MATERNAL AGE AND PARITY EFFECTS ON HUMAN BIRTH WEIGHT: A HOSPITAL SURVEY FROM LAHORE (PUNJAB), PAKISTAN

Pages with reference to book, From 131 To 137

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Abstract

The study is based on a total sample of 994 live births (470?$ and 524 dV) and 15 stillbirths in a hospital survey from Lahore (Punjab), Pakistan. The mean birth weight of newborns is 109±0109.025+0.95. The mean birth weight for female infants is 1G7.31±1.19 and that of male births 110.74+.0.71. The difference between the two sexes is highly significant (t_{992}=2.46; P <0.02). Lighter males are born to younger mothers (<19 years) than the females (t_{48}=0.47; P>0.6) but heavier male births are observed in the first birth order than the female babies (t_{335}=0.93; P>0.3).

The stillborn arc lighter than the live births with an average difference of 4.87 oz. The liveborn males and females are heavier than the male and female stillbirths with an average difference of 4.92 oz and 6.51 oz respectively.

The advancing maternal age shows highly significant negative effects on male birth weights (P<0.01), and non-significant positive effects on female (P>0.1). Birth order has highly significant positive influence on male birth weights (P<0.001), but insignificant effects on female birth weights.

Maternal age indicates non-significant effects on sex ratio (P>0.1); however birth order shows highlv significant negative effects on sex ratio(P <0.01) (JPMA30:131, 1980).

Introduction

Parental age and parity effects have been studied on various aspects in man. Penrose (1934), Collmann and Stoller (1962) showed that maternal age plays a significant role than the birth order on the incidence of Down's syndrome. Stillbirths in general increase in frequency in mothers aged over 40 years (Penrose, 1934, 1954; Millis, 1958). Shami and Sultana (1980) investigated that maternal age has negative effects on male stillbirths and significant positive effects on female stillbirths. They showed thatbirth order has highly significant positive effects on male stillbirths. James (1963), Warburton and Fraser (1964) examined that the incidence of abortions increases with the increase in maternal age. Shami and Sultana (1980) reported that maternal age has significant negative effects on abortion, but significant positive effects on birth order.

The variation in secondary sex ratio is independent of mother's age, but is dependent on increasing birth order and paternal age, that the sex ratio shows decline with two later factors (Novitski and Sandler, 1956; Shami and Tahir, 1978).

Maternal age and birth order also show-effects on human birth weights. Karn and Penrose (1951), Millis and Seng (1954) investigated that birth weight increases with parity and decreases slightly with maternal age. Karn (1952) reported that unlike-sex twins are heavier than the like-sex twins, but maternal age and parity have almost the same effects as that with single births. Survival rate, however, were higher in unlike-sex twins than the like-sex. Karn and Penrose (1951) and Jayant (1966) showed that selection has stabilising effects on birth weight, that the babies nearer the mean valne birth weight have higher survival rates than those nearer the two extremes. Banerjee and Roy (1962) reported that mean birth weight increases with parity upto certain parity levels and then decreases with higher parity

levels. Selvin and Garfinkel (1972) examined that young mothers showed tendency to have an increasing proportion of low-weight infants with increasing birth order, whereas, the opposite was true for mothers older than 45 years.
The present investigation reports the influence of maternal age and birth order on birth weight, and sex ratio of live births and stillbirths.

Material and Methods

Data were collected from Sir Ganga Ram Hospital and Lady Wellingdon Hospital, Lahore. The study is based on a total sample of 994 (470 ?$ and 524 and 15 stillbirths. The data contain those cases of livebirths and stillbirths which were visited at the time of delivery. The information collected includes maternal age at the time of birth of baby, sex of the child and birth order. The newborn were immediately weighed after birth. The weights were taken in ounces.
Methods of simple and partial correlations were applied for various analyses.

Results

The data of live births were analysed in relation to maternal age, birth order and birth weights. Maternal ages were grouped into seven age classes (<19, 20-23, 24-27, 28-31, 32-35, 36-39, 40+) with an interval of four years. In the <19 years age class all mothers less than this were included and 40+ years class included mothers of 40 years and over. Due to small data for weights of stillbirths the possible statistics were applied.
The overall weight of the newborn is 109.025±0.95. The mean birth weight for female infants is 107.31 ±1.19 and that for males 110.74 ±0.71. The difference of birth weight in female and male offspring is highly significant (1992= 2.45; P<0.02).
Younger mothers (<19 years) give birth to lighter males (106.27±4.51) than the females (109.00±3.57) (Table I and II, Fig. 1).

