THE INTERRELATIONSHIPS BETWEEN FETAL WEIGHT, SIZE OF PELVIC INLET, AND MATERNAL HEIGHT*

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One of many fascinating problems concerned with fetal physiology is that pertaining to the factors governing fetal growth. An extensive literature on this subject confirms the prevailing opinion that there are many factors concerned, and that each contributes to the whole in greater or lesser degree.[1]

As a result of a clinical comparison of the maternal pelvis and of the fetus, Lane[5] in 1903 concluded that "the child grows in utero in such a manner and at such a rate that at full term his size is proportional to that of the mother's pelvis through which he has to pass in order to be born." The validity of such a law of proportion finds ready acknowledgment in the case of progeny of different species. Clinical observation in veterinary obstetrics has repeatedly demonstrated that the size of the female, not that of the male, fixes the size of the fetus. Williams[12] reports results of crossing small mares with large draft stallions of more than three times greater weight in which not one case of dystocia attributable to excessive volume of the fetus was noted.

Controversy over this subject as applied to women had prevailed for a long time prior to Lane's report, and as early as 1887 La Torre[6] offered data in support of his contention that fetal weight bears no relationship to pelvic size. Contrariwise, Pinard[8] concluded that the average weight is larger in women with narrow pelves, and postulated an explanation for this. Seemingly it was the report of Pinard which prompted Wilcke[11] to make similar studies in patients with small pelves, and he presented findings showing lesser weight for the newborn of such women than for the newborn of women presenting "normal pelves."

Carrying forth an investigation in which he employed the identical methods of Lane, Leicester[7] could not agree with the conclusions of his countryman, for he found no such striking relationships as had been described.

Of much interest in this connection is an editorial appearing in

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the *Lancet*[2] in which it was stated, "To prove such a contention as Lane's, we think that a series of measurements of the pelvis carried out either on the cadaver or living subject under anaesthesia would be necessary, since differences of so small a measurement as a quarter of an inch are in question."

We, of course, must respect the sincere efforts of each of the aforementioned investigators. Yet at best their methods were quite inadequate, and their results are, therefore, not conclusive. One cannot justly employ any single linear measurement—and that crudely taken—to depict true pelvic size. The situation of the greatest pelvic diameter of the pelvic inlet may vary greatly, but even such a measurement, when accurate, cannot be acceptable as revealing pelvic size, as Scheyer[9] has ably demonstrated. In his observations of Chinese female pelves, he has noted that in leptosomes the surface area of the inlet is larger in the "long oval pelves" than in the "transverse oval," whereas this relationship is reversed in the pyknic. (His method for determining inlet surface area was not reported.)

The advancement of roentgen pelvimetry to its present stage of simplicity has brought to our possession a very convenient, and, in fact, the only method for accurately visualizing and measuring the true pelvic inlet. Employing such roentgen technic, a method for evaluating pelvic inlet surface area was devised, and this investigation of maternal pelvis-fetal weight relationship undertaken.

v. Gutfeld[4] in 1913 reported a direct relationship between maternal stature (height) and weight of the newborn. The question arises if pelvic size and fetal weight are directly correlated, i.e., whether stature is indicative of pelvic size. We have, therefore, considered this problem also.

Method

According to the methods devised and employed by Thoms,[10] tracings of the pelvic inlet were made from pelvimetric films of 362 white primiparous patients. By superimposing sheets of kodaloid, and cutting with a keen-edged blade along the inlet outline, a true pattern of each inlet was obtained. These figures were carefully weighed on finely balanced scales. The weight of kodaloid per square centimeter was determined by weighing several samples 25 centimeters square, and with this value the actual surface area of each kodaloid figure was computed by simple equation.

Kodaloid is ideal for making comparative observations of this nature. It is of uniform density and thickness, and is non-hygro-

