

Effect of stress on birth weight in two Johannesburg populations

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Summary

The effect of stress on birth weight was assessed in mothers delivering at Johannesburg (predominantly white) and Baragwanath (exclusively black) Hospitals. The Social Readjustment Rating Scale of Holmes and Rahe was used to assign maternal stress scores established during an interview conducted within 36 hours of delivery. Only mothers without medical problems who had delivered liveborn infants were included. Maternal age, obstetric history, smoking history and stresses present during the 12 months preceding delivery were recorded. Of 535 Johannesburg and 662 Baragwanath mothers studied, 48% and 55% respectively reported significant stresses. Analysis of the two groups revealed that for the Johannesburg mothers, smoking, cumulative stress score and previous preterm birth were important determinants of birth weight. Of the stress factors studied, marital separation and death of a spouse were significantly associated with a lower birth weight. For Baragwanath mothers the major determinants of low birth weight were maternal age, loss of income through being dismissed from work, or having to leave school as a consequence of the pregnancy.

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The concept of pregnancy outcome being affected by maternal experiences is not a new one,¹ and the subject continues to attract attention, since low birth weight (LBW), whether due to preterm birth or to intra-uterine growth retardation, is regarded as a central issue in perinatal health care today.² It has been stated that in developed and in developing countries an infant's birth weight is probably the single most important factor affecting neonatal mortality, and that it is a significant determinant of post-neonatal mortality and of subsequent infant and childhood morbidity.³⁻⁵

Several anthropometric, medical, behavioural and socio-demographic variables have been identified as risk factors for LBW. These include maternal age (delivery before 17 or after 35 years of age), height, pre-pregnancy weight and weight gain during pregnancy, parity, menstrual history and infertility, prior pregnancy history, health, prenatal care, ethnicity, socio-economic status, smoking and consumption of alcohol and other drugs.^{2,4,6,7} However, as pointed out by Ramsey *et al.*,⁷ while these determinants account for much of the variance in birth weight there is still a significant proportion of unexplained variance. In their prospective study they showed that family

functioning and money-related stress explained an additional 9% of the variance in infant birth weight. Other prospective studies have also shown a relationship between birth weight and psychosocial stress, in particular stress related to unemployment or a decrease in income;^{8,9} however, the point has been made that social support during pregnancy can reduce the effect of stress.^{10,11}

In a previous study from this Department, using the Social Readjustment Rating Scale,¹² we showed that a selected group of mothers delivering preterm infants had an apparent excess of scores in the moderate and severe stress ranges (40 - 80).¹³ The first objective of the present study was therefore further to explore the relationship between pregnancy outcome and moderate to severe stress factors at Johannesburg Hospital, this time in mothers of term and preterm infants. The second objective was to conduct a simultaneous study at Baragwanath Hospital to investigate stress effects in a group of black mothers. The study was considered to be relevant in the Baragwanath setting, since the rating scale includes several stresses known to be prevalent in Soweto at the present time.

Subjects and methods

Between March 1987 and March 1988 mothers were interviewed by one of two social workers within 36 hours of delivery. Interviewers aimed to conduct ± 15 interviews per week, ± 5 on each of 3 weekdays. The days of the week were randomised to avoid bias resulting from particular clinical units being on duty on particular days or any elective procedures being performed on particular days of the week. With the lower delivery rate at Johannesburg Hospital it was usually possible to interview all eligible mothers on each of the 3 days, whereas at Baragwanath Hospital, with 40 - 60 deliveries per day, the maternity register was used and every 8th - 10th name selected for interview. Only mothers of singleton, liveborn infants were eligible for study.

The basis of the interview was a questionnaire that included biographical data, medical and obstetric details and stress history for the year preceding delivery (Fig. 1). The Social Readjustment Rating Scale¹² was adapted to include only moderate and severe stresses (the complete scale encompasses a range of stresses from 'vacation' (score 13) at one extreme to 'death of a spouse' (score 100) at the other). The stress factors included in this study ranged from sex difficulties/marital problems (score 39) through to death of a spouse (Fig. 1). The selection of these particular factors was based on our previous study, which suggested an excess of scores in the 40 - 80 range in mothers delivering prematurely.¹³ Secondly, these specific stress factors were selected because they included the range of stresses of particular interest to us in the context of present-day Soweto.