Table I: Mean Birth Weight (oz) and Coefficients of Variation of Female Offspring in Different Maternal Age Groups.

Maternal age (years)	*Number*	*Mean*	*±S.E.*	*S.D.*	*C.V.*
< 19	24	109.00	3.57	17.51	16.00
20-23	93	102.62	2.49	24.05	23.43
24-27	105	106.40	2.41	21.97	20.65
28-31	131	106.91	1.95	22.35	20.90
32-35	73	109.82	4.86	41.57	37.85
36-39	25	120.88	3.97	19.88	16.44
40+	19	108.42	0.76	3.34	3.07
Total	470	107.31	1.19	25.99	24.23

Table II: Mean Birth Weight (oz) and Coefficients of Variation of Male Offspring in Different Maternal Age Groups.

Maternal age (years)	*Number*	*Mean*	*±S.E.*	*S.D.*	*C.V.*
< 19	26	106.27	4.51	22.99	21.63
20-23	113	108.85	1.98	21.07	19.36
24-27	127	110.93	1.72	19.39	17.48
28-31	137	110.89	1.52	17.76	16.01
32-35	76	114.59	2.54	22.14	19.32
36-39	22	100.54	5.97	28.01	27.86
40+	23	120.08	4.97	23.85	19.85
Total	524	110.74	0.71	16.34	14.75

