Is Maternal Stress and Morbidity Associated with Infant Malnutrition?

Saasa-Modise,M
MD (Bulgaria), MSc Human Nutrition (London), MFamMed (Medunsa)

Fehrsen,GS
BA (Unisa), MB, ChB (UCT), MFGP (SA)

Marais,LM
MB, ChB (Pret)
Department of Family Medicine, Medical University of South Africa

Levin,JB
MSc Numerical Computation (Manchester), MSc Biometry (Reading)
Centre for Epidemiological Research in South Africa, Medical Research Council, Pretoria.

Ellison,GTH
PhD
Institute of Urban Primary Health Care, Alexandra Health Centre and University Clinic, Johannesburg.

MacIntyre,U
PhD (PU for CHO)
Department of Paediatrics, Medical University of Southern Africa.

Correspondence to:
Prof. GS Fehrsen
Department of Family Medicine, Medical University of Southern Africa
P O Box 222, Medunsa 0204
South Africa.
samf@lantic.net

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Abstract

Aim: To examine the relationship between maternal stress, maternal morbidity, social support and infant malnutrition, among mothers living in the semi-formal and formal settlements served by the Gold Fields Nutrition Centre (the Centre) at the Medical University of Southern Africa (MEDUNSA)

Study design: Case control study of mothers with malnourished infants (the cases) and mothers with well-nourished infants (the controls).

Exposure: Maternal morbidity was assessed using a combination of tests, medical consultation, laboratory tests and health questionnaire. For maternal stress a questionnaire based on the Life Experiences Survey was used. The amount of social support that a mother received was assessed using a list of hypothetical circumstances in which they might seek help or support. In addition a detailed questionnaire was used to collect information on a variety of socio-demographic variables considered to be potential confounders.

Statistical Analysis: Variables were compared between cases and controls using paired t-tests (for continuous variables) and McNemar's Chi squared test (for binary data). In addition conditional multiple logistic regression analyses were conducted to assess whether there was an independent association between maternal stress, social support and morbidity on the one hand, and infant malnutrition on the other.

Results: Mothers with malnourished children were more likely to have greater stress and illness than mothers with well-nourished children. However the cases and controls did not differ much in their social support system. Using a conditional multiple logistic regression model it was found that malnutrition was significantly related to maternal illness ($p=0.008$) and maternal stress ($p=0.013$). Ill mothers (odds ratio = 3.37) and stressed mothers (odds ratio = 1.097) were more likely to have malnourished infants.

Conclusion: The study showed a strong association between maternal illness and child malnutrition and between maternal stress and child malnutrition. There was also no evidence of an association between social support and child malnutrition. In view of the high number of ill mothers, mothers of malnourished children need extra support and attention to care for their children.

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Introduction

The decision to assess the relationship between maternal stress, maternal morbidity and infant malnutrition followed the observation that mothers with malnourished infants, who received care and support at the Gold Field's Centre for Human Nutrition (the Centre) at MEDUNSA, often appeared mentally and physically unwell.

The important role of maternal health and well being in the provision of appropriate care for her infants has been recorded in a variety of different studies throughout the world: In Bangladesh studies showed that infants (3-36 months) weight for age was directly related to maternal nutritional status,

even after accounting for differences in socio-economic status and infant feeding practice.[1,2] Studies in the United States suggested that a stressful social environment and the psychological health of the mother might be related to infant growth.[3,4]

In Lesotho,[5] it was found that poor social support was a risk factor for severe protein energy malnutrition, and in Zimbabwe[6] an association was observed between lack of maternal decision making power and childhood malnutrition.

The aim of the present study was to re-examine these relationships among mothers living in the semi-formal and formal settlements served by the Centre. By quantifying the relative importance of maternal stress and morbidity in the aetiology of infant malnutrition it should be possible to design appropriate intervention aimed at improving the care and support provided for mothers with malnourished infants.

Methods

Study design

To assess whether maternal morbidity, stress and poor social support were independent risk factors for infant malnutrition, a matched case-control study was used to compare the health, social support and stress levels of mothers with malnourished infants (cases) to those mothers with infants who were not malnourished (controls).

Cases

Any mother whose 6-36 month old child had been referred to the Centre was eligible for inclusion in the study as a case. Infants were referred to the Centre by the Paediatric Department at Ga-Rankuwa Hospital if they were clinically malnourished and required remedial nutrition. Infants were classified as clinically malnourished if they fulfilled any of the following criteria: their weight-for-age fell below the 3rd centile; their weight-for-height fell below 5th centile; their height-for-age fell below the 3rd centile; and/or they exhibited nutritional oedema. NCHS reference values[7] were used to assess whether infants fell below the 5th and/or 3rd centiles for each anthropometric measurement. Weight measurements were conducted to the nearest 0.1kg using a hanging scale (Salter, UK). Mid-upper arm circumference and length measurements were conducted to the nearest 0.1cm using a fibre glass tape measure (Dean, UK) and a purpose-built length board. Nutritional oedema was diagnosed by clinical examination.