Also included in the interview were questions about the individual's perceptions of the stress(es), whether support had been required and, if so, received, and whether there was an ongoing need for counselling and/or support (Fig. 1).

After completion of the questionnaire, any stress factors present were assigned a score according to the scale; where there were multiple stress factors, a cumulative score was

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LIFE EVENT (WITHIN PAST YEAR) Details

Mark appropriate box(es)

1. Death of spouse

Divorce

2. Marital separation (vol./invol.)

Jail term

Death of close family member (incl. miscarriage)

Significant personal injury or illness (incl. previous preterm delivery < 34 weeks)

Marriage during pregnancy

3. Fired from work/retrenched (patient/husband)/left school

Marital reconciliation

Significant change in health of family member

Sex difficulties and/or marital conflict

Did you feel the need to discuss social/medical/work-related problems with a counsellor during the pregnancy? Y/N

If yes, specify problem(s)

If help received, specify type of counsellor

Do you feel the need **now** to discuss social/medical/other problems with a counsellor? Y/N

If yes, specify problem(s)

How would you rate the above stress?

Did not really affect me Mild effect

Moderate effect One of the worst years of my life

Fig. 1. Data collection form (omitting first section dealing with biographical data, medical and obstetric details and information on smoking).

calculated. Data were then entered on to a computer together with the outcome variable, i.e. birth weight. It was not possible to assess gestational age accurately as an outcome variable because maternal recollection of the date of the last menstrual period was often poor, obstetric data were often incomplete, and clinical assessment of gestational age was often not performed.

Statistical analysis was done using *t*-tests for normally distributed data and otherwise the Mann-Whitney test; chi-square tests were used to compare differences in proportions between groups, and interactive multiple linear regression analysis was used to explore the relationship between variables.

The study was approved by the University of the Witwatersrand Senate Committee for Research on Human Subjects.

Results

For the purposes of this paper, mothers with medical conditions were excluded from analysis because disease and/or its treatment are well-recognised factors in the causation of LBW.

Data were available for 1 197 mothers of liveborn, singleton infants; 662 from Baragwanath and 535 from Johannesburg Hospital. Single or multiple moderate to severe stress factors were reported by 366 (55,3%) of Baragwanath mothers and 255 (47,7%) of the Johannesburg Hospital group. The stress profiles of these two groups are shown in Table I. Contingency tables showed that the profiles differed significantly.

Table II shows the Johannesburg and Baragwanath Hospital maternal profiles. Noteworthy differences between the two hospital groups include birth weight and the low rate of formal

TABLE I. STRESS PROFILES OF MOTHERS DELIVERING AT JOHANNESBURG AND BARAGWANATH HOSPITALS

Type of stress experienced within past year (score from Social Readjustment Rating Scale)	History of particular stress(es) (%)*	
	Johannesburg (N = 255)	Baragwanath (N = 366)
Death of spouse (100)	1	—
Divorce (73)	2	0,5
Marital separation (65)	9	7
Jail term (63)		
Self	0,03	—
Spouse/partner	0,8	6
Death of close family member (63)		
Child	0,03	1
Abortion/stillbirth	5	6
Other 1st-degree relative	9	14
Other	19	26
Personal injury (53)	3	3
Marriage during pregnancy (50)	27	0,5
Fired from work/had to leave school (47)		
Self	9	15
Spouse/partner	11	16
Marital reconciliation (45)	2	—
Change in health of family member (44)	21	16
Sex/marital problems (39)	12	16

* The totals for the two groups exceed 100%, because several stress factors coexisted in many of the subjects.

marriage and the small number of smokers among Baragwanath mothers.