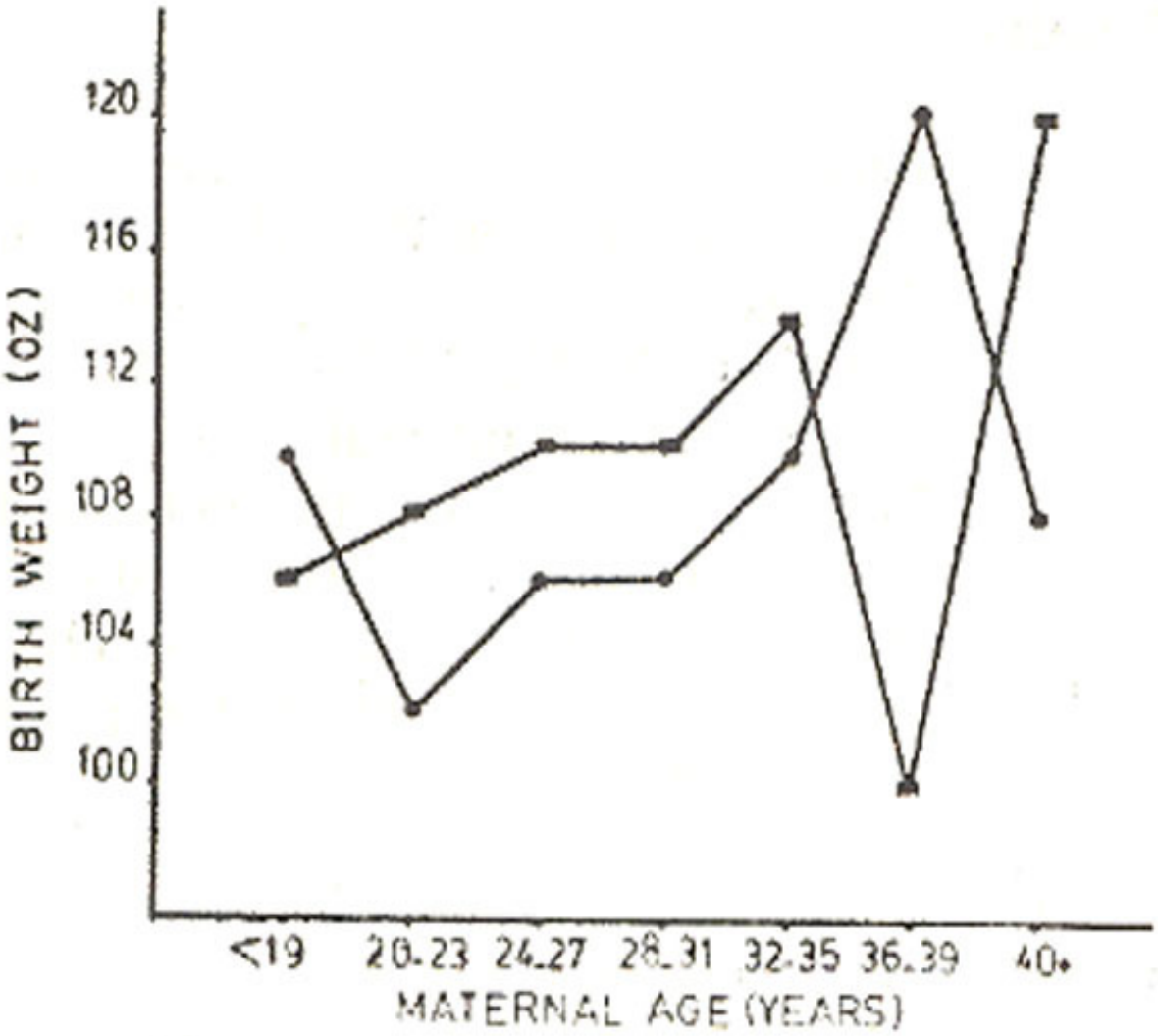

Fig. 1. Mean birth weight in female (●) and male (■) newborns in relation to maternal age.

The difference between the two is statistically nonsignificant (t_{48}=0.47; P> 0.6), The male babies show increase in birth weight upto maternal age between <19-35 years, but a sharp decrease in mothers of 36-39 years of age and a rise in mothers of 40+ years of age. The mothers between 20-35 years show decrease in birth weight of female infants, and a rise and fall in birth weights in mothers between 36-39 and 40+ years of age respectively (Table I, Fig. 1).

The male births are heavier (107.24+ 1.62) (Table IV, Fig. 2)

Table IV: Mean Birth Weight (oz) and Coeflicients of Variation of Male Offspring in Different Birth Orders.

Birth order	*Number*	*Mean*	*±S.E.*	*S.D.*	*C.V.*
1	169	107.24	1.62	21.10	19.67
2	108	112.34	2.31	24.06	21.42
3	65	111.80	2.39	19.31	17.26
4	38	111.18	3.68	22.67	20.38
5	41	109.12	7.89	50.53	46.31
6	26	112.85	4.35	22.21	19.68
7	29	118.72	3.99	21.51	18.18
8	15	114.40	4.63	17.93	15.67
9	11	110.73	7.79	25.86	23.35
10+	22	113.32	6.71	31.46	27.76
Total	524	110.74	0.71	16.34	14.75

than the females (105.58± 1.79) (Table III, Fig. 2)

Table III: Mean Birth Weight (oz) and Coefficients of Variation of Female Offspring in Different Birth Orders.

Birth order	*Number*	*Mean*	±*S.E.*	*S.D.*	*C.V.*
1	168	105.58	1.79	23.18	21.95
2	74	108.81	2.73	23.51	21.95
3	52	109.86	6.45	46.53	42.35
4	37	101.81	3.78	22.98	22.56
5	39	107.51	2.14	13.36	12.42
6	29	102.21	5.26	28.34	27.72
7	25	110.80	3.45	17.25	15.56
8	16	116.44	7.32	29.26	25.13
9	17	106.35	5.85	24.11	22.66
10+	13	120.77	6.27	22.61	18.72
Total	470	107.31	1.19	25.99	24.23

