Are clinical criteria just proxies for socioeconomic status? A study of low birth weight in Jamaica

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Abstract

Objective – To determine if the clinical risk factors for low birth weight are independent of socioeconomic risk factors in a population based sample from a developing country.

Design – Survey data from patient reported socioeconomic measures and their most recent pregnancy history.

Setting – A national sample of randomly selected households in Jamaica.

Subjects – All women aged 14–50 in the household who had had a pregnancy lasting seven months in the past five years (n = 952).

Main outcome measure – Birth weight.

Results – Clinical risk factors for low birth weight, such as parity and age, are independent of socioeconomic determinants, such as consumption and where a mother lives. Women who are nulliparous, 35 or older, poor, or living in certain areas are more likely to have lower birth weight children than those that do not have these characteristics (*t* statistics >2.0). The addition of socioeconomic factors to the multiple regression does not alter the estimates for the clinical risk factors for low birth weight. Thus, the effect of being nulliparous can be offset by being in the highest consumption quintile and, conversely, the risk of being older will be compounded if women are poor.

Conclusions – Both clinical and socioeconomic risk factors should be used to target women at risk. In terms of the quality of care, this study links clinical and socioeconomic risk factors to poor outcomes. Further studies are needed, however, to link the quality of care at various locations to these outcomes.

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Many countries try to target mothers who are likely to have low birthweight (LBW) infants or other poor birth outcomes. In developing countries, this is particularly important because about half of all infant deaths (during the first year of life) and two thirds of all neonatal deaths (in the first month of life) are attributed to low birth weight (defined as less than 2500 g).^{1,2}

Clinical and public health interventions in the prenatal period have been described as "efforts to identify and treat mothers who are at risk".^{3,4} Studies in the United States have

shown that primiparous mothers (nulliparous before delivery) and poor or black women are more likely to have higher infant mortality rates and lower average birth weights.^{5,6} Prenatal and other programmes that target these women have been associated with lower neonatal mortality, fewer LBW babies, and generally better birth outcomes.^{7,8} Thus, policy makers need information that delineates the various risk factors in pregnancy. With this information, policies can be specified that lead to a decrease in the number of women at risk or an increase in the birth weight of newborns.

In biological terms, the twin contributors to low birth weight are intrauterine growth retardation and prematurity.⁴ Clinical medicine associates these determinants with maternal age, parity, and prenatal complications.⁹ Clinical risk factors, however, may be indicators of many things. One explanation is that they identify women who have a biological predisposition to a low intrauterine growth rate and prematurity that result in poor outcomes. In this explanation, the different risk factors simply predict underlying clinical pathology.¹⁰ However, they might also be identifying women who do not receive care or, if they receive care, women who receive poor quality care that does not meet their medical needs.¹¹

Socioeconomic risk factors, such as education and income, influence the mother's nutrition, exposure to disease, and perinatal care decisions. Women may also not make optimal choices, such as being delivered by a trained practitioner, and these choices are also associated with socioeconomic status. Behavioural choices in turn will affect birth outcomes.^{12,13} Social science research has clearly linked socioeconomic variables, such as income and education, to birth outcomes and improvement of these determinants corresponds to improvement in child survival rates.^{2,14}

Eliminating or reducing clinical and socioeconomic risk factors can be viewed as an opportunity to improve the intrauterine environment.¹⁵ However, the analysis is complicated because socioeconomic factors are usually intertwined with clinical risk factors.^{16,17} Thus, an important policy question to ask is whether the clinical risk factors themselves are important indicators of biological processes or whether they just serve as markers for poor women or women with less education.

Unfortunately, little work has been done systematically and simultaneously to evaluate both the clinical and socioeconomic risk factors of

low birth weight.^{18 19} Most studies have looked only at data collected from deliveries in institutions. Birth weight data collected from institutions suffer from selection bias when births occur outside institutions, as in most developing countries. Population based data, which include birth weights regardless of where the delivery occurs, can be used to unravel the contributions of different risk factors, although they are not usually available.¹³ The notable exceptions are the pioneering work carried out in Malaysia and more recently in the Philippines.^{20 21} The Cebu, Philippines studies showed that clinical risk factors (previous births and maternal height) were associated with higher birth weight and that socioeconomic factors (household assets and education) indirectly related to birth outcomes through intermediate health behaviors.

This paper is concerned with identifying and estimating the effect of both the clinical and socioeconomic risk factors on birth weight using population based data. After identifying the risk factors for Jamaican women, this paper considers policy alternatives for targeting women at risk in order to increase birth weight and decrease infant mortality.