The relationship between birth weight and the various demographic, obstetric and stress factors was then analysed for each of the two hospital populations. At the Johannesburg Hospital, significant independent determinants of birth weight (i.e. taking all other maternal, demographic and stress factors into account) were smoking, previous preterm delivery and cumulative stress score (*P* values < 0,001, < 0,001 and < 0,01, respectively). Further analysis of the important stress factors in this group showed marital separation and death of a spouse to be the major contributors. Smoking, previous preterm birth and the latter two stress factors were responsible for 9,2% of the variability in birth weight in the total group of Johannesburg mothers (*F* value 13,8).

In the Baragwanath group, of the factors studied, the only significant independent determinants of birth weight were maternal age and a history of the mother or the spouse/consort/breadwinner being dismissed from work, or of the mother having to leave school. When this result was further analysed, it emerged that Baragwanath mothers under 20 years of age were at particular risk in terms of LBW. In this group, being dismissed from work/having to leave school/loss of income through the breadwinner being dismissed remained the major significant contributors to the stress score (*P* < 0,001); death of a family member was the secondary contributor (*P* < 0,01). These factors together were responsible for 14,8% of the variability in birth weight in mothers aged under 20 years (*F* value 11,9). Of particular interest in this group of younger Baragwanath mothers is the following: the mean birth weight was less than 3 000 g, the LBW rate was high, as was the rate of being dismissed from work or having to leave school, and death of a close family member had a more significant effect

TABLE II. CHARACTERISTICS OF JOHANNESBURG AND BARAGWANATH MOTHERS AND INFANTS

	Johannesburg	Baragwanath	P value for intergroup differences
No. of subjects	535	662	
Obstetric data			
Mean maternal age (yrs) (\pm SD)	24,7 \pm 5,2	25,8 \pm 6,3	< 0,001
Mean gravidity (\pm SD)	1,9 \pm 1,3	2,6 \pm 1,6	< 0,001
Primigravid (%)	48,9	30,8	< 0,001
Previous preterm infant (%)	2,2	(0,9) \S	NS
Previous stillbirth/abortion (%)	15,3	14,7	NS
Psychosocial factors			
Single mother (%)	23,9	71,9	< 0,001
Smoking (%)	32,1	3,1	< 0,001
Moved house* (%)	12,1	28,9	< 0,001
Support needed \dagger (%)	11,0	10,7	NS
'Worst year of life' \ddagger (%)	6,7	21,9	< 0,001
Mean stress score (\pm SD)	34 \pm 43	36 \pm 39	NS
Neonatal data			
Birth weight (g) (\pm SD)	3 192 \pm 543	3 053 \pm 618	< 0,001
LBW rate (%)	10,6	14,2	NS

* Local/regional move within previous year.

 \dagger Perception of need for help during pregnancy. \ddagger Self-assessment of effect of stresses during previous year. \S Treat with reserve owing to poor maternal recall and lack of specific information regarding previous pregnancies.

TABLE III. DIFFERENCES BETWEEN BARAGWANATH MOTHERS BELOW AND ABOVE 20 YEARS OF AGE

	< 20 years	\geq 20 years	P value for differences
No. of subjects	140	522	
Mean age (yrs) (\pm SD)	17,9 \pm 1,6	27,9 \pm 5,3	< 0,0001
Single (%)	93,6	66,1	< 0,001
Death of close family member (%)	22,9	21,7	NS
Fired/dropped out of school (%)	26,4	14,6	< 0,001
Mean birth weight (g) (\pm SD)	2938 \pm 620	3084 \pm 614	< 0,02
LBW rate (%)	22,8	11,9	< 0,001

TABLE IV. COMPARISON BETWEEN 'REFERENCE' GROUP AND VARIOUS SUB-GROUPS ACCORDING TO FACTORS IDENTIFIED IN THIS STUDY AS BEING SIGNIFICANT, INDEPENDENT DETERMINANTS OF BIRTH WEIGHT

	No. of subjects	Birth weight (g) (\pm SD)	LBW rate (%)
'Reference' group (white; no smoking/previous preterm infant/stress)	193	3 277 \pm 517	8,3
White smokers	174	3 050 \pm 493	14,4
White, cumulative stress score >100	58	3 012 \pm 656	17,2
White, previous preterm infant	12	2 721 \pm 583	41,6
Black, < 20 years	140	2 938 \pm 620	22,8

on birth weight than it did among older mothers, although this stress factor was present in similar proportions of the two age groups (Table III).