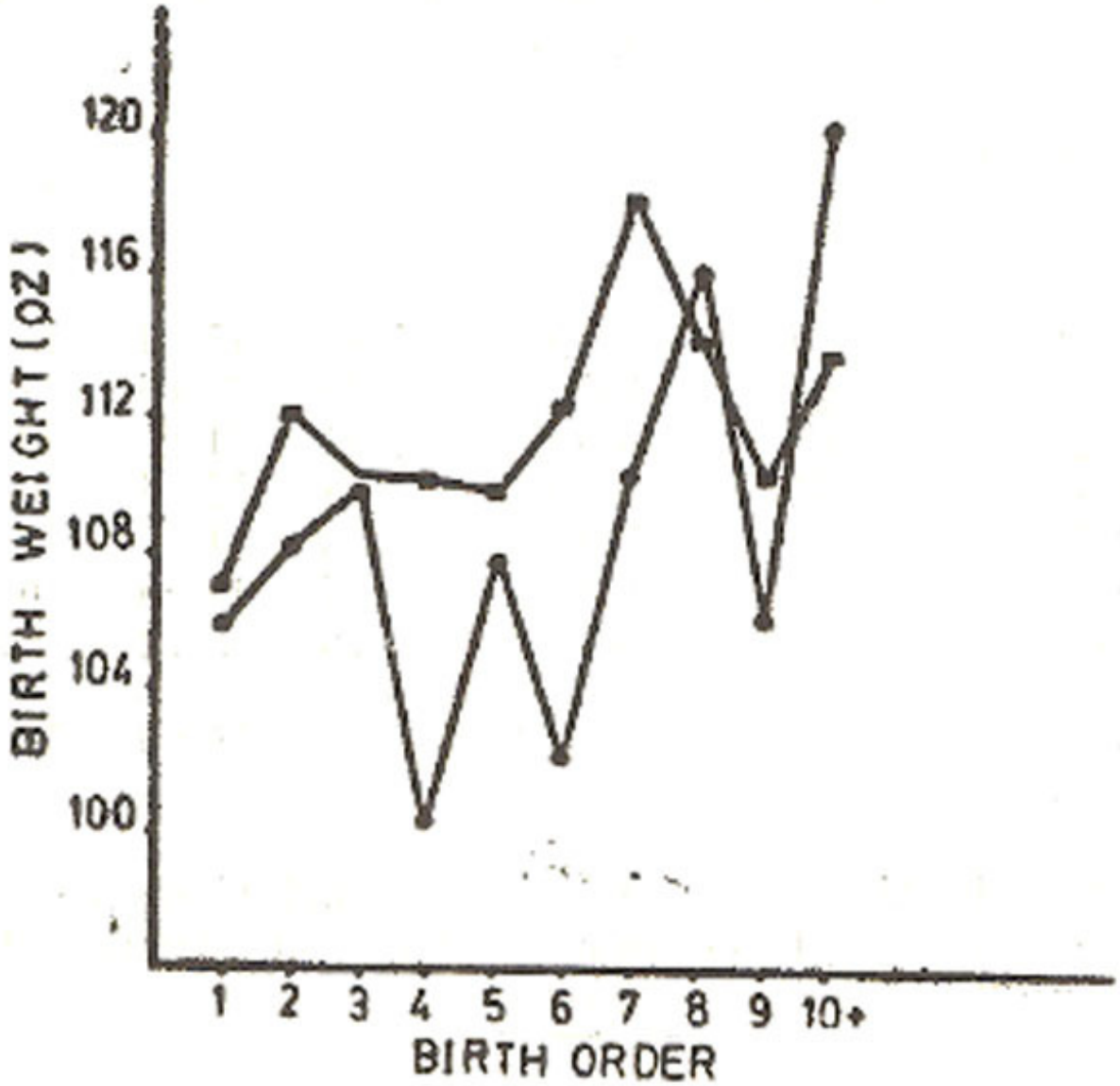

Fig. 2. Mean birth weight in female (●) and male (■) newborns in relation to birth order.

335=0.92; P>0.3). The males show a U-shaped curve between birth orders 2-7 and decrease in birth weight is seen thereafter with an increase in birth order 10+. The female infants show a constant rise and fall in birth weights in the successive higher birth ranks. The highest mean birth weight in males is seen in birth order 7(118.72±3.99) and in females in birth order 8 (116.44±7.32).

The mean birth weights of female and male offspring in the respective maternal ages and birth orders are given in Tables V and VI respectively.

Table IV: Mean Birth Weight (oz) and Coefficients of Variation of Male Offspring in Different Birth Orders.

Birth order	*Number*	*Mean*	*±S.E.*	*S.D.*	*C.V.*
1	169	107.24	1.62	21.10	19.67
2	108	112.34	2.31	24.06	21.42
3	65	111.80	2.39	19.31	17.26
4	38	111.18	3.68	22.67	20.38
5	41	109.12	7.89	50.53	46.31
6	26	112.85	4.35	22.21	19.68
7	29	118.72	3.99	21.51	18.18
8	15	114.40	4.63	17.93	15.67
9	11	110.73	7.79	25.86	23.35
10+	22	113.32	6.71	31.46	27.76
Total	524	110.74	0.71	16.34	14.75

Table V: Mean Birth Weight (oz) of Female Offspring in Different Maternal Age Groups (Years) and Birth Order.

