

# Growth in Indigenous and Nonindigenous Chilean Schoolchildren From 3 Poverty Strata

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Many Latin American countries, such as Mexico, Guatemala, Bolivia, Peru, and Ecuador, have large indigenous populations. These groups are generally the poorest and least educated, as well as the most growth retarded or stunted.<sup>1,2</sup> The question arises whether the high levels of stunting recorded among indigenous peoples are a result of poverty or are also (or instead) indicative of bias introduced by using an inappropriate reference population—that is, by using the National Center for Health Statistics–World Health Organization curves, which are derived from studies of US children of Northern European ancestry.<sup>3</sup>

If the small size of children of indigenous origin relative to Northern Europeans is the result of genetic differences in growth potential, the use of the current reference may overestimate the extent of true stunting. This is an important question for many Latin American countries, because the prevalence of stunting is commonly used to define the problem of malnutrition, to identify the groups most affected, and to allocate resources.

The work of Habicht et al.<sup>4</sup> established that child stature at 7 years of age differs substantially between the highest and lowest socioeconomic levels of many countries. On the other hand, children of well-off families from various countries in Asia, Africa, and Latin America were found to be very similar in size to each other and to children of European origin. These authors concluded that differences in child size associated with social class were marked and many times larger than those that might be attributed to ethnic differences. This seminal article<sup>4</sup> provided strong justification for the use of the current reference to assess the status of children worldwide.

Guatemala was one of the countries included in the analyses. A criticism of the approach of Habicht and colleagues is that social class distinctions in Guatemala reflect differences not only in wealth but also in ancestry, which is largely Spanish at the top of

**Objectives.** This study sought to determine whether the short stature of Mapuche children, an indigenous group in Chile, reflects poverty or genetic heritage and whether the international reference population, derived from studies of US children of mostly European origin, is appropriate for assessing growth failure in indigenous peoples of the Americas.

**Methods.** The study assessed 768 schoolchildren of Mapuche and non-Mapuche ancestry, aged 6 to 9 years, living under conditions of extreme, medium, and low poverty.

**Results.** Growth retardation was strongly related to poverty in both ethnic groups. Within poverty levels, there were no significant differences in stature between ethnic groups, and in low-poverty areas in Santiago, the capital city, mean stature was only slightly less than in the reference population.

**Conclusions.** Poverty, not ancestry, explains the short stature of Mapuche children, and use of the international reference to assess growth in this population is appropriate. (*Am J Public Health.* 2001; 91:1645-1649)

the social order and largely indigenous at the bottom. For Guatemala, as well as other Latin American countries, a more apt comparison would have been the growth of indigenous children vs that of nonindigenous children from families along the socioeconomic gradient. This was not done by Habicht et al., nor has it been done by anyone else, for the simple reason that few indigenous people have attained high socioeconomic status—a sobering social comment.

About 7% of the population of Chile is of indigenous ancestry, of which the Mapuche (also referred to as Araucanos) are the largest group.<sup>5</sup> The Mapuche inhabit the south central part of the country. Chile has experienced rapid economic and social development in recent years and this has brought significant improvements in the general standard of living.<sup>6</sup> Also, Chile has one of the best public health systems of the region, with many health and nutrition programs targeted at the poor.<sup>7</sup> Nevertheless, the Mapuche continue to be one of the poorest groups in the country, despite improved living conditions.

The situation in Chile permits studying the size of Mapuche children of various social classes. Consequently, the objective of this study was to compare the heights of indigenous and nonindigenous children aged 6 to 9 years at various levels of the socioeconomic

gradient. The general hypothesis tested was that poverty, not ancestry, accounts for the short stature of Mapuche children. The specific hypotheses tested were as follows.

1. Going from extreme to low levels of poverty, height increases among indigenous and nonindigenous groups.
2. Height does not differ between indigenous and nonindigenous children within poverty levels.
3. In areas with the lowest levels of poverty, the heights of indigenous and nonindigenous children will not differ from that of the international reference population.

