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Determinants of Birthweight of Twins

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The low birthweight of twins compared with singletons is only slightly influenced by the higher congenital abnormality rate in twins, or the increased incidence of proteinuric pre-eclampsia in the mothers. Reduced intakes of energy food or of zinc, copper, and iron do not account for the lower birthweight. The main cause of low birthweight is preterm delivery, and this is more common in monozygotic than dizygotic twin pregnancies, due particularly to premature rupture of the membranes. The type of placentation did not influence the preterm onset of labor. Preterm labor in monozygotic twin pregnancies is associated with a very high boy:girl ratio, but this did not apply in dizygotic twin pregnancies.

Key words: Birthweight, Malnutrition, Preterm labor, Twin placentation, Zygosity

Although the combined birthweight of twins is greater than that of singleton babies, the individual twins are usually lighter so that there is generally some degree of intrauterine growth retardation in twins. Twins are often smaller at birth also because of preterm delivery.

In a recent article on causes of intrauterine growth retardation [8] various factors concerned were considered and it is of some interest to consider these factors in relation to the growth retardation in twin pregnancies where they are relevant.

Congenital abnormalities can be associated with growth retardation and are more common in twin pregnancies than in singletons. Two recent studies, one from Aberdeen [5] and the other from America [10], both found a high percentage of malformations in twin pregnancies. In the Aberdeen study the malformations were detected at birth or in the first week of life, but in the American study the individuals were followed up for 7 years. The relevant findings from the two studies are shown in Table 1. However, this is a relatively uncommon cause of fetal growth retardation in twins.

Malnutrition is associated with reduced birthweight for gestational age. Poor maternal nutrition is thought to be more common in the lower social classes and there are more

TABLE 1. Distribution of Malformed Individual Twins by Zygosity

		Zygosity			
	Individuals	MZ	DZ	Not known	Total
Aberdeen	Malformed	20	26	11	57
	Total	380	712	222	1314
	% Malformed	5.3	3.6	5.0	4.3
NCPP Study	Malformed	90	91	38	219
	Total	373	617	205	1195
	% Malformed	24.1	14.8	18.5	18.3

small for dates babies born to women of lower social class. However, the evidence that this is due to poor nutrition is unconvincing, and it is more likely that the small weights of the babies are due to the fact that more often these women smoke more and they are themselves small.

Although baby weight can be reduced by poor nutrition, it is only when the energy intake falls quite low that this occurs. For example, in the Dutch famine of 1944–45 the birthweight was not reduced until the energy intake fell below 1,500 Kcal (6.3 mj per day). Dietary supplementation studies such as those of Stein et al [12] and Campbell-Brown et al [4] have shown that supplementation of the diet has little effect on the birthweight of the babies.

It might be expected that women with twin pregnancies would eat more than women with singletons. To investigate this, Campbell et al [3] carried out 7-day weighed dietary surveys and estimations of 24-hour urinary nitrogens at 30 weeks gestation in twin pregnancies and found that there was no difference in the intake of energy or protein in the women with twin pregnancies compared with singletons, but the energy intake was about 300–400 Kcal less than that recommended in the UK by the Department of Health and Social Security, namely 2,400 Kcal (Table 2). The output of nitrogen in 24-hour urine at 38 weeks gestation was also similar in the women having twin and singleton pregnancies (Table 3). Thus, it appears that although they are producing a combined birthweight of babies greater than in singletons, their intake is not any greater. This would appear to suggest that the recommended standard of dietary intakes should be amended. Similar results were found when the intakes of the zinc, copper and iron were measured.

Apart from places where there is likely to be severe malnutrition, it seems unlikely that maternal nutrition is a factor in contributing to the intrauterine growth retardation of twins.

Pre-eclampsia is a common complication of twin pregnancies in both the monozygotic (MZ) and dizygotic (DZ) types (Tables 4 and 5) and fetal growth retardation is quite commonly associated with proteinuric pre-eclampsia. Possibly this contributes at least in some part to the greater incidence of fetal growth retardation in twins, but it is certainly not always the cause. Indeed, it is only in the pregnancies with failure of expansion of plasma volume that fetal growth retardation is associated. In cases of pre-eclampsia in which the plasma volume expands by the normal amount there is no fetal growth retardation [9]. This is particularly applicable to primigravid singleton pregnancies. There is, however, an apparant contradiction in primigravidas with twin pregnancies because no relationship was found between the combined birthweights of the babies and the plasma volume in primigravidas, but there was a definite correlation in multigravidas with twin pregnancies. It would appear that the plasma volume is related to the development and expansion of the utero-placental blood flow and it is probable that the limitation which

occurs is in the failure of the physiological response of the uterine vasculature described by Brosens et al [2]. They found that there was this failure of physiological response in pre-eclampsia, but not in growth retardation unassociated with fetal pre-eclampsia. On the other hand, Sheppard and Bonnar [11] found that utero-placental vascular changes similar to those found in pre-eclampsia were found also in cases of idiopathic intrauterine growth retardation. The reasons for the absence of physiological changes are obscure and so far there have been no reports on studies of utero-placental bed vasculature in twin pregnancies.

