Acta Genet Med Gemellol 31:221-227 (1982)
The Mendel Institute/Alan R. Liss, Inc.

Maternal Nutrition in Twin Pregnancy

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Energy and protein intake as measured by 24-hour urinary nitrogen values are similar in twin and singleton pregnancies. The relationship between urinary nitrogen and nitrogen intake is equally significant in twin and singleton pregnancies. Dietary zinc, copper, and iron are not different in women with twins, nor are the levels of these elements in plasma. These observations are surprising in view of the extra fetal demands on the mother and the different adaptation of twin pregnancies.

Key words: Energy, Protein, Urinary nitrogen, Zinc, Copper, Iron

INTRODUCTION

The relationship between maternal nutrition and fetal growth in human pregnancy is as yet unclear. Although there have been studies in this area, results to date are conflicting. Proposed schedules of intakes of specific nutrients have been recommended for singleton pregnancies both in Europe and the United States, but there are no recommended dietary intakes for women with twin pregnancies.

In our own work on protein and energy intake in singleton pregnancies, we have found similar intakes in obese women as in short thin women with a poor weight gain or with normal pregnancies [2]. In the obese and in the short thin women there also was no relationship between energy intake and birth weight [3]. MacGillivray has previously reported that urinary nitrogen output, which is related to both protein and energy intake, was less in women with a twin pregnancy [11]. Two possible interpretations of this finding come to mind: either women with a twin pregnancy had a lower protein energy intake than women with a singleton pregnancy, or women with twin pregnancies utilized their diet more efficiently. It seemed that the latter explanation was more likely.

Recently the interest in the role of trace elements in pregnancy has extended to humans. Although trace metals such as zinc and copper are necessary dietary constituents, the amounts required are small. These substances are constituents of many of the enzymes necessary for cell function. For example, zinc is a component of more than 70 metalloenzymes. In plasma, 60–70% of zinc is bound to albumin. More than 90% of copper in plasma is present as ceruloplasmin (the remainder is mainly bound to albumin). There is no knowledge of the importance of such elements in twin pregnancies.

MATERIALS AND METHODS

Pregnant women expecting twins were asked to cooperate in a two-part study.

1. A weighed dietary survey was conducted over a period of seven days during which time all food was weighed and recorded. Dietary intakes were then calculated using the published food tables of McCance and Widdowson [10].

2. 24-hour urinary collections were done weekly on an outpatient basis. The number of 24-hour urines varied in twin pregnancies as a result of differing gestational lengths, and a mean weekly value for 24-hour urinary nitrogen has therefore been used. Urinary nitrogen was assayed by Kjeltec System 1, that is, a modification of the conventional Kjeldahl's method. Plasma zinc and copper were measured using a solvent dilution method and atomic absorption spectrophotometry [12]. Plasma iron was measured by trichloracetic acid precipitation and atomic absorption spectrophotometry. The population chosen for comparison included normal healthy primigravidae of average height and weight for Aberdeen, with normal birth weight babies.

RESULTS

Energy and Protein Intake

Tables 1 and 2 show the mean daily energy and protein intake at approximately 30 weeks gestation in twin pregnancies compared to singleton pregnancies and the UK recommended value [5]. There were no significant differences in the women with singleton pregnancies for energy or protein intake. Energy intake is 300–400 kcal less than that recommended in the UK by the Department of Health and Social Security, namely 2,400 kcal [5]. Table 3 shows the mean 24-hour urinary nitrogen again at approximately 30 weeks gestation. The values for twins and singletons are very similar. This is contrary to what was found in the previous study from Aberdeen, in which twins were found to have lower values than singletons. In the earlier study the mean urinary nitrogen was similar to that found in this study. However, the value for singletons was higher in the previous work. No obvious cause for this discrepancy was found.

Figure 1 demonstrates the relationship between 24-hour urinary nitrogen and nitrogen intake as assessed by diet in both the twin and singleton groups. In both groups of women the correlation coefficients were significant. There is no statistical difference between the slopes of the regression lines, but this statement does not imply necessarily that they are parallel.

The correlation coefficients are lower than those which were found in earlier nutrition work in Aberdeen, possibly as a result of a loss of accuracy in both urine and dietary measurements [4]. Nevertheless, the urine results confirm the nitrogen content of the dietary assessments. This observation validates the use of a seven-day weighed diet diary in pregnancy for assessing other nutrient intakes as well. In the diet, energy and protein intake usually are associated. This is confirmed in both the singleton and twin groups, the correlation between urinary nitrogen and energy intake being $r = 0.43$ in twins and $r = 0.47$ in the primigravid singletons ($P < 0.01$).

