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LITERATURE SUMMARIES

Carol Burke
10 - 11 - 73

Abramowicz, Mark and Henry Barnett
Sex Ratio of Infant Mortality.
Amer. J. of Diseases of Children, V. 119, April 1970, pp. 314-315.

RESULTS.

1. The excess of males in infant deaths has increased in the 1900's as infant death rates have declined. Data is presented for New York City and in a compilation of rates for select developed and underdeveloped countries (Australia, Chile, Denmark, England and Wales, Guatemala, Jamaica, Japan, Luxembourg, Mexico, New Zealand, Sweden, Switzerland and United States).

2. The rise in sex ratio is not a function of time alone. A plot of the sex ratio for 13 developed and underdeveloped countries between 1915 and 1945 showed points arranged in a rectangular distribution.

3. Male disadvantage in surviving infancy is less in nonwhites, lower socio-economic classes and medically underdeveloped countries.
Hammond E.: Studies in Fetal and Infant Mortality. Amer. J. Public Health 55:1152-1163, 1965.

4. Although all causes of death in infancy except pertussis are more likely to kill males, the elimination of many of these diseases has been accompanied by an increase in the sex ratio.
Wyllie J.: Sex Differences in Infant Mortality. Canadian Public Health Journal 24:177-185, 1933.

5. A British study reported that both still births with fetal defects and infants in whom congenital malformation is primary cause of death are more likely to be female.
American statistics report a male predominance in infant death from congenital malformation. (No data presented)

Carol Burke
10 - 11 - 73

Aykroyd, W.R.
Nutrition and Mortality in Infancy and Early Childhood: Past and Present Relationship.
AMER. J. Clinical Nutrition 24: April 1971, pp. 480-487.

To consider how past trends in infant mortality in developed countries and present differences ~~in differences~~ in infant mortality in undeveloped and developed countries relate to protein-calorie malnutrition.

LITERATURE REVIEW

1. Aykroyd describes England's experiences re: infant mortality in the early 1900's as documented in George Newman's Infant Mortality (1906). The following is a summary of these experiences.

   - High mortality districts in England prior to 1905 were characterized by high density of population and considerable degree of population, i.e., urban districts. This difference in rates between urban and rural districts is true of Ireland and France too.

   - There also were also higher infant mortality rates in slums than in prosperous areas of certain cities too.

   - Eighty-four percent of infant deaths in England and Wales in 1904 were caused by prematurity, congenital conditions, atrophy and debility, diarrhoea and enteritis, convulsions, pneumonia, tuberculosis, whooping cough or measles.

   - Prematurity, congenital conditions, and atrophy and debility were the three most common causes of death. And they were most fatal in early weeks. Diarrhea and enteritis was the fourth most common cause of death and was a killer throughout the first year.

   - Diarrheoa is 7 to 8 times higher in overcrowded urban areas than in rural areas.

   - Mortality ratio of hand-fed to breast-fed infants was 3 to 1.

   - Groups who breast feed--rural poor, urban well-to-do, Irish and Jews--had low mortality rates.

   - Infant deaths are most common in the first 3 months.

   - The percentage of total infant mortality occuring the first 3 months varies inversely with the total infant mortality rate.

- Mortality between 1 and 2 years was a quarter or a third as large as infant mortality.

RESULTS.

Aykroyd compares the past English experience to the present experiences of undeveloped countries. (No data or literature review provided for underdeveloped countries.)

Similarities include:

- Both have high infant mortality rates.
- Ratio of neonatal deaths to post neonatal deaths is similar, with a predominating percentage of deaths in the post neonatal period.
- Both have high mortality in 2nd year of life.
- Diarrhoea and enteritis are common causes of death in the 1st year; and they are more common in urban areas than in rural areas.
- Measles is an important cause of infant death for both.
- Early cessation of breast feeding endangers life for both because substitutes are often infected and lack nutritional value.

There is one important difference, that is no reference to kwashiorkor (a manifestation of protain-calorie deficiency in which protein is the etiological factor and seen mainly in children 1 to 3 years.)

- Atrophy and debility can perhaps be analagous to PCM.
- Mehlahrschaden described by German pediatricians, Czerny and Keller, in 1928 might be kwashiorkor. (Mehlahrschaden is an illness resulting from diets composed mainly of cereal gruels and characterized by diarrhea, muscular atrophy, edema and fatty. Similar conditions were observed in Italy and Switzerland.

PCM has been eliminated from some underdeveloped communities--Barbardos, Puerto Rico, and a Pakistani Vallage transferred to England. This is probably because milk substitutes in the communities are hygenic and nutritious.

Carol Burke
10 - 15 - 73

Baertl, J., Morales, E., Verastegui, G., and Graham, G.
Diet Supplementation for Entire Communities. Growth and Mortality of Infants. Growth and Mortality of Infants and Children.
Amer. J. Clinical Nutrition, V. 23, No. 6, June 1970, pp. 707-715.

To measure the effects of food supplementation to people living in otherwise unfavorable environments.

DATA BASE AND DESIGN.

Semiannual census and anthropometric measurement of all residents on a sugar plantation in northern Peru with four separate independent populations which were characterized by same management, similar ethnic origins, similar sizes, age distributions, occupations, housing conditions and wages, and partial payment in food, were taken from 1962-67. Two populations were given food supplements of equal caloric value, but one was provided almost twice the protein content given the other. Two populations were used as controls. (One control population had a food supplementation program for 6 to 30 month old children only beginning 1965.) All populations received medical care also.

RESULTS.

1. Total caloric intake was not increased, but rather foods of lesser nutritional value were displaced.

2. There was a similar increase in the heights and weights of adult men and women of all four groups apparently independent of food supplementation. This is consistent with fact that caloric intake was not increased.

3. There was appreciable improvement in the developmental quotients for weight and height of preschool children, for all four populations, particularly two groups (one supplemented, the other control) who were less well off initially.

4. There was no change in the quotients for weight and height of the school age children in all four populations.

5. A modest but steady improvement in height quotients of adolescents was apparent for all four populations.

6. There was marked seasonal variation in weight quotients of preschool children and adolescents of control populations.

7. There was a decline of more than 60 percent in both infant and preschool mortality in the two populations given additional food. [illegible]

There is graphic presentation of quotients for weight and height [illegible] by age and sex for the four populations.

PLR

Carol Burke
10-18-73

Berg, Alan and Robert Muscat.
Nutrition and Development: The View of the Planner.
Amer. J. Clinical Nutrition 25:
February 1972, pp. 186-209.

This article contains a brief literature review to establish that there is a nutrition problem in developing countries. Reference to Latin America are cited below. There is also a presentation of some findings of nutrition studies. For examples-- Malnutrition during the fetal period and infancy is associated with intellectual impairment which may be irreversible. Heredity is the key to the ultimate size a child can attain, but it is nutrition that largely determines how closely he will get to his genetic potential. Nutritional deficiency is common in pregnant women and is responsible for a considerable portion of maternal deaths and premature births. Nutritional deficiency is also common among children and an associative cause of many deaths. The remainder of the article is a cost-benefit analysis of returns to better nutrition.

LITERATURE REVIEW.

WHO/FAO Protein Advisory Group. Food Agr. Organ. U.N. Statement No. 3, 1969.

. Malnutrition is an underlying or an associated cause of 52 percent of all deaths of 1 to 4-year-olds in Latin America.

. Immaturity, often nutritionally related, caused 47 to 74 percent of deaths in the 1st month of life in Latin America.

. Malnutrition is an associated cause in 55% of the deaths attributed to infective or parasitic diseases among children under age 5 in Latin America.

Bengoa, J.M. Recent trends on Prevalence on Protein Calorie Malnutrition. Protein Advisory Group. SHO doc. 1.2.1/1. Geneva, September, 1969.

There is an appendix which contains data regarding child mortality and malnutrition in selected countries, including many Latin American countries.

. Malnutrition as an underlying or an associated cause of deaths of children under 5 years.

. Deaths by age group due to five nutrition-related causes of death.

. Malnutrition as the underlying or associated cause of death in children aged 1 to 4 years.

. Number of deaths by age group at existing rate compared with number if rates of India, Taiwan, Japan and Sweden were applied.

. Child mortality by age group, 1970.

Butz, William P.
Puzzles in the Demographic and Economic Behavior of Rural Southeast Asians: An Economist's View
Rand Paper P-4903
December 1972

- Reviews some unexplained reactions of Asians to various aspects of development and suggests some economic hypotheses for testing that might explain them.

- For a review of the evidence of a relationship between income and fertility, see N.H. Loewenthal and A.S. David, Social and Economic Correlates of Family Fertility: An Updated Survey of the Evidence, RTI, 1972.

- "Characteristics of inappropriate but common research methods..." are described in W.P. Butz, Research and Information Strategies to Improve Population Policy in Less Developed Countries, R-952-AID, February 1972.

Carol Burke
10 - 16 - 73

Chopra, J., R. Camacho, J. Kevany and A. Thompson
Maternal Nutrition and Family Planning.
Amer. J. Clinical Nutrition, Vol. 23, No. 8, August 1970, pp. 1043-58.

This is a report summarizing the findings presented at a WHO Expert Committee on Maternal Nutrition and Child Health (1969).

Defective nutrition of pregnant and lactating women results in poor physique and health among mothers and growth retardation and high mortality rates among infants.

RESULTS.

1. The nutritional needs in pregnancy and lactation are greater. (Exact requirements are presented.)

2. The diets in developing countries are likely to be deficient in vitamin A, B vitamins and ascorbic acid.

3. Toxemia and anemia are common clinical abnormalities of pregnancy.

4. Malnourished mothers, especially poor primigravidae, are liable to develop preeclampsia and eclampsia.

5. There is a well-marked socio-economic gradient in maternal stature and perinatal mortality rates are lower in tall mothers.

6. Pregnant women in developing countries tend to gain less than those in developed countries.

7. There is little evidence of successive pregnancies and lactation on maternal weight.

8. The smaller the interpregnancy interval, the higher the incidence of prematurity.

9. Protein-calorie malnutrition is more common in families with closely spaced pregnancy (less than 2 years).

10. Food intakes of pregnant and lactating women in Latin America are low compared to recommended allowances.

11. Latin American countries have low income, low animal protein supplies per capita and high mortality rates.

12. Abortion is a major cause of maternal mortality in Latin America. (Puffer and Griffith)

13. Lactating women tend to weigh less than non-pregnant, non-lactating women. (Arroyave)

14. Poor pregnant women in Latin America tend to gain little weight. (Arroyave)

15. About 13 percent of newborns in Latin American countries have birth-weight less than 2500 g.

16. Growth of breast fed infants in Latin America during first few months is satisfactory, but there is a falling off in growth thereafter. The falloff is more marked among non-breast-fed infants. (Monckeberg)

17. Gastrointestinal infections and infestations are probably causes of impaired growth and secondary malnutrition, especially when associated with unsatisfactory feeding practices. (Mata et. al.)

18. Impairment of physical development of infants is often paralleled by defective neurophysiological development.

19. Facial lesions are common to pregnant lactating women in Latin America. The incidence of thyroid enlargement also appears to increase during pregnancy. And goiter due to iodine deficiency exists in certain mountainous regions. (ICNND)

20. Blood levels of most substances of nutritional importance are relatively low during pregnancy. (INCAP)

21. The incidence of anemia (iron deficiency anemia) in pregnant women is twice that in non-pregnant women. (PAHO)

22. Poor pregnant women have low urinary excretion and reduced levels of red blood cell riboflavin in Guatemala. Furthermore, a pattern of plasma free amino acids suggestive of inadequate protein intake was found. Newborn children from these mothers also showed this alteration. (Beteta)

Carol Burke
11-7-73

A.S. David (Ed.)
Infant and Child Mortality and
Fertility Behavior Conference
Research Triangle Institute
October, 1970
AID Contract NESA/460

It is cost-effective to allocate family planning resources to health and nutrition programs.

Short effects: economy of combining two programs.

Longrun effects: a consequence of reducing infant and child mortality by improving nutrition and/or general health of mothers and infants, is a decline in fertility. The probable causal relationship is not known. ?

CONCLUSIONS

1. The use of nutrition supplements will affect population size and subsequent growth rates through
   1. completed family size, as infant and child mortality declines,
   2. fecundity, and
   3. acceptance of family planning services

2. Infant mortality and desired family size relationship

. Rational behavior is assumed, but myopia may prevail.

. Fertility may decline without decline in mortality; similarly, mortality may decline without a decline e.g. Taiwan (1906-1956) continually declining mortality from an expected life of 23 years to 45 years, with no declines in fertility.

. The impact of improved nutrition, more abundant economic opportunities and lower mortality, may be an increase in fertility, rather than the reverse: e.g. areas of India and Pakistan where the impact of increased food is relaxation and increased fertility.

. The exposure to risk of infant death is greater, the larger the family. So, finding that women with deaths of children have higher fertility is not evidence that they have increased fertility because of those deaths.

. Cross-sectional as well as longitudinal analysis indicates a relationship between declines in infant mortality and subsequent reduction in fertility. However, most studies have not looked at variables that might explain these declines.

. It is not possible to predict the overall effect of a decline in infant mortality on population growth since other independent variables that affect fertility may also change.

. Also other variables that affect fertility may also vary among different segments of the population.

. Birth rate, number of births, etc., may decline without a decline in desired family size. So, in order for a decline of mortality to decrease population growth, it must affect the variable completed fertility.

Carol Burke

10 - 11 - 73

Erhardt, C.L., H. Abramson, J. Parker and F. Nelson
An Epidemological Approach to Infant Mortality.
Arch. Environ. Health, V. 20, June 1970.

To examine the socio-influences on infant mortality, as well as the influences of duration of gestation, weight at birth, age of mother, parity, interval between pregnancies and certain abnormal birth conditions.

DATA BASE AND DESIGN.

Examination of 7,308 infant deaths recorded among 299,316 live births in New York City during 1966 and 1967 via a confidential medical report which accompanies forms for birth and fetal death.

RESULTS.

Most of the findings of this study are not relevant to our study. So I will merely list the subject area to which these findings pertain.

- Distribution of infant mortality rates by birth weight and ethnic group
- Distribution of infant mortality rates by duration of gestation and ethnic group
- Distribution of infant mortality rates by extent of prenatal care and ethnic group
- Distribution of infant mortality rates by district, i.e. class of median income
- Distribution of infant mortality rates by place of delivery (type of hospital)
- Distribution of infant mortality rates by age of mother, parity and ethnic group
- Distribution of infant mortality rates by type of pregnancy complication and ethnic group
- Distribution of infant mortality rates by mode of delivery and type of service(private or general)
- Distribution of infant mortality rates by causes of death, age and ethnic group
- Distribution by legitimacy, age and ethnic group

Feldstein, Martin, S., "A Binary Variable Multiple Regression Method of Analysing Factors Affecting Peri-natal Mortality and Other Outcomes of Pregnancy," Journal of the Royal Statistical Society, Series A (General), vol. 129, Part 1, 1966, pp. 61-73.

• Regressions are estimated in which each of the variables is binary. Data: a survey of all births for one week, all stillbirths and neonatal deaths for 3 months.

• The error terms for equations with dichotomous dependent variables are heteroscedastic (see Smith re Goldberger); OLS is inefficient, <u>but unbiased</u>, in the face of heteroscedasticity.

• When all variables are dichotomous, the elements of the moments matrix are simply counts of the observations in the relevant sub-class(es) and the matrix can be put together from the information in Q(Q-1)/2 two-way tables, where Q is the number of factors (each of which will have some number of sub-classes).

. "Adjusted percentage deviations" are defined as $d_i/\bar{y}$ where $\bar{y}$ is the mean of the dependent variable and $d_i = \alpha_i - \frac{1}{N}\sum_1^n \alpha_j n_j$. N is the sample size, α_i and α_j are the coefficients for the dummy variables of a particular attribute, say age, and the n_j are the numbers of observations that fall in class j of that attribute.

