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Risk Factors for Intrauterine Growth Retardation: Results of a Community-based Study from Karachi

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Abstract

There is a serious lack of community-based information on low birth weight or intrauterine growth retardation from Pakistan. A community based prospective study was conducted in four squatter settlements of Karachi, to examine the prevalence and risk factors for adverse pregnancy outcome. This paper reports on the prevalence and risk factors for intrauterine growth retardation (<10th percentile birth weight gestational age) among 755 singleton births. The incidence of intrauterine growth retardation was 25.4% (192 Intrauterine growth retarded and 563 appropriate for gestational age). Major socioeconomic risk factors identified were low maternal education (RR=1.4, 95% Cl=1.0,2.1) and poor housing material (RR=1.7, 95% Cl=10,3.0). Among the significant biologic factors, primiparity (RR=1.9, 95% CI=1.4,2.7), consanguinity (RR=1.4, 95% Cl=1.1,1.8), short birth to conception intervals (RR=1.5, 95% Cl=1.1 .2.1), short stature (RR=2.2, 95% Cl=1 .6,3.0), low maternal weight (RR=2.0,95% Cl=1.6,2.5) and non-vegetarian diet (RR=2.3, 95% Cl=1.3,4.2) were especially important. Investigations to assess the adverse mortality and morbidity effects of intrauterine growth retardation are ongoing (JPMA 44 : 30, 1994).

Introduction

Low birth weight (LBW) is recognized as a major health problem in Pakistan as well as in many developing countries. According to a report from the World Health Organization (WHO), there were 21 million LBW infants born in 1979, with over 90 percent being born in developing countries[1]. It is well known that LBW infants experience higher rates of mortality and morbidity and survivors have higher rates of physical, neurological and mental impalement than normal weight babies[2-4]. Birth weight is governed by two main processes-gestational duration and intrauterine growth rate, resulting in prematurity (babies born <37 weeks of gestation) or growth retardation (babies born too small for a given period of gestation). The risk factors associated with prematurity and growth retardation are different as are their associated mortality and morbidity. Villar et al[5]. stated that the excess rates of LBW babies in developing countries are due to growth retardation rather than to prematurity. Therefore, preventive measures for LBW babies in developing countries will have to be different from those in developed countries where LBW is predominantly due to prematurity. Intrauterine growth retardation is a multi-factorial condition influenced by fetal, environmental and maternal risk factors. Although there is extensive literature on the determinants of intrauterine growth retardation from developed countries, only a few community-based studies have been reported from developing countries[6] . The major risk factors for IUGR include racial/ethnic origin, social and economic deprivation (as measured by education, occupation or financial classification), infant sex, poor gestational nutrition, low pre-pregnancy weight, short maternal stature, low paternal weight and height, parity, short birth intervals, history of prior low-birth weight infant, general morbidity and episodic illness, malaria severe anemia, cigarette smoking or tobacco chewing[6,7]. In Pakistan, research projects,

especially those which are community-based, on the incidence and risk factors for LBW are rare. The report of a National Workshop on Health Research in Pakistan[8] cited studies of LBW as a predominant research priority. This paper reports on the incidence and risk factors for IUGR from a prospective community-based study conducted in four low socioeconomic squatter settlements of Karachi.