We did not find in either group that birth weight was affected by the mother's perception of the stresses experienced during the year preceding delivery, nor did we find that

psychosocial support during pregnancy prevented stress from having an effect on birth weight. In addition, we did not find any significant effect mediated through some of the commonly encountered stresses, e.g. unmarried status, moving house, marriage during pregnancy, marital problems or change in health of a family member.

Discussion

In this study a history of moderate to severe stress was sought in mothers from two population groups and possible effects on birth weight were evaluated. It is important to note that the study sample excluded mothers with known medical or obstetric conditions likely to result in a reduction in birth weight. We found a positive history of moderate to severe stress in 55,3% of the Baragwanath mothers and 47,7% of Johannesburg Hospital mothers, with the Baragwanath group differing in terms of several stress factors. Specifically, 26% of the total Baragwanath group had suffered loss of a close family member (v. 15,7%); 17% had had to leave school as a result of the pregnancy or experienced a loss of income as a consequence of being dismissed from work or the family breadwinner being dismissed (v. 9,5%); and 3,5% had experienced imprisonment of a spouse or consort during the pregnancy (v. 0,4%). The finding of lower mean birth weight and slightly higher LBW rate in the black group than in the white group is in keeping with previously reported results.^{2,4,6,14}

In the Baragwanath group, analysis of the relationship between birth weight and the various factors studied showed that maternal age (specifically age below 20 years) was a significant contributor. These findings are in keeping with previous data.¹⁵ Of interest in the present study is the finding that within the group of younger black mothers, loss of income and/or leaving school and/or death of a close family member accounted for almost 15% of the birth weight variability.

It could be argued that it is inappropriate to use the Social Readjustment Rating Scale in a community in which it has not been validated. Indeed, failure to detect a relationship between cumulative score and birth weight in the Baragwanath mothers could be an indication that priorities are different within that population and different scores need to be assigned to the particular stress factors. On the other hand, one cannot argue with the validity of the stress factors themselves, i.e. death of a spouse, jail term, death of a family member, etc., in seeking a relationship between presence of a factor and birth weight.

At Johannesburg Hospital, in keeping with other studies, smoking was the major determinant of birth weight,^{4,6,8,9} followed by history of a previous preterm delivery and cumulative stress score. Previous preterm delivery and previous LBW delivery are both recognised risk factors for a subsequent LBW baby,^{16,17} while a relationship between major life events and LBW has also been described.^{8,9,18} Of the stresses examined, marital separation and death of a spouse had major effects on birth weight.

In Table IV the various subgroups identified as being at risk for lower birth weight are shown (i.e. smokers, high cumulative stress score, etc.) and compared with an uncomplicated 'reference' group of white mothers. In studying this Table, it should be noted that although a subgroup such as the one with a history of previous preterm delivery has a mean birth weight 550 g below that of the reference group, the

numbers are relatively small and the standard deviations very wide. These facts account for the statistically greater effect of risk factors that have apparently smaller effects on birth weight but are based on much higher numbers (e.g. smoking; see 'Results'). Nevertheless, it can be appreciated that the risk factors identified are real and associated with substantial reductions in birth weight and increases in the LBW rate.

We do not regard our findings as representing an end-point but as providing us with baseline data for specific intervention studies. We believe that certain factors have been identified that might influence birth weight, either through an increase in the number of preterm births or as a result of intra-uterine growth retardation, and controlled trials are currently being planned to assess the effect of intervention directed against some of the risk factors suggested by our results.

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