• Derives formulae for the approximate standard errors of the adjusted percentage deviations. Basically, since each d_i is a linear combination of regression coefficients, its standard error is a linear combination (using the same weights) of the variances and covariances of those regression coefficients, $w'Vw$. The standard error of $d_i/\bar{y}$ is closely related.

• The rest of the article presents illustrative calculations from regressions using age, parity, and social class as their independent variables. Finds that relative disadvantage of women under 20 turns into a (statistically insignificant) advantage when social class and parity are held constant.

• Discusses "standardized rates" versus regression techniques. Indicates that standardized rates require many more cells, thereby running a greater risk that the estimates used will not be statistically reliable. Regressions can incorporate more factors.

Goodhart, Robert
Criteria of an Adequate Diet
(Eds.) Wohl, M. and R. Goodhart
Modern Nutrition in Health and Disease, Lea & Febiger (Philadelphia) 1964

. The animal body requires calories, certain fatty acids, amino acids, vitamins, minerals and water in varying amounts and combinations for growth and maintenance and repair of tissue.

. Diet patterns and food values vary among individuals and geographic areas. Also requirements for specific nutrients very depending upon genetic and environmental factors, diet patterns, age, sex, rate of growth, severity and nature of stress situation, etc.

. Dietary requirements have been recommended by many and they all differ. The ones presented in this article are Dietary Standards for Canada, National Research Council (U.S.A.), Interdepartmental Committee on Nutrition for National Defense (U.S.A.), Food and Drug Administration (U.S.A.) and Standard Nutritional Requirements for Japan. The differences are a function of age, extent of physical activity, source of nutrients, etc.

. Adjustments in calories are necessary for pregnancy, lactation, growth, physical activity and metabolic berrations.

. Protein requirement is increased during pregnancy and lactation, during recovery from disease and injury and during periods of rapid growth. The requirement is actually for amino acids, rather than protein as such. So the biological value of animal proteins, as compared to vegetable proteins, is higher; since vegetable proteins are incomplete in amino acid composition for animal tissue synthesis.

. Vitamin requirements are different for people suffering from disease, metabolic disorder and injury.

. The phosphorous allowance should be at least equal to the calcium allowance in diets of children and women during the latter part of pregnancy and during lactation. For other adults the phosphorous allowance should be about one and a half those for calcium.

. During pregnancy, active growth, active sexual period of the female and blood loss, iron requirements increase.

. During adolescence and pregnancy it is important to intake iodine.

Carol Burke
11-15-73

Gopalan C. and A. Nadamuni Naidu
Nutrition and Fertility
The Lancet, November 18, 1972, pp. 1077-1079

Malnutrition limits fertility.

Methodology.

Comparison of the sex ratio of populations at different age periods.

Results.

1. Effects of Malnutrition on Fertility.
   a. Sex Ratio of Populations

- In almost all affluent countries the F/M ratio is above 1000, while in developing countries the ratio is uniformly below 1000.

- There appears to be a decline in the sex ratio in age range 1-12 years in India which is attributed to higher mortality among girls than boys; and malnutrition is considered the main cause of this preschool mortality.

- The decline in the sex ratio in the reproductive period in India is attributed maternal mortality, again arising mainly from malnutrition.

Age of Menarche

- A survey of the Indian population showed that the mean age of menarche is higher in rural than in urban populations.

- Another Indian survey indicated that the age of menarche was higher in lower socio-economic classes.

- The above findings were considered evidence of higher age at menarche among malnourished groups.

- The delay in the onset of menarche is likely to marginally reduce fertility.

c. Pregnancy Wastage

A follow up of a survey of Indian women in malnourished Indian communities suggested that 30% of pregnancies ended in miscarriages and abortions.

d. Maternal Mortality

In India more than 20% of maternal deaths are caused by anemia. (Menon, 1967)

e. Stillbirths

The stillbirth rate is 11 per 1000 live births and prematurity attributed to maternal malnutrition is considered the major cause.

f. Lactation

- Practically all mothers in malnourished countries breast-feed their children (Someswar et. al., WHO report, 1959) and lactation is associated with infertility.

  Also, the mean interval between pregnancies in poor-income groups in India is about 32 months.

2. Effects of Uncontrolled Fertility.

a. On Nutrition

61% of cases of protein-calorie malnutrition were of birth order 4 and above.

b. On Maternal Health

Mean interval between pregnancies in India is about 32 months and much of that time women and nursing; and diets are not adequate to meet additional requirements of pregnancy and lactation.

A survey of pregnant women showed that 56% had low hemoglobin values and that the incidence of anemia and signs of nutritional deficiency were higher in women of later parities. (Visweswara, 1971

PLR

C.S. Burke
10-29-73

Hammoud
~~[illegible]~~, Esmat.
Studies in Fetal and Infant Mortality
Methodological Approach to the Definition of
Perinatal Mortality.
Amer. J. Public Health, V. 55, no. 7, pp. 1012-1023. (1965)

Mortality at ages where biological factors are more important than environmental factors, neonatal period (under 28 days), will be characterized by greater sex differences and less racial differences, smaller variability, weaker correlation with level of living, and less reduction with improvement of environment by time.

And the neonatal period where neonatal mortality is meant to be a measure of mortality due to prenatal and natal factors, or biological factors, is not homogeneous. Mortality beyond the first week of life behaves in a way similar to mortality during the postneonatal period, while fetal and early neonatal mortality behave in another common way. (So the term "perinatal mortality" should be used to refer to infant deaths during the first week of life and to fetal deaths.)

DATA BASE AND DESIGN.

U.S. Vital Statistics and Census Data for the 20 largest states (population greater than 3 million) are used to calculate six indexes -- average annual mortality rates per 1000 living for under one day, 1-6 days, 7-13 days, 14-27 days and 1-11 months and number of fetal deaths per 1,000 live births; and cumulative rates by age are computed from these six indexes, alone and in combination with fetal deaths. Also, five indicators of level of living derived from 1960 Census data are used -- 1959 median income of families, median school years completed by persons 25 years old or over, percent of housing units described as "sound, with all plumbing facilities," percent housing units with 1.01 or more persons per room (crowded), and number of persons in the occupation group "medical and other health workers" per 100,000 population. Rank correlation coefficient is used; ranks are assigned so that a negative correlation implies that, as level of living improves, the mortality index diminishes.

For long-term study, U.S. average annual rates for 1957-1959 and 1949-1951 are taken as percents of average rates for 1941-1943. The difference between these percents and 100 percent represent the achieved reduction in mortality.

RESULTS.

1. Sex and Race Differentials

. Mortality is higher among males than females during the first year of life and the differences between male and female rates are greater in the neonatal period than in the postneonatal period.

. Nonwhites have higher fetal and infant mortality than whites and the differences in rates are greater in the postneonatal than in the neonatal period.

. The first month of life is not a homogeneous interval. There are larger racial differences and fewer sex differences beyond 1st week.

2. Variability in the mortality indexes.

or: the standard deviation

. The coefficient of variation (arithmetic mean of the ratios for the 20 largest states) is smaller for the neonatal mortality rate than for the postneonatal mortality rate (9.5% and 27.9%).

. Within the first month of life, mortality during the first day of life has the smallest variability (6.1%); and variability increases with age until beyond first week and then remains at the same high level thereafter (24.0 - 27.9%).

average, incl 6.1

. The coefficient of variation for the fetal death ratio (16.9%) is close to that for infant mortality during 1st week.

3. Correlations between mortality indexes and level of living indicators.

Correlation coefficients between the fetal and infant mortality and indicators of level of living show that -

. There is a negative correlation that is highly significant (p less than 0.01) in most cases, including fetal deaths.

i.e., all indicators of level of living

. Correlation is stronger with the post-neonatal mortality rates than the neonatal mortality rates.

. Correlation is not significant with the index of mortality during the first day of life.

. The negative correlation gradually becomes stronger beyond the first day of life.

4. Trends in Fetal and Infant Mortality.

. Comparison of average annual U.S. mortality rates for periods 1941-1943, 1949-1951, and 1957-1959 show the greatest reduction occurred in the rates of mortality beyond the first week of life (two or three times as much as reduction in mortality ~~in earlier years~~).

in first week

Heer, D.M., and Hsin-ying Wu
"The Separate Effects of Individual Child Loss and Community Mortality Level Upon Subsequent Fertility in Taiwan"
Paper presented at the meetings of the International Union for the Scientific Study of Population, Liege, Belgium
August, 1973

- Based on samples taken from 2 Taiwanese villages -- one with high child mortality, the other with low child mortality -- the authors present a multiple classification analysis showing that the high mortality village had more births, when other variables were controlled for, and that, within the same village, parents who perceived a higher mortality had more births (for 2nd and 3rd parity women separately).

- Some evidence that there are more subsequent births if the existing children are female.

- Town mortality level appeared to affect subsequent births more strongly than perceived mortality, contrary to expectation. A retest showed that the correlation between responses to the perception questions was relatively low and thus that the variable may have been poorly measured.

DRAFT/CB
October 24, 1973

Hillman, Robert and Edward Hall

Nutrition in Pregnancy.
(Ed.) Wohl, Michael and Robert Goodhart
Modern Nutrition in Health and Disease, Philadelphia,
Philadelphia, Lea and Febiger, 1964, pp. 1105-1122.

Specific parameters that are influenced by maternal nutrition include: toxemia and other maternal complications; length of labor; newborn weight (notably liver weight), length and chest circumference; incidence of prematurity, stillbirth, abortion and sterility; and intelligence and reading ability of the offspring.

BODY WEIGHT.

. There is a positive relationship between maternal weight and fetal size, with large infants associated with parental adiposity (obesity). (Thompson and Billewicz, and others).

. Babies with birth weight ~~to~~ more than 2 lbs. above average fared as poorly as infants with the same degree of underweight at birth. (Baumgartner et al.)

. Women with better nutriture responded more favorably to treatment for recurrent abortion. (Forguin and Benum)

. There is an abnormal work response (?) in women with poor reproductive histories. (Seitchik)

. Serum protein concentrations appear meaningful to perinatal morbidity and perinatal morbidity seems to be reduced by administration of vitamin and mineral supplement. (Tompkins et.al.) However, a Vanderbilt experience indicated no advantages to dietary intakes in excess of recommended allowances or to a vitamin supplementation--results probably attributed to good overall nutrition status of patients on entering pregnancy.

PREMATURITY.

. Prematurity appears to occur most frequently among infants of undernourished women. (Baumgartner; Clements; Kaltreider; McGanity et.al.; etc.)

. Gravida (pregnant women) who are underweight at time of conception as well as those who fail to gain adequately during first and second trimesters seem especially disposed to have newborn in relatively lighter weight range that is associated with a tendency to premature separation of the placenta and an overall increase in morbidity and mortality.

. Infant birth weight is correlated more closely with weight and probably with maternal height at conception than with maternal weight during a pregnancy.

. Satisfactory nutriture at the outset of pregnancy does not protect against the adverse effects of an unsatisfactory gain throughout pregnancy.

. Big babies are not always the best babies. Example, the excessive size of infants born to diabetic women is due to thiamin deficiency in the infant (Beri Beri Infant).

TOXEMIA. (An ill-defined term referring to metabolic disorders of pregnancy characterized by hypertenion, (high arterial blood pressure) edema (an accumulation of an excessive amount of fluid in cells, tissue or serious cavities) and albuminuria (presence of protein in urine).

. Maternal nutriture influences the occurrence of toxemia. (Thompson; Steitchik; Smith; etc.) But the precise nature of this relationship is undetermined.

. Toxemia occurs most commonly among patients who are overweight at conception as well as those who gain weight excessively during second and third trimesters. A smaller though often more serious increment in toxemia is noted among women who are markedly underweight at conception and who fail to gain adequately during the antenatal period.

. Inclusive evidence has implicated the intake of protein, salt and single vitamin components in the causation of toxemia. The decrease in toxemia in parts of Europe since World War II has been attributed to a reduction in calories, fat and protein, as well as an increase in relatively underfined carbohydrate products (Dalderup). The concensus in United States is that a high rather than low protein intake protects against the development of toxemia. (Leathem; Beaton and Arroyane; Glowskietal; Werch et.al.; Smith et.al.)

. Norwithstanding increased vitamin B6 requirements during pregnancy, especially in toxemia patients, dietary supplementation with pyridoxine (Vitamin B6 which includes pyridoxal and pyridoxamine) does not appear to influence the frequency or course of toxemia. (Hillman et.al.)

. Excessive pregnancy weight gain and toxemia should be dissociated (Fish et.at.)

. Toxemia is associated with an excess of exchangeable sodium in the fat free tissue (Plentl and Gray).

. The effects of emotional stress on maternal metabolism are related to the occurence of toxemia (Soichit).

CONGENITAL MALFORMATIONS.

. Deficiency states caused by malnutrition or pharmaceutical agents are associated with congenital malformations. (Warkany; Hale; Millen; Frazer; Hammond) Efforts to identify nutritional deficiencies (no more than 10 percent of congenital malformations are directly attributable to genetic factors per se) have been unsuccessful.

- There is a greater frequency of congenital malformation among offspring of the lower socio-economic group (Coffey and Jessop; Anderson et.al.).

- There is an increased occurence of congenital malformation among children of the undernourished (Edwards).

ANEMIA. (low hemoglobin concentration)

- Some have associated anemia in pregnancy with complications of pregnancy both fetal and maternal (Traylor and Tropin; Giles and Shuttleworth; McClea; etc.) Usual anemias are not unique to pregnancy, but precipitated by and exaggerated during pregnancy.

- Hemodilution (Pseudoanemia) occurs during pregnancy, with hemoconcentration following labor and puerperium (period from termination of labor to indution of the uterus, usually 42 days)(Miller et.al.; Pritchard; Tjan and Okey). However, in most cases a fall in hemoglobin can be prevented or limited by adequate and timely supplies of iron (Lowenstein et.al.; Holly, Miller et. al.; Pritchard; etc.).

- The anemia-inducing potential of an infection, notably those involving the urinary tract, are relevant (Holly, Giles and Brown).

PL12

Carol Burke
10-31-7?

Holt, L. and S. Snyderman
Nutrition in Infancy and Adolescence
(Eds.) Wohl, M. and R. Goodhart,
Modern Nutrition in Health and Disease,
Lea & Febiger (Philadelphia), 1964. pp. 1123-1152.

- Infants need more of all nutrients. Not only do they require nutrients for growth, but in addition, their requirements for maintenance are higher than that of an adult because of their higher metabolic rate and more rapid turnover of nutrients.

- The requirements for a newborn infant are 2 to 3 times as great as those of an adult in terms of body weight.

- The basal heat production (heat production under conditions of rest) of an infant is high due to his relatively greater body surface and his larger proportion of active metabolic tissue.

- Energy required for growth is greatest in the newborn period, decreasing rapidly during first year and more gradually until puberty.

- Other special additions include crying which doubles the metabolic rate and excretion which is greater in infancy. (A placid infant may thrive on as little as 70 calories per kg., compared to 130 calories required for a child who cries often.)

1. Protein requirements

- More protein is required for maintenance of tissues, maturation of tissues and growth of new tissue during infancy. This is because all these functions require additional nitrogen expenditure, unlike general activity.

- The requirements for protein appear to be met by small quantities of breast milk (2.0 - 2.5 grams per kilo) because of its quality, constancy of composition and regularity of administration.

- Cow's milk, formerly regarded as inferior to breast milk, when processed in such a way to avoid curd indigestion, is equivalent (protein is utilized as efficiently).

2. Amino Acid requirements

References for studies of amino acid requirements of infants not under conditions of maximum sparing of essential amino acids, are provided.
(maximum protein)

- Certain amino acids, "patterns of essential amino acids," are required because they can not be synthesized by animals.

- FAO and WHO have concluded that no artificial pattern is superior to that of whole egg or human milk and the pattern of one of these is not superior to the other.

3. Fat requirements

- In feeding normal infants it appears desirable to include a certain amount of fat in the diet, but no particular fat is preferable

4. Carbohydrate requirements.

. Roughly half of an infant's caloric requirements are usually supplied by carbohydrates.

. Infants fed carbohydrate-free diets tend to develop retosis(?).