Birth Order	*Maternal Age*							*Mean birth weight*
	<19	20-23	24-27	28-31	32-35	36-39	40+	
1	106.50	102.39	105.79	112.71	101.17	134.00	—	105.58
2	121.50	106.17	107.82	107.06	124.50	148.00	96.00	108.81
3	—	102.70	107.45	110.50	116.33	154.00	—	109.86
4	—	91.00	102.28	105.25	94.00	122.67	85.33	101.81
5	—	92.00	108.00	102.54	110.81	119.50	—	107.51
6	—	120.00	109.00	86.22	111.15	—	98.67	102.21
7	—	—	104.00	111.67	113.54	116.50	102.80	110.80
8	—	—	—	132.50	108.50	108.00	116.60	116.44
9	—	—	—	95.40	103.00	111.33	148.00	106.35
10+	—	—	—	99.00	120.00	121.33	142.00	120.77
Mean birth weight	109.00	102.62	106.40	106.92	109.82	120.88	108.42	107.31
No.	24	93	105	131	73	25	19	470

The mothers of First male born to mothers aged <19 years are lighter than the females. Mothers of 20-23, 24-27, 28-31 and 32-35 yeas of age give birth to heavier males in the first birth order. The second and third male born to younger mothers (<19) show successive increase in birth weight. Mothers aged 20-23, 24-27, 32-35, 36-39 and 40+ years indicate a U-shaped curve between 2-5, 2-7, 2-10 + ,4-8 and 4-10+ birth orders respectively. Mothers of 28-31 years of age indicate a better picture, where increase in birth weight of male infants is seen in successive birth ranks upto 7th birth order except in 4th birth order.

The small data available for stillbirths show that females born dead are lighter (100.80 ± 16.33) than stillborn males (I05.82±9.05) (Table VII).

Table VII: Mean Birth Weights (oz) of Normal Female and Male Births and Stillbirths in the Two Sexes.

Item	*Number*	*Mean*	*±S.E.*	*S.D.*	*C.V.*
Normal female births	470	107.31	1.19	25.99	24.23
Female Still-births	5	100.80	16.33	36.51	36.22
Normal male births	524	110.74	0.71	16.34	14.75
Male Still-births	10	105.82	9.05	28.63	27.06
Total normal births	994	109.025	0.95	21.16	19.49
Total Still-births	15	104.15	3.87	30.23	29.02

The difference in the mean weight of the two is statistically non-significant (t_{13}=0.2688; P>0.70). The mean birth weight of stillborn females is lower (I00.80±16.33) than the live female births (107.31 ±1.19) (Table I). The difference between the two is non-significant (t_{473}=0.3983; P>0.60). Similarly, stillborn males are lighter (105.82 ±9.05) than the live male births (110.74±0.71) which difference is statistically non-significant (ts32=0.5387; P> 0.60). The total mean birth weight for live births (109.025±0.95) is higher than the stillbirths (104.15±3.87). The difference between the two is statistically non-significant (t_{1008}=0.6223; P>0.50).

Simple and partial correlations between maternal age and birth order, maternal and birth weight and between birth order and birth weight are shown in Table VIII.

Table VIII: Simple and Partial Correlations for Different Correlated Factors in Relation to Birth Weights (oz).

Correlated Factors	*Simple correlation*		*Corrected for*	*Partial correlation*	
	Male	*Female*		*Male*	*Female*
Maternal age and birth order	+0.7049	+0.6741	—	+0.7341	+0.6720
Maternal age and birth weight	+0.0902	+0.1271	Birth order	−0.3018	+0.1057
Maternal age and birth weight	+0.4056	+0.0729	Maternal age	+0.4841	+0.0175

Simple correlations (& =+0.7049; P<0.001; +0.6741; P<0.001) and partial correlations (tf= +0.7341;

P<0.001; $ =+0.6720; P <0.001) between maternal age and birth order are highly significant. Maternal age and birth weight show very low simple correlations for males (+0.0902; P>0.1) and females (±0.1271; P>0.1). Their respective correlations, corrected for birth order, show negative correlations for male infants (-0.3018; P<0.01), but non-significant positive correlations for female offspring (±0.1057; P>0.1). Simple (+0.4056; P0.001) and partial correlations, corrected for maternal age, are significantly positive for male infants (+0.4841; P<0.001), but insignificant positive simple (+0.0729; P>0.1) and partial correlations (+0.0175; P>0.1) are observed with female babies.

