr, Cd and Mn have lower values in the rural populations. It indicates the low nutritional exposure incidents for the elements by the rural populations.

6. Among the ten elements analyzed in the umbilical cord serum, it is found that Zn, Li, Ca Mg, Fe, and K have higher values in the metro population. Majority of the elements i.e. Li, Ca, Mg, Fe, TIBC, P, Na & K are found to have lower values in the rural population, which gives the evidence of slow or blocked transfer of the elements from the mother to the foetus or existence of elemental deficiency in the specified population.

7. Regarding the infant anthropometry infant low birth weight (<2.5kg) is noted in the LI group of rural and urban, MI and LI groups of metropolitan population

8. Lower infant height (45.26 cm) and lower head circumference (30.00cm) is found in the MI group of rural and metropolitan population respectively.
9. Lower chest circumference (30.60 cm) and mid upper arm circumference (8.18 cm) is found in the MI group of metropolitan and rural population respectively.

10. In the case of maternal anthropometry, lower height (151.44 cm) and lower weight (48.52 kg) is noted in the LI group of metropolitan population.

11. The ‘t’ test for the serum elements reveal that Ca alone is statistically significant at 1% probability level among the three income groups of three areas, whereas the inconsistency is noted for Zn, Cu, Li, Mg, Fe, TIBC, P, Na & K in the income and area wise correlations.

12. The ‘t’ test for urine elements also reveals that Ca alone is statistically significant at 1% probability level in between the HI, MI & LI groups of rural, urban and metropolitan population, which explains the homeostatic mechanism for blood – bone – excretory system.

13. Zn, Cn, Cr, Cd and Mn show statistically significant results for the 1% and 5% probability where many certain HI, MI, LI, group of rural, urban and metropolitan population and in between other groups they did not show statistically significant results.

14. The ‘t’ test for umbilical cord serum elements reveals that HI Vs MI and MI Vs LI shows that maximum elements are statistically significant when compared to the LI Vs HI Group of rural population.
15. In urban population except Na in MI Vs LI, all the other elements are statistically significant in MI Vs LI and LI Vs HI group. In metropolitan population except Na in HI Vs MI, Zn and Li in MI Vs LI and Li in LI Vs HI groups all the other elements are statistically significant among all the income combinations.

16. The correlation Co-efficient for Maternal serum and umbilical cord serum shows that in rural, urban and metropolitan population the LI groups shows high correlation, and it is unique that in LI group of rural population, Zn, Cu, Li, Ca, Mg, Fe, TIBC, P, Na & K are statistically significant at 1% probability level.

17. The 't' test for infant anthropometry shows that except infant height, weight and chest circumference in MI vs LI group of metropolitan population, infant height, weight, head-chest-mid upper arm circumference are statistically significant among all the income combinations of rural urban, and metropolitan populations.

18. The 't' test for maternal anthropometry reveals maternal weight & height are significant in certain income combinations and not significant in the remaining income combinations of rural, urban and metropolitan population

B. Second section of the study gives the following results of MLR models.

19. The MLR of maternal socio economic status for infant birth weight reveals health in HI, height and health in MI age square in LI Group is noted to be influencing factor of infant birth weight in the rural population.
20 Maternal height, age, and health of the mother in the HI group, maternal weight, height, age, and age square and health of the mother in MI group and height and weight in LI group of urban population are the influencing factors of infant birth weight.

21 Health of the mother, maternal height in HI, health of the mother in MI height and education in LI group are the influencing factor of infant birth weight of metropolitan population.

22 The MLR of maternal serum elements for infant birth weight reveals that Cu, TIBC in the HI, Ca, Mg, TIBC and P in the MI and Zn and Li in LI groups of rural population are the predictors of infant birth weight.

23 Li alone in HI, Zn, Cu, Li, Fe and Na in the MI and Fe and P in LI groups are the influencing elements of birth weight in urban population.

24 Cu, Ca, TIBC, P and K in HI, Zn in MI and TIBC in LI are the predictors of pregnancy outcome in metropolitan population. Modern life styles and food habits may enhance the elemental deficiency during gestation.

25 The MLR of maternal socio economic parameters and elements combined for infant birth weight reveals maternal health, TIBC, P in HI, maternal height, Ca, Mg, TIBC and P in MI and maternal age and Li in LI are the predictors of infant birth weight in the rural population.

26 In the urban population, maternal weight, age, health and Cu in the HI group, maternal height, weight, health, Li, Fe and Na in MI and maternal height weight and Mg in LI group are the predictors of infant birth weight.
27 In metropolitan population, maternal health, Cu, Ca and P in HI group, maternal Na in LI group are the best predictors of infant birth weight.

28 In rural mid upper arm circumference (MUAC) in the HI, chest and mid upper arm circumference in MI and LI are the best predictors of infant birth weight.

29 In urban infant head and chest circumference in HI, chest circumference in MI and head circumference in LI group is noted as the predictors of infant birth weight.

