Special Problems of Nutrition in the Pregnancy of Teenagers

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Introduction

From a biological standpoint the main nutritional issues in teenage pregnancy are that the adolescent mother may still be growing and hence would then have nutrient needs for the growth of her own body as well as the needs for the products of conception (expanded blood volume, uterine growth, placenta and fetus). The very recent Dietary Reference Intakes on Macronutrients [1] lists protein deposition rates ranging from 39 mg/kg/day during the 12th year of life, 23 mg/kg/day during the 14th year to only 8 mg/kg/day during the 16th year of life. Therefore growth in lean mass is rapid from 12 to 15 years, slows during the 16th year and on average has ceased in girls by 17 years of age. These results are derived from a recently published cross-sectional study of total body potassium using whole body counting [2]. Since potassium is primarily located within the cell, total body potassium provides a good estimate of lean body mass and body protein, and hence these results have greatly expanded our knowledge of growth and body composition. Based on these data it could be predicted that teenagers <16 years would be those at highest risk of an adverse pregnancy outcome (i.e. low birth weight and increased perinatal mortality).

In addition to the issues of protein and energy referred to above, adolescent diets are often lacking in micronutrients such as iron, zinc and folate [3, 4].

Although it is recognized that menarche is dependent upon maternal size, a very large analysis of 79,000 girls and women revealed that low body weight (<47.2 kg) does not prevent attainment of menarche and conception. Indeed low body weight was especially common in early maturing girls and in Puerto Ricans and Mexican-Americans [5]. This poses an additional problem since
the average birth weight is affected by maternal pre-pregnancy weight and weight gain during pregnancy [6].

**Pregnancy Outcome in Adolescents**

The average birth weight in adolescent pregnancies has been shown to be lower in both developing [7–10] and developed countries [11–13]. There is one study from Pittsburgh which did not show a difference in birth outcome between girls <16 years of age and young women aged 20–24 years; however the mean birth weights in both groups are low, 3,048 and 3,117 g, respectively [14]. It appears that adolescent girls had a mean birth weight comparable to the reduced values reported from other studies in developing countries while the young adult control group had a low mean birth weight [6]. Associated with a reduced mean birth weight, provided that the variance in weight distribution is comparable in adolescent pregnancies as in adult pregnancies, it would be predicted that the rate of low birth weight would be increased [6]. Since it is known that low birth weight has an associated increase in perinatal mortality [15], the reduced mean birth weight in studies of adolescent pregnancy is of concern. Approximately 14% of infants born to mothers less than 15 years of age were <2,500 g, compared to 9.9% of infants born to mothers 15–19 years old and 6.5% in infants of mothers 20–29 years of age [16]. In line with these observations is a recent study from Nigeria which showed that mother <15 years of age had a higher risk of low birth weight, premature labor and anemia [17].

Younger mothers have been shown to grow in height during pregnancy and it was noted that measurements of statural growth were not as sensitive as measurement of knee height growth [18].

**Maternal Diet and Pregnancy Outcome in Adolescent Mothers**

There are a number of studies of maternal intake in adolescent mothers [4, 19, 20] all of which show that teenage mothers may not meet all their nutrient needs. A recent study [20] showed that dietary sugar intake had an adverse affect on pregnancy outcome. The population studied were 594 adolescent mothers aged 13–19 years, of whom 61% were black, 30% were Hispanic (Puerto Rican) and 9% were white. High sugar consumption was >206 g sugar/day (n = 60). Adolescents consuming high sugar diets are at twice (9 vs. 17%) the risk of delivering small-for-gestational age infants. Puerto Rican mothers who were high sugar consumers were also at an increased risk of premature birth. Dietary intake data from this study showed no difference in energy intake but lower protein (73 vs. 92 g/day) and zinc intakes (9 vs. 11 mg/day). No differences were detected in iron intake. In a representative
sample of 300 adolescent mothers, Scholl et al. [21] showed that those who had inadequate weight gain ingested on average less energy (1,878 vs. 2,232 kcal/day) and they also ingested less protein. Associated with the inadequate weight gain was a average decrease in birth weight of 180 g and an increased prevalence of low birth weight.

