PREMATURE LABOUR AND BIRTH WEIGHT

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In recent years, various papers, including those of Whitbourne (1930), Piatel and Vandergoten (1940), Salber and Bradshaw (1951a), Scotland (1956) and Hollingsworth (1960), have referred to the birth weight of the African new-born child. They are all in agreement that the birth weight of these infants is lower than that given for European and North African ones.

The ultimate cause of a reduced birth weight is either a deficient growth of the foetus during gestation or an unduly high incidence of labours before term, or, indeed, a combination of both. The third report of the Expert Committee on Maternal and Child Health (1961) supported the view that a preponderance of small babies born to a group of women from an unfavourable environment is more likely to be associated with a deficient growth of the foetus at all stages of gestation.

The present is a study of birth weights in relation to duration of pregnancy amongst Sudanese women. In it, it will be shown that, whereas each of the two factors basically responsible for a reduced birth weight undoubtedly played a part, the explanation for the smallness of the Sudanese infant lies mainly in an unusually high incidence of labours before term.

Material and Method

Case records dating backwards from May, 1963, were examined with the object of collecting 4,000 deliveries where both the length of gestation to the nearest week and the weight of the infant were known. Only pregnancies at and beyond the 28th week were considered. As at the time of compilation no organised Records' Office existed and because a number of records were missing or contained insufficient data, the series was purposely a random one and extended over a period of six years. The group of patients analysed consisted entirely of Northern as opposed to Southern Sudanese. Ethnologically, these people are a joint product of Hamites (a branch of the Caucasian race) and Negro, with a very strong Arab admixture occurring later. All the patients were delivered at Khartoum Civil Hospital, which is the teaching hospital, and almost all belonged to the poorest non-paying third class wards.

Of the 4,000 pregnancies, 168 were multiple (162 twins and 6 triplets). This high percentage of multiple pregnancies is probably explained by a tendency for these to be delivered in hospital. Of the remaining 3,832 singletons, 248 were still-born. Multiple and still-births were excluded and only the remaining 3,584 single live births were studied. These consisted of 1,902 males and 1,682 females.

The period of gestation was calculated from the first day of the last menstrual period, in many cases corroborated by examination in early pregnancy and, in all cases, by obstetric examination during labour.

Data

The overall mean birth weight amongst the 3,584 live singletons was found to be 6.65 pounds. The weights ranged from 1.19 pounds to 10.75 pounds, male infants being heavier at all stages of gestation *(Table I)*. The overall mean birth weight was 6.80 pounds for males and 6.47 pounds for females and at the 40-41 weeks, it was 7.40 pounds per males and 7.15 pounds for females *(Table I)*. This table is given in two-weekly intervals so as to minimise any error arising from preference for any particular week or from uncertainty regarding menstruation dates.

Conforming with the recommendations of the Expert Group on Prematurity

TABLE I

Distribution of Single Live Births by Duration of Gestation and Birth Weight

Duration in weeks	*MALES*		*FEMALES*	
	Number	*Mean Weight (pounds)*	*Number*	*Mean Weight (pounds)*
28 — 29	32	2.58	48	2.47
30 — 31	58	3.37	50	3.17
32 — 33	70	4.03	68	3.97
34 — 35	134	5.60	124	5.23
36 — 37	224	6.66	168	6.44
38 — 39	610	7.19	540	6.88
40 — 41	738	7.40	650	7.16
42 — 43	36	7.62	34	7.49
Total	1902	6.80	1682	6.47

Number of births (live) = 3584
Mean birth weight = 6.65 pounds
Error of mean = 0.09 ,,
Standard deviation = 1.87 ,,

under the W.H.O. (1950b), the infants were recorded as premature when their weight was 5.5 pounds (2,500 Gm.) or under. There were 626 live premature infants: 274 males and 352 females, giving an incidence of 17.5 per cent. *Table II* (also set in bi-weekly intervals for reasons already stated) shows the incidence of premature infants at the various stages of gestation. *Table III* shows the distribution of all singletons by weight. It is recorded in one-pound brackets from 2.5 pounds, thus permitting the number of prematures to be seen easily.

For the purpose of this study, the expression "premature labour" has been taken to imply the interruption of pregnancy after the end of the 27th week and before the beginning of the 38th week *(vide infra)*. The number of deliveries taking place within this period totalled 967, an incidence of 27.2 per cent *(Table IV)*.