Dietary Zinc, Copper, and Iron

Having verified the validity of using a seven-day weighed dietary assessment, Tables 4, 5, and 6 show the daily zinc, copper, and iron intake, respectively, in women with twin pregnancies compared with a singleton group. For these tables the singletons are a group of primigravidae who delivered babies with less than 10th percentile birthweight [13]. There are no significant differences in the zinc and copper intakes in the women with twins compared to the singletons. However, zinc intake is approximately half the recommended dietary intake for human pregnancy and copper intake is slightly less than recommended [6]. With respect to iron intake, again there are no significant differences between twins and singletons, intakes in both instances being slightly less than recommended [5]. Trace metal intake, particularly zinc, is associated with protein intake in the diet; in the small number of women with twins there is a highly significant correlation, (r = 0.91, $P < 0.001$) between zinc and protein intake in the diet.

TABLE 1. Mean Daily Energy Intake at ± 30 Weeks

Energy intake	MJ	kcal
Twins (n = 40)	8.55 ± 2.26	2,036 ± 538
Normal singletons (n = 57)	8.92 ± 1.79	2,124 ± 426
Recommended	10.0	2,400

TABLE 2. Mean Daily Protein Intake (g) at ± 30 Weeks

Twins (n = 40)	70.31 ± 15.26
Normal singletons (n = 57)	75.48 ± 17.9
Recommended	60

TABLE 3. Mean 24-Hour Urinary Nitrogen (g) at ± 30 Weeks

Twins (n = 38)	8.26 ± 1.82
Normal singleton (n = 34)	8.78 ± 2.74

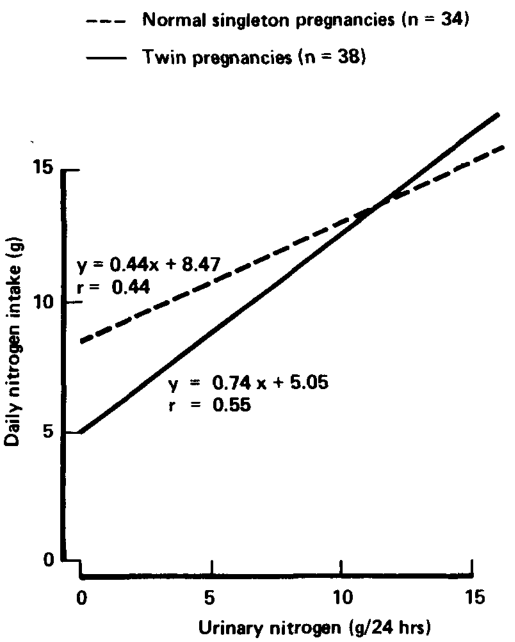

Fig. 1. The relation between urinary nitrogen and nitrogen intake in singleton and twin pregnancies.

https://doi.org/10.1017/S0001566000008321 Published online by Cambridge University Press

TABLE 4. Daily Zinc Intake

	μmol	mg
Twins (n = 10)	152.9 ± 27.83	10.00 ± 1.82
LBW singleton (n = 18)		
with < 10th percentile birth weight	151.0 ± 36.60	9.88 ± 1.42
Recommended	305	20

Abbreviations: LBW, low-birth-weight.

TABLE 5. Daily Copper Intake

	μmol	mg
Twins (n = 40)	22.33 ± 7.46	1.42 ± 0.47
LBW singletown (n = 18)		
with < 10th percentile birth weight	28.3 ± 21.7	1.8 ± 1.38
Recommended	32 ± 47	2–3

Abbreviations as in Table 4.

TABLE 6. Daily Iron Intake

	μmol	mg
Twins (n = 40)	190.31 ± 52.72	10.62 ± 2.94
LBW singleton (n = 18)		
with < 10th percentile birth weight	165.00 ± 43.7	9.21 ± 2.44
Recommended	235	13

Abbreviations as in Table 4.