It is a possibility that there is this absence of physiological response of the placental blood vessels in most cases of twin pregnancies, or, and this seems more acceptable, there

TABLE 2. Mean Daily Energy and Protein Intake at About 30 Weeks Gestation

	Energy (Kcal)	Protein (g)
Twins (N = 40)	2,036 ± 538	70.31 ± 15.26
Normal singletons (N = 57)	2,124 ± 426	75.48 ± 17.9
Recommended	2,400	60

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

Twins (N = 38)	8.26 ± 1.82
Normal singletons (N = 34)	8.78 ± 2.47

TABLE 4. Incidence of Pre-Eclampsia by Zygosity in 1,206 Twin Pregnancies in North East Scotland 1951–1980

	Proteinuric pre-eclampsia		Late pregnancy hypertension		Normotensive	
Twin zygosity	%	N	%	N	%	N
MZ paris (N = 342)	10.82	(37)	18.13	(62)	71.05	(243)
DZ pairs (N = 864)	11.11	(96)	19.10	(165)	69.79	(603)
Total (N = 1,206)	11.03	(133)	18.82	(227)	70.15	(846)

TABLE 5. Incidence of Pre-Eclampsia by Zygosity in 355 Primigravid and 851 Multigravid Twin Pregnancies in North East Scotland 1951–1980

	Proteinuric pre-eclampsia		Late pregnancy hypertension		Normotensive	
	%	N	%	N	%	N
Primigravidas						
MZ paris (N = 119)	17.65	(21)[a]	26.89	(32)	55.46	(66)
DZ pairs (N = 236)	18.64	(44)[a]	24.15	(57)	57.21	(135)
Multigravidas						
MZ pairs (N = 223)	7.18	(16)	13.45	(30)	79.37	(177)
DZ pairs (N = 628)	8.28	(52)	17.20	(108)	74.52	(468)

[a]Including 3 eclamptics.

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TABLE 6. Causes of Perinatal Deaths in Twins and Singletons in Aberdeen District in 1976–1981

	Twins		Singletons	
	%	N	%	N
Deformity	5.3	(1)	25.3	(40)
Preterm labor	52.6	(10)	8.2	(13)
Intrauterine death	15.8	(3)	27.9	(44)
Other (including pre-eclampsia and maternal disease)	26.3	(5)	38.6	(61)
Total	100	(19)	100	(158)

is a failure of expansion of the uterine arteries. This is comparable to the greater increase in uterine artery size in multiparous uteri compared to primigravid uteri found by the Dutch workers [1]. It appears that there is some limitation of the plasma volume expansion which can occur and this is presumably less in twin pregnancy. It would be of interest to know whether the second singleton babies following a first twin pregnancy are heavier than the second singleton babies following a first singleton pregnancy. If this were so, it would support the idea that the greater expansion of uterine arteries occurs in response to a twin pregnancy, but this is limited and not usually sufficient to allow the full potential growth of the two fetuses.

The expansion apparently can occur up to a limited point in gestation, as Dunn [6] has shown that the birthweights of individual twins are equal to that of singletons when the gestation is short. The divergence in weights of twins compared to singletons occurs in later pregnancy, presumably when the capacity of the uterus becomes restricted.

There is a relationship between maternal height and weight and birthweight of singleton babies. Presumably this also applies in twin pregnancies and it is of interest to note that it is the taller and heavier women who are more likely to have DZ twin pregnancies.

The causes of intrauterine growth retardation in twins are probably similar to the idiopathic growth retardation found in singletons, but is relatively more common in the later weeks of pregnancy because of the uterine size and uterine vasculature.

TABLE 7. Preterm Delivery (< 37 Weeks) of Twin Pregnancies of Known Zygosity and Placentation in Aberdeen Area 1968–1977

Total twin deliveries	624	
Total deliveries 37 weeks	176	(28.24%)
Spontaneous onset of labor	72	(11.54%)
Spontaneous rupture of membranes	73	(11.70%)
Induction of labor or caesarean section	31	(4.97%)

TABLE 8. Reasons for Termination by Caesarean Section or Induction of Labor

Proteinuric pre-eclampsia	22
Antepartum haemorrhage	6
Acute hydramnios	2
Previous caesarean section	1
Total	31

The more common cause of twins being of low birthweight is preterm delivery. Preterm delivery is much commoner in twin pregnancies than in singletons. Analysis of recent figures from Aberdeen confirms previous findings that the perinatal death rate in twins is about six times higher than in singletons. The high death rate in twins compared with singletons in the Aberdeen series is shown in Table 6. Half of the twin deaths are due to small size and immaturity, whereas in singletons this accounts for only 8%.