Controls

To facilitate the selection of appropriate controls, only those cases whose infants had been born in South Africa and who lived within 50km of the Centre were included in the study. The immediate neighbours of these cases were systematically screened until an appropriate control was found for each case. The first neighbouring mother with a 6-36 month old child, who was not clinically malnourished, was selected as a control provided she was no more than 5 years older or 5 years younger than the case mother. In this way, controls were matched for infant and maternal age, and were selected from mothers living in the same neighbourhood as each case.

Sample and Exposures

Sample

A sample size of 200 (100 cases and 100 controls was decided upon using the EPI-info 5 programme requiring a confidence level of 95%, power of 80%, 1:1 ratio of exposed to unexposed, incidence of unexposed 20% and of exposed 40%.

Exposures

(i) Morbidity: Maternal morbidity was assessed using a combination of clinical tests, medical consultation and health questionnaires. Haematological and urine analyses were conducted to screen for anaemia, hypoproteinaemia and proteinuria. The medical consultations were conducted in an open-ended manner to identify any morbidity. Each mother was then asked to complete the General Health Questionnaire[8] and the Duke Health Profile Questionnaire[9] to assess self-reported mental and physical wellbeing. Questionnaires were completed with the assistance of the second researcher in order to minimise bias.

(ii) Stress: Maternal stress was assessed using an inventory of stressful life events selected from the Life Experiences Survey[10] and those used in South Africa's Birth to Ten study[11]. Events were chosen that could have occurred during the previous 6 months, and mothers were asked to rank the impact of each event, from -3 (extremely negative) through 0 (no impact) to +3 (extremely positive). With 55 potentially stressful life events, the inventory created a score of maternal stress that range from -165 to +165.

(iii) Social support: Maternal descriptions of current marital status were used to evaluate whether she received social support from a partner. The amount of social support received from friends and family was assessed using a list of hypothetical circumstances in which she might seek help or support. For each set of circumstances mothers were asked whether nobody (0), one (1), a few (2) or several (3) people would usually provide help or support. Additional questions asked mothers whether they belonged to any community organisations (such as a church) and how often they attended meetings. The same approach had been successfully used to assess social support amongst mothers in South Africa's Birth to Ten-study[11] and with a total of 9 circumstances it created a score of social support that ranged from 0 to 31.

(iv) Socio-demographic confounders: To control for the effect of maternal and environmental factors that might have been responsible for any relationship between maternal morbidity, stress, poor social support and infant malnutrition, a detailed questionnaire was used to collect information on a variety of potential confounders. These included marital status, parity and self-reports of smoking and drinking habits. Information on maternal education, contraceptive use and crowding within the home (the number of cohabitants per room) were used as three indices of socio-economic status. The duration of breastfeeding provided an indication of infant feeding practices, while the birth weight and

immunisation status of each child was assessed by consulting its Road to Health card.

(v) Environmental conditions: The questionnaire also obtained information on the materials used to construct each mother's dwelling (brick, tin, mud, wood or other), the principal source of energy (electricity, coal, gas, paraffin, wood or other) and water facilities available (inside tap, outside tap, outside pump, outside well, river or other). This information was used to assess the extent to which matching cases with neighbouring controls managed to minimise variation in the environmental circumstances experienced by each group of mothers.

Statistical Analyses

All results are presented as means with standard deviation (SD) or percentages. T-tests for continuos variables, and Chi-squared tests for binary data were used to assess the statistical significance of differences in exposure between cases and controls. Paired t-tests and McNemar Chi-squared were used for data from matched case-control pairs.[12] Statistical significance was accepted at $p < 0.05$. To assess whether there was an independent association between maternal stress, social support, morbidity and infant malnutrition, conditional multiple logistic regression analyses were conducted to control for the potential confounding effect of other exposures.[13] Due to incompleteness of data two cases and two controls were lost to analysis.

Results and Discussion

It is clear from Table I that infants classified as clinically malnourished were anthropometrically different from infants from control mothers who were not. Malnourished infants were shorter, lighter and leaner than well-nourished infants were. This is hardly surprising considering the anthropometric criteria used to diagnose malnutrition (see Methods), but it does confirm that these criteria were adhered to consistently. There were significantly more girls than boys amongst the malnourished infants, and the mean birth weight of these infants was also lighter than those who were well nourished, although it did not reach statistical significance. However, there was no difference in access to health care (as evidenced by differences in immunisation) or in the duration of breast-feeding between these groups, both of which might have explained their differential nutritional status.

There was no significant difference in the proportion of brick dwelling occupied by mothers with malnourished and well nourished infants, and there was also no difference in the proportion of these dwellings with indoor water supplies, pit latrines and electricity supplies (see Table II). Both groups of mothers lived in similarly crowded dwellings, and the absence of substantial differences in environmental conditions suggests that the technique used to match each case and control living under similar circumstances was largely successful.

