MATERNAL NUTRITION PROGRAMS:

A CRITICAL ANALYSIS*

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I. INTRODUCTION

The fact that an adequate diet has possitive effects on the pregnant woman and her progeny is a generally accepted fact. This knowledge is in great part responsible for the establishment of programs oriented to improve the nutritional status of the pregnant woman.

The first evidence of the diet effects on reproduction had its origin in the 1930 decade, when studies in animals carried out by Hale,[1] and in humans by McCance *et al.*[2] and by Orr,[3] suggested that a deficient diet was associated with a greater incidence of fetal abnormalities and low birth weight.

The Second World War supplied the natural environment to prove these observations in a national context, through selective supplementary programs for pregnant

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* Presented at: Colloquium on "Prenatal and Perinatal Nutrition" held as part of the IV Latin American Nutrition Congress, Caracas, Venezuela, 21-27 November, 1976, under the sponsorship of the Latin American Nutrition Society (SLAN).

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women and children. In England, between 1940 and 1945 it was found that improvement of the diet was related with a significant reduction in the rate of stillborn infants. Since pregnant women did not count with adequate medical attention during this period, Thomson[4] later suggested that reduction in the mortinatality rates was primarily a consequence of a better nutrition during pregnancy, under extraordinarily deficient social and health conditions.

In a similar way, "natural food experiments" carried out in Oslo during the II World War also supported a possible relation between supplementation during pregnancy and the decline in the prematurity and mortinatality rates.[5]

Ebbs, Tisdall and Scott[6] in Toronto, provided supplementation to 90 women of low socioeconomic level, comparing them with 120 women of the same condition, not supplemented, and with 170 women of medium socioeconomic level. Even though weight at birth was similar in the three groups, the low socioeconomic women exempt of supplementation, exhibited a greater incidence of perinatal complications.

Balfour[7] on his part, evaluated the effects of an extensive supplementation program which included 11,618 women of low socioeconomic level, and his results supported those of previous studies. A lower fetal and neonatal mortality rate was observed in children whose mothers had received the supplemented diet.

Research carried out after World War II can be classified in three categories:

1. Controlled experiences in pregnant women carried out in the United States of America, Canada and Great Britain.

2. Transcultural studies in countries where malnutrition is prevalent.

3. Studies in animals.

Kasius *et al.*[8] provided vitamins, proteins and vitamins, and only proteins, to three groups of women in Philadelphia, without observing differences between birth weight, height and thoracic perimeter of children born from supplemented women with respect to those of a control group. Goldtich[9] in San Francisco, California, was also unable to demonstrate effects resulting from protein supplementation during pregnancy on the birth weight of children delivered by women of medium and low socioeconomic level.

Certain number of studies, however, back the favorable effects of supplementation, including those of Higgins,[10] Harrell, Woodyard and Gates[11] and Kasius *et al.*[8] For example, Higgins found a reduction in the incidence of prematurity in women of low socioeconomic level who received supplementation, even though the higher birth weight of the child was not considered related to supplementation. On their part, Harrell and his group informed of higher IQ's in the children of black women to whom supplementation had been provided. Kasius and co-workers also observed a decline

in prematurity and toxemia in supplemented women, but without proving any effect on the physiological conditions of their children.

In general, these last two studies are difficult to interpret and do not sustain the evidence of a clear impact of supplementation. Birch and Gussow[12] have formulated a series of methodologic considerations wich could be the responsible factors of these findings.

Among them, the impossibility of establishing the relative effects of factors such as maternal diet, the mother's health and the product of pregnancy should be mentioned. Furthermore, the probability exists that the studies in question did not include those women of low socioeconomic level subjected to the risk of severe nutritional deficiencies, both before and during pregnancy.

The transcultural-type of research has permitted to study populations affected by chronic malnutrition for various generations. These studies have shown a positive relation between supplementation and the pregnancy product, particularly when improvement of the diet reaches the more at-risk groups. Studies carried out by the Division of Human Development of INCAP in four rural villages of Guatemala,[13-15] revealed that birth weight was significantly higher in the case of those children whose mothers received greater supplementation during pregnancy, thus suggesting that the effect of the calories would be the most important. In addition, recent results show advantages in the development of these children as a consequence of the higher intake of the mother.[15] Chávez, Martínez and Yashine[16] have supplemented the diet of women and children in a village of Mexico. Their results demonstrate an improvement in the health of both groups, a more positive attitude of the parents towards the children that have received supplementation, and a more independent behavior of the children themselves. In view of the fact that the supplemented group has had greater contact with the investigators and no basic nutritional information is available for the experimental nor for the control groups, it cannot be definitively clarified whether the possitive effects observed can be attributed exclusively to dietary factors. Both studies, however, support a positive relation between food intake during pregnancy and the product, and the newborn and the breast-fed child when supplementation is provided to severely deficitary populations.