In most cases of singleton preterm delivery the cause is unknown and this also applies to twin deliveries. In some cases the early delivery is necessitated by some complication of pregnancy, such as pre-eclampsia or antepartum haemorrhage. As pre-eclampsia is so much more common in twin pregnancies compared to singleton pregnancies, this must account for at least some of the cases of preterm delivery of twins.

The causes of preterm delivery in Aberdeen were divided into those in which induction of labor or caesarean section were performed, those in which labor commenced with uterine contractions, and the third group in which preterm rupture of the membranes occurred and preceded labor (Table 7). The indications for induction and caesarean section are shown in Table 8 and pre-eclampsia is obviously the most common cause.

As zygosity and placentation might be concerned with the onset of preterm labor, the cases were divided by zygosity and then placentation. The MZ have a much greater incidence of preterm labor than the DZ twins (Table 9). This is mainly due to the fact that premature rupture of the membranes is more likely to occur in MZ than in DZ twins, and this difference is significant. The reason for the more frequent occurrence of premature rupture of the membranes in the MZ compared to the DZ is obscure, but it is possibly related to the more common occurrence of acute hydramnios in MZ twin pregnancies.

The type of placentation did not have any influence on either the onset of labor or the occurrence of premature rupture of the membranes as the incidence was the same in the monochorionic and dichorionic twin pregnancies (Table 10). It appears, then, to be the

TABLE 9. Preterm Delivery by Zygosity in Twin Pregnancies

	All	MZ pairs	DZ pairs
Term	624	240	384
Term deliveries	448	160 (66.7%)	288 (75%)
Preterm deliveries	176	80 (33.3%)	95 (25%)
Induction and caesarean section	31	16 (6.6%)	15 (3.91%)
Spontaneous premature labor	72	25 (10.4%)	47 (12.2%)
Spontaneous rupture of membranes	73	39 (16.25%)	34 (8.85%)

TABLE 10. Preterm Delivery by Placentation in Twin Pregnancies

	All	Monochorionic	Dichorionic
	594	119	475
Term deliveries	418	76 (63.78%)	342 (72%)
Preterm deliveries	176	43 (36.13%)	133 (28%)
Induction and caesarean section	31	11 (9.24%)	20 (4.21%)
Spontaneous premature labor	72	17 (14.29%)	55 (11.58%)
Spontaneous rupture of membranes	73	15 (12.61%)	58 (12.21%)

TABLE 11. Preterm Delivery and Sex of Twins

	MM[a]	MF	FF	Total M	Total F	M/F ratio
All (624)	223	198	203	644	604	1.07
Preterm deliveries (176)	74	45	57	193	159	1.21
Induction and caesarean section (312)	13 (9)	6 (3)	12 (10)	32	30	1.07
Spontaneous premature labor (72)	28	24	20	80	64	1.25
Spontaneous rupture of membranes (73)	33	15	25	81	65	1.25

[a]M, male; F, female.

TABLE 12. Sex of Babies in Monozygotic Preterm Twin Deliveries

	MM[a]	FF	M/F ratio
All (240)	130	110	1.18
Preterm (80)	49	31	1.58
Induction and caesarean section (16)	8	8	1.00
Spontaneous premature labor (25)	17	8	2.13
Spontaneous rupture of membranes (39)	24	15	1.60

[a]M, male; F, female.

TABLE 13. Sex of Babies in Dizygotic Preterm Twin Deliveries

	MM[a]	MF	FF	Total M/F	M/F ratio
All (384)	93	198	93	384/384	1.00
Preterm (96)	25	45	26	95/97	0.98
Induction and caesarean section (15)	5	6	4	16/14	1.14
Spontaneous premature labor (47)	11	24	12	46/48	0.96
Spontaneous rupture of membranes (34)	9	15	10	33/35	0.94

[a]M, male; F, female.

zygosity rather than the type of placentation that determines the preterm onset of labor in twins.

As it had been shown by Hall and Carr-Hill [7] that preterm labor was more common with boy babies than girls, the sex of babies was studied with reference to preterm labor in twins. The boy-girl ratio is increased in preterm labor in twin pregnancies (Table 11). When the zygosity of the twin pregnancies was considered, it was found that in MZ twin pregnancies the boy-boy to girl-girl ratio was very high in the women having spontaneous rupture of the membranes, but not in those who had labor induced or caesarean section (Table 12). In the DZ twin pregnancies, however, there was no such preponderance of boys to girls in the preterm deliveries (Table 13). There is no obvious explanation for this discrepancy.

In MZ twin pregnancy there is a very high incidence of preterm delivery. This is associated with premature rupture of the membranes and also with the combination of boy-boy compared with girl-girl babies.

Apparently in singleton pregnancies and MZ twin pregnancies, the preponderance of boys in preterm delivery could be related to the production of androgenic hormones, thus disturbing the endocrine balance which possibly initiates labor. The reason for premature rupture of the membranes in MZ twins is possibly due to either acute hydramnios or possibly to a greater tendency to weakness in the membranes.

These findings possibly give some assistance in determining the cause of preterm labor in singletons as well as in twins, but the actual reasons are still obscure.

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