TABLE II

Distribution of "Premature Single Live Births" by Duration of Gestation

Duration in weeks	*Total Births*	*Premature Infants*	*Percentage*
28 — 29	80	80	100.0
30 — 31	108	108	100.0
32 — 33	138	136	98.5
34 — 35	258	166	64.3
36 — 37	392	46	11.7
38 — 39	1150	64	5.6
40 — 41	1388	26	1.9
42 — 43	70	0	0.0
Total	3584	626	17.5

Discussion

The mean birth weight of the Sudanese new-born as found in the current study, whilst comparing quite favourably with that of other African infants *(Table V)*, does further confirm the smallness of the latter when contrasted with the English or North American ones *(Table VI)*. That the smallness of the African baby is not altogether a racial characteristic has been proved by Bakwin and Patrick (1944), who demonstrated, by means of well controlled investigations, that the Negro infant of well-nourished mothers in the higher income bracket showed no significant variation in weight when compared with those born to white women of the same socio-economic stratum.

TABLE III
Distribution of live Singletons by Birth Weight

Birth Weight (pounds)	*Males*	*Females*	*Total*
Up to 2.50	16	28	44
Over 2.50 to 3.50	82	82	164
,, 3.50 to 4.50	40	56	96
,, 4.50 to 5.50	136	186	322
,, 5.50 to 6.50	134	136	270
,, 6.50 to 7.50	1150	1040	2190
,, 7.50 to 8.50	304	144	448
,, 8.50 to 9.50	22	10	32
,, 9.50 to 10.50	16	0	16
,, 10.50 to 11.50	2	0	2
Total	1902	1682	3584

TABLE IV
Distribution of Single Live Births by Length of Gestation

Duration of Gestation in weeks	*Number*	*Cumulative Percentage*
28 — 29	80	2.2
30 — 31	108	5.2
32 — 33	138	9.1
34 — 35	258	16.3
36 — 37	392	27.2
38 — 39	1150	59.3
40 — 41	1388	98.0
42 — 43	70	100.0
Total	3584	100.0

As already pointed out, the ultimate cause of a reduced birth weight is either (a) a deficient growth of the foetus during gestation, (b) an unduly high incidence of premature labour or (c) a combination of both. That in the Sudanese series a major factor is not a deficient growth during pregnancy is demonstrated by *Table VII*. This table sets out the growth of the foetus at the various stages of pregnancy, a comparison, at the same time, being drawn between the Birmingham (McKeown and Gibson, 1951) and the current series. A remarkable parallelism of growth between the two series is demonstrated. Furthermore, the mean discrepancy of

TABLE V
Mean Birth Weight of Sudanese Infants born after the 28th week compared with those from other African Countries

Source	*Mean Birth Weight*	*Author*
Lagos, Nigeria	6.82	Whitbourne (1930)
Mayombe, Belgian Congo	6.44	Platel & Vandergoten (1940)
Rural Nyasaland	6.56	Platt (1947)
Ibadan, Nigeria	6.31	Walker (1950)
South Africa — Europeans	7.47	Salber & Bradshaw (1951a)
South Africa — Coloured	6.85	
South Africa — Bantu	6.77	
South Africa — Indians	6.46	
Southern Nigeria	6.62	Bruce-Chwatt (1953)
Kampala, Uganda — Bantu	6.44	Scotland (1956)
Kampala, Uganda — Non-Bantu	6.38	
Vom, Northern Nigeria	6.25	Gardner & Gardner (1958)
Accra, Ghana — Poor Africans	6.31	Hollingsworth (1960)
Accra, Ghana — Rich Africans	7.00	
Accra, Ghana — European Expat.	7.12	
Ilesha, Western Nigeria	6.17	Morley & Knox (1960)
Khartoum, Sudan	6.65	Present Series

TABLE VI

Mean Birth Weight of Sudanese Infants born after the 28th week compared with English and American ones

Nationality	*Source*	*Mean Birth Weight (lbs.)*	*Author*
English	London	7.22	Martin (1931)
English	London	7.22	Huggett (1944-45)
English	Birmingham	7.17	McKeown & Gibson (1951)
American (white)	Cincinnati	7.25	Anderson, Brown &
American (negro)		6.81	Lyon (1943)
American (white)	Atlanta	7.56	Bivings (1934)
American (negro)		6.87	
American (white)	Baltimore	7.13	Taback (1951)
American (negro)		6.63	
Sudanese	Khartoum	6.65	Present series

weight at the various weeks of pregnancy is only 0.06 pounds in favour of the Birmingham baby. This weekly mean variation is disproportionately small; one of a higher magnitude would be expected if an overall mean birth weight disparity of 0.51 pounds (Birmingham, 7.16 pounds; Khartoum, 6.65 pounds) were explainable primarily on the basis of a diminished growth of the foetus *in utero*. Could, therefore, a high incidence of premature labour have been responsible for the reduced birth weight of this series?