30 Chest circumference in HI, head and chest circumference in MI and head, chest and mid upper arm circumferences in LI is the best predictor of infant birth weight in the metropolitan population.

31 The computed 't' test for infant birth weight and the health of the mother (hypertension/normal) reveals the existence of significant difference between the mean birth weight of the infants of hypertensive and normal mothers.

C. The third part of the results statistically analyses the influence of the maternal socioeconomic and anthropometric parameters on the maternal health (hypertension) by adopting logistic regression model. The results are presented as follows.

32 Occurrence of hypertension in pregnant mother is highly influenced by age in HI and MI and by type of delivery and relative marriage in the LI group of rural population.

33 Occurrence of hypertension in pregnant mothers is highly influenced by age in HI and MI groups of urban population.
34 Occurrences of hypertension in pregnant mothers are influenced by maternal weight followed by infant sex in HI and by type of delivery and infant sex in MI groups of metropolitan population.

35 Age in LI groups of rural, urban and metropolitan populations give the higher chances for the occurrence of maternal hypertension.

D. In the final part of the study factor analysis was adopted to sort out the most maternal serum, urine, hair and umbilical cord elements and its impact on the pregnancy-related health aspects of HI, MI and LI group of rural, urban and metropolitan populations and the results are summarized as follows.

36 Heavy loading of the serum elements Zn, Cu, Li, Fe, TIBC and P are predominant in the LI group of rural population, which indicates the health care measures, which should be focused on this income strata of the particular population.

37 In urban, population, heavy loading of maternal serum Na and P are observed only in the LI group.

38 In the metropolitan population, similar to the other two population in the LI group heavy loadings of Zn and Na is observed. From these observations, the nutritional and prophylactic considerations should not be generalized even the same population but should be based on the level of economy.

39 In the case of urine elements, rural LI shows the heavily loadings of two elements Ca and K when compared to the single elemental loading of HI and MI group of rural population.
40 In urban population, Li and Na in HI group, Ca and Na in MI and Li and K in LI groups have been heavily loaded.

41 In the metropolitan population, three elements Li, Na and K have been heavily loaded in HI group when compared to the single elemental loadings in MI and LI groups.

42 In the case of hair elemental factor loading, three elements Zn, Mn and Cu are found heavily loaded in the LI groups of rural population when compared to the two elemental loadings in HI (Cd and Mn) and (Cu and Mn) in MI groups. It is unique to note that it is loaded in all the three income groups.

43 In urban population, Cd and Cr in HI, Zn and Cu in MI and Cd, Mn in LI group are heavily loaded.

44 In metropolitan population, Cu in HI, Cu and Cd in MI and Cu and Cr in LI are heavily loaded. These loading indicate that these elements are excreted because of the existence of homeostatic mechanism of maternal system.

45 In the case of umbilical serum elements, Zn, Cu, Li, Fe, TIBC and P are heavily loaded in the LI group of rural population. This observation is similar to that of the maternal serum elemental loadings of the same group.

46 In the urban population umbilical cord serum elements Zn and Li in HI, Zn and Cu in MI and Ca alone in LI are heavily loaded.

47 In the metropolitan population, HI shows the heavy loading of Mg, MI shows the heavy loading of Na and K and Cu & P are heavily loaded in the LI groups.
There is no specific universal methodology available to maintain the reproductive health of the women and for the betterment of pregnancy outcome. However, general health care guidelines of WHO are available. The present study aims at the effect of maternal socio-economic, anthropometric and elemental nutrition on the pregnancy outcome and a few decisions have been derived to achieve a safe and healthy pregnancy and their outcome. They are:

1. The present study is an effort to provide effective guidelines on elemental supplementations along with proper dietary modifications to the low-income groups belonging to rural, urban and metropolitan populations.

2. The present study confirms that excess Zn, Ca, Mg and P can be balanced inside the body via urinary excretion. Hence, the supplementation of these elements may be prescribed throughout the period of female reproductive phase.

3. In order to prevent the restricted elemental transfer from mother to foetus due to maternal placental vasoconstriction, sedentary lifestyle should be replaced by proper counseling, awareness and health improvement programmes in the high income group of urban and metropolitan populations.

4. Indian educational system may be expanded to the low-income maternal population of rural, urban and metropolitan areas in such a way to provide knowledge about their reproductive health.

5. The present study reveals that, in general majority of the income sectors of rural, urban and metropolitan population shows infant mid upper arm circumference and the chest circumference are the best predictors of the infant
birth weight. Nationwide generation of the anthropometric data is necessary to bring out the universal norms recommended.

6 The present study supports the fact that attainment of pregnancy should be age specific, as the occurrence of hypertension in high and middle income groups of rural and urban population is highly influenced by the maternal age.

7 Sodium restricted diet for pregnancy may be reanalyzed as this leads to deficient transfer of sodium to the foetus and

8 The results of the present study also show that as the elemental impact on the health of the pregnant woman varies from individual to individual, the nutritional, prophylactic and intervention programmes should be based on socio-economy and geographical area.