## METHODS

The study was a cross-sectional comparison of indigenous (Mapuche) and nonindigenous children in the first and second grades living in areas of decreasing levels of poverty. We used UNICEF's poverty classification. This system, which is used widely in Chile to guide government programs, divides poverty into extreme, medium, and low levels on the basis of 17 indicators, such as the proportion of the population living in poverty, the infant mortality rate, and maternal education levels<sup>8</sup>; the 3 levels of poverty correspond to the highest, middle, and lowest quintiles, respectively, of

UNICEF's poverty classification. Of the counties selected for study, 6 were classified as having an extreme level of poverty, 7 as having a medium level of poverty, and 19, in the metropolitan area of Santiago, as having a low level of poverty. The counties with extreme poverty were rural, in contrast with the urban counties with middle and low poverty levels.

In Latin America, it is customary for a person to use 2 surnames, derived from the parents' primary surnames. In the United States, this would be equivalent to using one's father's surname and mother's maiden name. Children were defined as Mapuche if all compound surnames of both father and mother were of Mapuche origin (i.e., all 4 surnames had to be of Mapuche origin). Nonindigenous children were defined as those whose 4 parental surnames were all of Spanish origin. Children with mixed Mapuche and Spanish surnames were omitted from the study, as were all those with "foreign" surnames (German, Italian, etc.). This process required screening a large number of children in many schools. A total of 41 rural schools, drawn at random from a larger list, were selected from areas of extreme poverty, and all 32 urban schools from areas of medium poverty were included. All 75 schools from low-poverty sectors in Santiago that were known to have Mapuche children were included.

Sample sizes were largely determined by resources and circumstances (i.e., nonprobabilistic sample selection). There were few nonindigenous children in the extreme-poverty group, so all children in this group who met the nonindigenous criteria was included ( $n=103$ ). For each such child, a Ma-

puche child of the same sex and within 6 months of the same age was selected. The Mapuches were least common in the medium-poverty group; all Mapuche children in this group were included ( $n=134$ ), along with a similar number of nonindigenous children. In the low-poverty group in Santiago, we could find only 90 children meeting the Mapuche definition. For convenience, we selected 3 nonindigenous children for every Mapuche child. Only one child per family was selected in all areas.

Trained personnel (4 persons) measured the heights of children in 1997 and 1998 using standard methods.<sup>9</sup> The values were expressed as sex- and age-specific  $z$  scores, using the National Center for Health Statistics/World Health Organization reference.<sup>10</sup>

Home interviews also took place in which information about parental education and household wealth was collected by methods used previously in Chile.<sup>11</sup> A factor analysis of household information (i.e., possession of appliances such as televisions, refrigerators, or washing machines, and characteristics of the home such as type of materials used in construction, number of rooms, sanitation, parental education) was used to generate an index of household poverty. Households falling in the lowest tertile of the distribution of this index were classified as poor and all others as nonpoor. Thus, 2 measures of poverty were used: poverty level as defined by UNICEF<sup>8</sup> (county level) and household poverty as defined by household possessions and characteristics (family level).

Cases with complete data for age, sex, height, and household poverty were selected for analyses. Final sample sizes are given in

Table 1. Values for indigenous and nonindigenous groups were compared within poverty levels, before and after adjustment for household poverty, by using multiple regression models (indigenous: 1=yes, 0=no; household poverty: 1=yes, 0=no). Age and sex were included as covariates in all models. A linear model was fitted to assess for linear trends in  $z$  score for height across poverty strata. Statistical significance was defined as  $P<.05$ .