Study site

Jamaica is a developing country that is particularly well suited to the study of these questions. It has a per capita income of \$1380 a year and a population of 2.4 million inhabitants. Health care is provided by an extensive network of 366 government and more than 600 private primary health care facilities and hospitals.^{22 23} These facilities are distributed throughout Jamaica's 14 parishes. More than 90% of Jamaican women live within 10 miles of the primary health care facilities and the average distance to a public facility is only 2.3 miles.²⁴ Thus, while Jamaica is poor, access to care is not a problem.

Despite the general availability of care, various health outcomes reflect the need for better interventions. Officially, the infant mortality rate has declined from 43 in 1970 to 15 deaths per 1000 live births in 1991, although 8% of all babies born in 1991 births were estimated to be LBW.²² Other studies suggest that the actual rates for either of these outcomes could be higher due to under registration of infant deaths, and may range from 14% to 33%.²⁵ The Ministry of Health also found that 74.7% of women had intervals of 24 months or more between pregnancies and that 90% of pregnant women had attended antenatal clinics at least once during their pregnancy. Health care workers attended 86% of births and earlier analysis

indicated that 83% of deliveries occurred in hospitals or maternity centres.^{24 26}

These basic findings are important because they describe a country where primary health care is generally available but the prevalence of low birth weight is relatively high – a situation not that dissimilar to poor non-white populations in the United States. This suggests that despite the general availability of facilities, the process of care and health outcomes could be significantly improved.

Data and measurement

The data for this study came from the third round of the Jamaica survey of living conditions, a multi-round household survey conducted in 1989 by the Statistical and Planning Institute of Jamaica. The sampling frame for the survey was based on the 1982 Jamaican census using a nationally representative selection of Jamaican households. Randomly selected primary sampling units consisted of (no less than) 80 dwellings which were clustered into regions. Within each selected sample unit, women from 36 different dwellings were interviewed. Detailed pregnancy histories on the most recent pregnancy in the past five years were taken from women age 14 to 50 who had a pregnancy lasting more than seven months. The data were self reported by eligible women. Birth weight and detailed pregnancy histories were available for 952 women who had had pregnancies during the past five years. The summary statistics of dependent and independent variables are available in tables 1 and 2 respectively.

BIRTH WEIGHT

The dependent variable (used in the model) is birth weight, expressed as a continuous variable, reported by mothers at the time of the survey. We considered using birth weight data collected from official sources or hospital records because it has the advantage of using measurements that are recorded at the time of the birth. However, it also has the major

Table 2 Independent variables – mothers' age, parity, length of education, and per capita consumption in study mothers

Independent variables	No	%
Mothers' age (y):		
Less than 16	34	4.5
16–19	157	16.5
20–35	700	73.5
35 or older	61	6.4
Overall	952	100.0
Parity:		
Nulliparous	217	22.7
Multiparous (1–4 births)	498	52.3
Grand multiparous (>5 births)	237	24.9
Overall	952	100.0
Time in education (y):		
6 or fewer	117	18.6
7–9	405	42.6
More than 9	428	45.1
Overall	950	100.0
Per capita consumption (Jamaican \$):		
Lowest quintile	191	20
Middle 3 quintiles	570	60
Highest quintile	191	20
Overall	952	100.0

Table 1 Dependent variable = birth weight divided by low birth weight, and birth weight in relation to gender

Dependent variable	No	Mean (g)	(SD)	Range (g)	
				Min	Max
Birth weight	952	3232	(555)	1530	4989
Low birth weight (<2500 g)	93	2249	(269)	1531	2494
Male birth weight	514	3308	(564)	1588	4990
Female birth weight	438	3142	(532)	1531	4905

disadvantage of only measuring babies born in hospitals or clinics and thereby excludes unrecorded births and introduces a selection bias into the estimates. This is a particularly large problem in developing countries where an important percentage of births occur outside of the hospital.²⁷ Indeed, in Jamaica between 11% and 17% of all births take place outside of hospitals.²⁸ Population based samples obviate the problem of selection bias by including all children regardless of where they were born.