TABLE VII

Mean Birth Weight (Males and Females) related to length of gestation

Length of Gestation in weeks	*Mean Birth Weight in pounds* Birmingham Hospital Series (1951)	Khartoum Hospital Series
28	2.85	2.41
29	2.75	2.64
30	2.95	3.03
31	3.55	3.47
32	3.85	3.67
33	4.20	4.23
34	5.20	4.94
35	5.95	5.79
36	6.35	6.42
37	6.45	6.72
38	6.70	6.93
39	7.20	7.10
40	7.40	7.27
41	7.60	7.40
42	7.40	7.56
43	7.65	7.71
Overall mean birth weight	7.16*	6.65

* Deduced from Table XIII (McKeown and Gibson, 1951).

Premature labour is sometimes defined as one which leads to the birth of a premature infant, i.e. one of a weight of 5.5 pounds or less. Such a definition does nothing to establish a relationship between a given point in pregnancy and its corresponding mean birth weight. This is because birth weight in itself is not of necessity an index of the time spent by the foetus *in utero*. Such a definition, too, would exclude, on the one hand, the large baby (e.g. that of the diabetic mother) delivered at the 35th-36th week and, on the other hand, include others who, because of foetal, placental or maternal abnormality are small (< 5.5 pounds) though born at or near term. Regardful of this, a more satisfactory interpretation of premature labour would be based, therefore, on the juncture in pregnancy at which the infant was born. Thus the term "premature labour" has been taken to signify the discontinuation of pregnancy after the end of the 38th week, after Greenhill (1955). This is not an unassailable definition either, if only because it is so dependent on memory and hence inherently open to inaccuracy. Still, the only practical way, as yet, available for assessing the expected date of delivery is based on Naegele's rule of subtracting 3 months from the last menstruation and adding 7 days. Unfortunately, and indeed oddly enough, remembering the date of the last period does not seem to come naturally to most women

TABLE VIII

Distribution of Live Singletons by Length of Gestation

Duration of gestation in weeks	*McKeown and Gibson (1951)*		*Taback (1951)*		*Present Series*	
	No.	*Cumulative Per cent*	*No.*	*Cumulative Per cent*	*No.*	*Cumulative Per cent*
28	13	0.08	29	0.3	44	1.2
29	8	0.1	9	0.4	36	2.2
30	15	0.2	27	0.7	50	3.6
31	33	0.4	6	0.8	58	5.2
32	31	0.6	41	1.2	66	7.1
33	58	1.0	12	1.4	72	9.1
34	102	1.6	66	2.1	124	12.6
35	243	3.1	31	2.4	134	16.3
36	407	5.6	192	4.5	222	22.4
37	736	10.1	98	5.6	170	27.2
38	1440	18.9	277	8.6	412	38.7
39	3343	39.3	154	13.2	738	59.3
40	4725	68.2	7990	97.9	1262	94.5
41	2988	86.5	72	98.6	126	98.0
42	1386	95.0	91	99.6	60	99.7
43	486	97.9	12	99.8	10	000.0
Over 43	338	100.0	21	100.0	0	100.0
Total	16,352		9,128		3,584	

and the African woman presents no exception. Furthermore, many women in the present study calculated their dates on the Muhammedan calendar (Higrija) so that some small errors may have resulted in translating these to the Gregorian (Muladija). Nevertheless, there is no prima facie evidence that such errors actually exist in the series. Moreover, it is believed that even if such errors do exist, they will seriously affect the results only if they are gross, frequent and unevenly distributed.

There were 976 labours in this series that, according to the definition accepted above, ended prematurely, constituting 27.2 per cent of all live single deliveries. This is very high incidence and compares very poorly with reports from elsewhere, e.g. McKeown and Gibson (1951) and Taback (1951) viz. 10.1 per cent and 5.6 per cent, respectively *(Table VIII)*. These two series have been selected for comparison because of their large numbers and reliability.

The number of premature infants naturally will be expected to rise with an increase in labours ending before term. There were 626 such prematures in the current series, an incidence of 17.5 per cent*, which is higher than most other published hospital reports *(Table IX)*. An increased incidence of premature infants, however, is not necessarily a proof of more premature labours. What is more likely to be an index of the incidence of early labours is the number of *unexplained* premature infants. Naturally, the percentage of premature infants of known etiology will increase the more readily one accepts conditions affecting the pregnant woman as being casual rather than incidental to prematurity. Nevertheless, the quoted ratio between explained and unexplained prematures is fairly constant. In the report of neonatal mortality and morbidity by the Joint Committee of Obstetricians and Gynaecologists and the British Paediatric Association (1949), it is

* It is noteworthy that in the Khartoum Civil Hospital Annual Report for 1963/64 (Lumsden and Verzin) the prematurity incidence was 17.8 per cent, thus showing a remarkable constancy.