Sev Ratio: The sex ratio for total live births, scored for birth weight, is 0.53 and that for stillbirths is 0.66. The data for live births were arranged to see the sex ratio in different maternal ages and birth orders (Table IX).

Table IX: Sex Ratio, Based on Birth Weights of Live Births, in Relation to Maternal Age and Birth Order.

		Maternal Age (Years)								
Birth Order		< 19	20-23	24-27	28-31	32-35	36-39	40+	*Total*	*Sex ratio*
1	M	21	81	41	24	2	—	—	169	
	T	41	147	94	45	8	2	—	337	0.50
2	M	3	22	34	42	4	2	1	108	
	T	7	34	47	73	6	3	2	182	0.59
3	M	2	7	20	26	10	—	—	65	
	T	2	17	31	50	16	1	—	117	0.55
4	M	—	2	12	10	11	2	1	38	
	T	—	5	19	26	16	5	4	75	0.50
5	M	—	1	11	10	16	2	1	41	
	T	—	2	18	23	32	4	1	80	0.51
6	M	—	—	5	12	5	3	1	26	
	T	—	1	8	21	18	3	4	55	0.47
7	M	—	—	4	8	9	3	5	29	
	T	—	—	5	14	20	5	10	54	0.54
8	M	—	—	—	1	8	4	2	15	
	T	—	—	—	5	14	6	6	31	0.48
9	M	—	—	—	1	4	1	5	11	
	T	—	—	—	16	29	7	6	28	0.39
10+	M	—	—	—	3	7	5	7	22	
	T	—	—	—	4	11	11	9	35	0.63
Total	M	26	113	127	137	76	22	23	524	
	T	50	206	222	267	150	47	42	994	0.53
Sex ratio		0.52	0.55	0.57	0.51	0.51	0.47	0.55	0.53	

M=Total male births T=Total number of births.

Each cell in the table contains total male births and total live births. Sex ratio in each cell was adjusted by weighing factor MF/M±F after Barrai et al (1961). Sex ratio based on total number of live births and total male births in different maternal age groups shows that in younger mothers (<19) the proportion of males and females is nearly 1:1. In the next two age groups (20-23 and 24-27 years) the proportion of males is higher than the females, and decreases thereafter.

In the first birth order there is 1:1 ratio for male and female live births. The 2nd birth order shows a sharp rise in the sex ratio (0.59) and then declines in the higher birth ranks, except in 10th birth order where a sudden rise in sex ratio is observed (0.63).
Estimates of correlations, carried out for sex ratio (Table X)

Table X: Simple and Partial Correlations for Different Correlated Factors in Relation to Sex Ratio.

Correlated factors	*Simple correlation*	*Corrected for*	*Partial correlation*
Birth order and maternal age	+0.3609	—	+0.3786
Birth order and sex ratio	—0.4037	Maternal age	—0.4189
Maternal age and sex ratio	—0.0367	Birth order	+0.1276

show that simple (+0.3609; P~0.01) and partial correlations (+0.3786; P=0.0l) in relation to maternal age and birth order are highly significant. Negative simple correlations (-6.0367; P>0.1) and partial correlations, corrected for birth order, (+0.1276; P>0.l) are very small in relation to maternal age and sex ratio. Birth order and sex ratio show highly significant negative simple (-43.4037; P<0.01) and partial correlations, corrected for maternal age (-0.4189; P<0.01).

Discussion

The present investigation shows that the mean birth weight of male infants is significantly higher than those of females. Comparatively, lighter males are born to younger mothers than the females, this difference is statistically nonsignificant (t_{48}=0.4745; P>0.6). Males bornto mothers of an average age of 20-23, 24-27, 28-31, 32-35 arc heavier than the females born to mothers of the respective age groups. All these differences are statistically non-significant. Heaviest female babies are born to mothers of 36-39 years of age (120.88±3.97) and males to mothers of 40+ years of age (120.08±4.97). The picture is different with birth order where heavier male births though statistically non-significant (t_{335}=0.9274; P>0.3), are seen in the first birth rank than the females. Upto 7th birth rank the male babies are heavier than the females. The differences are statistically non-significant. James (1969) examined that babies in the first birth order are heavier than the second one, and increase in birth weight was shown upto 5th birth order. The present findings show that the babies in the first birth order are lighter than the second one.
The data suggest that the maternal age has positive effects on birth weight of male infants upto maternal age between < 19-35 years. The situation is different with female birth weight where U-shaped curve is seen indicating heaviest females born to younger mothers (<319 years) and older mothers (36-39 years, Fig. 1). The birth weights of female infants show an irregular pattern with birth order, but males show a trend in the increase of birth weight in higher birth ranks (Fig. 2). Karn and

