Maternal and Child Health

DO MATERNAL ENERGY RESERVES LIMIT FETAL GROWTH?

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Summary Birth weight and maternal anthropometric measurements were made in a sample of 2456 deliveries in a poor, African peri-urban community. Maternal anthropometry was similar to that observed in affluent societies, whereas birth weight was significantly lower, even when adjusted for maternal weight and parity. Moreover, multiple stepwise regression showed that for a given maternal weight, fatter women had smaller babies. This is at odds with the classical hypothesis that a maternal energy deficit limits fetal growth.

INTRODUCTION

MEAN birth weights in developing countries are noticeably lower than in affluent societies.[1] It is often assumed that this difference is due to maternal malnutrition, and maternal energy supplementation, especially during the last trimester of pregnancy, is what UNICEF advocates as the first measure to be taken to reduce the proportion of low birth weight babies in the developing world.[2] The situation prevailing in urban Senegal does not accord with this interpretation. Mean birth weight is lower than in industrialised countries but it is hard to believe that the mothers are energy deficient. As a result of price subsidies, food is relatively cheap and in communities with some purchasing power, as in the peri-urban slums, obesity in women is becoming a concern. This study was undertaken to determine whether the low mean birth weight in poor social urban groups could be accounted for by poor maternal nutritional status.

PATIENTS AND METHODS

This work took place in a maternity hospital for underprivileged women in the periphery of Dakar. Data were collected from September, 1980, to December, 1981. Every morning, all the children born during the night and their mothers were examined anthropometrically. Mothers were weighed and measured in minimum clothing with a UNICEF scale regularly checked during the study. Their arm circumference was measured with a fibreglass tape measure. The triceps skinfold was measured with a Harpenden calliper. Upper arm muscle circumference was estimated from arm circumference and triceps skinfold thickness according to Jelliffe.[3]

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Children were weighed with a "Testut" scale with a precision of ±10 g. They were classified as "premature" or "at term" children according to whether a neurological examination showed their gestational age to be below or above 37 weeks, respectively. We did not attempt to get a more precise estimate of gestational age since clinical methods are not suitable for this purpose for children born near term, as were most children in our sample. Birth weight was recorded within 12 h of birth.

Twins, children with malformations, and premature newborns were not included in the study. The final sample consisted of 2456 mother-child couples.

RESULTS

Maternal Anthropometry (Table I)

The mean maternal height was very similar to that observed in affluent societies. There are no suitable data from affluent societies for comparison of post-partum weight. However, comparison of arm circumference, triceps skinfold, and muscle circumference with those of North American norms for adult non-pregnant women[5] indicated that the nutritional status of these women was not very different from that in well-off communities (table II). Arm circumference and triceps skinfold were slightly lower in our sample, but the mean muscle circumference was similar to that of US norms.

Birth Weight

The mean birth weight (±SD) was 3025 g (±415) for the whole sample. The birth weight of children born to primiparas (2860 g±385 SD) differed significantly from that of children born to multiparas (3050±415 g) ($p<0\cdot001$). Both values were much lower than those reported in all birth weight statistics from industrialised countries.[1]

TABLE I—MATERNAL ANTHROPOMETRY

—	Primiparas (n=368)	Multiparas (n=2088)	p
Height (cm)	162·5±6	162·5±6	NS
Post-partum weight (kg)	55·8±8·2	58·3±10·3	<0·01
Arm circumference (mm)	235±24	249±28	<0·01
Triceps skinfold thickness (mm)	12·6±4·9	13·5±5·7	<0·05
Arm muscle circumference (mm)	195±16	206±18	<0·01

Results given as means±SD.

TABLE II—ARM CIRCUMFERENCE, TRICEPS SKINFOLD THICKNESS, AND ARM MUSCLE CIRCUMFERENCE OF DAKAR SAMPLE AND NORTH AMERICAN NORMS

—	North American norms	Mean values in Dakar sample	SD
Arm circumference (mm)	260	247	28
Triceps skinfold thickness (mm)	17	13·4	5·6
Arm muscle circumference (mm)	205	204	18

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TABLE III—RELATION BETWEEN BIRTH WEIGHT AND MATERNAL ANTHROPOMETRY

Significant variables	Regression coefficient	t	p
Maternal weight (kg)	18·6	15·4	<0·001
Triceps skinfold thickness (mm)	−16·8	7·8	<0·001
Sex of infant (boy=1, girl=2)	−127	7·5	<0·001
Parity (primiparas=0, multiparas=1)	165	7·0	<0·001
Multiple regression coefficient	0·405		

Dependent variable: birth weight (g). Constant term: 2220 g.

