

# THE VARIABILITY OF BIRTH-WEIGHT

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## Summary

In Malta the mean birth-weight for male babies is 3446g., and for female babies 3358g. The mean birth-weight tends to increase with the mother's parity, and this trend continues even with the higher parities. The association between birth-weight and rising maternal age remains uncertain. It is also probable that birth-weight has a geographical determinant. Birth-weight is a multifactorial product and cannot be very reliable as a clinical parameter. A new terminology is necessary to distinguish between three different groups of babies with low birth-weights.

## Introduction

For over 200 years attempts have been made to study birth-weight accurately. Since Roederer's publication (1753) this parameter has been measured repeatedly in several countries with the belief that it constitutes "the cornerstone of paediatrics as we know it" (Cone, 1961) and a reliable assessment in obstetric practice. International study-groups continue to find no better yard-stick than birth-weight for defining prematurity, although the definition is universally admitted to be inadequate and misleading. It is important to bear in mind that birth-weight depends upon a multitude of factors. These include not only the duration of gestation and the health of the placenta, but also the mother's age, her parity, height and weight, glucose tolerance, social status, race and ethnic group, and geographical locality — quite apart from such influences as foetal congenital malformation and multiple pregnancy.

In this investigation special attention has been devoted to older mothers, high parity and over-sized babies, since infor-

mation on these data is still insufficient in published work.

## Material and Method

The material for this study was obtained from the maternity records relating to single births occurring in Malta throughout 1965. In this year there were 5,719 total births; of these our sample covers 2,517 births (44.11 per cent). The records were personally examined by one of us (Cremona, 1967) from St. Luke's Hospital, from private Hospitals, and from the District Nursing Association. While relatively few domiciliary confinements could be included in the study, yet it is clear that the actual sample reviewed is closely representative of the total births in relation to all the factors mentioned earlier.

TABLE I  
Comparison of sample with total births  
in Malta for 1965

Total	Live births		Stillbirths	Unknown Sex
	Males	Females		
Total	2922	2706	91	—
Sample (seen)	1276	1171	60	10
Sample (used)	1232	1126	—	—

Table I shows the composition of our sample. The 60 stillbirths were not considered any further. There were also 99 cases which had to be excluded because of multiple pregnancy, unknown sex, or inadequate information. From the remaining 2,358 cases, records were kept of the baby's sex, birth-weight, gestation time, maternal age and parity. The means and standard deviations of these variables are shown in Table II.

It is pointed out that in this sample the mean parity is appreciably higher than in

TABLE II

Means and Standard deviations of weight, gestation time, maternal age and parity

	Birth Weight (g.)		Maternal age		Parity		Gestation time (wk.)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
M	3446 ± 15.25	535.4	27.88 ± 0.18	6.29	2.12 ± 0.08	2.94	39.78 ± 0.052	1.84
F	3358 ± 15.28	512.9	28.18 ± 0.19	6.34	2.19 ± 0.08	2.81	39.73 ± 0.051	1.72

many similar investigations (Karn and Penrose, 1951; Fraccaro, 1956), because our data are not weighted by an undue prevalence of first-born babies.

### Results

Table III is reproduced in order to demonstrate that, whereas parity exerts no appreciable effect on the duration of pregnancy, the mean birth-weight increases steadily as parity rises. For instance, for parities of 10 or more the weight of the average male baby exceeds the over-all mean weight for males almost by 350g.

In the higher parities the number of cases tends to be small. We have therefore analyzed the relevant data from a parallel study on the 'grande multipara' extending over previous years; thereby we could add a further 290 cases of parities of 5 and over. The result is shown in Table IV. Our findings show that birth-weight increases linearly with parity and that this influence continues unabated with the higher parities.

These additional 290 cases are not included in any other Table in this study, nor in any further consideration.

It might be argued that the effect which is being attributed to rise in parity could be due, partly or wholly, to the concomitant increase in maternal age: a mother who is Para 6 or 8 is very likely to be much older than one who is Para 0 or 1. This difficulty should be cleared up. We sought to analyse the mean birth-weight of either sex for given parity in rising maternal age-groups. The data in the various sub-groups were often too few, so that in many instances we re-grouped data together. Table V sums up our findings. We believe that by and large these are inconclusive. A trend is suspected for the older mother to bear a heavier baby than her younger sister of identical parity; yet even if this were so, the influence does not seem to be so strong as to account for the effect ascribed earlier to parity.

Table VI demonstrates this uneven trend for the mean birth-weight to increase with rising maternal age, although the effect of parity is not being taken into consideration. It is also interesting that the mother's age does not appear to influence the duration of gestation.