Recently, some transcultural studies have been aimed at the relationship between low socioeconomic level and inadequate conception products. Since malnutrition is highly prevalent in these sectors, it may not be useful to try to separate the nutritional effects from those resulting from social stratification.

The central objective of the research carried out in animals has been to study the effect, on the product, of dietary restriction during pregnancy and lactation. Winick[17] has demonstrated that nutritional restriction during pregnancy is associated with a decrease of 15% of the cerebral cells at birth, and that reductions of up to 60% are observed when the animals are subjected to malnutrition *in utero* and during lactation.

Chow and Lee[18] and Chow *et al.*[19] also demonstrated growth arrest and abnormalities in the protein and carbohydrate metabolism as a result of dietary restrictions during only pregnancy, and in the pregnancy and lactation periods, with more markedly effects in the latter case.

These studies together with those of Smart and Dobbing,[20] Barnes *et al.*[21], Frankova and Barnes[22] and others, indicate that in the rat, the nutritional status during pregnancy is associated to anatomic and behavioral changes of the product.

However, the intergenerational malnutrition models in animals are more comparable to human groups who have suffered from malnutrition for various generations than the unigenerational models. These studies have shown that malnutrition present in more than one generation is associated to more serious effects, and that their correction requires more prolonged periods of dietary supplementation.[23]

Galler and Rosenthal[24] have studied a rat colony with intergenerational malnutrition supplemented from birth, by crossing them with well-nourished female animals. These rats rapidly increased their weight and at the moment of weaning did not differ from the well-nourished animals in weight or in body length. Nevertheless, the differences in behavior persisted, observing that the intergenerational malnourished rats were fed less frequently by the female rats than the well-nourished animals. When the females with intergenerational malnutrition were supplemented before pregnancy, the product weight at weaning was higher than that of those who received an adequate diet only as of birth; this indicates that the earlier the supplementation is instituted, the greater the favorable effects on the pregnancy product.[25] In summary, the studies in animals on the consequences of malnutrition in pregnancy and in their products have not always rendered the type of evidence expected from them, due to problems in the methodology and design employed.[26, 27]

In spite of it, these data in general suggest significant effects when the pregnant females are exposed to malnutrition. On the other hand, even though these results cannot be extrapolated to the conditions existing in the human being, together with the studies previously referred to, they permit to point out an important number of relations which require more at depth research.

II. NUTRITION PROGRAMS

Programs leading to improve the nutritional status of the pregnant woman are becoming increasingly more common in the developing countries, for the purpose of modifying the high infant mortality and malnutrition rates that exist in the majority of them. Supplementary feeding and nutrition education constitute the interventions more frequently used. Although the importance of these programs cannot be overlooked, they are subject to numerous limitations in their design and implementation which need to be examined and corrected if the purpose is to improve them in the future.[28] A direct consequence of these limitations has been the inability to seriously evaluate the nutritional impact of such programs.

As happens with educational activities, supplementation has also been almost totally implemented through the health services that in addition provide prenatal care. But it has been proved that, unfortunately, important groups of women do not benefit from these services, a fact which limits their scope in a considerable degree. The experiences of Chile with the National Leche Program is illustrative in this respect (Tables 1 and 2). Having an extensive net of health services, in 1972 only 54% of all the pregnant mothers could be supplemented. On the other hand, even though through studies carried out in the rural areas it was proved that 78% of the program beneficiaries regularly received their milk quota, certain marginal and rural sector groups were excluded not only from dietary supplementation but also from all health care measures.[28] As already commented in this paper, if the effects of supplementation can only be detected in those populations who are more at risk of malnutrition and poverty, it is quite possible that in the case of Chile, the Leche Program did not cover an important group of pregnant women who really were in need of said supplementation.

TABLE 1

COVERAGE OF THE NATIONAL LECHE PROGRAM, CHILE 1972

Beneficiary groups	Population*	Coverage, %	
		Programmed	Carried out
Breast-fed infants (0-23 months)	523,000	85	57
Preschool children (2-5 years)	981,000	70	59
School children	2,027,000	80	90
Pregnant women	437,000	70	54

* These figures were obtained from the Annual Report of the United Nations, 1972. The age structure is based on the percentages utilized by the Public Health Department of the University of Chile.