Using self reported data, however, raises the question of whether the recalled birth weight data are accurate. In Jamaica, babies whose births are attended are weighed, regardless of location, and the results are reported to mothers. Thus, Jamaican women generally know the birth weights of their children and it is reasonable to use recall data from a household survey. Additionally, the accuracy of self reported birth weight has already been considered in earlier studies which show that children born outside of the hospital tend to be poorer and have lower birth weights. However, these studies also showed that in diverse developing and developed countries, recalled birth weight data were comparable to recorded birth weights and could be used in lieu of recorded birth weights.²⁰⁻²⁹ To determine if there was any systematic recall bias over time in our own data that either overestimated or underestimated birth weights, we regressed birth weights against the child's current age. No pattern of bias was identified. Similarly, to determine if parity cohorts were associated with recall bias, we regressed birth order against weight and found that birth order was also not associated with a bias pattern.

The average birth weight of Jamaican newborns recorded in the household survey data was 3232 g, and 9.7% were of LBW (see table 1). The distribution of birth weights is shown in figure 1, and displays the expected normal distribution (skewness=0.001). By comparison, birth weights in developed countries average roughly 3500 g, and only 3–7% of new-

borns weigh less than 2500 g.³⁰ The average birth weight of black newborn infants in the USA is also lower than that of white babies, but at approximately 3370 g it is slightly higher than our findings in Jamaica. Lower average birth weights and higher rates of LBW have also been found in other developing countries. In Cebu, Philippines, for example, the average birth weight from a population based survey was 3004 g and 11.7% were LBW.²¹ In Malaysia birth weight ranged between 2900 and 3136 g depending on ethnicity, with 10.6% found to be LBW.²⁰ This supports the intuition that the average birth weight would be lower in Jamaica and that a developing country would have an increased percentage of LBW infants compared with either a developed country or white newborns in the United States. The higher weight of baby boys (by 153 g) is also similar to differences reported in standard paediatric series and remained unchanged regardless of the other factors that are taken into account.³¹

CLINICAL RISK FACTORS OF AGE AND PARITY

The average age of mothers giving birth in Jamaica was 24.9 years, with 21% of the sample delivering during their teenage years. If age-risk for low birth weight is defined as either less than 17 or more than 34 years, then 10.9% of Jamaican pregnancies were at risk. Another clinical risk factor is parity. Nearly half of the sample (47.6%) was either nulliparous (no previous children) or grand multiparous (more than five) and the average woman had just more than three children (see table 2). The average age of nulliparous women at the time of delivery was 20.2 years; grand multiparous women had an average age of 30.2.

SOCIOECONOMIC FACTORS OF INCOME AND EDUCATION

In this study, the standard of living is measured using the value of household per capita consumption, which is a typical measure of permanent income in developing countries.³² Consumption is a measure of long term average economic resources available to the family and it is a more robust measure of economic resources available to a family than is monetary income. In fact, income underestimates economic resources because family or family business income is uneven and much of the consumption is home produced or bartered. By contrast, consumption is easier to measure because families smooth household consumption over periods with and without income. In this study, we calculated consumption from reported expenditure on food, non-food items, the values of household produced consumption, and the rental value of housing. These values were divided by the number of people in the household and the average per capita consumption quintiles are shown in table 2. For the subsequent regression analysis, the individual consumption levels are logarithmically transformed (to produce a normal distribution).

Education is measured as years of schooling. Women in Jamaica generally have all gone to

Figure 1 Distribution of birth weights in Jamaican babies.

Table 3 Birth weight and percentage of low birth weight in relation to mother's age, parity, education, and per capita consumption

	No	% low birth weight (mean 9.7%)	Mean (SD) birth weight (overall mean 3232 g)
Mother's age (y):			
16 or less	34	2.8	3069 (347)
17–19	157	9.7	3116 (516)
20–34	700	9.3	3246 (556)
35 or more	61	19.0*	3098 (660)
Parity:			
Nulliparous	217	10.8	3161 (492)
Multiparous (1–4)	498	9.6	3243 (569)
Grand multiparous (5 or more)	237	8.9	3281 (574)
Time in education (y):			
6 or fewer	117	12.5	3230 (673)
7–9	405	9.0	3249 (525)
10–12	428	9.5	3221 (552)
Per capita consumption:			
Lowest quintile	191	9.0	3237 (556)
Middle 3 quintiles	570	9.8	3229 (554)
Highest quintile	191	9.0	3239 (546)

* Pearson χ^2 significant at the 0.05 level.