Subjects and Methods

A prospective community-based study: the Pregnancy Outcomes Study (POS), was conducted in four urban squatter settlements of Karachi, from August 1990. These settlements are sites for prototype development of Primary Health Care Systems of the Department of Community Health Sciences, The Aga Khan University. Basic demographic information on all households are available. Our requirement strategy was based on minimizing interference with the ongoing primary health care service delivery and reducing the time to recruit our target sample. We projected a recruitment of about 1000 women from all sites for analysis. Recruitment into the study was contingent on pregnancy status. We calculated a target sample for each field site depending on the population of women of reproductive age and the pregnancy rate. Thus, in each field site, a quick survey of ever-married women in the reproductive ages was initially conducted to determine their pregnancy status. If a woman was doubtful whether she was currently pregnant, a pregnancy test was performed, women who reported or were known to be pregnant were recruited into the study irrespective of gestational age. Further recruitment was conducted until the targetted sample for each field site was achieved, women were included in the study only after informed consent was given. The instruments were pilot tested on 30 pregnant women. Due to administrative difficulties, the study could not be simultaneously conducted in all sites, although the methodology for recruitment was similar. Ongoing research by the Department of Community Health Sciences, The Aga Khan University, in these settlements has indicated that there was a considerable variability in sociocultural characteristics between these sites. Thus, field sites have been included in the analytical framework of risk factors for IUGR. At recruitment, detailed information on socioeconomic, demographic, housing conditions, diet prior and during pregnancy, consanguinity, family planning, prior reproductive history and medical and obstetric conditions was obtained. Complete physical examination including blood pressure and anthropometric measurements and vaginal examination was conducted at the primary health care centre. Laboratory investigations included haemoglobin levels, urinalysis and a stool examination. Follow-up visits were conducted at the Primary Health Care Centre and women who did not come for follow-up were vigorously followed. The subjects were repeatedly reminded to inform the Community Health Worker as soon after delivery as possible. Generally, subjects were contacted within 24-96 hours after delivery arid a complete assessment of the newborn for gestational age, birth weight, head circumference and length were obtained. The neonates were then recruited into the Child Survival Study (CSS) after informed consent by the mother. Interviews and physical examinations were conducted by study nurses and physicians who were specially recruited and trained for this study by the study obstetrician and pediatrician. In the current analysis, the outcome variable of interest is intrauterine growth retardation (IUGR). Gestational age was estimated by physical examination of the newborn using the criteria developed by Parkin et al.[9]. This method utilizes only four criteria, skin colour, skin texture, breast development and ear firmness, to estimate gestational age. Gestational age assessment was generally conducted by the study physicians or nurses who had been specially trained on this technique by the study pediatrician at the Aga Khan University Hospital. If birth weight fell below the 10th percentile birth weight gestational age on the chart of fetal growth developed by Brenner et al[10]. then the neonate was classified as IUGR, else the neonate was classified as appropriate for gestational age (AGA), the comparison group. The 755 singleton Infants included in this analysis. is the total sample for which weight for age could be determined. Mean and standard deviations were calculated for several independent variables in the two

groups. Crude relative risks and 95 percent confidence intervals were also calculated for all the variables studied[10].

Results

A total of 994 women had completed interviews and physical examination. There were 9 pairs of twins reported. However, detailed information on only 854 birth outcomes (including 6 pairs of twins) are available. Assessment of IIJGR requires information on both birth weight and gestational age and this was collected for only 755 singleton births and 6 pairs of twins. Thus, the completeness of information in this prospective study for singleton births was 76.6 percent. The mean birth weight in this population was 2998 gins for males and 2968 gms for females. The incidence of IUGR (<10th percentile weight for gestational age) was 25.4 percent.

Table I. Means and standard deviations of selected variables for intrauterine growth retarded (IUGR) and appropriate for gestational age (AGA) groups.

Variables	IUGR		AGA		P value
	n	Mean	n	Mean	
Mother's age (years)	190	24.37 5.08	557	25.25 5.04	<0.05
Parity	192	2.83 2.78	563	3.16 2.43	<0.05
Birth to Conception Interval (months)	152	18.04 14.48	497	18.03 12.35	N.S.
Mother's Weight (kgs)	192	50.56 9.74	557	54.79 10.72	<0.001
Mother's Height (cms)	190	152.43 3.57	551	153.44 3.66	<0.05
Mother's Mid-arm Circumference (cms)	192	24.45 3.57	553	25.75 3.66	<0.001
Mother's Skinfold Thickness (mms)	156	14.91 4.27	451	16.19 4.65	<0.001
Mother's Haemoglobin (dl%)	176	10.54 1.75	501	10.51 1.58	N.S.
Family Income (rupees per month)	173	2279.08 1689.08	514	2298.43 1591.86	N.S.
Birthweight	192	2.40 0.27	563	3.18 0.37	<0.001

IUGR< 10th percentile birthweight-gestational age.
AGA ≥ 10th percentile birthweight-gestational age.
N.S. Non-significant.