**Maternal Hemoglobin and Pregnancy Outcome**

Iron deficiency is often a marker of an inadequate diet and the literature suggests that mothers who are iron-deficient have adverse pregnancy outcomes [22]. However, when this was evaluated in a population of adult mothers who were in a program of nutritional assessment and rehabilitation, iron deficiency, as reflected by reduced red cell size and red cell hemoglobin content, did not have an adverse pregnancy outcome. This study allowed separation of macronutrients (protein and energy) from the effect of the micronutrient iron. Overall the study showed that birth weight was inversely related to antepartum hemoglobin levels; this was interpreted as being due to expansion of plasma volume to a greater degree than red cell mass [22]. Chang et al. [23] studied some of the same issues in African-American adolescents. They found a U-shaped distribution between antenatal hemoglobin levels and adverse birth outcomes. Adolescents with preeclampsia had higher hemoglobin values (>120 g/l) during the 2nd and 3rd trimesters and a risk ratio of 3.11 for a low birth weight infant. They concluded that additional attention needs to be paid to adolescent mothers with a 3rd trimester hemoglobin of <95 or >120 g/l.

**Nutritional Intervention in Adolescent Mothers**

In light of the increased dietary requirements and the potentially adverse outcomes described above, nutrition services have been available in larger cities in the USA since at least the 1970s, mostly through the Women, Infants and Children (WIC) Special Nutrition Program [24]. It is therefore disturbing to read in a recent retrospective case-control study that teenagers are still gaining less weight during pregnancy and are more likely to deliver a low birth weight or very low birth weight infant [25]. Nevertheless nutrition intervention studies have been shown to improve pregnancy outcome in adolescent mothers [26, 27]. In disadvantaged black teenagers Paige et al. [26] showed that giving a nutritionally balanced supplement, which provided mean intakes of 8,691 kcal and 530 g of protein over 15.1 weeks, a significant improvement in mean birth weight (269 g) was noted in the infants of mothers <16 years who were supplemented when compared with those who were not. The proportion of low birth weight infants was lower in the supplemented group.
but the population size (n = 79) was too small to demonstrate statistical significance. A much larger study (n = 1,203 singleton live births) conducted by the Montreal Diet Dispensary (MDD) using the Higgins Nutrition Intervention Program (which was first developed in adult mothers [6]) showed a corrected mean increase in birth weight of 55 g (p < 0.05) and a 39% decrease in low birth weight rate (p < 0.001) and a 56% decrease in very low birth weight infants (p < 0.01) [27]. The average increased intakes during pregnancy were 900 kcal/day and 52 g protein/day in the second half of pregnancy. The Montreal Diet Dispensary program consists first of an assessment of nutritional risk followed by corrective allowances of protein and energy given mostly as whole milk [6, 27]. Those without any risk are not given any corrective allowances, only the normal pregnancy requirements as they are considered to have a good pregnancy outcome. It is interesting to note that their average intakes were 2,709 kcal/day and 94 g/day of protein.

Conclusions

It is now well accepted that suboptimal fetal growth is associated with higher fetal mortality and neonatal morbidity and mortality. Further that suitable nutrition-based interventions can substantially improve the health of mothers and their infants [28]. To date most of the studies have been conducted in adult mothers. However, as reviewed above, there are clear data that adolescent pregnancies especially in mothers <16 years are at increased risk. Further appropriately targeted nutritional intervention as described by the Montreal Diet Dispensary can significantly improve pregnancy outcome. Many questions remain, such as what is an optimal nutritional intervention for a teenaged mother, and secondly how to motivate the adolescent mother to take the additional food to ‘both feed herself and her unborn baby’ [6, 27].