Table 4 Regression analysis – birth weight regressions, dependent variable = birth weight (g)

Independent variable	Coefficient*	Coefficient*
Clinical risk factors:		
Sex of child (male)	166.06 (4.66)	167.96 (4.71)
Mother's age 16 or less	–125.52 (–1.26)	–152.08 (–1.5)
Mother's age 35 or more	–163.82 (–2.24)	–173.74 (–2.33)
Nulliparous mothers	–92.19 (–2.05)	–93.22 (–2.02)
Constant	3177.94 (11.18)	2665.55 (10.74)
Socioeconomic risk factors:		
Mother's education 0–6 y	—	4.38 (0.32)
Mother's education 7–9 y	—	5.42 (0.81)
Mother's education 10–12 y	—	0.63 (0.12)
Per capita consumption household level (Ln)	—	59.47 (2.06)
Location:		
Parish dummy variables f statistic (13 936) =	—	2.11
Number	952	949
R ²	0.034	0.064

* *t* statistic reported in parentheses.

school and most have received a basic level of education. In fact, 96.1% had received at least six years of education, 88% of the women interviewed had been educated beyond primary school and the mean number of years of schooling was 9.2.

LOCATION

In order to control for differences in available health care and other environmental factors, this study considered the location of households. Residents live in one of 14 parishes in Jamaica and are classified as urban or rural. With health care available, almost always nearby, and prices uniform, parish location probably captures area variations in the quality of services and the health environment. Just more than half of the population (58%) lived in rural areas, although the urban/rural distribution varied from parish to parish. Different parishes also had different distributions of consumption levels, although the average consumption in rural settings was not statistically different from urban areas.

Correlates of birth weight

Table 3 reports separately the mean birth weights in relation to clinical and socioeconomic risk factors. This simple bivariate approach only identified an increased chance of a low birth weight child in women more than 35 and nulliparous women, although the

difference was only statistically significant (χ^2 test) for women more than 35. It is not clear from the bivariate correlations if these risk factors are markers for age alone or if they are also confounded by other factors such as parity and income. When bivariate comparisons were made using birth weight as a continuous variable, the findings were the same (shown in the last column in table 3). Except for mothers more than 35 or those less than 16, there was no group that was significantly different when compared to the sample average of 3232 g.

Determinants of birth weight

To investigate the joint impact of clinical risk factors on birth weight and to observe the effect of adding socioeconomic determinants to standard clinical risk factors, we estimated a series of multiple regression models. The regression results are summarised in table 4 and are divided into the effects of clinical risk factors, socioeconomic factors, and location.

The first column reports the result of a model that only includes clinical risk factors which categorises at risk pregnancies in relation to age or parity. The results show that either young teenage mothers or older mothers were more likely to have lower birth weight children. Mothers more than 35 years old gave birth to babies that weighed 164 g less than other mothers (significant at the 0.05 level). Mothers aged less than 16 also exhibited a large but statistically insignificant lower birth weight even when considerations were made for primiparous births. The lack of statistical significance might be due to the limited sample size of mothers less than 16, but the direction and magnitude were similar to that of older mothers. Firstborn children (to nulliparous mothers) consistently weighed less than other babies, but babies born to nulliparous or grand multiparous mothers weighed the same. Thus, the clinical risk factors of age and parity clearly identify Jamaican women at risk. The question remains, however, as to whether these clinical markers were genuine risk factors or just proxies for socioeconomic status.

The second column reports the results of the model that adds socioeconomic factors. The addition of socioeconomic factors and location does not alter the estimated impact of the clinical risk factors. These results also show that mothers in households with larger per capita consumption have babies with heavier birth weight. The point estimates indicate that a 1% increase in per capita consumption was associated with a 595 g increase in birth weight. These findings reflect the importance of economic resources in Jamaica and are similar to findings from studies done in developed countries.⁸ Location explains a significant amount of the variation in birth weight (the r^2 increases from 0.036 to 0.064). By contrast, education in Jamaica is not significantly associated with an increase in birth weight in these data. This may reflect the fact that nearly all Jamaican women report having a primary education and that there are only limited benefits of more education without higher in-

comes. Several interaction terms were tested to see if the effect of age or parity varied in relation to education but these did not predict differences in birth weight and added little to the estimation. Testing was done for non-linear education effects but this had little additional explanatory power. In addition, interaction terms between age and parity, age and education, and education and consumption were individually and jointly rejected at conventional significance levels.

Discussion

In this study we have estimated multivariate regression models of the determinants of birth weight by simultaneously considering both clinical and socioeconomic risk factors. We found that when socioeconomic factors were controlled (education, economic status, and location), the clinical risk factors remained important. This means that the measures of parity and age are not just picking up poor women or women with less education, but rather indicate separate risks. Since the clinical coefficients were not confounded (that is, decreased) by the addition of the socioeconomic measures, this suggests that socioeconomic factors are not just proxies for clinical criteria. These findings are useful because they help substantiate the use of these two common clinical risk factors by health care workers and policy makers in developing countries.