Penrose (1951) showed an increase in birth weight with parity, but slight decrease with maternal age. Millis and Seng (1954) investigated a strong relationship between parity and birth weight, in particular with male infants which show an average increase in birth weight with parity. Banerjee and Roy (1962) reported irregular effects of parity on birth weight. Selvin and Garfinkel (1972) examined that young mothers showed tendency to have increasing proportion of low birth weight infants with increasing birth ranks, but opposite was true for mothers over 45 years.

Simple and partial correlations carried out on the present data show that the maternal age has highly significant negative effects ($P<0.01$) on the male infant birth weights, but nonsignificant positive effects ($P>0.1$) on female birth weights. However, birth order indicates highly significant positive influence ($P<0.001$) on male birth weights, but insignificant effect on female birth weights. The present findings suggest maternal age 24-27 years as the optimum age in which female infants show an increase in birth weight in successive birth ranks (upto 6th birth order). In case of male infants favourable maternal age is between 28-31 years where increase in birth weight in successive births is seen upto 7th birth order.

The stillborn babies are lighter than the live births with a mean difference of 4.87 oz. The male stillbirths are heavier by 5.02 oz than the stillborn females. The live born males and females are heavier than the male and female stillbirths with a mean difference of 4.92 oz and 6.51 oz respectively. All these differences are statistically non-significant mainly due to a small sample of birth weights for stillborn babies. However, the magnitude of difference in birth weights suggests that natural selection eliminates babies lighter than the average mean birth weight of the live births. Karn and Penrose (1951) and Jayant (1966) showed stabilising effects of selection on human birth weights. Their investigations show that babies closer to the mean birth weight have higher percentage of survival than the others.

There are certain physical and social factors associated to the human birth weight. Banerjee (1969)pointed out that the economic position of mother has significant effects on birth weight than sex of the infants in the birth order, length of gestation time and maternal age. Legg et al (1970)showed that low birth weight decreased significantly with increasing education. Record et al (1969) looked at the relationship of measured intelligence to birth weight and gestation time. Their results, based on verbal reasoning score (VR), showed that mean VR scores were less for children coming from early or late pregnancies. Wocrner et al (1971) studied that the schizophrenics weighed nearly six ounces less than the normal. Chen et al (1969) analysed that low-birth weight is an important factor in the early childhood death of Down's syndrome. Chen et al (1971) examined a trend of decreasing birth weight with an increase in the number of X-chro-mosomes and not of Y-chromosome. Brown et al (1972) observed that the birth weight of the babies born to mothers with sickle cell trait was significantly less than those from normal mothers.

The sex ratio calculated for infants, scored for birth weight, shows that large number of male babies are lost due to stillbirths (sex ratio 0.66), but the secondary sex ratio (0.53) based on live births is nearly 1:1. Simple and partial correlations show that maternal age has nonsignificant effect on sex ratio, but with birth order highly significant negative effects on sex ratio are observed. Shami and Sultana (1980) reported that maternal age has negative effects on sex ratio of stillbirths, but significant positive effects on sex ratio were seen with parity. Negative effects on sex ratio of live births with advancing age of father and birth order were shown by Novitski and Sandler (1956), Shami and Tahir (1978). Teitelbaum et al (1971) found significant negative effects of birth order on sex ratio. Negative effects of paternal age and birth order are seen on tertiary sex ratio as well (Shami, 1980).

References

1. Banerjee, P. (1969) Birth weight of the Bengali newborn; effect of the economic position of the mother. Ann. Hum. Genet., 33:99.