5. Mineral requirements

. With the exception of iron, the breast fed infant appears to get the required amounts of minerals.

. Deficiencies in minerals do not ordinarily arise from inadequate intake, but rather from pathologic processes in which there is an abnormal loss of electrolytes from the gastrointestinal tract, kidney and skin.

. Oxidized sulfur is not required since it can be manufactured by animals if protein intake is adequate.

. Iron deficiency is the important and common mineral deficiency. It is seen in infants fed exclusively milk (both cow's milk and human milk are deficient.) does anemia predate [illegible]

. Calcium supplementation is usually necessary for a milk free diet.

. The requirements of children for trace minerals -- copper, manganese, line and selenium -- are unknown.

6. Vitamin requirements

. Nicotinic acid can be synthesized from protein. So if protein intake is adequate, it is not required.

. Vitamins B_{12} requires no consideration in an infant's diet.

. Folic acid is not required in an infant's diet, if the diet contains adequate Vitamin C and if antibiotics are not being given.

. Other known B factors and lipoic acids important as catalysts in metabolic reactions, are not established as required.

. In infant feeding ascorbic acid and Vitamin D are important. In sterilizing milk much of the ascorbic acid is destroyed. [illegible] and unfortified cow's milk do not furnish adequate Vitamin D.

. It has been claimed that Vitamin E deficiency exists in many premature infants (György).

. Instances of macrocytil anemia in Kwashiorkor patients have responded to administration of Vitamin E.

7. Water Requirements

. Infants are peculiarly susceptible to lack of water. Water loss through kidney and skin is greater in infants than adults. In addition, they are more subject to pathological processes causing water loss, such as vomiting and diarrhea.

. A daily intake of 150 cc. per kg is required in non-tropical conditions. In tropical conditions 175cc. per kilo or more is required.

8. Overnutrition

. The extent to which effective reserves can be stored is questionable. Reserves of flesh in the case of calories, can be accumulated against future situations of caloric deficit. When it comes to specific nutrients it does not follow. Water soluble vitamins (dehydration fever), proteins, carbohydrates (kwashiorkor), fats (ketosis, lipemia and fatty liver) and minerals (toxic episodes), in excess can have adverse effects.

9. The nutrition values of cow's milk, selected modified milk and breast milk are discussed, along with relative mechanical difficulties of digestion and pathogenic organisms.

10. Premature infants

. Their caloric requirements are high despite low activity.
. They absorb fats and fat soluble vitamins poorly.
. They have greater need for Vitamin C.
. Their basal energy requirements are higher.
. Their growth rate is more rapid.
. Caloric loss in the excreta (largely unabsorbed fat) is greater.
. Recommended caloric intake for premature infants is 125 calories per kg. as soon as this can be tolerated.

Carol Burke
12-14-73

Derrick B. Jelliffe
Child Nutrition in Developing Countries
A Handbook for Fieldworkers
Agency for International Development
Washington, D.C., 1969.

I. Nutrient Requirements.

- The requirements for protein, calories and iron are proportionately higher in young children than in adults because of their rapid rate of growth.
- Many bacterial and parasitic infections which are common to young children such as diarrhea and roundworm, increase their nutritional requirements. Diarrhea prevents full absorption and large parasites take up food themselves. Also, fever increases the body's needs for protein, as well as resulting in poor appetite and vomiting.
- Pregnant and lactating women have very high dietary needs for growth of fetus and uterus and for human milk production.
- Table of nutritional requirements by age is attached.

II. Food Preparation

- Methods of food preparation affect the nutritional content, as well as the digestibility of foods. For example, over-soaking and cooking too long in water can result in loss of water soluble vitamins. Also, over-cooking can destroy nutrients such as vitamin C or certain amino acids.

III. Tropical Foods

Tropical diets are usually based on one or more staples, and therefore, are composed of bulky carbohydrates principally. Roots, plantains, etc. These foods are largely sources of carbohydrates. They are particularly difficult for children to eat in nutritionally adequate quantities, because they are both low in protein (1-2 percent) and extremely bulky. These include sweet potatoes, yuca, potatoes and vegetable fruits such as carrots, breadfruit and dasheen.

Cereals. Cereal grains are not only sources of carbohydrates, but also contain significant quantities of protein (10 percent). But their protein is low in the essential amino acid, lysine. They are also sources of iron and the Vitamir B complex. Cereals are prepared by de-husking and sometimes by milling. The more severe the milling, the whiter the end product and the greater the loss of nutrient which go with the germ, including thiamine. (Beriberi is thiamine deficiency.)

Rice. Thiamine is contained in some quantities in rice germ. However it can be removed by over-milling, or by oversoaking or over-cooking in too large a volume of water, since thiamine is water soluble. Rice is easily digestible by young children in the form of pastes or gruels from soft boiled rice or from rice flour.

Corn. Corn has the disadvantage of not only being low in the amino acid, lysine, but also B vitamin, niacin and troptophan (an amino acid from which the body is capable of synthesizing niacin). Pellagra (niacin deficiency) occurs in areas where corn is the major food. Corn can be eaten on the cob after boiling or barbecuing, or can be milled into cornflour. The preparation of white flour includes overmilling and repeated washing with water which removes protein.

Wheat. Wheat is usually used as a flour which requires milling. (Wheat bread is considered a prestige convenience food in tropical urban areas.)

Barley, tapioca, oats and quinoa, which are cereals common to Latin America are not specifically mentioned in this article.

Legumes, Nuts and Oilseeds. This group is called pulses by PAHO. It is a good source of calories and the principle plant source of protein.

Legumes. Legumes as a group contain about 20 percent protein, except for soybeans which contain up to 40 percent. However, the protein in legumes is deficient in the essental amino acid, methionine. Legumes are also sources of B complex and iron. Their vitamin content can be increased by allowing them to germinate and sprout before cooking. The use of legumes, except for chick peas, for infant feeding is limited by their relative indigestibility. The infant

feeding requires removal of skins, soaking, boiling and staining. Most legumes are usually boiled whole, although various flours may be prepared from them which can be cooked with water to produce soup, gruel or dry pancakes. They include beans, peas, lentils, groundnuts, etc. Soybeans and groundnuts (peanuts) contain more nutrients than other legumes. Groundnuts have, like other legumes, a high protein content and they contain 40% fat. They are also a source of the B vitamin complex. Groundnuts can be eaten raw or roasted, powdered or minced into butter-like preparations which an infant can digest. Also groundnut butter can be digested by small children. Soybeans also have a high protien content and contain up to 20 percent fat. Also soybeans can be powdered and added to other foods eaten by small children.

Vegetables. They are usually high in water and low in both protein and carbohydrates. However, they contain carotene, vitamin C and minerals. They include certain roots, stalks, fruits, flowers and leaves. In tropical regions dark green leafy vegetables are valuable. They contain important quantities of carotene, vitamin C and the B complex, calcium and iron, in addition to significant protein content. But often they are regarded as low prestige food of the poor. Various beans and peas, okra, cocoyams, hibiscus, pumpkins and baobab are common tropical ones. Vegetables such as lettuce and cabbage which has more status, are nutritionally inferior. Dark leafy vegetables may be pounded and mixed with other foods intended for young children.

Fruits. They are important sources of vitamin C and in some cases carotene. They have the advantages of not requiring cooking, and of being easily digested by young children.

Animal Proteins. They contain all the eight amino acids in abundance. They supplement the vegetable protein of vegetables, legumes and cereals.

Meat: It is a source not only of protein, but B vitamins and iron. It needs to be chopped, shredded or grated before cooking to be palatable for infants. In addition to problems posed by preparation, it is scarce in tropical countries, and most of it goes to male adults as prestige food.

Milk: All milk contains protein, milk suger, fat, calcium and vitamins, both the fat- and water-soluble kind. All milk is poor in iron.

1. Human Breastmilk. This is a source of clean, digestible, high quality baby food. It's protein composition is superior to other foods. However, while its protein content is relatively unaffected by inadequate maternal nutrition, its content of water soluble vitamins can become deficient if the mother's diet is low in these nutrients. Also, if mother's diet is deficient, the output of breast milk may be diminished, especially in late lactation.

2. Animal Milks. It contains 2 to 3 times as much protein as human milk, the same quantity of fat and half as much milk sugar. The protein of cow's milk is relatively indigestiable. However, it can be modified by diluting it with water to decrease its relative protein content, by boiling it to make it more digestible and by adding sugar to increase its caloric content. Cow's milk is scarce in Latin America. Also, because of the addition of unclean water, its use can result in infective diarrhea. Young infants need about 2 1/2 oz. per lb. body weight per day of modified cow's milk.

Eggs. They are a rich source of protein with a full and well-balanced range of essential amino acids. But also the yolk contains iron, vitamins A and D, the B complex and fat. They are also easily digested.

Fish. They are not only a source of protein, but they contain vitamin B complex, vitamin A and D, calcium and iodine.

Oils and Fats. Fats may be important for children whose diets consist of bulky carbohydrate foods of low caloric density. Fats have high caloric value. Animal fats are present in meat, egg yolk, milk and its products and the flesh of certain fish. Extracted animal fats include butter, lard and some margarines.

Fats derived from milk are sources of vitamin A and D. Vegetable fats contain no vitamin A or D. They include vegetable margerine and oils from groundnuts, sesame, mustard seed, cottonseed, coconut, etc.

Sugar. It contains no nutrients, only calories.

III. There is also a presentation of the sources and functions of various nutrients which is not presented here. Most of the source information is presented here.

APPENDIX I

FOOD AND NUTRITION BOARD, NATIONAL ACADEMY OF SCIENCES

National Research Council Recommended Daily Dietary Allowances,[a] Revised 1968

Designed for the Maintenance of Good Nutritition of Practically All Healthy People in the U.S.A.

	Age[b] (years)	Weight		Height				Fat-Soluble Vitamins			Water-Soluble Vitamins							Minerals				
	From Up to	(kg)	(lbs)	cm	(in.)	kcal	Protein (gm)	Vitamin A Activity (IU)	Vitamin D (IU)	Vitamin E Activity (IU)	Ascorbic Acid (mg)	Folacin[c] (mg)	Niacin (mg equiv)[d]	Riboflavin (mg)	Thiamin (mg)	Vitamin B_6 (mg)	Vitamin B_{12} (μg)	Calcium (g)	Phosphorus (g)	Iodine (μg)	Iron (mg)	Magnesium (mg)
Infants	0-½	4	9	55	22	kg×120	kg×2.2[e]	1,500	400	5	35	0.05	5	0.4	0.2	0.2	1.0	0.4	0.2	25	6	40
	½-½	7	15	63	25	kg×110	kg×2.0[e]	1,500	400	5	35	0.05	7	0.5	0.4	0.3	1.5	0.5	0.4	40	10	60
	½-1	9	20	72	28	kg×100	kg×1.8[e]	1,500	400	5	35	0.1	8	0.6	0.5	0.4	2.0	0.6	0.5	45	15	70
Children	1-2	12	26	81	32	1,100	25	2,000	400	10	40	0.1	8	0.6	0.6	0.5	2.0	0.7	0.7	55	15	100
	2-3	14	31	91	36	1,250	25	2,000	400	10	40	0.2	8	0.7	0.6	0.6	2.5	0.8	0.8	60	15	150
	3-4	16	35	100	39	1,400	30	2,500	400	10	40	0.2	9	0.8	0.7	0.7	3	0.8	0.8	70	10	200
	4-6	19	42	110	43	1,600	30	2,500	400	10	40	0.2	11	0.9	0.8	0.9	4	0.8	0.8	80	10	200
	6-8	23	51	121	48	2,000	35	3,500	400	15	40	0.2	13	1.1	1.0	1.0	4	0.9	0.9	100	10	250
	8-10	28	62	131	52	2,200	40	3,500	400	15	40	0.3	15	1.2	1.1	1.2	5	1.0	1.0	110	10	250
Males	10-12	35	77	140	55	2,500	45	4,500	400	20	40	0.4	17	1.3	1.3	1.4	5	1.2	1.2	125	10	300
	12-14	43	95	151	59	2,700	50	5,000	400	20	45	0.4	18	1.4	1.4	1.6	5	1.4	1.4	135	18	350
	14-18	59	130	170	67	3,000	60	5,000	400	25	55	0.4	20	1.5	1.5	1.8	5	1.4	1.4	150	18	400
	18-22	67	147	175	69	2,800	60	5,000	400	30	60	0.4	18	1.6	1.4	2.0	5	0.8	0.8	140	10	400
	22-35	70	154	175	69	2,800	65	5,000	-------	30	60	0.4	18	1.7	1.4	2.0	5	0.8	0.8	140	10	350
	35-55	70	154	173	68	2,600	65	5,000	-------	30	60	0.4	17	1.7	1.3	2.0	5	0.8	0.8	125	10	350
	55-75+	70	154	171	67	2,400	65	5,000	-------	30	60	0.4	14	1.7	1.2	2.0	6	0.8	0.8	110	10	350
Females	10-12	35	77	142	56	2,250	50	4,500	400	20	40	0.4	16	1.3	1.1	1.4	5	1.2	1.2	110	18	300
	12-14	44	97	154	61	2,300	50	5,000	400	20	45	0.4	15	1.4	1.2	1.6	5	1.3	1.3	115	18	350
	14-16	52	114	157	62	2,400	55	5,000	400	25	50	0.4	16	1.4	1.2	1.8	5	1.3	1.3	120	18	350
	16-18	54	119	160	63	2,300	55	5,000	400	25	50	0.4	15	1.5	1.2	2.0	5	1.3	1.3	115	18	350
	18-22	58	128	163	64	2,000	55	5,000	400	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	100	18	350
	22-35	58	128	163	64	2,000	55	5,000	-------	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	100	18	300
	35-55	58	128	160	63	1,850	55	5,000	-------	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	90	18	300
	55-75+	58	128	157	62	1,700	55	5,000	-------	25	55	0.4	13	1.5	1.0	2.0	6	0.8	0.8	80	10	300
Pregnancy						+200	65	6,000	400	30	60	0.8	15	1.8	+0.1	2.5	8	+0.4	+0.4	125	18	450
Lactation						+1,000	75	8,000	400	30	60	0.5	20	2.0	+0.5	2.5	6	+0.5	+0.5	150	18	450

[a] The allowance levels are intended to cover individual variations among most normal persons as they live in the United States under usual environmental stresses. The recommended allowances can be attained with a variety of common foods, providing other nutrients for which human requirements have been less well defined. See text for more-detailed discussion of allowances and of nutrients not tabulated.

[b] Entries on lines for age range 22-35 years represent the reference man and woman at age 22. All other entries represent allowances for the midpoint of the specified age range.

[c] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay. Pure forms of folacin may be effective in doses less than ¼ of the RDA.

[d] Niacin equivalents include dietary sources of the vitamin itself plus 1 mg equivalent for each 60 mg of dietary tryptophan.

[e] Assumes protein equivalent to human milk. For proteins not 100 percent utilized factor should be increased proportionately.

APPENDIX III

Weight for Age Table (Birth to 60 Months, Sexes Combined)[1]

Age (months)	*Standard*		*80 percent*		*60 per cent*	
	lb-oz	*kilos*	*lb-oz*	*kilos*	*lb-oz*	*kilos*
0	7–8	3.4	5–14	2.7	4–6	2.0
3	12–8	5.7	9–14	4.5	7–8	3.4
6	16–5	7.4	13–0	5.9	9–14	4.5
9	19–9	8.9	15–9	7.1	11–11	5.3
12	21–12	9.9	17–6	7.9	13–3	6.0
15	23–5	10.6	18–11	8.5	14–1	6.4
18	24–14	11.3	19–13	9.0	14–15	6.8
24	27–5	12.4	21–12	9.9	16–8	7.5
30	29–11	13.5	23–12	10.8	17–13	8.1
36	31–14	14.5	25–8	11.6	19–2	8.7
42	34–2	15.5	27–5	12.4	20–8	9.3
48	36–5	16.5	29–0	13.2	21–12	9.9
54	38–4	17.4	30–13	14.0	23–2	10.5
60	40–8	18.4	32–5	14.7	24–3	11.0

[1] From Harvard Standards—Stuart and Stevenson (1959).