The mean birth weight varied slightly with time of year: it was lowest between October and February (mean=2995 g). This variation is significant ($F_{11\ 2444}=1\cdot98$, $p<0\cdot05$).

Relation between Maternal Anthropometry and Birth Weight

Maternal age, parity, and all maternal anthropometric variables were related to birth weight ($p<0\cdot001$). However, all these variables correlated highly between themselves and simple correlations gave little information on the factors really associated with birth weight. Table III gives the results of multiple stepwise regression with birth weight as dependent variable and all the previously studied variables as independent variables. Parity data were pooled into two categories (primiparas and multiparas) since birth weight did not vary significantly within these two groups. The sex of the child was also included in the stepwise regression. Of the anthropometric variables, only maternal weight and triceps skinfold were significantly related to birth weight. Maternal height was rejected by the stepwise regression. Moreover, triceps skinfold correlated negatively with birth weight. In other words, for a given maternal weight, the fattest mothers had the smallest newborns.

The exclusion of maternal height from a regression explaining birth weight was surprising since this maternal variable is usually considered to be one of the important factors influencing fetal growth.[1] To test whether this exclusion was due to the presence of maternal triceps skinfold thickness among the independent variables, we repeated the stepwise equation without this variable. Results are reported in table IV. When maternal triceps skinfold thickness was not introduced in the equation, maternal height correlated significantly with birth weight.

Comparison with Western Standards of Birth Weight

Many standards of fetal growth or birth weights related to gestational age have been published in developed countries. Among them, those from Aberdeen (UK) are unique since they are adjusted for maternal height, weight, and parity.[6] A rough comparison can be made with our data, since it is possible, by the use of multiple regression, to calculate the average birth weight for every class of maternal weight for different parity groups. Such a comparison is made in table V. It must be kept in mind, however, when comparing these figures, that the Dakar data were based on post-partum maternal weight whereas that in Aberdeen was based on maternal weight at 20 weeks of pregnancy. Moreover, the Aberdeen standards, being based on a much larger sample of women with a known duration of pregnancy, could be adjusted with more precision than was possible with the Dakar data. In other words, some of the differences in birth weights reported in table V may be due to imperfect comparison. However, the difference between the Dakar and Aberdeen data is so large that it seems impossible to ascribe it entirely to a difference in methodology. On average, Dakar women have babies whose birth weights are similar to those born to British mothers of the same parity but 30 kg lighter. Senegalese babies are much lighter at birth than might be expected according to the mean weight and parity of their mothers.

TABLE IV—RELATION BETWEEN BIRTH WEIGHT AND MATERNAL HEIGHT AND WEIGHT

Significant variables	Regression coefficient	t	p
Maternal weight (kg)	10·5	11·6	<0·001
Parity (primiparas=0, multiparas=1)	170	7·0	<0·001
Maternal height (cm)	6·2	3·8	<0·001
Multiple regression coefficient	0·350		

Dependent variable: birth weight (g). Constant term: 2220 g.

DISCUSSION

As assessed by anthropometry, maternal nutritional status in the periphery of Dakar does not seem to be much different from that in the West. Arm circumference seems to be slightly smaller than for North American women, but this difference seems to be due mainly to a low proportion of subcutaneous fat, which was related negatively to birth weight. Poor maternal nutritional status does not seem to be a likely explanation for the low birth weight observed in this community. At all events, comparison of birth weights adjusted for maternal weight with Western standards fits poorly with this hypothesis.

The hypothesis that these Senegalese mothers have low birth weight babies because of marked energy deficit is also hardly compatible with the negative relation observed between maternal subcutaneous fat and birth weights.

The negative correlation of fat with birth weight is at odds with the strong belief of most nutritionists that solid energy reserves are essential for a normal fetal growth. It seems, however, that this relation is quite usual: in Aberdeen, for any given weight, taller women have heavier newborn babies.[6] Since, on average, for any given weight, taller women have less fat, a negative relation between birth weight and maternal fat probably existed in the Aberdeen sample. In our sample, maternal height was related to birth weight when maternal triceps skinfold thickness was not introduced into the stepwise regression: this suggests that the classical relation between maternal height and birth weight should be interpreted as meaning that birth weight is regulated by an

TABLE V—COMPARISON OF MEAN BIRTH WEIGHTS FOR DIFFERENT MATERNAL WEIGHT CLASSES IN DAKAR AND ABERDEEN

	First pregnancy		Second and subsequent pregnancies	
Maternal weight (kg)	Dakar	Aberdeen	Dakar	Aberdeen
35	2615	2830	2780	2950
40	2675	2950	2840	3070
45	2735	3065	2900	3185
50	2790	3175	2955	3295
55	2850	3280	3015	3400
60	2910	3380	3075	3500
65	2970	3475	3135	3595
70	3030	3565	3195	3685
75	3090	3650	3255	3770
80	3150	3735	3315	3855