The study also found that socioeconomic measures and location had important effects on the outcome. In Jamaica, if consumption increased by 100%, it was associated with a 59.5 g increase in birth weight. In contrast to other studies, education had surprisingly little effect on birth weight.^{21 33} This may be due to the fact that Jamaican women are by and large educated. Still other studies, however, report that maternal education is unrelated to outcome. These studies are from settings where access to health resources was either limited or where care was ineffective.^{12 16} Differences in location, on the other hand, were associated with differences in birth weight and may reflect geographical variations in the processes of care. In fact, important concerns have already been raised about variations in basic health care between rural and urban settings and public and private providers.²³ In Jamaica, because primary health care is generally available and access is not a major problem, these quality attributes of care may explain the geographical differences in birth weight.

The relationship between clinical risk factors and economic status is also interesting. In order to estimate outcome differences by economic status, we calculated the birth weight for each consumption quintile. Holding everything else constant, this shows that there was a birth weight difference of 122 g between women in the lowest quintile and women in the highest quintile (see fig 2). This gain in birth weight is commensurate with the loss in birth weight associated with clinical risk factors. Thus, a clinical risk factor can be completely offset by being in a higher income group.

Figure 2 Change in birth weight in relation to consumption quintile.

Policy implications

In public health policy, the main objective of prenatal care is to identify women at risk and then to intervene to prevent low birth weight. An important issue for policy makers is whether risk factors can be identified for poor outcomes. Clinical risk factors such as age and parity are frequently used in poorer countries to direct policy interventions. The data to support this has come almost exclusively from studies done in other settings in more affluent countries. We were interested in simultaneously evaluating the clinical and the socioeconomic effects on low birth weight in Jamaica.

We think that several policy conclusions can be drawn from this analysis. Firstly, clinical factors such as age and parity are important predictors of outcomes in Jamaica and not just proxies for socioeconomic differences. Thus, policy interventions that are targeted towards nulliparous or older women may be important in improving pregnancy outcomes as measured by higher birth weight. Secondly, socioeconomic status and where a woman lives are also associated with lower birth weights. Thirdly, not only do more affluent households have babies that weigh more, the effect of being either a nulliparous mother or 35 and older can be offset by being a mother in the highest consumption quintile. Conversely, the risk incurred by women who are older or nulliparous is compounded if they are poor.

Policy interventions, therefore, should continue to target clinical risk factors but also concentrate on women who are poor. More analysis is needed, however, to explain which factors might contribute to the geographical variation in the outcomes. Since most women have access to care in Jamaica, the geographical variation suggests that supply side characteristics matter. For example, it would be useful to consider the results of this study with process or other quality of care measures obtained from facilities where care is actually provided.

In Jamaica, this raises another policy question – What kind of care do women at risk receive if they already have access to care? In an early study, we reported that there was a significant problem of underutilisation of services by high risk women.²⁶ This same study showed that, even when women at risk received care, the health system had little success in providing more than just routine care for these women.

By looking at birth weight outcomes in Jamaica, this study extends the analysis of earlier work in two ways. Firstly, it shows that women at risk actually have a worse outcome and that they are more likely to have an infant that weighs less at birth. Secondly, this study, combined with our earlier work, shows that it is the same group of women who have a poor outcome who do not obtain adequate prenatal care. In other words, the assumption of being at risk for an adverse outcome can now be linked to the inadequate processes of care demonstrated by the earlier investigation. This is significant because it links the set of risk factors (such as age, income, and location) and the processes of care (such as underutilisation, lack of specific clinical interventions, and non-hospital delivery) to LBW infants.

The term “quality of care” refers to measures of the attributes of care and these are generally divided into the categories of structure, process, and outcome.^{4,34} In this paper the primary concern is only with the “outcome” of birth weight as a measure of quality in Jamaica. The authors recognize, however, that low birth weight is linked to structure (particularly in developing countries with constrained resources) and to the process of care (in all settings).

These findings, the findings of previous studies, and the finding that location matters, suggest that the selected structural and process characteristics of care may further explain differences in birth weight in Jamaica. From studies done in the United States and other developed countries it is already known that better processes of care, such as glucose monitoring and counselling, are linked with higher birth weights and better birth outcomes.^{35,36} There are, however, few studies in the literature on developing countries that relate quality outcomes to structure or process.³⁷ Further research will be needed to see if this is true in Jamaica.

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