Carol Burke
10 - 11 - 73

Jelliffe, D.B. and E.F. Jelliffe
Adaptive MCH Service.
Clinical Pediatrics, 10:10, October 1971, pp. 552-554.

This is an article pushing maternal and child health centers as an important part of the solution to the problem of malnutrition in the entire population. None of it pertains to the determinants of infant mortality.

Carol Burke
10-6-73

Mason, Karen, Abraham David, Eva Gerstel,
Quentin Lindsey and Michael Rulison
Soual and Economic Correlates of Family
Fertility: A Survey of Evidence
Research Trinage Institute North Carolina (1971)
AID Contract NESA/460

To identify the factors affecting family size decisions and their interrelationships; and to evaluate current state of knowledge about each relationship

ASSUMPTIONS

Fertility decisions are governed by consideration of cost and benefit, both economic and social.

Fertility is a function of potential net utility of children and ability to control fertility behavior.

HYPOTHESES

The utility of children is a function of family wealth or income, education of family members, family social status, functional inclusiveness of family, status of women in family, religion and religiosity of family and family access to family planning programs.

DATA BASE AND METHODOLOGY

A literature search on the determinants of fertility: the independent variables were reported by nature of relationship -- direct, inverse, no or indeterminant; and strength of relationship -- high, medium or low. Also, a judgment regarding adequacy of research for each independent variable is listed.

RESULTS

1. The nature of the relationship of some variables to fertility or contraception varies according to the level of development of the country.

2. Stratification Variables

- There is a positive relationship of per capita income to crude birth rate for developed countries, a fluctuating and nonsignificant relationship for intermediate countries and a negative relationship for underdeveloped countries.
- It seems probable that developed nations have a higher average age at marriage than undeveloped countries.
- The greater the extent to which families utilize children for labor, the higher the fertility. Farm occupation/urban residence used as the proxies for the extent of utilization of children for labor in most studies, were found to be related to fertility.
- The higher the social status of the family, the greater the cost of rearing children, hence the lower the fertility. This relationship between occupation or social status is true for developing countries but not for the United States.

Variables which measure income status are highly correlated with economic status, so findings are questionable.

. The greater the inter- or intra-generational upward mobility of a couple, the lower their fertility. Only four of thirteen studies substantiated this hypothesis. The influence of social mobility was obscured by other variables such as age of marriage and urbanization.

. The greater the geographic movement of the married couple, the lower their fertility. Most studies did not distinguish the age when migration occurred; some which did found no relationship to fertility. Several studies found the inverse relationship; they include the farm to nonfarm movement which is clouded by an occupational shift as well as a geographic shift.

. The higher the education level of the husband or wife, the lower the fertility. There was overwhelming evidence for this hypothesis, 24 out of 32 studies. Also, education is related to length of time between marriage and first birth, but not subsequent intervals.

. The greater the education of husband and wife, the greater the use of contraception or other effective means of controlling fertility. Most studies confirm this.

. Educational attainment will be negatively associated with fertility only when the curricular content of the education is largely western or "modern", rather than traditional. The two studies which investigate this hypothesis, confirm it.

2. Family Division of Labor Variables

. The more functions performed by the family, the higher its fertility <u>or</u> extended or jointly organized families will encourage higher fertility than simple, conjugal or nuclear families. Studies of family types and fertility reported both no relationship and inverse relationship.

. Families which act as units of economic production will have higher fertility than other families dependent on wage-earning of adult family members. No studies are addressed to family function as such.

. Families which depend on adult children for economic and social support of the aged will have higher fertility. Studies whose methodology is questionable, indicate this is true.

. The more institutionalized and permanent the sexual union, the higher the fertility. Most studies found the expected correlation, but there are some, not all, Latin American studies which are exceptions.

3. Sex Division of Labor

. The greater the participation of women in economically-remunerative activities, especially in the labor force, the lower the fertility. This inverse relationship is found in numerous studies and is one of the strongest

correlations; however, several studies in less-developed countries do not find it. Also, labor force might affect child spacing, not total fertility.

- The higher the wage-rate a woman worker can command, the lower her fertility. This has not been well-studied, especially outside the United States; a few studies have confirmed it.

- The more egalitarian, companionate and communicative the husband-wife relationship, the lower the fertility and the higher the contraceptive use and efficacy. The findings are mixed.

4. Religion Variables

- The greater the religiosity of a couple, the higher the fertility. Most studies in the U.S. found this relationship, but studies for developing countries are rare.

5. Family Planning Variables

- The greater the availability of family planning services, the more couples will utilize contraception, and the lower the fertility. Most studies did not provide a control group; one which did more or less supported this hypothesis.

Carol Burke
9-28-73

Mata, L., J. Urrutia, C. Albertazzi, O. Pelleler and E. Arellano.
Influence of Recurrent Infections on Nutrition and Growth of Children in Guatemala.
Amer.J. of Clinical Nutrition 25: November 1972, pp. 1267-75.

To illustrate the influences of infection on nutritional status and growth retardation.

LITERATURE REVIEW.

1. Infection is one of the most important negative factors affecting nutritional status and growth.
   Scrimshaw, N.S., C.E. Taylor and J.E. Gordon, "Interaction of Nutrition and Infection", World Health Organization Monograph Series No. 57, 1968, p.329.

2. (Other INCAP studies indicate (a) malnutrition in the mother during pregnancy is an important cause of fetal growth retardation and (b) adequate dietary supplementation during pregnancy results in greater ? birth weight. Mata et. al. believe intra-uterine infection is more releva

DESIGN AND DATA BASE.

The design and certain preliminary findings are not described in this article.
This article presents observations re: growth retardation at certain stages of development from a long-term field study (1964-1970) of a Guatemalan Highland poor rural village with minimum environmental intervention. The observations include weight, height and circumference of head and thorax at birth, weekly for one month, fortnightly for one year, monthly for another year and every three months thereafter.

RESULTS.

1. There is marked growth retardation at birth, throughout infancy and in preschool years.

Data on birth weight and fetal growth for 232 live newborns in the community for a 6-year period are presented below.

Birth Weight --

- Birth weight for 91 percent of all live births was 2,540 $\pm$ 409g (mean $\pm$ SD)
- 41 percent of all live births were underweight (less than 2,500 g)
- 11 percent of all live births were premature (gestation of less than 37 weeks)
- 29 percent were born at term but were considered to show fetal growth retardation

12 percent had birth weights similar to those babies from the higher socio-economic group in Guatemala and from industrialized societies

Mother's weight (53.08 ± 5.90 kg; mean ± SD) or height (143.08 ± 4.43 cm; mean ± SD) (which are quite similar for all mothers of cohort babies) and birth weight were significantly correlated ($r = 0.25$ and $r = 0.28$).

Growth Retardation --

- Growth during first 3 months was adequate. Departure from expected growth pattern was observed at 3 to 4 months and all children age one year showed growth retardation that extended throughout the preschool and school age

2. This marked growth retardation, as well as poor nutritional status, may begin in the utero area when maternal nutrition and hygiene are poor. There is evidence of frequent intra-uterine infection.

   - Approximately one-half of 123 consecutive newborns were born with high levels of cord IgM (immunoglobin M)
   - 37 percent of 88 newborns without detectable cord IgA, show high IgM levels(?)

3. Infection with enteric (intestinal) viruses during the first 3 months affects post natal growth.

A cohort of 45 was divided into three groups of 15 infants each according to frequency of enteric viral infection detected during the first 3 and 6 months. The growth curve for weight and length for each child was fitted using the model: $Y = a + b_1t + b_2int$. All fittings resulted in r^2's greater than 95 percent. The weight and length at 3 month intervals during the first year were predicted for each child from individually fitted curves using the model: $y = a + b_1t + b_2int$.

- The group with a greater viral infection rate during first three months showed a significantly lower weight at all ages than other two groups. And the differences at each age were of similar magnitude. However, this was not true for length.
- When viral infection occuring during the first 6 months is considered, again the group with a greater viral infection rate had a predicted weight lower than the other groups and the differences were of a similar magnitude. The predicted heights were significantly lower this time for this group.
- The weight and height achieved at 6 months when weight and height at 3 months is adjusted by analysis of covariance for birth weight and height, were not different for the three groups.
- The differences also disappeared when weight and height at 9 and 12 months were adjusted for values observed in the preceding trimester.

The differences at 3 months, however, persisted after an adjustment for birth weight.

Therefore, growth retardation is not a function of birth weight, but of viral infection during the first 3 months.

4. There was an interrelationship between frequency of infectious diseases (dysentery and broncho-pneumonia) and retarded growth in a cohort of 42 children, separated into quartiles according to growth rates estimated by regression lines (details not presented in this article).

5. Whooping cough has a greater impact on nutritional status and growth than some other infectious diseases. This appears to be related to the fact that whooping cough is characterized by a long period of reduced dietary intake. Of 44 cases of whooping cough observed, 16 percent required 17 to 24 weeks to recover from initial weight loss and 25 percent required more than 25 weeks.

6. Babies with low birth weight have a significantly lower capacity for survival from infectious diseases. The following table presents observations re: infant deaths in relation to birth weight from the sample of 323 live newborns observed. 7 out of 13 neonatal deaths were due to pneumonia; the cause of the other 6 deaths were not determined. Of 23 postneonatal deaths, 21 were attributed to acute infections and 2 were of unknown origins.

Infant deaths in relation to birth weight, 323 live newborns (Santa Maria Cauqué, 1964 to 1970)

Birth weight, g	No. of infants	Deaths		
		Neonatal	Postneonatal	Total
<2,151	42	8 (19.0)	13 (31.0)	21 (50.0)
2,151-2,499	89	3 (3.4)	3 (3.4)	6 (6.7)
2,500-2,949	152	2 (1.3)	7 (4.6)	9 (5.9)
>2,949	40	0	0	0
Total	323	13 (4.0)	23 (7.1)	36 (11.1)

Nutritional status has a relationship to survival from infectious disease in postnatal period. A case history of a girl born underweight who experiences a series of infections which increase in frequency in postnatal period causing malnutrition, growth stagnation and finally death, is presented as evidence.

Carol Burke
10-30-73 pl12

Mata, L., J. Urrutia and A. Lechtig
Infection and Nutrition of Children
of a Low Socio-Economic Rural Community
Amer. J. Clinical Nutrition, V. 24,
Feb. 1971, pp. 248-259.

Infection and infectious disease contribute to the retarded growth of children who are receiving poor diets.

DATA BASE AND DESIGN.

The data base and design used in this study are the ones used in Mata's et al. "Influence of Recurrent Infections of Nutrition and Growth of Children in Guatemala."

. Examination of a cohort of 95 infants who were live births in a 2-year period (1964-66). Half were studied intensively for intestinal infections from birth to 3 years of age. Examinations included anthropometric measures, clinical appraisals, dietary studies, umbilical cord blood analysis and feces analysis, both of infants and mothers. The place of study was a rural Indian community in Guatemala highlands. (Santa Maria Cauque).
. Statistical analysis included calculation of growth rates through fitting of regression lines (y=a+bx) to observations available for each subject, calculation of slopes for periods 0-5, 6-17 and 6-35 months of age, grouping into quartiles subjects by these slopes, comparison of extreme quartiles in terms of illness experience and calculation of correlations of slopes with disease frequency.

RESULTS.

1. Igm cord serum as evidence of intrauterine antigenic stimulation.

. Mean concentrations of IgM and IgA were significantly higher than those of apparently normal newborns from areas with adequate sanitation in Lima and California.

immunoglobulin

. 43 percent of village newborns had elevated values of IgM (greater than 0.20); 20 percent had elevated IgA (greater than 0.10); and 44 percent had high concentrations of IgG (greater than 15 mg/ml).

. Mothers of cohort children had enteril infections. (Distribution is provided.)

2. Nutrition of fetus

. Average weight and height of infants were significantly lower than those of newborns from well nourished Guatemalans.

. 42 percent of the newborns had birth weights below 2.500g, only 13 percent were considered premature.

. 29 percent of underweight newborns showed normal psychomotor development and adequate weight gain during first week. These cases were considered to have intrauterine growth retardation. Deficiency of nutrition in utero was likely given inadequate dietary intake.

A significant correlation was found between infant birth weight and leg circumference (p less than 0.01).

Intrauterine infection is a contributing factor to the low birth weights, in light of the frequency of elevated cord IgM and the burden of infection in mothers.

3. Nutrition in the child.

. No measures of the output of maternal milk were made. Probably maternal lactation was insufficient to meet child's needs in the third month in some cases.

. Supplementation at 24 months of age (at age 1 year most children received supplementary food) was deficient in protein, and judging by low figures for weaned children, in calories.

. In 3-year-olds, the intake of weaned children was improved, but still low in Vitamin A intake since protein came from corn.

4. Postnatal infection, infectious disease and growth.

. Infections with protozoa were rare and with no tendency to persist.

. Shigella infections were found in 3.7%.

. 28% excreted enteroviruses and more than 20% excreted these agents during the first 3 months.

. Weight faltering and weight loss, in general, were detected after infectious disease became established. (This does not rule out that disease became established because there was a nutritional or immunological deficiency.)

. Greater deterioration of nutrition was observed during weaning period.

. Growth improved in the third year of life, but at this? all children were below 16th percentile of the standard.

5. Fitting of weight curves by regression.

. The linear fittings for weight on age for 43 children in cohort yeilded r^2 values above 0.90 in 95% of the cases for the 0-to-5 month period.

. 34 percent of cases had r^2 values above 0.90 for period 6-7 months. (Since this period spans the ages of maximum growth deceleration, deficient slopes, occasionally of negative sign, were recorded in this period.)

. 70 percent had r^2 values above 0.90 in the 6-to-35-month period.

6. Correlation between illnesses and growth.

. Correlations between the number of illness and growth rates (calculated b values) in weight were not significant during 6-to-35 month interval, whether illnesses were considered separately or combined. This is probably due to the similarity of morbidity rates of all children in the cohort.

After grouping children according to their b values, their upper and lower quartiles were compared by illness experience. (Measles, whooping cough and diseases occurring in epidemic form were not included.) It was found that some diseases were less frequent for children who had greater rates of weight gain.

- All illnesses, except febrile bronchitis, were more common in the group with the lowest rate of growth.

- Dysentry (diarrhea with blood and mucus) was significantly more frequent in group with lowest rate of growth.

- In the case of bronchopneumonia, the difference approached significance; and bronchopneumonia for the period 18-35 months had a significant difference for the two group.

Carol Burke
10 - 16 - 73

Mata, L. and R. Wyatt
Host Resistance to Infection.
Amer. J. Clinical Nutrition 24, August 1971, pp. 976-986.
(INCAP study)

Human milk is better than cow's milk in protecting the newborn infant against infection through a greater concentration of secretory IgA (antibodies against pathogenic bacteria and viruses) and of bifidus factor (a type of bacteria which dominates other bacteria and protozoa) and lysozyme (an enzyme destructive to cell walls of bacteria).

LITERATURE REVIEW.

Wholly bottle-fed infants had greater morbidity rates for gastrointestinal disorders, respiratory infections, and otitis media. Infections tended to be of longer duration and mortality was greater. No differences were due to social class. Britain (1951) Robinson.
Bouts of fever were fewer in breast-fed than artificially fed children. Sweden (1954) Sydow and Faxen.
Incidence of acute infections, otitis media, febile upper respiratory infections and acute diarrhea were lower in breast-fed than in bottle-fed infants aged 3 months to one year. Mellander et.al.

These above studies were in populations with adequate sanitation.

- Children have a low incidence of diarrheal disease during the early months of exclusive breast feeding and the attack rates increase as weaning progresses. Guatemala. Mata et.al.
- The association of diarrheal disease with weaning, i.e. weaning diarrhea, is affected by a contaminated environment and deterioration of nutritional status. Gordon et.al.
- The high point of weaning diarrhea varies by region and age according to the weaning practices prevailing in a particular region. And infant mortality follows the same trend with high rates in areas where children were weaned early (Behars). And a continued high mortality throughout preschool ages in areas where weaning is late. (Behars; Gordon et.al.)