TABLE I

CORRELATION TABLE FOR WEIGHT OF NEWBORN AND SIZE OF PELVIC INLET
362 CASES

grams	cm² 70	75	80	85	90	95	100	105	mean	110	115	120	125	130	135	140	145	150	155
5000													1						
4900																			
4800																			
4700							1	1											
4600							1			1									
4500											1	1							
4400											2								
4300				1				1		1				2		2			
4200				1			1	1		3	2	1							
4100				1		3	1	1		1	1	1		1					
4000					1	1					1	2	1		1				
3900							6	2		2	6	2						1	
3800				1	1		5	2		2		2						-	
3700							3	3		7	5	1	1			1			1
3600			2	2			7	6		4	6	2	4	1					
3500					2	1	7	6		4	1	1	1	1					
3400																			
mean						5	3	7		1	4								
3300					1	4	7	2		2	5	1	3		1		1		
3200				1	2	1	10	5		8	1	3	1						
3100			3	1	4	3	7	5		5	7	1							
3000		1	1	3	2	3	2	3		3	3	2	3	1	2				
2900			1	2	4	3	3	1		3	2		1	1		1			
2800			1	3	2		6	3		3	1	1	1			1			
2700	1			1	2	2	1	2		1	2		1						
2600					4		1				1								
2500																			

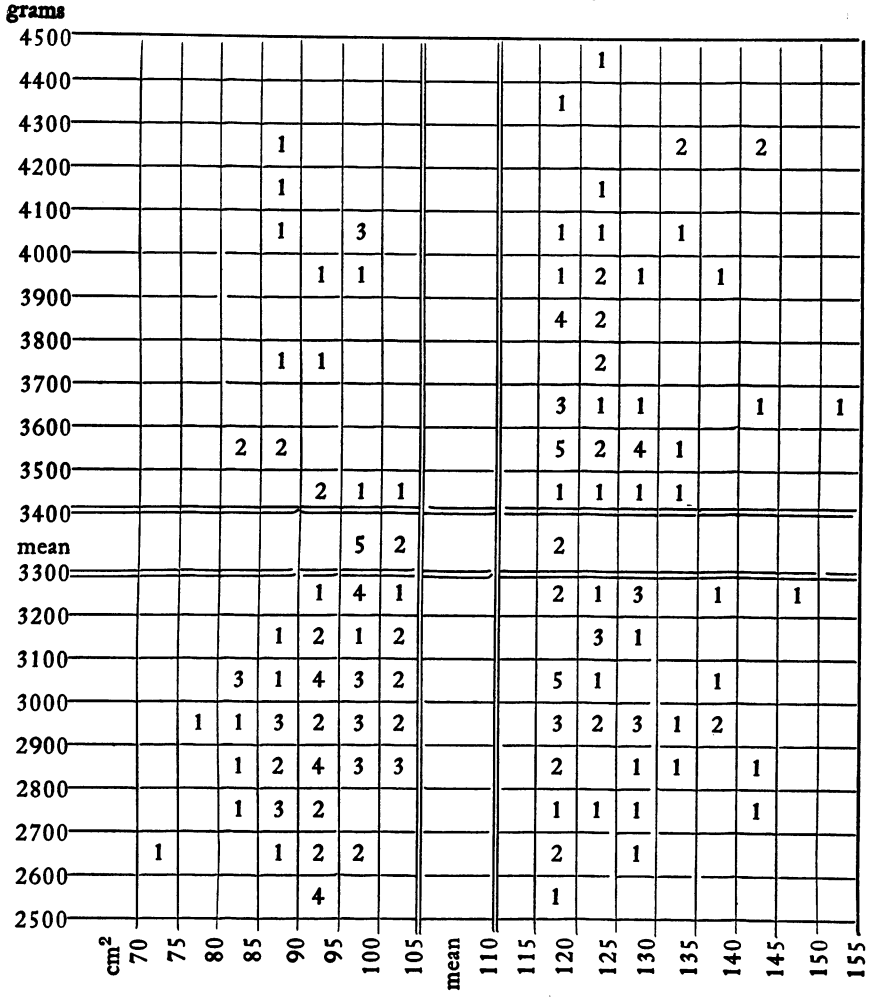
scopic, hence such source for error may be ignored. Furthermore, its transparency readily permits direct tracing.

TABLE II

CORRELATION TABLE FOR LOWEST QUARTILE OF TABLE I

TABLE III

CORRELATION TABLE FOR HIGHEST QUARTILE OF TABLE I



One must concede that the width of the pencilled outline from which the pattern is cut is slightly inconstant in the same and different tracings, yet, at most, this can be but a negligible source

of error, and does, of course, tend to be a factor common to every tracing. This possibility is significant only in that it appears to be the most outstanding source of error in arriving at a workable image of the pelvic inlet.

In this series the fetal weight was determined within an hour or two after birth, and includes only infants of 2500 gms. and over. In seven instances, pregnancy was terminated by cesarean section, three of which were performed after spontaneous labor had started, and in seven instances, also, labor was induced at or near term. While it is felt that this information should be mentioned, it is doubtful that the end results in this investigation are materially influenced.