TABLE III

## Mean Birth Weight and Mean Gestation time for given Parity

Parity	Weight (g.)				Gestation time (wk.)			
	Males		Females		Males		Females	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean
0	431	3346.45	371	3255.58	431	39.85	371	39.86
1	278	3464.24	269	3371.90	278	39.72	269	39.74
2	164	3500.76	145	3403.26	164	39.77	145	39.86
3	111	3519.15	92	3374.55	111	39.68	92	39.45
4	66	3417.91	69	3393.56	66	39.53	69	39.65
5	39	3501.56	47	3406.40	39	39.85	47	39.43
6	37	3611.05	39	3524.26	37	39.62	39	40.05
7	26	3497.15	26	3414.23	26	39.81	26	38.88
8-9	41	3436.80	30	3580.87	41	39.80	30	39.83
10+	39	3792.94	38	3551.87	39	40.10	38	39.45
All	1232	3446.35	1126	3358.49	1232	39.78	1126	39.73

The finding that gestation time bears no appreciable relationship to parity (Table III) or to maternal age (Table VI) lends greater value to Table VII, wherein the distribution of birth-weight is tabulated in relation to gestation time.

From the same data we have calculated the incidence of over-sized babies born in Malta. There were 272 babies whose birth-weight exceeded 4000g. (11.5 per cent of the total sample), 36 babies over 4500g. (1.5 per cent) and 2 babies over 5000g. (0.08 per cent). This incidence is compared (Table VIII) to that obtaining in seven other countries, from data compiled by Koskela (1965). Our findings fit in with this author's suggestion that the incidence of large newborn babies seems to increase from the Equator towards the Arctic Circle.

earlier study by Agius *et al.* (1966), who reported that the mean weight for births in Malta was 7.6 lbs. (3452g.) for boys and 7.29lb. (3307g.) for girls. Their sample comprised 4,103 live births, although these were drawn from the births occurring during the years 1951 to 1959 inclusive (i.e. 5.16 per cent of the potential sample of 79,504 births in these nine years).

The effect of parity upon birth-weight continues to provide interest. Several workers (Fraccaro, 1956; Achar and Yankauer, 1962; Shaw, 1933; McKeown and Gibson, 1951) have shown that there is a tendency for birth-weight to increase linearly with the mother's parity, but doubt is often expressed on whether this tendency remains applicable to parities over 3, or over 8. However, studies in which the number of mothers with the higher parities was not small have usually demonstrated that the increase in birth-weight does tend to continue beyond the eighth pregnancy (Uttley, 1940; Lee, 1948). This conclusion also appears to result from Fraccaro's own analysis of a large sample of Czechoslovakian births (Fraccaro, 1958), although he states that in the higher parities the mean weights remain rather constant. Our data in the group of higher parities refer to an appreciable number of mothers, and we have concluded that the tendency for the mean birth-weight to increase with parity continues even with the higher parities (Camilleri and Cremona, 1969).

Table IV

## Mean Birth-weight in High Parities

Parity	Males		Females	
	No.	Mean	No.	Mean
5	75	3442.86	75	3480.53
6	71	3579.61	58	3497.79
7	58	3593.93	49	3511.39
8+9	67	3590.36	59	3537.58
10+	80	3703.87	70	3645.00

## Discussion

Our study provides a reliable assessment of the average birth-weight in Malta. The mean birth-weight of male babies is 3446g., and that of females is 3358g. These findings correspond fairly closely with an

It would be interesting to accumulate

TABLE V

Mean Birth Weight (g.) for given Parity and Maternal age group

## (a) MALES

Parity Mat. age	0	1	2	3	4+5	6+7	8+9	10+
15—	3335.05	} 3440.60		3837.81				
20—	3337.42				} 3471.43			
25—	3370.84	3484.54	3593.43	3546.87			} 3509.04	} 3521.00
30—	3316.28	3417.93	3526.78	3532.86	3414.68			
35	} 3410.63	3608.00	} 3415.44	} 3436.00	3678.14	3585.93	3572.86	
40+		—				3121.33	3715.00	3108.18

## (b) FEMALES

Parity Mat. age	0	1	2	3	4+5	6+7	8+9	10+
15—	3183.05	3382.00	} 3412.81					
20—	3279.29	3334.93			} 3210.24	} 3360.54		
25—	3296.15	3336.94	3487.98					3376.40
30—	3000.52	3448.51	3342.52	3483.07	3391.52	3464.52	3338.42	} 3731.94
35	} 3387.30	} 3563.05	} 3339.18	} 3489.41	3473.83	3586.12	3570.27	
40+							3386.91	3991.09

TABLE VI

Mean Birth Weight and Mean Gestation time for given Maternal Age

Mat. Age	Weight (g.)				Gestation time (wk.)			
	Males		Females		Males		Females	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean
15—	67	3389.4	55	3204.7	67	39.57	55	40.13
20—	369	3390.2	293	3301.17	369	39.86	293	39.90
25—	331	3453.5	350	3343.49	331	39.91	350	39.80
30—	243	3448.3	229	3366.9	243	39.63	229	39.44
35—	161	3560.9	137	3508.6	161	39.69	137	39.76
40+	61	3499.8	62	3487.8	61	39.61	62	39.26

