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A health priority for developing countries: the prevention of chronic fetal malnutrition*

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The incidence of intrauterine growth retardation (IUGR) due to fetal malnutrition was 23.8% in a poor urban population of Guatemala City. Of these, 79.1% were chronically malnourished in utero (defined as IUGR with an adequate ponderal index). Data from Guatemala and from developed countries show that this IUGR subgroup of chronically malnourished infants do not recover from their intrauterine damage and score the lowest in mental development tests even up to school age. In Latin America it can be expected that at least 2 million infants born every year are at birth already destined to remain undergrown and underdeveloped. Public health programmes should aim at reducing the incidence of chronic fetal malnutrition if there is to be a real improvement in the wellbeing of populations in the developing countries.

Intrauterine growth retardation (IUGR) due to fetal malnutrition is one of the most important perinatal syndromes. In developing countries, the incidence of low-birth-weight (LBW) infants (<2500 g) can be as high as 30%, prematurity accounting for a fixed 5-7%, the excess being almost entirely due to IUGR (*1*). Although the latter appears to respond to medical and public health interventions (*2, 3*), infants who are malnourished at birth are known to have increased morbidity, mortality, and long-term disabilities (*4-6*).

Intrauterine growth-retarded newborns can be classified into subgroups based on differences in their nutritional status. These differences can be distinguished at birth using the ratio of weight-for-length, which is summarized by Rohrer's ponderal index (PI) (*7*). IUGR infants who have *low* PI values (IUGR-LPI) (i.e., below the 10th percentile) are the result of acute or subacute fetal malnutrition and are referred to as disproportionately growth-retarded, "asymmetric", "wasted", or "late flattening" (as shown by ultrasound). IUGR infants who have an *adequate* ponderal index (IUGR-API) (i.e., above the 10th percentile) are the result of chronic fetal malnutrition and are referred to as proportionately growth-retarded, "symmetric", "stunted", or "low profile" (as demonstrated by ultrasound) (*8*).

Several studies have shown that these two IUGR subgroups have distinct differences in their placental characteristics (*9, 10*), the incidence and type of neonatal morbidity (*11*), postnatal growth patterns

(*12-14*), and performance in mental and developmental tests later on (*6, 12, 15*).

Our hypothesis is that IUGR-API infants (due to chronic fetal malnutrition) are more prevalent in underdeveloped countries, while IUGR-LPI infants predominate in developed countries. The present study reports the proportion of chronically malnourished neonates in an urban population in Guatemala and compares it with the findings from other populations in both developed and developing countries.

MATERIALS AND METHODS

A total of 3557 neonates born consecutively, during 1983, in the Obstetrics/Gynecology Hospital of the Guatemalan Social Security Institute (IGSS), in Guatemala City, were prospectively enrolled in the study. This population represents the lower-middle class sector of the city. The gestational age of all the newborns was estimated by the last menstrual period (LMP) of the mother and by physical examination at birth (*16*). In all cases the gestational age as estimated by physical examination was used for the IUGR classification.

IUGR newborns are considered to be those whose weights are below the 10th percentile of a sex- and race-specific, birth-weight and gestational-age distribution, based on a developed country population (*17*). Of the 848 who were in this category, 68 were preterm-IUGR infants (<37 weeks gestation, ≤10th percentile) and 780 were term-IUGR infants (≥37 weeks gestation, ≤10th percentile).

The ponderal index was calculated for each infant using the following formula: weight/length^3×100. These PI values were used to further classify the IUGR population as having chronic fetal mal-nutrition (IUGR-API) or subacute fetal malnutrition (IUGR-LPI) if, respectively, above or below the 10th percentile of the standard PI distribution of Lubchenco et al. (*18*). Both term- and preterm-IUGR newborns were included in the analysis, so that differences in obstetrical management would not influence the incidence of IUGR-LPI and IUGR-API infants A comparison group of 723 normal-birth-weight (NBW) term infants was selected by systematic random sampling from the remaining 2709 births. Standardized anthropometric measurements and physical examination of the newborns were performed within 24 hours of all births by two trained obstetricians.