DATA BASE AND DESIGN.

A review of findings relevant to the mechanisms by which human milk induces host resistance to infection is done here. (Most of the findings require a knowledge of biochemistry far greater than mine. So details will not be presented below.)

RESULTS.

There are 13 proteins of human colostrum (first milk secreted at termination of pregnancy) which are peculiar. IgA is the

most important immunoglobin because IgA contains antibodies of all types.
The flora (intestinal life) of breast-fed infants differs from that of bottle-fed infants, mainly in the almost exclusive content of bifidobacteria. This is because a principle of human milk, the bifidus factors, promotes the development of this characteristic flora. Mechanism is unclear to Mata.
Lysozyme, an enzyme destructive to certain bacteria, is found in human milk. Also lysozyme is found in the feces of breast-fed infants, but not in those fed cow's milk formula.

Carol Burke
10-29-73
PLB

McClung, Jean
Effects of High Altitude on Human Birth
Harvard University Press, 1969

To determine whether low birth weight at high altitude results from shortened gestation period, fetal malnutrition or a decrease in fetal growth rate, and whether the decrease in birth weight contributes to the high neonatal mortality.

DATA BASE AND DESIGN.

Comparison of mothers, newborns and placenta in eighty or more births at the Cuzco Hospital which is located at an altitude of 11,200 feet in Peru, with those at the Maternidad de Lima at an altitude of 665 feet in Peru, during the summer of 1966.

RESULTS.

- The decrease in mean birth weight at Cuzco is statistically significant.
- The increase in neonatal mortality is statistically significant.
- Weight of the placenta is not reduced in births at high altitudes, even though birth weight on the average is less. (Cuzco infants are, on the average, more than 200 grams less than those of Lima infants.)
- The area of the placentas were greater even though the weights are the same, for they had a greater diameter and lesser depth.
- The differences in birth weight do not appear to be racial differences, for Cuzco-born women who move to Lima give birth to infants that weigh as much as the infants of Lima-born mothers. Also, the weights of babies born in Cuzco of European mothers are below the average birth weight of the lowland population.
- The lower birth weight at high altitudes is not the result of premature delivery nor maternal or fetal malnutrition. The major contributing factor is fetal hypoxia (oxygen deficiency in tissue and organs).
- The increased placental area in highland pregnancies may represent an adaptation to increase gas exchange and minimize hypoxia.
- (No significant differences in maternal fertility, as measured by total pregnancies per woman, frequency of stillborn and abortion, or age at first pregnancy, were found.)

Carol Burke
10 - 15 - 73
PLR

F. Mackeberg
Factors Conditioning Malnutrition in Latin America, with Special Reference to Chile.
Advices for a Volunteers Action.
Bibliotheca 'Nutritio et Dieta', No. 14, pp. 23-33. (1970)

DATA BASE AND DESIGN.

Mackeberg has assembled data regarding infant mortality and living conditions for U.S.A., Argentina, Chile, Costa Rica, Paraguay, Peru, Columbia, Mexico, Ecuador, Salvador, and Guatemala.

RESULTS.

1. The lower the living conditions, i.e. income per capita, percentage of illiteracy in people above 10 years of age, percentage of inhabitants in urban areas, animal protein per capita, percentage of population that has sewage systems and public water facilities, the higher the infant mortality rate.

2. When socio-economic conditions are poor, undernutrition affects especially the preschool children; when socio-economic conditions are improved, undernutrition especially affects children under one year old.

3. Chile: Mortality rate of preschool children is the lowest, but mortality rate of children under one year old is the highest of Latin America. This is probably due to the fact that maternal lactation is extraordinarily short in Chile. Only 25 percent of mothers feed their children exclusively on breast at the third month of age. The decrease in natural lactation, a consequence of the knowledge of formulas, is not accompanied by adequate improvement in sanitation and education.

   Despite the fact that 80 percent of infants and 50 percent of preschool children are under medical care, the infant mortality rate has not decreased significantly.

   ? The distribution of free powdered milk which provides 70 percent of nutritional needs, has not lowered the infant mortality rate either. This implies malnutrition is not due to lack of food alone.

   Another factor influencing malnutrition is low intelligence performance of the parents in low socio-economic groups. Comparison of intelligence quotient of mothers and growth (real growth/expected growth) per child is made.

Carol Burke
10 - 17 - 73

PUE

Morris, J.N. and J.A. Heady
Social and Biological Factors of Infant Mortality:
I. Objects and Methods
The Lancet (Feb. 12, 1955), pp. 343-349

LITERATURE REVIEW:

Social factors affecting infant mortality include income, family size, class differences in physique, quality of maternal care, work in pregnancy, the mother's education, availability of antenatal care, the relative advantages of domiciliary and hospital confinement, housing conditions and climatic differences.

Mat [illegible] important to the outcome of a pregnancy; e.g., elderly primipara are liable to toxaemia and to unexplained stillbirth and premature birth, the risk of difficult labour and birth trauma. Other relationships include the association of age with fertility, with twinning, and with maternal mortality; of parity with birthweight, with frequency of antepartum haemorrhage or rhesus-factor complications.

- The stillbirth rate increases with the mother's age for a given number of children. The rate is high for firth birth, falls sharply in second birth and rises steadily thereafter. (Yerushalmy and others).
  Neonatal patterns are not so clear.

Yet, the differences between stillbirth rates of the social classes are not affected by the fact that the upper class contains more elderly primiparae or that the lower class mothers are younger on the average.

- The male stillbirth and infant death rates are higher than female rates; the ratio of male to female stillbirths increases with age of the mother.

- The ratio of males to females for stillbirth, macerated foetuses, and anencephallus, increases with duration of gestation.

- Stillbirths and infant deaths due to different congenital malformation show different sex ratios.

- Like-sexed twins have a higher stillbirth rate and neonatal death rate than unlike sexed twins.

- Neonatal deaths are higher in multiple births than single births. Stillbirths as a whole are also higher in multiple births than in single births.

- Multiple births occurring in the youngest mothers show a very high stillbirth-rate. This rate falls with the age of the mother to a minimum at 25-34 years and thereafter rises again.

- Women who have had stillbirths are likely to have further stillbirths; and the same is true of neonatal and postneonatal deaths.

There is an association between congenital malformation in one child in a family and abortion, stillbirth and similar malformation in its siblings.

. Very close spacing and very distant spacing may influence the stillbirth and neonatal death rates.

. Consanguineous marriage may increase stillbirth and infant mortality rates.

. Stillbirth and neonatal mortality rates are higher for children of younger and older fathers compared with those aged 25-34 irrespective of the mother's age.

DATA BASE AND DESIGN.

This was an epidemological exercise using documents of birth and death registration of England and Wales for 1949-50. Certain material re: social circumstances was taken from the 1951 Census.

AREAS INVESTIGATED.

. The influence on death rates of mother's age and the number of children she has borne given a variety of social circumstances.

. The relationships between various causes of death and maternal age and parity.

. The effect of birth spacing on the death rates.

. The relationship between the occurrence of stillbirths and infant death and the loss of previous children by the same mother.

. The effects of mother's age on single and multiple stillbirths.

Carol Burke
10 - 12 - 73

PLB.

Naeye, Richard L.
The Epidemiology of Perinatal Mortality. The Power of the Autopsy.
Pediatric Clinics of North America, 19:2, May 1972, pp. 295-310.

Premature delivery and antenatal growth retardation contributes to low birth weight in infants born to poor (and black) mothers in the United States, undernutrition of mother during pregnancy being operative in antenatal growth retardation and antenatal bacterial infections being operative in premature babies.

LITERATURE REVIEW.

The excess United States infant mortality appears related to low birth weights in the poor which is a function of premature delivery or antenatal growth retardation. Several sources are cited.

DATA BASE AND DESIGN.

Analysis of autopsy results from 361 stillborn with gestational ages from 22 to 44 weeks and 683 infants who died within 72 hours -- New York City Babies Hospital.

RESULTS.

1. Undernutrition in newborn infants as evidenced in birth weight, length and organ structure probably is not related to abnormalities that restrict nutrient flow to the fetus, but rather to inadequate maternal nutrition during pregnancy.

Data re: body weight, body length and organ structure is analysed for all cases except those with recognized uterine and placenta abnormalities.

- Body weight for infants from families below poverty line was 13 to 17 percent less than the mean for infants from non-poor families. Body length and all organ weights were also smaller in infants from poorer families.
- There were almost no differences in body and organ weight by ethnic group (white, black and Puerto Rican) when economic class was considered.
- Organ structure was abnormal in infants from poor families; the abnormalities being characteristic of undernourishment.

2. Antenatal bacterial infection might be an important cause of prematurity and consequential perinatal deaths, especially in the poor.

Data re: infections in ? analysed for all cases.

- More than 45 percent of infants from poor families had congenital pneumonia or chorioamnionitis (inflammation which most often results from amniotic fluid infection).
- Rates of antenatal and intrapartum infections for the poor was double or more the rates for the non-poor.
- 46 percent of the cultures from neonates showed pathogenic bacteria in moderate or large numbers and 63 percent of the

of the cultures from neonates who had congenital pneumonia showed such pathogenic material.
One or more late gestational maternal abnormalities (premature rupture of the membranes, predelivery abnormal bleeding, fever, pyuria, and leukocytosis) were recorded in 95 percent of mothers whose infants had pneumonia. Whereas, one or more late gestational maternal abnormalities were recorded in only 24 percent of mothers whose babies had no congenital pneumonia.
There were no significant differences in incidence of maternal disorders in mothers of infants who had congenital pneumonia by economic status (or ethnic group).
Recovery of pathogenic bacteria from maternal reproductive and urinary tracts was associated with congenital pneumonia. An even stronger association was found when the analysis was for the same predominant organism in mother and her offspring.

3. Sex Ratios.
2735 autopsies in newborn infants at Los Angeles Babies Hospital and Chicago lying-in hospitals.

0.95:1 is the male to female ratio for stillborns. Sex ratio for infants dying after birth were far greater than the stillborn ratio. And the sex ratio for most disorders in live-borns was greater than the ratio for the same disorders in stillborns, with the exception of congenital pneumonia.

The sex ratio for live-borns who died soon after birth was greater for the poor than the non-poor. If all live-borns with prenatal infections are excluded, half of the differences in the sex ratio disappear between poor and non-poor, rising the possibility the antenatal bacteria infections might make a contribution to perinatal deaths rate of the poor.

4. The remainder of the article discusses selected common causes of neonatal death (cerebral intraventricular hemmorrhage, hyaline membrane disease and hydramnios and oligohydramnios) and concludes that neonates who are either undernourished or have bacterial infections are more vulnerable to them.

Carol Burke
11-6-73

National Academy of Sciences
Maternal Nutrition and the
Course of Pregnancy:
Summary Report
Washington, 1970

Gary and Stiven (1936) reviewed over 300 animal and human studies relating to the role of individual nutrients and compare standards for pregnant and non-pregnant women.

Gary and Wood (1946) update this above study with 400 studies made since the original.

Key et. al. (1950) reviewed the evidence available on the relation of nutrition to various aspects of pregnancy.

NRC Bulletin Maternal Nutrition and Child Health (Toverud et. al., 1950) is a literature review.

WHO Nutrition in Pregnancy and Lactation (1965) reviews evidence from epidemiological and laboratory sources.

1. Maternal physiological adjustments

. Pregnancy is characterized by reduced concentrations of hemoglobin in blood and albumin in plasma, enlargement of thyroid gland, changes in cardiac function; spillage of amino acid in urine and edema.

. Weight gain reflects physiological consequences of pregnancy. Thompson and Billewicz (1957) found an average ~~weight~~ gain in total weight of healthy pregnant women in Scotland of 12.5 kg (27.5 lb) and a gain of 1 lb per week during second half of pregnancy associated with lowest incidence of pre-eclampsia, low birth weight in infants and low perinatal mortality. By contrast, Tompkins (1955) in the United States found average total weight gain in healthy pregnant women to be 24 lbs. ~~Also there is variability is weight gain.~~

Also there is variability in weight gain. Young women tend to gain slightly more weight than older women. Primigravidas gain slightly more than multigravidas. Thin women gain slightly more than fat women.

. The total "energy cost" of pregnancy for a healthy woman is about 40,000 kcal or an additional daily requirement of about 200 kcal. This is consistent with a total weight gain of 25 lbs.

2. Anemia complicating pregnancy

. Hemoglobin (red respiratory protein of mature red blood cells) production requires protein to furnish amino acids, calories to protect the protein from catabolic degradation, iron, copper, zinc, folic acid, Vitamin B_{12} and other vitamins.

. During pregnancy, increased maternal erythropoiesis (formation of mature red blood cells) occurs at the same time as appreciable nutritional demands are being made by the growing fetus.

. Iron-deficiency anemia and anemia due to blood loss are most common anemias of pregnancy.

. Anemia is a significant reduction in the concentration of hemoglobin per 100 ml. of blood, the number of erythrocytes per cu. mm. of blood or the volume of packed red cells per ml. of blood.

. Iron-deficiency anemia.

Iron utilization during pregnancy with a single fetus amounts to about 0.8g, including augmented maternal erythropoiesis requirement and fetus and placenta requirements.

Neither average maternal iron stores nor usual diets of healthy young American women meet iron requirement of pregnancy.

Iron supplementation during the latter part of pregnancy, in the form of ferrous salts, is usually required in the United States. 30-60 mg. daily is recommended by NRC.

. Megaloblastic anemia (reduction of a precursor of erythrocytes.)

Megaloblastic anemia is due to maternal folate (salt of folic acid)deficiency.

Folate deficiency may be common late in pregnancy, especially among poorer women; and may be implicated in several forms of pregnancy wastage.

3. Relation of nutrition to fetal growth

. Restricting maternal diet during gestation affects cellular growth patterns of the progeny, but different organs respond differently.

. Interference with cellular growth patterns may result in persistent modification, but if diet is correct during normal period of cell division, a deficiency in cell number may be minimized or corrected.

. Animal experiments have shown that alterations in maternal diet can have profound effects on size of litter, survival rates, size at birth, growth patterns, etc. Uncertainties persist as to their relevance to human reproduction because of species variations.

. Evidence that nutrition is important to human reproduction is derived from studies of large populations.

. A number of studies have shown a strong positive association between total weight gain of mother and birth weight of infant. And there is also a strong positive association between prepregnancy weight of mother and birth weight of infant.

. Whether retardation of physical growth in utero is followed by retardation of later growth is open to question.

4. Relation of nutrition to pregnancy in adolescence

. The course and outcome of pregnancy of girls 17-20 years of age resembles those of mature young women aged 20-24 years, whereas there is a sharp increase in infant mortality for each year of age under 17. Young teenage mothers also have a disproportionate number of underweight babies.

The nutritional requirements of adolescent girls, nonpregnant or pregnant, are high and often not met. Intake of iron, calcium, Vitamin A and ascorbic acid tend to be inadequate.

5. Relation of nutrition to toxemia

. Little is known of the etiological factors considered important to toxemia.

. A variety of symptom complexes have been included under the generic term toxemia. The toxemias considered in this summary were those that can be divided into eclampsia and pre-eclampsia. Pre-eclampsia is acute hypertensive disorder appearing after the 20th week of pregnancy and accompanied by edema of hand and face and/or proteinuria. Eclampsia is closely related to pre-eclampsia and usually its end result. (?)

- There is no evidence that women with large weight gain due to excessive accumulation of fat are more likely to develop toxemia than women with lesser accumulation.
- Evidence of the influence of protein intake on toxemia incidence is inconclusive, although it is widely suspected that increased protein intake contributed to the decrease in the incidence of toxemia in the United States.
- Safety of salt restriction and diuretic is questionable.