Taken from Hakim and Solimano.[28]

In addition, the effectiveness of these nutrition activities depend in a great measure of access means to the health services. Firstly, in the majority of the

developing countries, the rural and marginal urban communities do not have or have only a limited access to such services. Secondly, the possibility of absence of perinatal complications is closely related with the good health conditions of the mother during pregnancy, so that the lack of medical attention itself and, *per se*, determines negative consequences for these at high-risk communities.

TABLE 2

FAMILY CONDITION AND PARTICIPATION IN THE LECHE PROGRAM, CHILE, 1972

Socioeconomic level of the family	Percentage of families participating in the Program
Medium and high income	65
Medium-low income	78
Low income	82

Participation according to number of beneficiaries

Number of beneficiaries in the family	Percentage of families participating in the Program
1	69
2	72
3	80
4 or more	88

Taken from Hakim and Solimano.[28]

Another concept that should be taken into consideration and that obviously makes the evaluation of these programs a difficult task, is that maternal nutrition constitutes one of the many independent variables that affect the fetal viability and survival. More still, fetal viability may not have any relation with the nutritional measures if other necessary conditions are not fulfilled. The observed changes in the infant mortality rates in Chile during the last 40 years, when food supplementation has been provided to women and children at risk of malnutrition are illustrative in this sense.[29] Even though this rate has significantly diminished (Table 3), the reduction has been proportionally greater in the medium and high-income sectors who did not receive supplementation through public programs (Tables 4 and 5).

TABLE 3

INFANT MORTALITY RATES (PER 1,000 BORN ALIVE), CHILE, 1927-1973

Year	Rate	Year	Rate
1927	226	1964	105.3
1930	234	1965	99.8
1935	251	1966	101.9
1940	192	1967	98.4
1945	164.5	1968	86.6
1950	136.2	1969	78.7
1955	119.2	1970	79.3
1960	126.2	1971	70.5
1961	114.1	1972	71.1
1962	113.6	1973	65.3
1963	105.5		

Taken from Solimano and Hakim.[29]

TABLE 4

INFANT MORTALITY IN PROVINCES WITH HIGH, MEDIUM AND LOW INCOME, CHILE, 1940-1947

	Infant mortality rates (per 1,000 born alive)		Per cent change
	1940	*1947*	
Provinces with high income	179	144	20%
Provinces with medium income	199	163	18%
Provinces with low income	205	184	10%
National average	197	167	15%

Taken from Solimano and Hakim.[29]

TABLE 5

INFANT MORTALITY IN PROVINCES WITH MEDIUM AND LOW INCOME, CHILE, 1958-1959 AND 1968-1969

	Infant mortality rates (per 1,000 born alive)		Per cent change
	1958-1959	*1968-1969*	
Provinces with high income	98	59	40%
Provinces with medium income	130	96	26%
Provinces with low income	136	105	23%
National average	116	81	30%

Taken from Solimano and Hakim.[29]

In certain countries like Cuba, China, and others, programs oriented to improve the nutrition of the pregnant woman, form part of the integral health care that the Government provides to all citizens. As a result of these integrated programs, significant reductions in perinatal mortality (see Table 6) have been observed in Cuba[30] in spite of the fact that the percentage of children born alive with a weight of 2,500 grams or less has somewhat increased during the 1968-1974 period (Table 7).

TABLE 6

PERINATAL MORTALITY, CUBA, 1968-1974

Years	Fetal mortality*	Mortality < 7 days	Perinatal mortality**
1968	17.2	16.8	33.4
1969	16.3	17.4	33.2
1970	15.3	17.2	32.1
1971	14.8	17.1	37.4
1972	13.5	15.7	28.8
1973	13.1	15.9	28.7
1974	12.9	15.6	28.2

* Of 7 months and more of gestation according to fetal death certificate.

** The denominator includes born alive and fetal deaths.

Taken from Riverón.[30]

The integral health care in Cuba is possible thanks to measures such as: 1) distribution of the service units and human resources throughout the country, including the rural areas. This measure allowed provision of institutional attention to 96.6% of all parturitions occurring in 1974. 2) Equality of access to the health services and gratuitous attention as the State's responsibility. In this manner, an average of 9.0 prenatal consultations have been achieved, and 5.5 consultations per child during his first year of life. Maternal mortality decreased from 11.8 in 1972 to 5.6 per 10,000 born alive in 1974.[30]

TABLE 7

MORTALITY RATES AND PREMATURITY INDEX, CUBA, 1968-1974

Years	Fetal mortality*	Neonatal mortality	Percentage of born alive with 2,500 g or more**
1968	17.2	23.1	8.1
1969	16.3	25.7	8.5
1970	15.3	22.8	10.3
1971	14.8	22.4	9.9
1972	13.5	19.2	9.8
1973	13.1	19.4	10.4
1974	12.9	18.6	10.7

* Of 7 months and more of gestation according to fetal death certificate.