Table I describes the maternal characteristics for the IUGR and AGA groups expressed as means and standard deviations. IUGR babies had mothers who were significantly younger, had lower parity, lower weight, were smaller, and had lower mid-arm circumference and skin fold thickness. There were no

differences in means birth to conception interval, mean haemoglobin and mean family income for the two groups.

Table II: Distribution of socioeconomic characteristics for Intrauterine growth retarded (IUGR) and appropriate for Gestational Age (AGA) Groups by relative Risks (RR) and 95 percent Confidence Interval (CI).

Risk Factors	IUGR n=192 %	AGA n=563 %	RR	95%CI
Field Sites				
Grax	34.4	5.9	1.7	1.2,2.5
Chanesar Goth	35.4	29.7	1.6	1.1,2.4
Orangi	15.1	21.1	1.1	0.7,1.7
Essa Nagri (Ref)	15.1	23.3	1.0	
Housing Material				
Kutcha	6.3	4.6	1.7	1.0,3.0
Kutcha-Pucca	77.0	70.3	1.5	1.1,2.1
Pucca (Ref)	16.7	25.1	1.0	
Paternal Employment				
Unemployed	7.8	3.6	1.7	1.2,2.6
Employed (Ref)	92.2	96.4	1.0	
Maternal Education				
Upto Primary	85.9	79.2	1.4	1.0,2.1
More than Primary (Ref)	14.1	20.8	1.0	
Religion				
Hindu	7.8	3.7	1.9	1.2,3.0
Muslim	67.7	67.2	1.2	0.9,1.5
Christian (Ref)	24.5	29.1	1.0	
Main Language Spoken				
Balochi	9.9	8.9	1.4	0.9,2.3
Punjabi	31.8	35.9	1.2	0.8,1.7
Sindhi	25.0	15.3	1.8	1.3,2.7
Pushto	4.7	6.4	1.0	0.5,2.0
Others	10.4	7.8	1.6	1.0,2.6
Urdu (Ref)	18.2	25.8	1.0	
Source of Water Supply				
Community Tap	53.6	44.1	1.3	1.0,1.7
Tap inside (Ref)	46.4	55.9	1.0	

IUGR < 10th percentile birthweight-gestational age.
AGA ≥ 10th percentile birthweight-gestational age.
(Ref) Reference Category.

Table III: Distribution of Demographic, Prior Pregnancy and Anthropometric Characteristics for Intrauterine Growth Retarded (IUGR) and Appropriate for Gestational Age (AGA) Groups by Relative Risks (RR) and 95 percent Confidence Interval (CI).

Risk Factors	IUGR n = 192 %	AGA n = 563 %	RR	95%CI
Maternal Age[1]				
< 20	15.8	10.4	1.7	1.1,2.5
20-24	42.1	37.0	1.4	1.0,1.9
25-29 (Ref)	24.2	32.0	1.0	
30-34	14.7	16.5	1.1	0.8,1.7
≤ 35	3.2	4.1	1.0	0.5,2.2
Consanguinity				
Related	41.2	51.9	1.4	1.1,1.8
Not Related (Ref)	58.8	48.1	1.0	
Parity				
Primipara	24.0	12.8	1.9	1.4,2.7
1-3	42.7	47.8	1.1	0.8,1.6
4-7(Ref)	25.5	33.8	1.0	
8+	7.8	5.7	1.6	1.0,2.5
History of Prior Child Deaths[2]				
Yes	27.1	20.6	1.5	1.1,2.0
No (Ref)	53.1	68.6	1.0	
Outcome of Previous Pregnancy[2]				
Stillbirth/Abortion	11.2	7.8	1.5	1.0,2.2
Livebirth (Ref)	68.5	81.0	1.0	
Birth to Conception Interval[12] (months)				
≤ 12	50.0	39.8	1.5	1.1,2.1
13-24 (Ref)	28.3	38.4	1.0	
25-36	13.2	13.9	1.2	0.8,2.0
> 36	8.6	7.9	1.4	0.8,2.3
Diet during Pregnancy				
Non-vegetarian	94.8	86.5	2.3	1.3,4.2
Vegetarian* (Ref)	5.2	13.5	1.0	
Haemoglobin Level[13] (dl%)				
≤ 8	11.4	7.4	1.4	1.0,2.0
≥ 9 (Ref)	88.6	92.6	1.0	
Maternal Height[4] (cms)				
< 145	10.5	3.3	2.2	1.6,3.0
≥ 145 (Ref)	89.5	96.7	1.0	
Maternal Weight[5] (kgs)				
< 50	57.3	34.5	2.0	1.6,2.5
≥ 50 (Ref)	42.7	65.5	1.0	
Maternal Mid-arm Circumference[6] (cms)				
< 22.0	23.4	12.5	2.0	1.4,2.8
22.1-24.0	27.6	23.9	1.5	1.0,2.0
24.1-26.0	19.8	22.6	1.2	0.8,1.7
≥ 26 (Ref)	29.2	41.1	1.0	
Maternal Skinfold Thickness[7] (mms)				
8-10	20.5	13.3	2.3	1.3,4.0
11-20	71.2	71.0	1.7	1.0,2.8
21 + (Ref)	8.3	15.7	1.0	