References

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Discussion

Dr. Yin: Do you think recommended daily allowances for adult pregnant women can meet the pregnancy requirements of teenagers?

Dr. Pencharz: We analyzed this as part of what I had to do for the North American dietary reference intake and also for the World Health Organization. If you look at it from the factorial point of view, you have to add an additional factor for growth, at least in those who are 15 years and younger. So older than that, I don’t see a difference
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because there are the same components, but 16 and younger or 15 and younger, you have to add the growth component for the mother as well as the pregnancy.

*Dr. Lönnerdal:* I just wanted to emphasize something. We did a study on young lactating teenagers a few years ago [1], and basically we were thinking along the same lines here that if you have a competition for nutrient requirements would breast milk composition be compromised? We found identical values for protein, individual protein composition, fat, fatty acids, carbohydrates, but for the first time ever we found significantly lower milk calcium levels. Of course this was an observational study and we speculated that in this situation you have the calcium demands of the mother, the calcium demands of the fetus and then the calcium demands for milk production. I just wonder what would happen with the bone mineralization of the fetus? We haven’t looked at it but it might be something that is compromised also. By the way these patients were caught relatively early during their pregnancy/lactation, they got nutritional counseling during pregnancy and lactation, and they also obtained lactation counseling. So it is in the upper segment of that group but they were still compromised with regard to calcium.

*Dr. Pencharz:* That is a nice comment though. What about total milk volume, was that normal? That was normal; so it is fascinating that they are also regulating, obviously the mother’s body needs more calcium so the calcium needs are high.

*Dr. Uauy:* Given the international group that we have here, you mentioned that in Italy this was not a problem. Perhaps the question should be: is this a problem in China; is this a problem in India; how much of the low birth weight that we see is linked to teenage pregnancy and its nutritional needs as a major contributing factor? Are we neglecting to make the right adjustments when we talk about nutritional interventions for pregnancy? Actually the numbers are what you said, but in the problematic matter how are we doing this?

*Dr. Pencharz:* I think that is an interesting question and it was only an anecdotal statement from the person I was speaking to from Italy. But as I looked through the studies, I identified studies from Nigeria in Africa, there was one from Kenya that I didn't specifically mention, there were a number from Peru, so from developing countries if you like, and I also referred to studies from India. I guess your questions is what is the prevalence of teenage pregnancy, particularly in women who are at particular risk. I have defined that biologically as 15 years of age and younger. I don’t know if any one can comment on that.

*Dr. Bleker:* All I can tell you that beyond 19 it is below 5 per 1,000, so it is not a problem at all. It is a matter of sexual health in the sense of an open atmosphere to talk in schools and in families about sexuality and offers of contraception and things like that. Prevention is very important.

*Dr. Pencharz:* I agree with you completely, and that was part of the point from this very nice Nigerian study with the Nigerian girls who were 15 and younger. Those who were open enough to come for early perinatal care had perfectly good outcomes; those who were afraid to seek perinatal care in fact had bad outcomes. So the message there seems to me that you want to have an open process, if they happen to get pregnant and they chose not to have an abortion then they should be encouraged to seek perinatal care.

*Dr. Endres:* As you said most of these teenage pregnancies are accidental but there are countries where it belongs to the culture. The girls are already married when they are 12 or 13 and they have several children before they reach the age of 20. Is that a special problem that the intervals between deliveries are very short?

*Dr. Pencharz:* I haven’t seen data specifically for teenagers but I have seen data for mature mothers, and it is very clear that the space between pregnancies is an issue in terms of birth weight. In developing countries where there are frequent pregnancies,
the birth weight tends to fall. In developed countries in fact the first baby weighs about 120 g less than the second baby when you correct for gender because boys weigh about 140 g more than girls. If you put that into a general analysis in developed countries, subsequent pregnancies up to the third baby generally weigh more, whereas in developing countries with frequent pregnancies with short intervals it looks as though the mother’s lean body mass and all her reserve become depleted and you tend to have smaller babies. So one would assume, but I don’t know of any data, that one needs to pay particular attention to the nutrient intake of that mother to make sure she is eating enough for her own growth because, remember the study in Peru, if she hasn’t grown, as defined by reaching the same height as her mother, she is going to have a smaller baby.