** Born alive in institutions.

Taken from Riverón.[30]

The integral care program of women carried out at the levels of primary attention unit, polyclinic or rural hospital, include activities destined to prevent and minimize the risk of the pregnant woman and of the fetus. Among these, early captation, nutrition education and provision of income to maternal homes as of the 8th month of pregnancy for those women who live in very isolated zones or who have been catalogued as at high risk, have first priority.

Another limiting factor of supplementation is that foods are generally not exclusively consumed by the pregnant woman, but are distributed among the different members of the family. Although the available evidence is limited, this fact must be taken into account when designing interventions of this type.[31, 32]

An assumption accepted up to this moment is that the poor do not utilize their food budget in a nutritionally efficient way and, therefore, their diet would significantly improve as a result of nutrition education. However, recent studies have demonstrated that with the existing income levels, only marginal effects are to be expected as the result of changes in the purchasing habits of these groups.[33]

Birch and Gussow[12] have expressed that "it is evident that even though differences in habits and beliefs are very important, poverty constitutes the fundamental factor, that joined to ignorance, maintains the low-income woman badly fed." The same authors cite the studies of Grant and Groom[34] who, in 1956, found a direct relationship between protein intake and economic level in black women of South Carolina.

During the last years new approaches have been and continue to be tested to improve the food supplementation programs. Based on the evidence that it is difficult to effectively supplement only one member of the family unit, the need of providing foods to all members of the at high-risk families with children and women in their reproductive age, is recognized. When these population groups do not have access to health services, especially in the rural sectors, foods are directly delivered to the beneficiaries.

In 1974 Panama initiated a program of this type in the Province of Veraguas whose impact is now being evaluated.[35] Nevertheless, it must be recognized that the health policy followed by this country since 1969 has placed special emphasis in the integration of the Health Services; the organization and participation of the community in all health activities; the priority of the rural sector, and the reallocation of human and material resources in accordance to the needs. The evolution of certain health indicators can be appreciated in Table 8.[36] Consequently, it is a rather difficult task to elucidate the specific effect of nutritional interventions, even at province level.

In spite of this, even countries that count with the best health services have not assessed at national level their maternal supplementation programs, through the use of indicators that could supply more sensible and direct information in regard to their effects. The weight increment during pregnancy, the incidence of small for gestational age newborns, and certain perinatal morbidity are extemely useful indicator if collected systematically and in a reliable way. The follow-up of representative population samples constitutes a mechanism not difficult to implement if established opportunely.

In synthesis, we believe that the available experience supports the increasing need for integrating the nutrition programs with the health programs directed to the more vulnerable groups, that is, to women in the reproductive age and growing children. More still, protection of the mother and child binomial must go further than mere health care, by establishing social, legal and economic measures, especially for working women. The character of these measures will vary according to the political and institutional organization of each country, but undoubtedly, it is necessary to exchange experiences and obtain maximum benefit from them.

TABLE 8

HEALTH INDICATORS IN PANAMA

Year	Mortality						
	General*			Infantile**			Maternal***
	Total	Urban	Rural	Total	Urban	Rural	Total
1969	7.0	5.7	8.2	39.9	30.2	47.0	1.4
1970	7.1	6.0	8.2	40.5	36.1	51.0	1.4
1971	6.7	–	–	37.6	34.0	41.0	1.1
1972	6.0	–	–	33.6	28.6	39.5	1.1
1973	5.8	5.0	8.2	33.3	22.8	45.7	1.0
1974	5.6	5.1	6.0	33.0	24.7	37.2	0.8
1975 (p)	5.2	4.8	5.6	29.2	24.2	37.4	0.9

(p) Preliminary figures.

* Per 1,000 inhabitants.
** Per 1,000 born alive.
*** Per 1,000 born alive.
– Figures not available.

Taken from Said.[36]

Actual knowledge on the at-risk factors permits a better definition of populations who should benefit from nutritional interventions considering not only their biologic vulnerability, but also their social vulnerability. These elements must be taken into account when planning these programs. The participation of researchers in the different countries, and the integration of interdisciplinary teams, constitute a very useful mechanism if established in an adequate manner.

Finally, all nutritional intervention programs must include in their budget an allotment for applied evaluation and research work, the latter destined to study alternatives that permit maximizing the impact of such programs.[37]

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