2. Banerjee, A.R. and Roy, S.K. (1962) Preliminary study on the quantitative genetics in man; the effect of parity of the mother on the birth weight of the offspring. J. Ind. Ped. Soc, 1:89.
3. Barrai, I., Fraccaro, M., Lindsten, J. and Zei, G. (1961) Birth weight and related variables for offspring of mothers aged 42 or more years. Ann. Hum. Genet., 25:189.
4. Brown, S., Merkow, A., Wiener, M. and Khajezadeh, J. (1972) Low birth weight in babies born to mothers with sickle cell trait. JAMA., 221:1404.
5. Chen, A.T.L., Chan, Y.K. and Falek, A. (1971) The effect of chromosome abnormalities on birth weight in man. I. Sex chromosome disorders. Hum. Hered., 21:543.
6. Chen, A.T.L., Ebbin, A.J., Schimpler, S., Health, Jun, C.W. and Falek, A. (1969) Birth weight and mortality in Down's syndrome. Soc. Biol., 16:290.
7. Colhnann, R.D. and Stoller, A. (1962) A survey of mongoloid births in Victoria, Australia, 1942-1957. Am. J. Public Health, 52:813.
8. James, W.H. (1963) Notes towards an epidemiology of spontaneous abortion. Am. J. Hum. Genet., 15:223.
9. James, W.H. (1969) Birth weight and birth order. Hum. Genet., 32:411.
10. Jayant, K. (1966) Birth weight and survival; a hospital survey repeated after 15 years. Ann. Hum. Genet., 29:367.
11. Karn,M.N. (1952) Twin data; further study of birth weight, gestation time, maternal age, order of birth and survival. Ann. Eugen., 17:233.
12. Karn, M.N. and Penrose, L.S. (1951) Birth weight and gestation time in relation to maternal age, parity and infant survival. Ann. Eugen., 16:147.
13. Legg, S., Davies, A.M., Prywees, R., Stark, V.V. and Weiskopf, P. (1970) Pattern of low birth weight in West Jerusalem with special reference to maternal origin. Br. J. Prev. Soc. Med., 24:89.
14. Millis, J. (1958) The influence of maternal age and birth order on the outcome of pregnancy in poor Chinese women. Ann. Hum. Genet., 22:362.
15. Millis, J. and Seng, Y.P. (1954) Effect of age and parity of mother on birth weight of the offspring. Ann. Hum. Genet., 19:58.
16. Novitski, E. and Sandler, L. (1956) Relationship between parental age, birth order and the secondary sex ratio in humans. Ann. Hum. Genet., 21:123.
17. Penrose, L.S. (1934) The relative aetiological importance of birth order and maternal age in mongolism. Proc. Roy. Soc. Lond., 115:431.
18. Penrose, L.S. (1946) Familial data on 144 cases of anence-phaly, spina bifida and congenital hydrocephaly. Ann. Eugen., 13:73.
19. Penrose, L.S. (1954) Mongolian idiocy (mongolism) and maternal age. Ann. N.Y. Acad. Sci., 57:494.
20. Record, R.G., Mckeown, T. and Edwards, J.H. (1969) The relation of measured intelligence to birth weight and duration of gestation. Ann. Hum. Genet., 33:71.
21. Selvin, S. and Garfinkel, J. (1972) The relationship between parental age and birth order with percentage of low birth weight infants. Hum. Biol., 44:501.
22. Shami, S.A. (1980) Parental age, birth order and tertiary sex ratio in the human population of Punjab, Pakistan. Pak. J.Z. (in press).
23. Shami, S.A. and Sultana, N. (1980) Maternal age, stillbirths, abortions, and factors related to maternal blood groups; a hospital survey from Lahore (Punjab, Pakistan). JPMA, 30:27.
24. Shami, S.A. and Tahir, A.M. (1978) A study of relationship between parental age, birth order and secondary sex ratio in human population of Punjab (Pakistan). Biol. (Pakistan), 24:373.
25. Teitelbaum, M.S., Mantel, N. and Stark, C.R. (1971) Limited dependence of the human sex ratio on birth order and parental age. Am. J. Hum. Genet., 23:271.
26. Warburton, D. and Fraser, F.E. (1964) Spontaneous abortion risks in man; data from reproductive histories collected in a medical genetics unit. Am. J. Hum. Genet., 16:1.

27. Woerner, M.G., Pollack, M. and Klein, D.F. (1971) Birth weight and length in schizophrenics; personality disorders and their siblings. Br. J. Psychiarr., 118:461.