However, cases (mothers with malnourished infants) were significantly more likely to be single than controls, and

***Table I:* Demographic, anthropometric and nutritional differences between malnourished and non malnourished infants**

	Malnourished (N=98)	Well-Nourished (N=98)	Statistical Significance
Age in Months (SD)	6.3 (6.8)	14.8 (7.0)	t=1.56; p=0.119
Sex ratio (M:F)	37:61	51:47	x^2=4.04; p=0.0044
Months Breastfed (SD)	12.6 (7.2)	12.4 (6.3)	t=0.13; p=0.891
Immunised	92.7%	93.9%	x^2=0.11; p=0.891
Birth Weight in kg (SD)	2.86 (0.72)	3.09 (0.61)	t=1.68; p=0.096
Length in mm (SD)	708.3 (62.4)	735.1 (63.6)	t=2.97; p=0.003
Weight in kg (SD)	7.3 (7.1)	9.6 (1.6)	t=9.95; p<0.001
Wt/Ht as kg/m (SD)	10.3 (1.6)	13.0 (1.4)	t=12.39; p<0.001
MUAC in mm (SD)	12.2 (3.1)	14.4 (2.4)	t=5.73; p<0.001
Sum of skinfolds in mm (SD)	14.0 (10.3)	17.1 (10.9)	t=2.09; p=0.038

***Table II:* Characteristics of dwellings occupied by cases, mothers with malnourished infants (N=98) and controls, mothers with**

	Cases %	Control %	Statistical Significance
Brick House	37.8	39.6	x^2=0.068; p=0.794
Electricity	5.1	7.1	x^2=0.355; p=0.551
Pit Latrine	81.6	76.5	x^2=0.771; p=0.380
Running Water	12.2	11.2	x^2=0.049; p=0.824
Crowding Index	2.0 (1.0)	2.2 (1.3)	t=0.709; P=0.480

there was a strong trend for more control mothers to have post-primary education than their respective cases (see Table III). These differences might account for the significantly greater stress and illness experienced by mothers with malnourished infants, although they did not have significantly less social support than their controls.

Because the researchers involved in the present study knew whether or not each mother had a malnourished infant, it is possible that more intensive clinical consultations were provided for mothers known to have malnourished infants, and that these created a biased view of health status amongst cases and controls. In an attempt to maintain consistency of diagnosis, the same doctor performed all consultations.

To assess the independent association between maternal morbidity, stress, poor social support and infant malnutrition, a conditional logistic regression model was created (see Table IV). The regression model accounted for differences in infant age (p=0.022), sex ratio (p=0.123) and access to health care (immunisation status, p=0.296) as well as maternal differences in marital status (p=0.084), together with contraceptive use (p=0.042) and education (p=0.084) which were included as indices of socio-economic status. There remained a highly significant association between maternal illness (p=0.008), maternal stress (p=0.013) and infant malnutrition, such that "ill" mothers (OR = 3.37) and stressed mothers (OR = 1.097) were much more likely to have malnourished infants. While there was a trend towards a higher risk of infant malnutrition amongst mothers with good social support (OR = 1.098, p=0.08). This might reflect the lower socio-economic status of mothers with higher perceived social support after taking into account differences in marital status.

***Table III:** Socio demographic differences between the mothers of malnourished infants (Cases) and mothers of well-nourished infants (Controls)*

	Malnourished (N=98)	Well-Nourished (N=98)	Statistical Significance
Single	58.15%	42.9%	x^2=4.59; p=0.032
Parity as live births (SD)	2.8 (2.0)	2.6 (7.1)	t=0.78; p=0.432
No Contraception	75.5%	67.3%	x^2=1.38; p=0.240
No secondary education	49.5%	39.2%	x^2=2.50; p=0.11
No alcohol	94.9%	96.9%	x^2=0.52; p=0.470
No smoking	90.8%	95.9%	x^2=2.06; p=0.151
Unemployed	94.5%	90.2%	x^2=1.19; p=0.275

***Table IV:** Parameters from conditional logistic regression model for 1:1 matched study with Odds Ratios and upper and lower limits of 95% confidence intervals.*

Parameter	Odds ratio	95% Confidence interval for OR
Maternal Illness	3.37	1.27 - 8.32
Social support	1.10	0.99 - 1.22
Stress score	1.10	1.02 - 1.18
Child's age	1.09	1.01 - 1.17
Child's gender	1.97	0.83 - 4.66
Marital status	2.18	0.66 - 7.18
Education	0.08	0.01 - 0.57
Immunisation	0.30	0.04 - 1.97
Contraception	2.57	1.04 - 6.39

Note: Odds Ratio and significance. The bigger the Odds Ratio the bigger the effect but this depends on the scale. With age it is a measure of the risk for aone-month change in age. Significance depends on the size of the odds ratio and the standard error.

Conclusion

The results of this study confirmed that maternal morbidity and maternal stress are strongly associated with infant malnutrition even when examining matched cases and controls living under similar circumstances, and after accounting for a variety of potential socio-economic and nutritional confounders.[1,3] The most plausible explanation for this association is that maternal illness and stress are risk factors for malnutrition amongst their infants. However, it is also possible that caring for a malnourished infant might create stress and illness amongst mothers living under the harsh socio-economic and environmental conditions prevalent in the present study. Clinicians caring for the malnourished child should therefore pay attention to the health and wellbeing of the mother to ensure that mothers who become ill receive adequate support to feed and care for themselves and their infants until they both recover.

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