TABLE IX
Incidence of Premature Infants amongst Singletons

Source	*Percentage Incidence*	*Author*
Birmingham, U.K.	5.9	McKeown and Gibson (1951)
Baltimore, U.S.A.		
White	7.4	Taback (1951)
Negro	12.0	
Dublin, Eire	7.2	Feeney (1952)
Southern Rhodesia	5.9	Houghton and Ross (1953)
Natal, South Africa		
Europeans	4.6	Salber (1955) *
Coloured	9.6	
Bantu	11.5	
Indian	18.3	
Accra, Ghana		
Europeans	4.6	Hollingsworth (1960)
Rich Africans	8.6	
Poor Africans	25.1	
Khartoum, Sudan	17.5	Present series

* Salber classified as premature only infants weighing less than 5.5 pounds.

stated that in only 50 per cent of cases can a definite cause for the prematurity be discovered. This figure tallies with observations from other sources, e.g. Aberdeen, 51.9 per cent (Baird, 1945); New York, 50.3 per cent (Bookstaver, 1951); Dublin, 45 per cent (Feeney, 1952); Birmingham, 49.7 per cent (Grosse, 1952); Australia, 43 per cent (Shedden, 1959). Even when these figures are corrected by the exclusion of multiple births, there still exists a considerable discrepancy between them and the 68.7 per cent incidence of *idiopathic* prematurity discovered in the present series. In *Table X*, an attempt has been made to list the main etiological factors which may have precipitated the onset of labour or necessitated the artificial termination of pregnancy.

The high incidence of premature babies (17.5 per cent), but more especially, the high ratio (430 : 196) of unexplained ones must be regarded as an expression of a high incidence (27.2 per cent) of labours terminating by the 37th week of pregnancy. It is considered, therefore, that in the current series amongst Sudanese, early labour is more closely related to the small birth weight than is a deficient growth of the foetus *in utero*.

Among factors which may have accounted for the large number of premature labours, two appear to be worth mentioning here. They are *malnutrition* and *fatigue*.

Malnutrition

Marked nutritional deprivation was not a feature of the Khartoum series.

TABLE X
Alleged causes of Premature Single Live Births

Cause	*Number*	*Per cent*	
Pre-eclamptic Toxaemia	112	17.9	
A.P.H. (excluding toxaemic separation of placenta)	28	4.5	31.3%
Pyrexia	25	4.0	
Miscellaneous	31	4.9	
Unknown	430	68.7	68.7%
Total	626	100.0	

Undernutrition and anaemia, however, were present to a greater or lesser extent since almost all patients came from poor families. The diet is thus likely to have been inadequate both in quantity and in its protein, mineral and vitamin content. Anaemia (defined as haemoglobin of 60% or less) was certainly prevalent, and, amongst those in whom the haemoglobin level was recorded, the incidence was 19 per cent.

In any society, poverty must be the ultimate limiting factor in the matter of diet. By any western standards, the majority of the patients forming this series would belong to an extremely low socio-economic stratum. Amongst the Sudanese, other factors — social ones — further contribute to dietary insufficiency and poor nutrition in their women. The paramount claim of hospitality at the expense of the family, especially the women and children, the day-to-day family distribution of provision in favour of the men, and the long periods of lactation often lasting for 18-24 months or merging into another pregnancy — all these combine to undermine the woman's health and sap her nutritional status. How diet influences the length of gestation is not clear. It may be that muscular hypertrophy and hyperplasia on which uterine distension ultimately depends in the second half of pregnancy are adversely affected by an inadequate diet in the early months (Jeffcoate, 1955).

Fatigue

Hard physical work and insufficient rest in the later weeks of pregnancy predispose to early labour (Douglas, 1950, Browne and Browne, 1955 and Baird, 1964). Of significance, too, is the fact that this type of parturient often has a large family, is poorly housed and is generally undernourished. In the Sudan, it is customary for pregnant women of the class examined here to work to within a few days of labour, so that this may have decided some of the early labour.

Summary

Documents of 4,000 Sudanese women delivered at Khartoum Civil Hospital were studied in respect of birth weight and length of gestation.

The mean birth weight was found to be 6.65 pounds among live singletons.

Evidence is put forth suggesting that the main cause of reduced birth weight in this series is a raised incidence of labours before term.

Two factors — malnutrition and fatigue — operative in the Sudan and almost certainly responsible for, at least, some of the early labours are emphasised.

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