APPENDIX C RECOMMENDED DAILY DIETARY ALLOWANCES FOR GIRLS AND WOMEN AT VARIOUS AGES, WITH ADDED ALLOWANCES FOR PREGNANCY

	Recommended Daily Allowances for Nonpregnant Women					Recommended Daily Allowances Added for Pregnancy
	12-14[a] years old	14-16[b] years old	16-18[c] years old	18-22[d] years old	22-35[d] years old	
Calories (kcal)	2,300	2,400	2,300	2,000	2,000	200
Protein (g)	50	55	55	55	55	10
Vitamin A (IU)	5,000	5,000	5,000	5,000	5,000	1,000
Vitamin D (IU)	400	400	400	400	–	0
Vitamin E (IU)	20	25	25	25	25	5
Ascorbic acid (mg)	45	50	50	55	55	10
Folacin (mg)	0.4	0.4	0.4	0.4	0.4	0.4[e]
Niacin (mg equiv.)	15	16	15	13	13	2
Riboflavin (mg)	1.4	1.4	1.5	1.5	1.5	0.3
Thiamin (mg)	1.2	1.2	1.2	1.0	1.0	0.1
Vitamin B_6 (mg)	1.6	1.8	2.0	2.0	2.0	0.5
Vitamin B_{12} (μg)	5	5	5	5	5	3
Calcium (g)	1.3	1.3	1.3	0.8	0.8	0.4
Phosphorus (g)	1.3	1.3	1.3	0.8	0.8	0.4
Iodine (μg)	115	120	115	100	100	25
Iron (mg)	18	18	18	18	18	f
Magnesium (mg)	350	350	350	350	300	150

[a]Body size, 44 kg; height, 154 cm.
[b]Body size, 52 kg; height, 157 cm.
[c]Body size, 54 kg; height, 160 cm.
[d]Body size, 53 kg; height, 163 cm.
[e]The diet may be supplemented with 0.2-0.4 mg of folacin daily
[f]It is recommended that the diet be supplemented with 30-60 mg of iron per day.

Carol Burke
10-17-73

Plank J.S. and Milanesi, M.L.
Infant Feeding and Infant Mortality in Rural Child
Bulletin World Health Organization, No. 48, 1973, pp. 203-210.

LITERATURE REVIEW.

Differential in infant mortality rates are attributable to bottle feeding and neglect of supplementary foods; not family income, education, environmental factors or medical care.

. Rural populations in developing countries are generally not yet affected by early weaning. (Becroft & Bailey, 1965; Cántrelle & Lendon, 1971; Gordon, et al, 1964; Harfouche, 1970; Martin et al, 1964; Taba, 1970; Thompson et al, 1966; Urruria & Mata, 1969; Wyon & Gordon, 1971)

. Both village and urban mothers wean their babies early in Chile. (Ariztia, 1955; Monckeberg et al, 1967) and it has been suggested that this practice might be responsible for Chile's high infant mortality rate. (Ariztia, 1955; Behar, 1964; Monckegerg, 1970; Behmetal, 1964).

DATA BASE AND DESIGN.

Women aged 15 to 44 years old in 15 rural Chilean communities were interviewed. Data on reproductive histories, housing, and other factors influencing their health and fertility was obtained. Recent mothers were questioned re: last child about obstetrical care received; infant feeding practices and medical attention given the child. Neonatal deaths and children under 4 weeks were excluded.

RESULTS.

. The duration of breast feeding was significantly lower with advancing age and parity.

. Breast feeding decreased as maternal education and income rose. The correlation with education continued to be significant when data was standardized for income, whereas earnings were no longer significant when adjustments were made for years of schooling.

. Education was also more closely correlated with duration of breast feeding than parity.

The proportion of infants surviving at 6 months who were weaned before that age by maternal age, parity, education and income are presented in article.

. Postneonatal deaths were more frequent among infants who started bottle feeding in the first three months than among those exclusively breastfed during that time. (3:1).

• Infants given bottles as supplement to breastfeeding fared no better than those who received no breast milk beyond fourth week. And there is no evidence that deaths among mixed diet children occurred only after breast-feeding stopped. In other words, death rates are similar whether bottle-fed babies continue to receive breast milk or not.

• Mortality was 70 percent higher than for bottle-fed w/ supplements during the second and third trimester for bottle-fed babies who were not given any other food.

Mortality in the first year among infants surviving after 4 wks, 3 mos. and 6 mos. of age by type of milk given, and total deaths and death rates on different types of diet in second and third trimester are presented in this article.

• Higher mortality among children of older mothers appears to be related to diet. 31.5 percent of older mothers (over 35 yrs.) introduced other foods by the end of the first 6 months compared to 41.6 percent of younger mothers.

• The proportion of infants receiving bottles but no additional foods at 6 mos. rose from 34% to 44% as mother's age increased. This paralleled a rise in infant death rates from 42 to 54 per 1000 infants.

• As the mother's educational level rose, the proportion of children who were bottle-fed but received no additional food at 6 mos. increased from 33% to 45% and then fell to 37%, and the mortality followed a similar trend.

Postneonatal deaths and death rates, by maternal education and paternal income are presented.

• Sanitary conditions were better in homes where infant deaths occurred. There were 48.1 postneonatal deaths per 1000 infants (17% of total) in houses with running water as compared to 32.3 in those without it. The rate was 36.0 (83% of the total) in houses with some sort of sewerage as compared to 30.0 in those that had none.

• The risk of postneonatal death was higher if mothers had prenatal care than if they had professional care only at delivery or none at all - 37.5 as compared with 27.3 per 1000 infants.

PLI

Carol Burke
10 - 15 - 73

Pollitt, Ernesto
Behavior of Infant in Causation of Nutritional Marasmus.
American Journal of Clinical Nutrition, V. 26, March 1973, p. 260-270.

Behavior of the infant influences the occurence of nutritional marasmus.

LITERATURE REVIEW.

This article is a review of other studies of malnutrition.

RESULTS.

Sucking behavior, level of arousal and interrelationship with mother are adversely affected in the nutritionally marasmic infant prior to the development of malnutrition.

1. Nutritionally marasmic children are commonly the offspring of grand multiparous women.
   - 44 percent of 22 marasmus cases in Peru were sixth or later born. 88 percent of 55 cases of kwashiorkor in Peru were third or later born.
   - 49 percent of 145 children in Columbia with protein calorie malnutrition were sixth or later born and 37 percent of children who were fifth or earlier had protein calorie malnutrition.

2. Nutritional marasmic children are commonly the offspring of women with a history of closely spaced pregnancies.
   - 78 percent of mothers of malnourished children in Jordan weaned their children because of new pregnancies.
   - A significant positive correlation between numbers of preschool children in the family and preschool malnutrition was found in a Columbian study. 47.9 percent of 79 children with four or more preschool siblings were malnourished, compared to 29 percent of 352 with three or less siblings.
   - A study comparing 19 undernourished children admitted to Denver General Hospital with matched controls of similar economic level showed stress of one or more siblings less than 2 years as a differentiating factor. There were similar findings on growth development in a Jamaican study.

3. Nutritionally marasmic children are likely to have low birth weight. There is little direct evidence of it. It is rather inferred from study of parity and spacing of pregnancies.
   - 10 of 19 cases with undernutrition in Denver General Hospital had birthweights of 2,500 g. or less.
   - A sample of 14 malnourished children with birthweights above 2,500 g. is also reported.

The incidence of malnutrition is greater in underdeveloped countries where birthweight averages less.

4. Nutritionally marasmic children are weaned early.
   Jordan study cited above.
   In a study of 22 cases of marasmus in Peru, an average duration of 2.0 months of exclusive breast feeding was recorded.

5. Nutritionally marasmic children born of multiparous women with closely spaced pregnancies and with low birthweights are probably unable to ingest milk in amounts sufficient for usual development during first month of life due to lethargy and immature sucking.
   Waldrop and Bell.
   Furthermore, children of mothers who experience many closely spaced pregnancies are lethargic. Specifically, they are inefficient in obtaining nourishment as measured by suck rate and number of sucks,and cry little.
   Thoman et al.
   No relationship between parity and amount of formula consumed. (Waldrop and Bell included months of age difference between child studied and next older sibling, and average span between births, as well as parity.)
   Two other studies indicated a positive association between birthweight and food intake, a consequence of the effectiveness of the suck. The suck-swallow pattern of premature infants is less adequate than for infants of normal weight. Furthermore, early weaning might be a response to ineffectual sucking and lethargy of the infant. Also, declining breast milk output might be due to inadequate nipple stimulation.
   A mother feeds an alert, vocal child more often.
   Primiparous mothers fed infants for longer periods.

Carol Burke
10-18-73

pl

Pollitt, E. And H. Ricciuti
Biological and Social Correlates of Stature Among Children in the Slums of Lima, Peru.
Amer. J. Orthopsychiatry 39 (5),
October 1969, pp. 735-747.

Children differing in stature differ also in other biological and/or psycho-social variables which, independent of nutrition, affect psychological development.

LITERATURE REVIEW.

1. Cravioto, Delicardie and Birch.
Nutritional deficiency of short children (Guatemalan Indians) accounts for their poor performance on neurointegrative tests.

They tested and obtained parental heights for a control group of tall and short upper middle class urban children as well as the rural Indian children.

Parental heights was not significantly related to children's height in the rural group. But father's height was significantly related to children's height in the urban upper-middle class group. This comparison was taken as suggesting that for rural children variations in stature are a function of nutritional variation rather than genetic endowment.

Test score: No significant differences between tall and short urban upper middle class children as compared to tall and short rural poor children.

. There was a marked difference in the amount of maternal education in both groups - tall children tended to have better educated mothers. Although better educated mothers may have provided a better nutritional environment, they may also have provided more psychological stimulus.

2. Others have found various indices of intellectual development, socio-economic status and general conditions of physical and mental health tend to ~~for~~ correlate positively with each other. (Douglas et al; Douglas and Simpson; Jones; Thompson)

3. The factors of increased age, high parity and poor physical condition of mothers are detrimental to a lower class child's intrauterine and later physical growth (Crump et al; O'Sullivan et al; Thompson and Bellewicz) and heighten the risk of central nervous system damage during fetal growth and at birth. (Birch; Knobloch and Pasamanick).

4. There is a relationship between birthweight, measure of intrauterine growth and later intelligence quotient scores. (Crump et al.)

Thus, the same factors that tend to produce reduced physical stature may also affect intellectual development adversely.

DATA BASE AND DESIGN.

Two groups of 48 children from 6 to 53 mos. of age attending a day center for children of working mothers living in slums. Each group was equally divided by sex and equally distributed into four 12-month age intervals Height measurements were taken and data on biological and social variables was obtained by interviewing the children's mothers.

RESULTS.

1. Prenatal variables.

. Maternal Height: The mothers of the tall children were significantly taller than the mothers of short children, by 5 cms. The difference between maternal height of tall (151 cms.) and short (146 cms.) children reached 0.01 level of significance.

. Mothers of females were significantly taller than mothers of males.

. Mothers of younger children were taller than mothers of older children.

. The mean father's height was the same for tall and short groups.

Number of pregnancies:
. On the average, the mothers of the tall children had had fewer pregnancies (3.77) than mothers in the contrasting group (4.68.) This difference reached the 0.10 level of significance.

. There were no age and sex differences.

Mothers' age at childbirth:

. There was almost no difference between the two groups. The mean age was 26.5 years for mothers of tall children and 27.0 years for mothers of short children.

II. Perinatal Variables.

Birthweight:
. The birthweight of tall children was much higher than that of other children and this difference reached .01 level of significance.

Medical care at birth:
. A higher percentage of short children (35%) were born without medical care than was the case for tall children (25%), but this difference is not significant statistically. (p. 7.10).

III. Social Variables

Maternal Education:
. Mothers of tall children had more schooling (2.51 years) than mothers of short children (1.31 years) (p less than .05). This difference was consistent in comparisons by age and sex.

- Fathers of tall group had a higher average (4.40 years) than those of short group (3.61 years). But the difference reached only the .10 level of significance.

Family instability:

- Only 17 percent of the mothers of tall children reported two or more marriages and 42 percent of the mothers of short children reported a similar experience. (p less than .01)

- No differences were found in comparisons involving presence or absence of a father figure.

Family income:

- Monthly income for families of tall and short children did not differ significantly. Also there were no age or sex differences income between groups.

Family size:

- The average family size was very similar for the tall and short groups. (6.66 and 6.70).

Mothers' years of residence in Lima:

- The number of years of residence was similar for mothers of the children in tall and short groups. (15.83 and 14.39).
- No differences were reported by sex and age group.

Mothers of short children, in contrast with mothers of tall children, were significantly shorter, had a history of more pregnancies, had significantly less education and had been married significantly more often. Also, shorter children had significantly lower birthweight.

These height relationships indicate that nutritional factors are not necessarily over-riding and that genetic effects can confound the significance of using stature as a nutritional index, and other studies indicate that these variables are not only related to stature but to intellectual level and socio-economic status.

PLP

Carol Burke
10 - 11 - 73

Roopnarinesingh, S.S.
The Young Negro Primigravida in Jamaica.
J. Obstetrics and Gynaecology of British Commonwealth, Vol. 77, May 1970, pp. 424-426.

LITERATURE REVIEW.

Conflicting reports re: outcome of pregnancy in young primigravidae. Hofmeister and Burgess (1955) suggested adolescent gestation was hazardous. Marchetti and Menaker (1950) and Obeng (1969) found no increased risk. Aznar and Bennett (1961) stated safe but undesirable for psychological and socio-economic reasons.

DATA BASE AND DESIGN.

Comparison course of pregnancy and labour in 122 Negro primigravidae under 16 years with 122 primigravidae aged 22.

RESULTS.

Maternal and fetal complications occur more frequently in the young primigravida.

- 36 percent of young primigravidae had complicated antenatal course. Only one in control group had complications. Hypertension, the most common complication, occured in 18 percent of juvenile mothers compared to 10 percent of control group.
- 19 percent of juvenile mothers delivered before 36th week compared to 2 percent of the control group.
- Operative delivery rate was 13 percent for juvenile group, almost twice that of the control group.
- There was a higher incidence of fetal distress in juvenile group,but little difference in the incidence of prolonged labour in the two groups.
- Sixteen babies of juvenile mothers had Apgar score below 7, compared to 5 in control group. (Apgar score is an evaluation of infant's physical status by assigning numerical value to heart rate, respiratory effort,muscle tone, reflex irritability and skin color).
- There were two stillborns and two neonatal deaths in juvenile group, and only one stillborn in control group.
- 25 babies of juvenile mothers weighed less than 2.5 kg. at birth and 8 babies of control group did so.

Carol Burke
10 - 12 - 73

Roopnarinesingh, Syam, David Morris and ~~Chang~~, Elizabeth Chang
The Underweight Jamaican Parturient
J. Obstetrics and Gynaecology of the British Commonwealth, V. 78, April 1971, pp. 379-382.

Maternal size and birth weight are significantly correlated.

LITERATURE REVIEW.

Maternal weight is an important factor affecting fetal outcome. (Thompson and Billewicz, 1957; O'Sullivan et. al., 1965)

There are obstetric hazards for the overweight Negro parturient. (Roopnarinesingh and Pathak, 1970)

DATA BASE AND DESIGN.

Comparison of the reproductive performances of 146 patients weighing 100 lbs. or less at the 14th week of gestation with those of 146 women weighing more than 100 lbs. at 14 weeks. The underweight parturients were consecutively selected and the control group was selected by randomly sampling from a total of 200 patients.

RESULTS.

- The incidence of ~~prematurity~~ prolonged labor and anaemia was greater among underweight mothers.
- Although a large proportion of underweight mothers delivered before the 38th week, the incidence of this complication was the same for the control group. So, premature labour alone can't account for the higher incidence of low birthweight among underweight women.
- The mean "booking" weight of underweight mothers was considerably less than the control and the mean birthweight of infants of underweight mothers was less than the birthweight of infants in control group.
- The relationship between antenatal weight gain and birthweight was not statistically significant. The mean weight gain in the underweight mother increased with size. The reverse was true for the control group.

Statistics are presented for age, parity, weight gain, time and mode of delivery, pregnancy complication and birthweight.