RESULTS

Mean values and standard deviations for gestational age, birth weight, length, head circumference, and PI for the IUGR and comparison groups are shown in Table 1. As expected by the definitions used, the IUGR-LPI newborns had a mean birth weight similar to that of the IUGR-API newborns; both were significantly lower than that of the NBW group ($P < 0.01$). On the other hand, the IUGR-API infants were shorter and had smaller head circumferences than both IUGR-LPI and NBW infants.

The incidence of IUGR in this population was 23.8%. Among the IUGR infants, 177 (20.8%) had PI values below the 10th percentile standard (indicating subacute fetal malnutrition or IUGR-LPI), and 671 (79.1%) had PI values above the 10th percentile (indicating chronic fetal malnutrition or IUGR-API). Among the preterm-IUGR infants, 85% were IUGR-API; among the term-IUGR infants, 78.6% were IUGR-API. The IUGR-LPI group had 2.8 times more infants with Apgar scores

Table 1. Anthropometric characteristics of the population studied

Variables	NBW group (n = 723)	IUGR-LPI group (n = 177)	IUGR-API group (n = 671)
Gestational age (weeks)	39.3 ± 0.8 [a]	38.9 ± 1.2	38.5 ± 1.8 [b]
Birth weight (grams)	3214 ± 331 [c]	2384 ± 331	2484 ± 336 [d]
Length (centimetres)	49.4 ± 2.0 [c]	48.5 ± 2.1	46.2 ± 2.6 [d]
Head circumference (centimetres)	34.0 ± 2.3 [c]	32.5 ± 1.7	32.2 ± 1.8 [b]
Ponderal index (W/L^3× 100)	2.68 ± 0.44 [c]	2.08 ± 0.15	2.51 ± 0.33 [d]

[a] $P < 0.0003$ (NBW (normal-birth-weight infants) vs IUGR-LPI).

[b] $P < 0.02$ (IUGR-LPI vs IUGR-API).

[c] $P < 0.0001$ (NBW vs IUGR-LPI and IUGR-API).

[d] $P < 0.0001$ (IUGR-LPI vs IUGR-API).

Table 2. Proportion of chronically malnourished newborns (IUGR-API) in the total IUGR population in developed and developing countries*

Population, year and reference	No. of IUGR Infants	IUGR-API group (%)
Urban Guatemala, 1984 (current study)	848	79.1
Rural Guatemala, 1984 [12]	143	68.5
Rural South Africa, 1979 [19]	188	67.5
Netherlands, 1982 [11]	119	61.3
USA, 1980 [20]	33*	39.4
England, 1979 [13]	47	34.0
Canada, 1978 [5]	83	22.9
Yugoslavia, 1978 [21]	118	20.3†
USA, 1973 [22]	165	20.0
England, 1982 [23]	51	19.6

* IUGR is defined as <10th percentile for gestational age, except for the result marked * (<5th percentile). IUGR-API is defined as >10th percentile of a ponderal index distribution, except for the result marked † (>5th percentile).

<7 at 1 minute than the NBW group, while the IUGR-API infants were 2.0 times more at risk of Apgar scores <7 at 1 minute.

Table 2 compares the results from studies carried out in various populations in both developed and developing countries. These results show that populations in developing countries have a higher incidence of chronically malnourished neonates (IUGR-API) within their IUGR population (67–79% of the IUGR group), while populations in developed countries have a predominance of subacute fetal malnutrition (IUGR-LPI), the proportion of chronically malnourished newborns (IUGR-API) being only 20–40% of the total IUGR population, with one exception [11].

DISCUSSION

The results presented here on the incidence of two types of intrauterine growth retardation from an urban, lower-middle class population in Guatemala City should be considered as population- rather than hospital-based because 90% of all deliveries in public institutions of IGSS-eligible women occur in the Obstetrics/Gynecology Hospital. Our series of consecutive births prospectively collected can, therefore, be considered as representative of this segment of Guatemala City's population.

All the anthropometric measurements were carefully obtained by two observers associated with the study. Reliable gestational-age information, so difficult to obtain for large samples, was always confirmed by using a standardized method based on the physical characteristics of the newborn [16]. The growth standard employed was obtained from a cross-section of births in the USA [17]. We decided to use this standard because of strong evidence that differences in the growth patterns between populations in developing and developed countries are not based on a genetic effect ("normally smaller"); they are rather a manifestation of differences in nutritional status [24, 25].