TABLE VII

Distribution of Birth Weight and Gestation time:— All Births

Wt. (g.)	Gestation time (weeks)																					Total				
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48		49	50	51	
5770.5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
5450.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5150.5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
4850.5	—	—	—	—	—	—	—	—	—	—	—	—	2	3	2	1	—	—	—	—	—	—	—	—	—	8
4550.5	—	—	—	—	—	—	—	—	—	—	1	—	8	6	2	1	—	—	—	—	—	—	—	—	—	18
4250.5	—	—	—	—	—	—	—	—	—	2	5	15	32	20	13	4	—	1	—	—	—	—	—	—	—	92
3950.5	—	—	—	—	1	—	—	—	1	4	15	19	69	52	24	6	—	4	—	—	—	—	—	—	1	196
3650.5	—	—	—	—	—	—	—	1	5	8	31	87	131	92	42	8	5	1	—	—	—	—	—	—	—	405
3350.5	—	—	1	—	—	—	1	3	6	16	49	120	209	121	52	12	3	2	—	2	—	—	—	—	—	597
3050.5	—	—	—	—	—	2	2	3	8	12	60	98	194	87	30	4	6	4	—	—	—	—	1	—	—	511
2750.5	—	—	—	—	—	—	—	3	9	23	46	76	104	30	23	4	1	1	—	—	—	—	—	—	—	320
2450.5	—	—	1	—	—	1	2	8	10	16	22	19	26	18	5	1	—	—	—	—	—	—	—	—	—	129
2150.5	—	—	—	—	1	—	2	3	2	9	6	8	12	3	1	—	1	1	—	—	—	—	—	—	—	49
1850.5	—	—	—	—	1	—	3	—	—	1	1	—	3	—	1	—	—	—	—	—	—	—	—	—	—	10
1550.5	—	—	1	—	—	—	4	2	—	—	3	1	—	1	—	—	—	—	—	—	—	—	—	—	—	12
1250.5	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
950.5	—	—	—	1	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	4
650.5	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
350.5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	1	—	3	2	3	7	15	23	41	91	239	437	792	434	195	41	16	14	—	2	—	1	—	1	—	2358

TABLE VIII

## Geographic distribution of large babies

Country	Incidence of large babies (per cent)		
	4000g. or more	4500g. or more	5000g. or more
Nigeria	0.28	—	—
Venezuela	2.71	0.33	0.023
U.S.A.	3.4 to 11.9	0.61 to 1.77	0.15 to 0.2
Malta	11.5	1.5	0.08
France	9.2	1.6	—
Germany	9.3	0.94 to 1.3	0.12
Russia	11.38	—	—
Finland	17.1	3.19	0.32

evidence of alterations in birth-weight in successive pregnancies in the same mothers. Such a study would truly help to define the effect of parity on birth-weight, but the difficulties of collecting sufficient reliable data on these lines must be considerable.

One complicating factor in these studies is the fact that a rise in parity is accompanied by an increase in maternal age, since this age in itself may exert a noticeable influence on birth-weight (Uttley, 1940; Lee, 1948; Gregersen, 1937). This influence remains debateable. Thus McKeown and Gibson (1951) concluded that there was no consistent association between weight and maternal age when birth rank was fixed. In the large Czechoslovakian series Fraccaro (1958) observed a parabolic distribution of mean birth weights for given mother's age, with the highest point in the age-group 30-34 years, but he thought that this parabola was probably not real. Our own results (Tables V and VI) again leave us in doubt on the true nature of the effect of maternal age upon birth-weight. However, viewed in another way, these data do seem to strengthen our earlier contention that there is a trend for birth-weights to be heavier in the higher parities.

Yet another important factor which appears to be involved in the study of birth-weights is that of geographical variation. Koskela (1965) has drawn attention to this point, emphasizing that the considerable

variations in percentages of large babies born in different regions of the world suggest that factors other than maternal diabetes or the pre-diabetic state play an appreciable role in determining foetal size. One may attempt to attribute these variations to genetic factors, climate, social conditions, maternal nutrition, parental size. For instance, Hollingsworth (1960) found that in Ghana the mean birth-weight of babies of poor Africans was lower than that of rich Africans, and that these latter weights were practically similar to those of European babies born in the same hospital. Nevertheless, one cannot lose sight of the evidence that the incidence of large newborn babies seems to follow a definite geographical pattern, increasing towards the Arctic region. Our own figures for Malta fit in well within this pattern. As Brandt (1949) has observed: "Geographic locality has a modifying effect on the size of the newborn in the same way as geographic locality causes modifications in plants and animals of one and the same species".

It is evident therefore how unreliable birth-weight must be as a parameter for the assessment of the duration of pregnancy. This point is again emphasized by Table VII, which shows a wide extension of the same birth-weight over a span of gestation time, and a great variation in birth-weight at any one week of gestation. At the same time it is also unrealistic to define prematurity as a birth-weight below 2500g. In 1961 the W.H.O. recommended that the concept of prematurity should be substituted by that of low birth-weight because it is premature by gestation time, or because of a hostile intra-uterine environment ("small for dates"), or simply because of natural determining factors (genetic, geographical, and so on). It is important to distinguish these three groups of small infants. It is time that the W.H.O. Expert Group discarded its old terminology and introduced a new one.

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