Carol Burke
11-5-73 PLR

Rulison, Michael
Topical Investigation and Analysis of
Nutritional Supplements in Family Planning
Programs in India and Pakistan
Research Triangle Institute
North Carolina (AID Contract NESA/460), 1970

LITERATURE REVIEW AND HYPOTHESES

1. A decrease in birth rates is associated with a decrease in infant and preschool child mortality.
. Data on infant mortality and birth rates is given for Sweden, Japan and Chile.
. Frederiksen (1966). Comparison of birth rates and death rates among districts in Ceylon, Mauritius and British Guiana, and among 21 countries with varying levels of economic development.
There is a significant correlation between relative change in birth rates and relative change in death rates during a preceding period.
There is a high negative correlation between rate of natural increase (excess of birth rates over death rates) and subsequent relative change in birth rates of districts within a country and of countries with varying levels of economic development.

2. The time lag between decline in infant mortality and that in birth rate can be estimated. Lags are calculated for Chile, Sweden, United Kingdom and Japan.

3. Couples do perceive changes in infant and preschool child mortality.
Poffenberger (1968; India) Pareek (1970; India)

4. Fertility is controlled when desired family size is reached or exceeded. Statistics on family planning acceptors are reported. Phoffenberger (1968; India) Unpublished U.S. AID Report (1970)

5. Couples increase desired family size as a result of changes in infant and preschool deaths.
Hassen (1966; Egypt)
80 percent of deaths were found among first three birth orders and 38 percent within the first four years of marriage.

6. Family planning is more likely to be adopted when the survival of at least one son is assured.
. Preschool mortality is higher for girls than boys in India and Pakistan, in contrast with developed countries. (Keyfitz and Flieger, 1968; Pakistan Ministry of Health, 1965; May and Heer, 1968; and Mosely et. al., 1968.)
. Desired family size is not merely a number of children desired, but includes sex distribution. (KAP studies ?)
. Family planning acceptors in India have three to five living children including two or more boys. (AID report)
. Given existing levels of infant mortality, high fertility is necessary to insure son survivorship at the time the fathers reach age 65. (May and Heer, 1968)

. The probability of attaining a surviving son is related to infant and childhood mortality and life expectancy. (Heer and Smith, 1968.)

7. Nutritionally-caused deaths can be identified and their number estimated.

In less developed countries, the post neonatal period is characterized by higher mortality rates and from different causes. There is a higher incidence of respiratory disease, gastroenteritis, and infectious diseases, such as smallpox, measles, and whooping cough. These infectious diseases are often fatal because of malnourished state of infant.

Also, death rates are proportionately much higher during second year of life. (Gordon et. al., 1963)

Many infant deaths are related to malnutrition:

Gordon et al. (1967) In rural north India 70 percent of all deaths at ages 0-4 occur during second year of life because when children are weaned the available diet becomes inadequate without a mother's milk. This is aggravated by occurrence of weanling diarrhea.

Behar et. al. (1958) investigated causes of deaths of children under age 15 in Guatemalan villages: 34% were malnutrition and disorders of the digestive system; 25% were respiratory disease and whooping cough; 20% were congenital and early infancy diseases; and 21% were miscellaneous causes.

Puffer and Serrano (1961). Nutrition was deficient in 56 percent of 35,000 deaths of children under age five in 13 areas of Latin America. Nutrition was the underlying cause of 10% of the deaths, contributing cause of 31% and consequence of underlying cause of 15%.

Banik et al (1967). In a study of 1,000 children during the first two years of life reported 75% of illnesses were respiratory or gastrointestinal origin, 35% were associated with acute diarrhea and nearly 20% were associated with pneumonia.

Gordon and Scrimshaw (1965) found in India neonatal deaths caused by birth difficulties and diseases resulting from unsanitary care. Postneonatal deaths were the result of infection such as pneumonia (10.7 per 1000 live births), measles (2.8 per 1000 live births), tuberculosis (2.1 per 1000 live births) and typhoid (2.1 per 100 live births) and the result of diarrhea disease (27.8 per 1000 live births).

8. Levels of nutrition are low in target populations.

The nutritional standards against which malnutrition is measured are generally derived from standards proposed by British Research Council and (U.S.) National Research Council.

Various studies documenting nutritional deficiencies in India and Pakistan are presented.

9. The availability of a nutrition supplement at a family planning clinic can increase the number of family planning acceptors. This is based on data from a demonstration project.

10. Fecundity, as a biological function necessary to survival of the species, will be relatively insensitive to nutritional changes.

- Material on the influence of nutrition on conception is scarce. (Smith, 1947) (Holland) Conception is probably impaired by severe malnutrition only.
- Varying degrees of malnutrition will increase spontaneous abortions, still-births, low birthweight babies, prematurity, obstetrical difficulties and neonatal mortality.

11. The impact of nutrition intervention on population growth can be estimated for short-and long-run periods.

DATA BASE AND METHODOLOGY

- Population and vital rates by 5-year age groups for India were taken from Keyfritz and Flieger, World Population (1968).
- Population by 5-year age groups was distributed to single years and birth and death rates for each 5-year group were applied by single year to yield births and deaths during a given year. The exception to this procedure was population aged 0-4. Death rates by single year were approximated so that infant mortality and total deaths for 5-year period matched other sources. Exact procedure is not given.
- Within the population established for the 50-year period, measures of population change were computed -- rates of birth, death and natural increase, youth dependency ratio and population size aged 0-5 and 0-15.
- These measures of population change were computed for three models.

Model A (control population) used the existing data representing population and vital statistics of India in 1961.

Model B used death rates at ages 0-4 lower by 30 percent for all fifty years.

Model C was Model B plus a reduction in birth rates at year 10. This approximates the experience of Chile.

RESULTS

- The 30 percent reduction in birth rates at ages 0-4 has little effect for at least 20 years. Population B is less than 4 percent larger than population A in 20 years, although both increased more than 50 percent because of high fertility.
- At the end of 50 years population B is 13 percent larger than population A. The enlarged cohorts resulting from lower death rates, are in the midst of their reproductive years.
- The crude rate of natural increase (excess birth rate/death rate) for model A is 2.2 percent per year over the 50 year period with little variation. In model B this rate is 2.4 percent as a result of lower early life mortality. While Model C, the increase declines sharply in the ten years following the fertility reduction to a level of 1.8 percent per year and then drops to 1.6 percent in the 50th year.
- A reduction in death rates from the levels of Model A to those of Model B would raise the size of population ages 0-5 by less than 7 percent during the first 20 years. If, in addition, a reduction in birth rates can be expected as in Model C, this age group would decrease in size, from 15 to 28 percent in the 40 years following the reduction.
- In the initial population the youth dependency ratio (the population aged 0-14 as a proportion of the population aged 15-65) was at .766. In Model A it remained within the range .75-.77. For Model B with lower death rates at

ages 0-4, it rose to .82 and ended at .81. For Model C, with lower death and birth rates, it rose to .81 and then fell to .62. Thus, the effect or reduction of fertility in early life is outweighed by the effect of changes in fertility.

. Model A and B-C yield expectation of life at birth of 48.2 and 51.1 years, respectively. This increase of 2.9 years is equivalent to that which might occur over six years according to assumptions made by the United Nations in setting up model life tables. But comparing infant mortality rates with those in the model life tables, it appears that a comparable amount of reduction in those rates in the model life tables would ordinarily require a period of 17-20 years. 17-20 years is associated with a change in life expectancy of about 10 years. Inconsistent — Significant reductions in early life mortality have relatively small impacts on total population.

Russell
11-1-73

T. Paul Schultz and Julie DaVanzo
Analysis of Demographic Change in East Pakistan: A Study of Retrospective Survey Data
Rand Report R-564-AID, September 1970

The authors use survey data for a sample of 4,200 women in East Pakistan to test a number of hypotheses about the determinants of fertility.

HANDLING OF THE DATA

. Comparison of vital rates computed from the survey with those from other sources provides a check on the survey's external validity.

. Reproductive histories, and the surviving age and composition of each woman's family were reconstructed for the data for each year since marriage.

. Average age at marriage calculated for each sample cohort, i.e., by age at the time of the survey.

. Infant mortality, total and by age of mother, is calculated for each year. Rates computed are cohort survival rates, i.e., infant deaths divided by children born or less than one year of age in the specified year. The level is high (100-180 per 1000) and the trend is down between 1950 and 1960, in spite of the tendency for earlier events to be forgotten so that infant deaths in the earlier period may be understated.

. Age-specific birth rates: number of births occurring to women in a particular age group, divided by the number of women in that age group.

. A check against the accuracy of recall data: does the sex ratio increasingly favor males as the data goes back?

. Average number of children ever born and children now alive are calculated for women in each age group. The large differences reflect high mortality.

REGRESSION MODEL

. Two basic sets of forces: biological (=fecundity) and behavioral (= desired children, ability to avoid unwanted births).

. Death of a child has behavioral (replacement) and biological (loss of post-partum sterility) effects.

. Regression estimates a linear approximation to the probability of birth.

. Probability of birth in the current year is hypothesized to be a weighted sum of lagged birth probabilities for 2 years past plus a weighted sum of the children dying in each of 5 prior years, plus a function of the difference between the numbers of desired and living children. Since the survey did not provide the variables to represent desired children, the model reduces to:

$$B_{t \cdot j} = \alpha + \sum_{i=1}^{n} \beta_{t-i} B_{t-i \cdot j} + \sum_{i=7}^{m} \gamma_{t-i} D_{t-i,j}$$

- The constant term, α, is the probability of a birth in the absence of any previous births or deaths.

- The ratio $B_{t-i,j}/\alpha$ measures the relative sterility effect of a prior birth on the conditional probability of birth, adjusted for the absence of prior births or deaths.

- $\Sigma \gamma_{t-i}$, divided by the average birth rate for the woman's age cohort (a proxy for potential biological fecundity) gives the proportionate increase in the average cohort probability of birth associated, over the 5 year period, with the death of a child.

RESULTS

TABLES

- Other things (including the desired number of children) constant, age-specific birth rates should decline for women who have more living children. Although it is not possible to correct for other factors, tabulated data for East Pakistan lend spotty support to the hypothesis.

- Data cross-tabulated for women 30-39, showing birth rates by number of children ever born and number that died, gives similarly spotty support for the notion that infant mortality is a cause of high birth rates.

REGRESSIONS

- The sample of married women was partitioned by 5 year age intervals and separate regressions were run for each age group combined, and divided into rural and urban. Births (0-1; in 1961?) were the dependent variable; birth in the previous year and child deaths in the previous 5 years were entered as dichotomous independent variables. The combined sample was used to estimate coefficients for the deaths in previous years (the "lag structure") and then these weights were apparently used to combine the child death variables into a single variable. The R^2's of the regressions were low, but for women 15-39, both variables were significant, generally at the .01 level (one-tailed t-test).

- Relative effects of births and deaths, as defined in the model section, are presented.

- [Why didn't they consider the possibility of an interaction between the number of living children and the response to child death?]

- Ran regressions with child deaths separated by age at death to examine for the possibility of a differential response by age of child and age of mother. Results are sporadically significant, sometimes of the wrong sign.

- When deaths are distinguished by sex of child, response to death of a boy is generally greater than to a death of a girl, although the difference is seldom significant and is not as great as the authors expected. They suggest that this confirms that biological effects (post-partum sterility) are part of the response.

- Appendix describes data definitions and checks for internal consistency.

Carol Burke
9-27-73

Scrimshaw, Nevin S.
Synergism of Malnutrition and Infection. Evidence from field studies in Guatemala.
JAMA, June 8, 1970, V. 212, no. 10, pp. 1685-1693.

To test the extent to which nutritional improvement alone or medical care and environmental sanitation measures alone improve nutritional status, and lower the high morbidity and mortality, and promote growth and development among preschool children.

LITERATURE REVIEW.

1. Acute nutritional disease (kwashiorkor, beriberi, scurvy, keratomalacia or nutritional anemia) seems to be precipitated by a prior episode of infectious disease (diarrheal disease, measles, whooping cough and chicken pox) in children in borderline nutritional status.

2. Improved nutritional status might reduce the frequency and severity of infectious disease is supported by review of extensive literature on this subject.
   N.S. Scrimshaw, C.E. Taylor and G.E. Gordon, "Interaction of Nutrition and Infections", Amer J. Med. Sci., 237, 1968.

3. A prior study of children 1-4 years in Guatemala indicated that nearly two-fifths of 109 deaths were associated with kwashiorkor and in every case an episode of diarrhea, measles, chickenpox, whooping cough or other infection seemed to be a precipitating cause. Respiratory complications usually from one of these communicable diseases accounted for most the remaining deaths.

4. Other preliminary studies indicate that poor nutrition is a major determinant of diarrheal disease in children and that it is associated with poor weaning practices.

A study was done on 10,000 fecal specimens taken from a group of about 1,000 rural Guatemalan children at two month intervals from 1956-1958. The frequency of Shigella, E coli and C Albicans which are bacterial infections was negligible and they were equally distributed among children with and without diarrhea. This was true for intestinal protozoa and helminths. Shigella, a bacterial infection, was isolated in only 13% of patient with diarrhea compared with 6% of those without diarrhea. And there was a high and equal frequency of entero-viral agents in children with and without diarrhea. Therefore, diarrhea is caused by unidentified agents not normally pathogenic for well-nourished children.

5. Other preliminary studies identified environmental factors in the origin and transmissions of diarrheal disease in these Guatemalan villages.

6. The frequency and severity of diarrhea increases with the severity of malnutrition as measured by the degree of retardation in weight for age.

7. Other Institute of Nutrition of Central America and Panama (INTH) document universal retardation of physical growth, high frequency of PCM and gross dietary inadequacies in preschool children in Guatemalan highlands.

DESIGN AND DATA BASE.

per school or total?

Comparison of 3 highland Guatemalan villages of about 1,000 population, each with a different intervention program.

1. Treatment Village (Santa Maria Cauque)
   - medical clinic
   - safe and continuous water supply
   - sanitary privies for each household
   - immunization against small pox, diptheria, tetanus, pertussis and poliomyelitis
   - sanitarian

2. Feeding Village (Santa Catarina Barahona)
   - provision of protein-rich vegetable mixture supplement for preschool children, pregnant women and nursing mothers

3. Control Village (Santa Cruz Balanya)
   - no intervention

Data collected from 1959-1964 includes (a) data on disease, injury, and death (2 week intervals), (b) anthropometric measures (3 month intervals), (c) rectal swabs (3 month intervals), and (d) data on size and structure of households, improvements in housing and sanitary facilities, new houses and municipal improvements (annual).

No statistics provided in article.

RESULTS.

Feeding Village --
- decreased mortality
- increased growth and development
- slightly decreased morbidity

Treatment Village --
- no effect on morbidity e.g. diarrheal disease is not affected by sanitation or drug treatment
- no effect on physical growth and development
- modest reduction in number of deaths

Second year deaths remained high and physical development after 4 months was marked retarded in both the treatment and feeding villages.

REFERENCE.

Scrimshaw, N.S., C.E. Taylor and J.E. Gordon, "Interaction of Nutrition And Infection", WHO monographs series no. [illegible], 1968.

Carol Burke
10-16-73

Scrimshaw, N, J. Salcmon, H. Bruch and J. Gordon
Studies of Diarrheal Disease in Central America. VIII.
Measles, Diarrhea and Nutritional Deficiency in Rural Guatemala.
American Journal of Tropical Medicine and Hygiene, Vol. 15,
No. 4, pp. 625-631. (1966)

The nutritional state of a measles patient is relevant to its course and fatality, and measles may precipitate severe protein deficiency.

DATA BASE AND DESIGN.

Observations were taken for two rural temperate highland Guatemalan villages over a five year period. In one village, Santa Catarina Barahona, children aged 6 mos. to 5 yrs. and pregnant or nursing mothers were offered a daily dietary supplement of a protein-rich vegetable mixture with added powdered milk, sugar and banana. The other village, Santa Cruz Balanya, was a control village. No medical care, except educational efforts related to feeding programs were offered. Observations include a biweekly record of illnesses of children under 5 yrs., height, weight and skinfold thickness of preschool children at 3 mos. intervals and annual physicals. Measles patient weight was taken at short intervals throughout early convalescence.