Missing Information

	IUGR	AGA
1.	2	6
3.	16	62
4.	2	12
5.	0	6
6.	0	10
7.	36	112

2. Primiparas information not included.
* Vegetarian diet includes milk and milk products.
IUGR < 10th percentile birthweight-gestational age.
AGA ≥ 10th percentile birthweight-gestational age.
Ref. Reference category

Tables II and III present the distribution of socioeconomic, demographic, prior pregnancy history and anthropometric factors, their relative risks and 95 percent confidence intervals for variables which were statistically significant. Cut-off points for transforming continuous variables into categorical ones were generated either along traditional levels (for example age, birth to conception interval) or by the level

of their risk estimates. The reference group for all risk factors was generally the level with the least risk.

Socioeconomic Factors

Infants born in households with "Kutcha" (mud, wood or straw) or "Kutcha-Pucca" (concrete with asbestos or tin roofs) housing material had a higher risk of IUGR (RR=1.7.95% Cl=1.0,3.0 and RR=1.5,95% Cl= 1.1,2.2 respectively) as compared to those living in "Pucca" (concrete walls and roof) homes. There was a strong association between IUGR and paternal unemployment. Mothers who had upto primary level of education were at an increased risk of delivering a IUGR baby (RR= 1.4,95% Cl= 1.0,2.1). The field site with the least risk was Essa Nagri which is largely inhabited with Punjabi Christians. Gra.x and Chanesar Goth showed the highest risk (RR= 1.7, 95% Cl= 1.2,2.5 and RR= 1.6,95% Cl= 1.1,2.4 respectively). Religion was significantly associated with IUGR.

Hindus had a higher risk of IUGR as compared to Christians while Muslims were at only slightly increased risk. The main language spoken in these sites was used as an indicator of ethnicity. Urdu, the ethnic group with the least risk, was used as the reference category. Balochs, Punjabis and Sindhis, all showed increased risk of IUGR

Demographic, Prior Pregnancy and Anthro-pometric Factors

Mothers who were less than 25 years were at a significantly higher risk of an IUGR baby as compared to mothers who were 25-29 years. Primiparous and grand multiparous women were also at substantially increased risk. A history of prior child death was positively associated with IUGR (RR= 1.5,95% Cl= 1.1,2.0) as was a history of stillbirth or abortion in their previous pregnancy (RR= 1.5, 95% Cl= 1.0,2.2). Extremely short (<12 months) or long (36 months) birth to conception intervals were positively associated with IUGR. There was a significant positive association between consanguineous parents and IUGR(RR= 1.4,95% CI= 1.1,1.8). Maternal anthropometric measurements that were included in the study were associated with an increased risk of IUGR. Mothers shorter than 145 cms or weighing less than 50 Kgs had a relative risk of 2.2(95% Cl= 1.6,3.0) and 2.0 (95% Cl= 1.6,2.5) respectively. About 11.4 percent of mothers of IUGR babies had haemoglobin levels of _8 dl% as compared to 7.4 percent of mothers of AGA babies which was significantly different.

