#2

Malnutrition and the Immune Response,
edited by R. M. Suskind.
Raven Press, New York © 1977.

Umbilical Cord Immunoglobulins and Fetal Maturity: Neonates in a Guatemalan Indian Village

Leonardo J. Mata and Elba Villatoro

Instituto de Investigación en Salud, Universidad de Costa Rica, Costa Rica; and Instituto de Nutrición de Centro América y Panamá, Guatemala City, Guatemala

During a 9-year prospective study in a Mayan Indian village (1), umbilical cord blood was collected by untrained midwives from most newborns. Specimens mixed with maternal blood were screened according to their ratios of immunoglobulin M (IgM) to immunoglobulin A (IgA) (2). All remaining specimens with levels of IgA equal to or greater than 0.10 mg/ml were also excluded. Of the 401 original specimens, 250 were used in the study.

The immunoglobulin levels in umbilical cord blood are summarized in Table 1. Two notable findings are the high concentrations of IgM and IgG in village neonates, and the high frequency (40%) of IgM concentrations equal to or greater than 0.20 mg/ml levels, in excess of those found in industrialized countries (3,4).

Analysis of variance revealed no clear pattern associating IgM values with birth weight or gestational age (Table 2,3). Highest values were noted in infants of 35 to 36 weeks' gestation. Comparison of IgM values with combined birth weight and gestational age (fetal maturity) showed that the highest values were in three infants classified as preterm, moderate low birthweight (Table 4). Analysis of IgG values, on the other hand, revealed a clear pattern; mean IgG was significantly correlated with birth weight, increasing until birth weight reached 3,000 g. The correlation with gestational age was even higher, lasting until 41–42 weeks' gestation. The lowest IgG

TABLE 1. *Immunoglobulins in umbilical cord serum (mg/ml), 250 cases, Santa María Cauqué, 1964–1972*

Class	Minimum	Maximum	Mean (SD)	Elevated[a]
IgM	0.025	0.850	0.217 (0.174)	101 (40.4)
IgA[b]	0.035	0.090	0.036 (0.008)	
IgG	6.30	28.80	13.72 (4.07)	66 (26.4)

[a] Elevated levels (mg/ml): IgM $\geq$ 0.20; IgG $\geq$ 15.00. Numbers represent number and percent of cases studied.

[b] By definition, all cases with IgA $\geq$ 0.10 mg/ml were not tabulated (see text).

TABLE 2. *Mean concentration of IgM and IgG, by birth weight, 250 cases, Santa María Cauqué, 1964–1972*

Birth weight	No. of cases	IgM M±SE	IgG M±SE
<2,001	18	0.192 ± 0.042	11.12 ± 0.98
2,001–2,500	82	0.218 ± 0.017	13.48 ± 0.37
2,501–3,000	123	0.217 ± 0.012	14.20 ± 0.38
3,001–3,500	27	0.232 ± 0.027	14.02 ± 0.86
F		0.279	3.234
p		>0.05	<0.05

TABLE 3. *Mean concentration of IgM and IgG by gestational age, 244 cases, Santa María Cauqué, 1964–1972*

Gestational age (weeks)	No. of cases	IgM M±SE	IgG M±SE
31–32	2	0.240 ± 0.047	7.33 ± 0.48
33–34	5	0.125 ± 0.031	11.37 ± 1.41
35–36	11	0.316 ± 0.067	11.73 ± 1.37
37–38	31	0.228 ± 0.031	12.51 ± 0.50
39–40	154	0.215 ± 0.011	13.91 ± 0.32
41–42	41	0.211 ± 0.022	14.64 ± 0.68
F		1.442	3.016
p		>0.05	<0.01

values were in preterm, severe low birth weight infants, whereas the highest values were in term newborns.

Differences in IgG concentration as a function of fetal growth have been reported and reviewed by others (5–7). Preterm infants, having a lower level of maternal antibody, may exhibit a shorter period of passive immunity. Unfortunately, the proportion of preterm babies is greater in underdeveloped societies, where there is also greater risk of infection than in industrialized

TABLE 4. *Mean concentration of immunoglobulin, by fetal maturity, 243 cases, Santa María Cauqué, 1964–1972*

Class	No. of infants	IgM (mg/ml)	IgG (mg/ml)
Preterm, severe low birth weight	14	0.218(0.195)[a]	10.83(4.53)
Preterm, moderate low birth weight	3	0.446(0.097)	12.90(0.81)
Term, small-for-gestational age	81	0.207(0.150)	13.39(3.36)
Term, moderate birth weight	118	0.218(0.139)	14.13(4.24)
Term, high birth weight	27	0.232(0.143)	14.02(4.48)

[a] Mean value (SD)

countries. The finding of a high proportion of neonates with elevated values of IgM has been a matter of concern. A confirmatory study was conducted utilizing the infrastructure of the INCAP study of nutrition and mental development. Dr. Hernán Delgado obtained blood shortly after birth from a significant number of babies born consecutively in four lowland Guatemalan villages. Elevated IgM values were found in 15% of the neonates (8). Such findings have classically indicated congenital infection. In fact, high prevalence of antenatal infection has been demonstrated in Santa María Cauqué (1) and among infants of low social class in the United States (3). Although several explanations could be advanced, the most likely is that the fetus responds to microbial antigens or components or to maternal antibodies produced during infection in pregnancy.

REFERENCES

1. Mata, L. J., Urrutia, J. J., Cáceres, A., and Guzmán, M. A. (1972): The biological environment in a Guatemalan rural community. In: *Proc. West Hemisph. Nutr. Congr.*, Vol. III, pp. 257–264. Futura Pub. Co.
2. Lechtig, A., and Mata, L. J. (1971): Levels of IgG, IgA and IgM in cord blood of Latin American newborns from different ecosystems. *Rev. Latinoam. Microbiol.*, 13:173–179.
3. Alford, C. A., Foft, J. W., Blankenship, W. V., Cassady, G., and Benton, J. W. (1969): Subclinical central nervous system disease of neonates: A prospective study of infants born with increased levels of IgM. *J. Pediatr.*, 75:1167–1178.
4. Stiehm, E. R., and Fudenberg, H. H. (1966): Serum levels of immune globulin in health and disease: A survey. *Pediatrics*, 37:715–727.
5. WHO (1972): A survey of nutritional-immunological interactions. *Bull. Org. Mond. Sante*, 46:537–546.
6. Cáceres, A., and Mata, L. J. (1974): Niveles de immunoglobulinas en una población del altiplano guatemalteco. *Bol. San Pan.*, 76:115–124.
7. Faulk, W. P., Demaeyer, E. M., and Davies, A. J. S. (1974): Some effects of malnutrition on the immune response in man. *Am. J. Clin. Nutr.*, 27:638–646.
8. Mata, L. J. (1975): Malnutrition-infection interactions in the tropics. *Am. J. Trop. Med. Hyg.*, 24:563–574.