1 popn = 815 Santa Catarina Barahona

5 children 4 mos. was Santa Cruz Balanya, total popn = 1459

RESULTS.

. The greatest incidence of measles occurred during the second year of life in both villages and more than half the cases occurred in children less than 3 years old. The feeding village recorded a greater proportion of cases in the preschool years, probably because it was a market center and was invaded by measle cases more often.

. An acute diarrhea was a prominent and early complication of measles. Diarrhea occurred in half the patients less than 5 yrs. old. In the control village the incidence of diarrheal disease among patients with measles less than 5 years old was about eightfold that for children the same age without measles. For older children, the diarrhea rate during measles was half that for the younger group and yet 86 times the incidence for those without measles.

. The frequency of diarrhea as a complication of measles is in direct relation to the extent of malnutrition. Diarrhea in patients less than 75% of normal weight of age was three times that for patients within 10% of normal weight.

. Measles was a precipitating cause of Kwashiorkor in 2 of 41 preschool children with measles in control village and in none of 55 in the feeding village.

- The age specific death rate of children under 5 years in the village with food supplements declined from 973 per 100,000 during 1950-59 to 286 per 100,000 during 1959-1964 (rest period). No measles deaths occurred among children receiving food supplements at least 25 percent of the time. Death rates in the control village of a similar high order did not change.

- Case fatality among preschool children was 6.8 percent in the control village and 4.3 percent in the feeding village.

Carol Burke
11-1-73

PLR

Scrimshaw, N.S., C.E. Taylor and J.E. Gordon
Interactions of Nutrition and Infection
World Health Organization, Geneva, 1968.
Selected readings.

1. Infection and Nutritional Status.

- Infections exert an adverse effect on Vitamin A metabolism.

- Infections can precipitate beriberi in persons on a diet inadequate in thiamine.

- Infections are able to induce anemia when folic acid is deficient.

- Studies of the effects of infections on various B vitamins are inclusives.)

- Infectious diseases worsen the ascorbic acid nutritional status of persons among some less privileged populations. INCAP unpublished study indicated loss of Vitamin C in urine during the height of the primary reaction to vaccinations against both smallpox and against measles virus, as well as during acute stages of measles and chickenpox.

- Pneumonia may aggravate rickets (a calcium deficiency disease.) (Vitamin D positively affects calcium and phosphorus levels in blood and thereby produces growth in younger children.)

- Hookworm disease is responsible for much iron deficiency anemia, due to blood passing through worms into the intestine.

- Malaria often results in significant iron loss.

- Chronic bacterial or viral infections produce "anemia of infection" by interfering with iron-binding capacity and ~~orthrolytic~~ erythrocytic (red blood cell) life-span.

- Some acute infections produce hemolytic anemia. (Anemia resulting from destruction of erythrocytes ~~orthrolytes~~.)

- Numerous infectious diseases, as well as local enteric (intestinal) infections, cause diarrhea which disturbs electrolyte balance via potassium and chloride loss.

- Infections appear to interfere with calcium and phospherous metabolism.

- Although infection often increases the amount of fat in the liver , significance is doubtful. Intestinal infection likewise have insignificant effects on fat absorption.

- Low blood glucose levels are common in infectious diseases, probably due to reduced caloric intake.

- Infections commonly alter the activity of essential enzymes.

- Infections reduce food intake by reducing appetite. Also OFTEN therapy wrongly requires withdrawal of solid foods or other changes in diet, usually producing protein deficiency.

- Even minor infections result in increased loss of nitrogen in the urine.

- Acute diarrhea characteristic of most infections decreases nitrogen absorption.

- Helminthic diseases (intestinal worms) reduce nitrogen absorption.

- Kwashiorkor is precipitated by acute diarrheal disease, measles and other infections superimposed on diets already low in protein and calories.

- No nutritional deficiency is more consistently synergistic with infectious disease than Vitamin A. A deficiency in Vitamin A results in increased susceptibility to infection.

- Synergism with infection is observed with deficiencies of Vitamins D and E, ascorbic acid, thiamine (with viral and protozoal infections), pathothenic acid, folic acid, and Vitamin B12 (to a lesser extent).

2. Determinants of the Effects of Nutrition on Infection.

- Host characteristics, including resistence to infection, are a result of genetic variation and environmental influences, such as diet.

- The direct effect of malnutrition on host resistance is well documented.

- Nutritionally induced changes in antibody formation, phagocytic activity, tissue integrity, inflammatory response, intestinal flora, endocrine metabolism and non-specific mechanisms are reviewed in the section. Almost every nutrient is relevant.

Schneider (1950).

genetic? of mice

- When natural resistance was high, disease did not result no matter how the diet was varied.

- When natural resistence or constitutional resistence was low, severe infectious diseases occurred regardless of nutritional factors.

- When natural or constitutional resistence was neither high nor low, nutritional factors did affect the outcome of the infection.

Russell
11-5-73

PLB

Sloan, Frank
Survival of Progeny in Developing Countries: An Analysis of Evidence from Costa Rica, Mexico, East Pakistan, and Puerto Rico
Rand Report No. R-773-AID, July 1971

The study uses regression analysis of regional averages to identify the determinants of infant and preschool child mortality in less-developed countries.

DATA BACKGROUND

. Data are available for political subdivisions of Costa Rica, Mexico, East Pakistan, and Puerto Rico. Infant and preschool death rates are presented for some of the subdivisions of each country.

. General review of measurement error effects: if errors in the dependent variable are correlated with an independent variable, the coefficient of that variable will be biased; if errors in the dependent variable are unrelated to any independent variables, the standard errors of the coefficients will be larger than in the absence of error; if an independent variable is measured with error, the coefficient estimate will be biased toward zero.

LITERATURE REVIEW AND HYPOTHESES

. Single equation model estimated here measures only the partial or direct effects of each variable (e.g., education is expected to have a negative direct effect on mortality, but it has a positive effect on labor force participation, which has a positive effect on mortality; the total effect of education is the weighted sum of its direct and indirect effects).

. Education. More education is expected to be associated with lower infant mortality; primary reasons suggested have to do with better knowledge of appropriate health measures of educated parents, from cleaning dishes to seeking vaccinations.

. Maternal Time Input. More time at home is expected to be associated with lower infant mortality because of better care, longer breast feeding. Proxy for this variable, labor force participation for all women, may be a poor measure because in many countires, mothers with small children are less likely to work, although the need for additional income may counteract this in poor countries; and because not all work requires a lot of time away from home.

. Nutrition. Better nutrition is expected to be associated with lower infant mortality. Two mechanisms supported by the literature: poor nutrition reduces resistance to infection; infectious disease may worsen nutritional status. This study tests for the effect of protein deficiency. [Hellman & Hall, p. 1102: maternal malnourishment affects amount of breast milk more than composition.]

. Sanitation and Housing. Improvements in both are expected to be associated with lower infant mortality, but the evidence is contradictory. Public health measures have reduced deaths due to typhoid fever and malaria. There is no evidence that housing has an important effect on health, either through regressions or through experimental-control group tests (which suffer, in practice, from income effects due to the housing subsidies).

. Medical Care. Medical care is expected to be associated with lower infant mortality rates, although there is little persuasive quantitative evidence. Resources per capita can be used as a proxy for price; if possible, government and private should be disaggregated because of the money price attached to the latter. Health expenditures are a proxy for flows of services. More direct measures of services: e.g., percentages of births and deaths at home.

. Sex of Child. Male infant and preschool mortality usually exceeds female.

. Parity and Age of Mother. A U-shaped, or increasing, relation between parity and mortality is often observed but the suspicion seems to be that this is actually due to other variables such as: spacing of births, maternal age, poorer nutrition of mother and child in large (poor) families, [do the PAHO data show that higher birth order children are more poorly fed?]; higher order children are more likely to be unwanted, hence more poorly cared for.

RESULTS

COSTA RICA

. Corrected R^2's are about .15-.20 in the infant mortality equations and .50 in the child mortality equations, for 68 observations. Female literacy is negative and significant in both equations. Percent of infants of low birth weight, a proxy for nutrition, is positive and significant in the infant mortality equation. Percent of births at home, a proxy for medical services, is positive but significant only in the child mortality equation. Variables representing water supply and housing quality are insignificant.

MEXICO

. Data available for 1950 and 1960 revealed no structural differences between years, none between male and female children. R^2's average .35 for infant equations, .45 for 1950 child equations, and .70 for 1960 child equations. Female literacy is negative and significant only in the child mortality equations. Female labor force participation is insignificant. Nutritional variable, percent eating animal products less than once daily, is positive and significant. Housing variables are generally insignificant. Medical care, as measured by the availability of a doctor, is insignificant. Ran additional regressions using the changes in the variables between 1950 and 1960 to test for omitted variables that vary between the Mexican states, but not overtime; the results differ from the regressions run on the levels of the variables and are unconvincing (note that the only nutrition variable available for both years was a measure of wheat bread consumption, not the protein consumption variable used successfully in the 1960 regressions).

EAST PAKISTAN

. Nothing is consistently significant except hospital beds per capita and an urban-rural dummy.

PUERTO RICO

. Initial results were implausible and the correlation between infant mortality and medical facilities suggested a registration problem, with consequent errors in variables.

APPENDICES

. A discusses measurement error in registration-based data.

. B presents a statistical analysis of the determinants of the nutrition measures available for Mexico and East Pakistan [We might consider an analysis of the child's nutrition along similar lines]. In the East Pakistan data factor analysis is used and produces two factors: one is made up primarily of Vitamin A and Vitamin C deficiencies related to the consumption of green vegetables; the other is made up primarily of calorie, protein, thiamine, and niacin deficiencies which are related to the consumption of meat, eggs, pulse, (e.g., peas, beans, lentils) corn, and rice.

. C presents a statistical analysis of housing.

. D analyzes the percent of births not attended by a physician, as a measure of medical services to infants. Income and the ratio of legal to consensual marriages are statistically significant; the negative sign of the latter is taken as support for a hypothesis advanced earlier that parents in consensual marriages will be less likely to invest in medical care for their children. Variables reflecting medical resources are not significant.

Carol Burke
10-18-73 pub

Wray, J.D.
Population Pressure on Families:
Family Size and Child Spacing
Reports on Population/Family Planning
(New York) 9: August 1971, pp. 403-46.

We are missing pages 456 through 459.

This article is a summary of the studies which related to family size or birth intervals and their association with morbidity, mortality, physical growth, intelligence and maternal health.

Day. Summary of the studies re: effects of either increasing family size or decreasing birth interval on survival of fetus and child. (A complete citation is not available because it appeared on one of the missing pages.)

1. Family size related to morbidity, mortality, physical growth and maternal health.

Morbidity. Economic limitations, crowding and generally poor sanitation are associated with increased morbidity and increased family size.

- Family size is one of the factors involved in the etiology of malnutrition. (Columbia, Agurrie and Wray)

- The size of the family appears to have little effect per se on health of younger children; rather family is "at risk" because of poverty accompanied by poor parental capability. (Roberston and Kemp, South Africa.)

Mortality.
(Morris and Heady, England)

- There is an increase in mortality with number of children by social class.

- Deaths due to causes associated with prenatal factors - congenital malformation - do not vary with family size or social class as do those associated with environmental factors, such as infections.

- Mortality increases with family size throughout the second year in all maternal age groups but especially in young mothers.

- Mortality rates increase with family size in all social classes; but especially in younger mothers, regardless of social class.

- Increasing mortality is associated with prematurity, maternal age, and social class. cw?)
(Chase, NYC.)

. At all stages, including early and late fetal periods, death rates are highest with higher orders of pregnancies.
(Yerushalmy, Hawaii).

. Congenital malformations of various kinds are associated with maternal age rather than parity with two exceptions. There is a statistically significant increase in risk for offspring of advanced birth order for ~~for~~ infective and parasitic diseases; and an increased risk associated with higher parity in the younger mothers. (Newcombe and Tavendale, British Columbia; Morrison et al England.

Physical Growth.

. Differences in the growth of children associated with family size were not limited to the lower class, but reached a maximum in lower class and were established by age 4 1/2 in both sexes. (Douglas and Simpson, England).

. Later born children of any consecutive pair within a family tended to be taller than the preceding one. (Grant, England)

Findings re sex maturations and family size are omitted.

Intelligence.

Maternal health.

. Incidence of hypertension increased with the number of children.
(Scotch, Africa)

. The increase in diabetes with increasing parity of women is statistically significant. (Pyke, England).

. Repeated pregnancies followed by prolonged lactation periods will produce sustained needs for high quality protein. (Jelliffe, U.S.)
"Maternal Depletion Syndrome." (Eastman, U.S.)

. Maternal mortality exceeded the average overall mortality risk for those 35-50 years old. Obstetrical complications also increase with maternal age.
(Wright, Ceylon: Perkins, Thailand.)

2. Birth interval related to mortality, morbidity, prematurity, and maternal health.

Mortality.

. Minimum stillbirth rates appear in increasingly older age groups as parity increases. (Yerushalmy) ?

. Abortions, stillbirths, premature delivery and neonatal death are all proportionately higher in very small birth interval groups. Differences among other groups are small. (Eastman, U.S.)

. In all maternal age groups and in all social classes, the postneonatal mortality rates are higher in closely spaced groups than in other groups. (England).

. Both neonatal and infant mortality rates were higher among infants born at short intervals and differences are statistically significant. (Gordon and Wyon, India.)

Morbidity.

. No studies of the association between birth interval and morbidity were found; only studies of the clear-cut association between mortality rates and birth interval. Also there are some studies indicating that there is a statistically significant relation between malnutrition and short birth intervals as measured by number of preschool children in a family. (Douglas, England.)

Prematurity.

. Eastman (U.S.) found high rates of prematurity among children born after a brief interval.

Growth.

. Growth, used as an indicator of nutritional status, was found to be associated with birth interval. (Agurrie and Wray, Columbia.)

. The advent of each additional child acts as a check on the growth of all preceding siblings. (Grant, England.)

Intelligence.

Maternal health.

. "Maternal depletion syndrome" is a consequence of short birth intervals (Eastman, U.S.) He examined five factors in relation to birth interval: maternal anemia during pregnancy, toxemia of pregnancy, postpartum hemorrhage, puerperal fever and maternal mortality. Anemia was more common (34.5 percent) in the brief interval (less than 12 mos.), but the group was too small to warrant conclusions. Also, the longer the interval between births, the more likelihood there is to suffer hypertensive toxemia of pregnancy. Eastman was unable, however, to control for age, also associated with toxemia of pregnancy.

The data for most of the studies mentioned above is presented either in graphic or tabular form in this article.

Carol Burke
11-1-73

Zucker, Theodore and Lois Zucker
Nutrition and Natural Resistance to Infection
(Eds.) Wohl, M. and R. Goodhart
Modern Nutrition in Health and Disease, Lea & Fetiger
(Philadelphia), 1964, pp. 633-657.

. Natural resistance to microbial infectious states is genetically determined.

. Barriers or defense mechanisms which protect the host against microbial diseases are epithelial surfaces (skin and mucus membrane), naturally occuring bactericidal substances in tissue and body fluids (betalysin, leukin, plakin, saliva, nasal secretions, tears, lipid fraction in serum, lysozyme in mucus secretions, tears and egg whites, certain polypeptides in amino acids, and others) and blood leukocytes or macrophages.

. The environmental factors which predispose to infection are exposure to low temperature, fatigue and corticoadrenal activity (stress).

. In some cases deficiency of particular nutritional essentials may increase natural resistance, particularly with infective agents which are parasitic such as virus, [illegible]

. Nutritional factors, particularly Vitamin A, are essential for the intactness of epithelial surfaces.

. Few studies of nutritional effect on resistance with all the necessary controls exist.

. It appeared that a factor responsible for increased resistance is contained in wheat. (Howie)

. Low ascorbic acid levels in blood or tissue and infection are associated. (Dubos; Raffel; Reed).

. Resistance depends on an interaction between more virulent and less virulent organisms present in the inoculum, and is not due to any activity of the host (Schneider). This is contrary to generally accepted teaching.