Discussion

Before discussing the implications of the results, we will consider some limitations of this community-based study. Twenty three percent of births did not have information on either gestational age and/or birth weight and therefore could not be included in the study. Also, the birth weight and gestational age was generally measured between 0 to 96 hours after delivery which may result in some under-estimation of birth weight for birth weights obtained after twenty four hours. A number of risk factors, such as smoking and pre-eclampsia which have been consistently shown to be associated with IUGR, were studied. However, given the low prevalence of these risk factors in our study, there were not enough cases for a meaningful evaluation. Among the 755 women whose births were included in our study, only 5.4 percent reported smoking hookah. For the blood pressure readings, only 8.7 percent of women had diastolic blood pressure values 90 mmHg and 8.3 percent had systolic blood pressure values 130 mmHg. Despite these limitations, our results have the advantage of being population-based and longitudinal. The prevalence of LBW infants is high in South Asia, and particularly high in Pakistan, where about 27 percent of babies have birth weight below 2500 gms[1]. In our study, the IUGR rate of 25.4 percent is consistent with reports from other developing countries[6,12] and comparable to the LBW rates for Pakistan and India[1]. In the present study, we observed significant differences for maternal age, parity, birth weight, height, weight, mid-arm circumference and skin fold thickness between the two groups, consistent with findings from Guatemala[12]. The mean birth weight in our study population was 2,894 gms, about 200 gms higher than reported for Pakistan[6]. Socioeconomic

factors such as paternal unemployment, poor housing material, low maternal education were associated with an increased risk of IUGR. Studies conducted in India and Brazil also indicate similar findings[13,14]. Our sample population represents the major ethnic (as indicated by the main language spoken) and religious groups in the country. Hindus generally dwell in Grax and Chanesar Goth, while Christians live in Grax and Essa Nagri. Muslims, belonging to various ethnic groups are dispersed in all four sites. The highest risk for IUGR is in Grax and Chanesar Goth, among Hindus or those who speak Sindhi. Hindus live in Grax and Chanesar Goth, and generally represent the poorest of the poor. This suggests that ethnicity, religion and field sites are proxies for socioeconomic status, and that in our data set, field sites best explain this variability. As expected, maternal weight, height, mid-arm circumference and skin fold thickness all showed moderate to strong positive associations with IUGR, consistent with reports from other developing countries[6,13,15]. Though we followed women prospectively, weight gain data obtained were faulty for analysis. The maternal weight used in the analysis is the weight taken at the first interview which in most cases represents weight taken during the third trimester. Thus, maternal weight used in this analysis combined pre pregnancy weight and weight gain during pregnancy up to the time of the measurement. Not surprisingly, our findings for such biologic risk factors as maternal age, parity, poor obstetric history and short birth to conception intervals were consistent with studies conducted in developing and developed countries[6]. Diet showed an interesting relationship. Unexpectedly, women who reported a vegetarian diet (including milk and milk products) displayed the least risk for IUGR and this was statistically significant. The effect of vegetarian diet may be due to confounding with some unknown factor or there may be a substantial caloric difference in the nutritional content of the vegetarian and non-vegetarian diet. We may also need to explore the role that milk and milk products play. The literature on the effect of parental consanguinity on fetal growth is conflicting. Some studies have shown that parental consanguinity is positively associated with fetal growth retardation[6,17] others described no effect[18,19]. Honey man et al. [20] reporting on a study conducted on Pakistani Muslims in Birmingham, indicate that parental consanguinity is associated with IUGR. Our findings also indicate significantly increased positive association of parental consanguinity and IUGR In summary, findings of our study generally support the published literature on the determinants of IUGR The striking findings in this community-based study is the significant relationship we reported for parental consanguinity and diet. Further studies examining the consequences of IHGR with respect to mortality, morbidity, physical and mental growth are currently underway.

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