Mean gestational age was assumed to be 40 weeks for both groups.

unknown factor related to lean body mass and not by energy reserves.[7]

The factors depressing birth weight in Senegalese women are not clear. Maternal infection, and especially malaria,[8] is known to be associated with lower birth weight. The pattern of birth weight variations with the seasons in Dakar is quite compatible with this hypothesis. It is unlikely, however, that this factor explains entirely the lower birth weight observed in Dakar. Malaria is very seasonal and is virtually absent from April to January. Even during this period the mean birth weight (3070 g) is lower than might be expected from the nutritional status of the mothers.

Compression of the maternal aorta between the pregnant uterus and the spine when there is lumbar lordosis, which tends to be very pronounced in African women, has been said to be a possible cause of retarded fetal growth at the end of pregnancy.[7] This hypothesis, however, needs further supportive evidence.

Our findings raise some doubts about the general assumption that higher energy intakes during pregnancy ought to be a priority whenever a low mean birth weight is observed in a community. There seems to be no doubt that an acute restriction has a negative impact on fetal growth: this has been well documented during the famine in Holland during the 1939–45 war,[9] and more recently in a rural community in the Gambia when there was an acute food shortage just before the harvest.[10] When there is no food shortage and the maternal food intake is low but regular, the situation is not so clear. Results from a supplement study in Guatemala[11] are often cited as evidence that, in these situations, increasing maternal food intake increases birth weight. This study, however, was made in a rural community, with variable food availability, and it is not clear whether this effect was permanent or restricted only to the periods of acute food shortage, when there is little doubt that such supplementation is effective. Moreover, the design of this study was such that the observed effect could be due partly to self selection of mothers who took the supplements.

At all events, our findings set a limit on the efficacy of energy supplementation during pregnancy: It is likely to be effective only for mothers with lean body mass deficit. For other women, any supplementation that results in only increased fat deposition seems to be unlikely to have a beneficial effect on fetal growth.

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National Health Service

LEAVING A DOOR AJAR IN THE CORRIDORS OF MEDICAL MANPOWER

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"Down the fair-chambered corridor of years,
The quiet shutting, one by one of doors." Hagedorn

A DECADE ago external assessors on advisory appointments committees for consultant posts in the major specialties sometimes found that no applicant was suitably trained or experienced. However, no-one who sits on such a committee nowadays can fail to be impressed by the calibre and experience of the many applicants, almost all of whom would fill the post admirably. Senior registrars wait with an ever-increasing sense of frustration at the difficulties to be faced in obtaining a post for which they are fully trained. The accreditation certificates they have obtained from the higher medical training bodies may fill their filing cabinets or adorn their office walls but do little to ease their plight. As the United Kingdom turns out more and more medical graduates each year, so the outlets into consultant posts in the National Health Service or equivalent posts overseas become more tight and congested. The expansion of the consultant grade envisaged in the Short report[1] has not materialised.

At the same time as entry into the consultant grade has become more difficult, in many specialties the workload has continued to grow, putting an increasing strain on those in post. To take one example, the Royal College of Physicians' Committee on Gastroenterology has suggested that district general hospitals should have two gastroenterologists on their staff,[2] owing to the increase in workload caused partly by the development and applications of fibreoptic endoscopy in diagnosis and treatment.[3] Yet the prospects of such expansion appear remote despite the fact that the work is there to be done.

The medical profession has concentrated on the difficulties at the start of a consultant career, but perhaps the time has come to look at the other end of the consultant's working lifetime in an attempt to alleviate the present manpower difficulties. The NHS is just reaching the point at which, with or without the purchase of added years, most retiring consultants have worked long enough to receive an adequate pension at the age of 60. This is reflected in the increasing numbers retiring before 65, yet still only a fraction avail themselves of this opportunity. The reason is undoubtedly that, despite the disruptions in the past few years, most are attached to their work, which provides stimulation and satisfaction, and they fear the abrupt cut-off that retirement brings. Many general practitioners are able to take 24 hour retirement, receive their pensions, and yet continue to work with reduced workloads to the age of 70 or beyond. This option is not open to the consultant, who retains full and often heavy responsibilities to the end of his or her professional career.

One approach to the difficulties at either end of the consultant's working life that has not yet received much attention would be to allow the 60-year-old consultant to retire, to collect his or her pension, and to be re-engaged for a few sessions a week. The post would be filled by a newly