TABLE IV

CORRELATION TABLE FOR MIDDLE QUARTILES OF TABLE I

grams	95	100	105	mean	110	115	120
4700		1	1				
4600		1			1		
4500						1	
4400						1	
4300			1		1		
4200		1	1		3	2	
4100		1	1		1		
4000							
3900		6	2		2	2	
3800		5	2		2		
3700		3	3		7	2	
3600		7	6		4	1	
3500		6	6		4		
3400							
mean		1	7		1	2	
3300		6	2		2	3	
3200		8	5		8	1	
3100		5	5		5	2	
3000			3		3		
2900			1		3		
2800		6	3		3		
2700		1	2		1		
2600		1					
2500							

cm^2

Results

Table I is a distribution diagram of 362 cases constructed on axes of pelvic inlet area and newborn weight. Considering the group as a whole, the coefficient of correlation between weight of infant and size of inlet is +0.223. The probability[3] that such a correlation would arise by random sampling from an uncorrelated group is less than one in ten thousand. The observed correlation must be, therefore, regarded as significant, indicating a definite trend toward infants of greater weight in patients with larger pelves.

From a further analysis, however, it is apparent that this trend is due chiefly to a preponderance of small infants in patients with small pelves. Tables II, III, and IV are distribution diagrams of cases grouped as small, large, and medium pelves. The

last of these tables includes all cases lying within the interquartile range, whereas the large and small lie above and below that range.

The mean weight of infants in each of these groups is 3,127 gms., 3,405 gms., and 3,403 gms., representing small, medium, and large pelves respectively. The mean weight for the "small" group is 278 gms. less than is that for the "medium"; this 5.1 times the standard error of the difference, and hence statistically significant. The difference between the mean weights of the middle and upper groups is only 2 gms.; this is 0.035 times the standard error of the difference, and hence not statistically significant.

This analysis reveals that patients with small pelves have infants which, on the average, are significantly smaller than are the infants of patients with medium-sized pelves. The infants of patients with large pelves, however, are not significantly different from the average.

TABLE V

CORRELATION TABLE FOR MATERNAL HEIGHT AND SIZE OF PELVIC INLET

cm	cm² 75	80	85	90	95	100	105	mean 110	115	120	125	130	135	140	145
177								1						1	
174										1			1		
171								1	3	3					
168								1		3					
165					1		2		5	5	1	2			
162						1	5	3	2	2	1				
159															
mean						1	3	3	5	1	1				
156				2		3	5	3	2	1	1				
153				1			3	3							
150			1	1	5		2	1							
147							2								
144				1											
141			2												
138															
135															

TABLE VI

CORRELATION TABLE FOR FETAL WEIGHT AT BIRTH AND MATERNAL HEIGHT

grams	cm. 138	141	144	147	150	153	156	mean	159	162	165	168	171	174	177
2500		1								1					
2600							3								
2700					1	1	1								1
2800	1				1		1	1							
2900							1	2		1					
3000	1				1				1				1		
3100									2	4			1		
3200				1	2	1	2	2							
3300															
mean								1	1					1	
3400															
3500					1	2	1	1	1	2			1		
3600					3	1	1	1	1	1	2				
3700									2	3					
3800					1		1								
3900						1	1		1		1				
4000										1	1				
4100							1	1							
4200								1	1						
4300								1							
4400													1		
4500															
4600															
4700														1	

Tables V and VI are distribution diagrams of 98 and 78 cases arranged on axes of maternal height and pelvic size, and maternal height and fetal weight at birth.

A very striking coefficient of correlation of 0.643 exists between size of pelvis and maternal height, the taller women having larger pelves. This coefficient is proven to be statistically very significant ("t" test[8]).

A coefficient of correlation equal to 0.269 exists for maternal height-fetal weight relationship. This approximates the trend noted in Table I.

Conclusions

There is a very striking tendency for women with small pelves to have smaller infants than do women with medium sized pelves.

The newborn of women with large pelves do not differ significantly in weight from newborn of women with medium pelves.

Maternal stature (height) and pelvic inlet size are directly correlated. Stature tends to be indicative of pelvic size.

The relationship between maternal height and weight of the newborn parallels that between the size of the pelvic inlet and the weight of the newborn.

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