The present study of an urban population shows that 24% of all newborns were intrauterine growth-retarded; that is to say, at birth 24% of the population was already malnourished. This represents a handicap almost impossible for developing countries to overcome.

Many studies tend to underestimate the magnitude of the IUGR problem when they did not include those infants whose birth weight fell below the 10th percentile and yet who weighed more than 2500 g at birth [1]. This is because the 10th percentile of birth-weight-for-gestational-age-at-term is higher (about 2900 g in various standards) than the 2500 g mark, and this difference accounts for a relatively large number of infants.

In 1983, there were approximately 12 million deliveries in Latin America [26], the large majority being those in underprivileged populations. Assuming a 24% incidence of intrauterine growth retardation, it can be argued that in this region there are at least 2.8 million infants per year who are already malnourished at birth. This is a conservative estimate of the actual number, because the Guatemalan population studied did not include rural or unemployed families. Furthermore, from our data, it can be calculated that between 70% and 80% of all IUGR infants were chronically malnourished in utero, or proportionately growth-retarded (IUGR-API).

It has clearly been shown that, in both developed [14] and developing countries [12], the chronically intrauterine malnourished infants (IUGR-API) will not recover from the damage suffered; they remain lighter, shorter, and with a smaller head circumference till at least 3 years of age. More remarkable is that they score the lowest in tests evaluating mental development from 3 years of age [12] up to school age [6, 15, 23].

Using our calculations, we can estimate that at least 2 million infants, born every year in the Latin American region, are already at birth destined to remain undergrown and underdeveloped. Public health programmes in developing areas should therefore be focused on preventive activities to reduce the risk factors associated with chronic IUGR and on

screening programmes to identify the at-risk women in early pregnancy so that medical and nutritional interventions can be started to overcome the damaging effects of the risk factors.

Finally, a note of caution is needed. Recently, a number of international and developed-country-based organizations have been promoting and supporting programmes aimed at child survival, e.g., treatment of acute diarrhoea, detection of childhood malnutrition, promotion of immunization and breast-feeding, etc. Although these interventions could be effective in reducing case-fatality, morbidity and mortality rates, they do not attack the fundamental causes of malnutrition and infection early enough to produce the needed long-term impact on people's health. Both short- and long-term health and development actions are, for technical and ethical reasons, needed if there is to be a real improvement in the well-being of people in developing countries. Only these joint efforts can break the vicious circle of poverty, malnutrition, low birth weight, undergrowth, underdevelopment, poor education and employment, all of which perpetuate poverty.

RESUMÉ

LA PRÉVENTION DE LA MALNUTRITION FOETALE CHRONIQUE, PRIORITÉ POUR LES PAYS EN DÉVELOPPEMENT

La présente étude a porté sur un total de 3557 enfants nés en 1983 à l'hôpital d'obstétrique et de gynécologie de l'Institut guatémaltèque de sécurité sociale (IGSS) à Guatemala. Cette population est représentative des couches inférieures de la classe moyenne de la ville. Deux obstétriciens expérimentés ont déterminé le poids à la naissance, et l'âge gestationnel a été estimé dans tous les cas à partir de la date de la dernière menstruation de la mère et par examen physique à la naissance. On a considéré que les nouveau-nés dont le poids à la naissance et l'âge gestationnel étaient au-dessous du 10e centile présentaient un retard de croissance intra-utérin (IUGR). L'indice pondéral (poids/taille^3×100) a servi d'indicateur de l'état nutritionnel à la naissance. L'incidence de l'IUGR était de 23,8%; parmi les nouveau-nés présentant ce retard, 20,8% avaient un indice pondéral au-dessous du 10e centile (malnutrition foetale subaiguë ou IURG à faible indice pondéral), alors que pour 79,1% d'entre eux, l'indice était au-dessus du 10e centile (malnutrition foetale chronique ou IURG à indice pondéral acceptable). Dans les pays en développement, la majorité des cas d'IUGR (67 à 79%) sont dus à une malnutrition foetale chronique, contre 20 à 40% des cas dans les pays développés.

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