Plasma Zinc, Copper, and Iron

It is difficult to know in which tissue to measure trace element metals in order to assess the amounts of these nutrients in the whole body. Plasma concentrations reflect dietary deficiencies and, in clinical practice plasma is the most readily accessible tissue. It is reasoned that in pregnancy plasma zinc is likely to represent the metabolizable zinc available to the fetus. The plasma levels of zinc, copper and iron are shown in Tables 7, 8, and 9. There are no significant differences in zinc and copper levels between twin pregnancies and singleton pregnancies, either at approximately 20 weeks gestation or at 30 weeks gestation. Interestingly, in neither group is there a fall in zinc concentration between 20 and 30 weeks as might have been expected from earlier work [7, 8, 9]. Similarly, there is no marked rise in copper concentration in association with gestation as has been previously reported [7,8]. There is, however, a significantly lower plasma iron concentration in women with twins compared with the normal singletons at 20 weeks but not at 30 weeks gestation. The meaning of this is unclear, and may represent a chance finding due to the small numbers in each group. Nonpregnant values of zinc and copper in plasma are 13.46 ± 1.83 μmol/l and 16.85 ± 3.62 μmol/l, respectively. Seven women with twins had dietary assessments of copper, iron, and zinc in addition to measurements of plasma levels of these elements. There was no clear pattern of association between dietary intake and plasma levels in these women (Tables 10, 11, and 12, respectively).

TABLE 7. Plasma Zinc Concentration (μmol/l)

Gestation	20–22 wk	30–32 wk
Twins	10.91 ± 3.30 (12)[a]	9.95 ± 3.15 (15)
Normal singletons	11.08 ± 3.33 (10)	11.61 ± 3.41 (10)

[a]Numbers in parentheses indicate numbers in each group.

TABLE 8. Plasma Copper Concentration (μmol/l)

Gestation	20–22 wk	30–32 wk
Twins	31.14 ± 5.58 (12)[a]	33.12 ± 5.75 (15)
Normal singleton	29.01 ± 5.39 (10)	30.82 ± 5.55 (10)

[a]Numbers in parentheses indicate numbers in each group.

TABLE 9. Plasma Iron Concentration (μmol/l)

Gestation	20–22 wk	30–32 wk
Twins	14.38 ± 3.79 (12)[a]	10.83 ± 3.30 (15)
Singletons	23.06 ± 4.8 (10)	10.39 ± 3.22 (10)

[a]Numbers in parentheses indicate numbers in each group.

TABLE 10. Zinc

Twin	Plasma (μmol/l)	Diet (mg)
AG	9.6	7.1
LW	8.0	9.2
JC		
1	11.2	11.7
2	10.3	13.7
JM	8.4	8.2
KMcI	12.0	11.4
LB	8.4	7.7
FH	11.3	11.4

TABLE 11. Copper

Twin	Plasma (μmol/l)	Diet (mg)
AG	25.6	1.2
LW	33.0	1.3
JC		
1	29.5	1.9
2	32.0	2.1
JM	33.7	1.9
KMcI	29.5	1.8
LB	33.0	1.0
FH	43.5	1.7

TABLE 12. Iron

Twin	Plasma (μmol/l)	Diet (mg)
AG	11.2	9.15
LW	10.2	11.34
JC		
1	11.6	14.15
2	11.2	15.96
JM	10.2	16.12
KMcI	13.1	14.31
LB	9.8	6.06
FH	13.5	14.72

DISCUSSION

These studies of energy and protein intake in twin pregnancy add to our belief that fetal growth is not directly linked to nutrient intake in human pregnancy. Although the combined birth weight for twins undoubtedly is greater than that of singletons, the mothers' diet is not different from those women with only one baby in utero. This is true also for the intakes of zinc, copper, and iron, which are similar in women at the extremes of the birth weight range, namely those with growth-retarded singleton babies and those with twins. Dietary intakes of these elements are in general less than the recommended standards, although protein intake is adequate. This observation suggests that a revision of recommended dietary allowances is needed. Physiologic adaptation is exaggerated in women with twin pregnancies, and it therefore seems likely that absorption and utilization of nutrients will be increased to meet the demands of the greater fetal mass.

Plasma volume expansion is known to be greater in women with twin pregnancies [1] and it might have been expected that twin levels of zinc and iron would have been lower than those of the singletons. The exact reason for the fall in plasma zinc is not yet established, but it seems unlikely that it indicates deficiency. Plasma copper increases in pregnancy. This is partly due to an increase in the binding protein ceruloplasmin, an estrogenic effect, and also to increased demand from the fetus as fetal organs contain a higher concentration of copper than adult ones. Again, one might have expected differences in the women with twins on account of the increased estrogen levels and increased fetal demand found in twin pregnancies.

As a group, the women with twin pregnancies do not have a different dietary intake compared to those with singleton pregnancies. This is surprising. Appetite control by the hypothalamus may be reset in pregnancy by placental hormones; in general these hormones are increased in twin pregnancies. Finally, differences between women with monozygotic and dizygotic twins have still to be determined.

ACKNOWLEDGMENTS

We thank Mr. A.W. Wilson, Robert Gordon's Institute of Technology, Aberdeen, for his statistical advice.

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