**Dr. Yajnik:** You asked about India. The average age of mothers in our rural study was 21 years. As you mentioned it is a common practice to marry girls early in India. One intervention which would improve birth weight in India is to postpone the age at the time of the first conception. In my study 10% of pregnancies are below 18 years of age. In India it is illegal to marry girls before the age of 18, but it doesn’t prevent parents from marrying them. If someone complains the parents will be in trouble but no one complains because in villages that is a common practice. About parity and birth weight, within our data set we have analyzed the effect of maternal parity on birth weight and body composition, and interestingly multiparous women deliver babies which are about 120 g heavier but most of that comes from excess fat. Head circumference and length are similar. We thought multiparous women themselves must be fatter but to our great surprise they were thinner (less adipose). In trying to analyze possible causes, we found they had similar intake of macronutrients but they were spending more time working in the farms. Multiparous women had lower hemoglobin, lower systolic blood pressure, lower circulating albumin concentration, suggesting higher vascular expansion. The total leukocyte count was lower in multiparous women suggesting a lower immune response to pregnancy. Vascular expansion and the lower white blood cell count explained only some of the difference in offspring body composition, thus parity influenced body composition of the offspring in some extra manner.

**Dr. Kramer:** I think we have to be very cautious about some of the things you presented. If one could tell the effectiveness of nutrition supplementation programs or any other intervention programs by comparing people who participate in such programs with those who don’t, we could all stop doing randomized trials. In fact, no randomized supplementation trial has shown a reduction in the proportion of women who deliver very low birth weight babies or babies with respiratory distress syndrome, and that is because those babies are extremely preterm. There is no good evidence that even in very malnourished populations (as in the Gambia) that supplementation reduces the risk of those outcomes. I don’t know if you are aware, but there has been a randomized trial of the Montreal Diet Dispensary type of program not restricted to teenagers; it is called ‘Naitre égaux, grandir en santé’, and the intervention had no effect on mean birth weight or on the rate of low birth weight percent [2]. Obviously, the people from Montreal are not too keen on publicizing that, but I think we have to be very careful about inferring the effectiveness of this and other programs from observational studies.

**Dr. Pencharz:** I share your limitations, I am not a doctrinaire. I think I was asked to come and present the information there was. The study we designed was the best that we could do at the time, and it was randomized.

**Dr. Kramer:** I disagree; you randomly selected a control group among those who did not receive the intervention; the intervention allocation was not randomized.

**Dr. Pencharz:** Alright, but they received the same obstetrical care, which is another one of the parameters that must be dealt with. So it was the closest that could
be achieved at the time. Now I look forward to better studies being done. But one of the problems with many of the other studies is that the dietary components are not properly done. So you are an epidemiologist, I am not, and I will accept criticism from an epidemiological point of view. But equally as I looked at many of these other studies I don’t think that the dietary design is particularly good. The poor women in Montreal didn’t drink milk, so the corrective allowances were given in the form of milk, and those mothers were actually taught that this is the best food for a baby. So if I ask you to use a single word for what is the best food for a baby I think most of you, and this is obviously a Nestlé symposium, would say milk. And in fact that is the correct answer. You want The mother to feed milk to her baby but she can’t feed it directly because that baby is a fetus, therefore she has to drink it herself. So the carton of milk would have a marker on it saying this is the baby’s milk and the mother had to take it, so it wasn’t fed to other children. These are the kinds of things that you have to do to get the mother to say it is important enough not just to stop smoking and stop drinking, but also to drink the milk to take additional things. So you can have a dietary design but then you also have to have an implementation program in which you get the person to take the treatment.

References