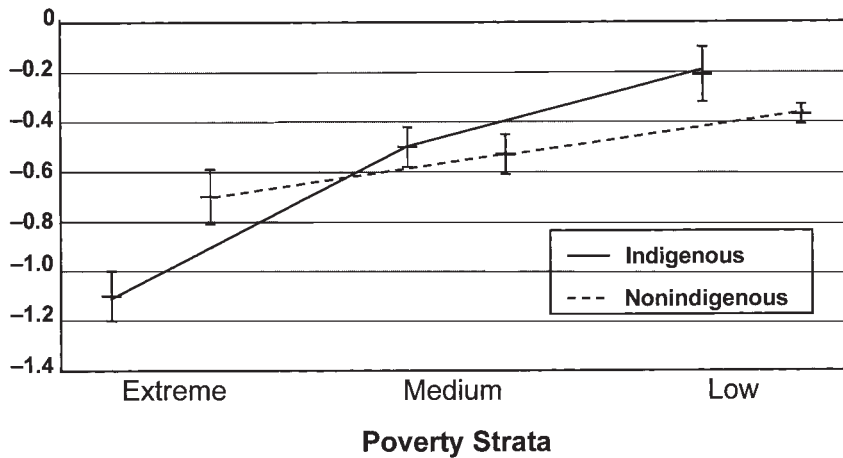
## RESULTS

The characteristics of the sample are given in Table 1. The 2 groups were similar in age and percentage of males. The percentage of households classified as poor was greater for the Mapuche sample in all poverty strata. The  $z$  scores for mean height ranged from  $-1.1$  for indigenous children living in areas of extreme poverty to  $-0.21$  for indigenous children living in low-poverty areas. Differences in height between indigenous and nonindigenous groups were statistically significant only in the extreme-poverty level, with indigenous children being shorter.

In Figure 1,  $z$  scores for mean height for indigenous and nonindigenous groups are given by poverty level. There was a linear trend for height to increase with decreasing levels of poverty in indigenous ( $P<.001$ ) and nonindigenous ( $P<.03$ ) groups. The  $z$  scores for mean height in areas of low poverty were  $-0.21 \pm 0.11$  for indigenous children and  $-0.37 \pm 0.04$  for nonindigenous children (Table 1). These values were not significantly different from 0 (i.e., from the reference value) for indigenous children ( $P=.06$ ) but

**TABLE 1—General Characteristics of Sample of Indigenous (Mapuche) and Nonindigenous Chilean Schoolchildren, by Poverty Strata: Chile, 1997–1999**

Variable	Poverty Strata								
	Extreme			Medium			Low		
	Indigenous	Nonindigenous	<i>P</i>	Indigenous	Nonindigenous	<i>P</i>	Indigenous	Nonindigenous	<i>P</i>
<i>n</i>	92	92	...	124	124	...	84	252	...
Mean age $\pm$ SE, y	8.1 $\pm$ 0.07	8.1 $\pm$ 0.10	.9	7.7 $\pm$ 0.09	7.6 $\pm$ 0.06	.7	8.0 $\pm$ 0.08	8.00 $\pm$ 0.07	.9
Male, %	50	50	1	57.3	49.3	.7	47.4	47.6	.97
Household poverty, %	91.3	64.1	.001	51.6	14.5	.001	15.5	1.2	.001
Height $z$ score $\pm$ SE	-1.10 $\pm$ 0.10	-0.70 $\pm$ 0.11	.04	-0.50 $\pm$ 0.08	-0.50 $\pm$ 0.08	.76	-0.21 $\pm$ 0.11	-0.37 $\pm$ 0.04	.15



Note. Bars denote standard errors. The linear trend is significant for both groups ( $P < .05$ ).

**FIGURE 1—z scores for height-for-age among indigenous (Mapuche) and nonindigenous schoolchildren: Chile, 1997–1999.**

**TABLE 2—Regression Coefficients for Ethnicity of Height z Scores by Poverty Strata, Before and After Adjustment for Household Poverty: Chile, 1997–1999**

Poverty Strata	Variable	Unadjusted Model		Adjusted Model	
		$\beta$	<i>P</i>	$\beta$	<i>P</i>
Extreme	Indigenous	-.303	.047	-.225	.161
	Household poverty	NA	NA	-.289	.135
Medium	Indigenous	-.037	.759	.157	.230
	Household poverty	NA	NA	-.323	.021
Low	Indigenous	.166	.151	.218	.072
	Household poverty	NA	NA	-.361	.142

Note. For both indigenous and household poverty, 1 = yes and 0 = no; NA = not applicable. Age and sex were included as covariates in both unadjusted and adjusted models.

were significantly different from 0 for non-indigenous children ( $P < .01$ ).

Ethnic differences within a poverty level were examined before and after adjustment for household poverty (Table 2). For the extreme-poverty group, being of Mapuche ancestry was associated with a z score of  $-0.303$  in the unadjusted model ( $P < .05$ ); after adjustment, the z score was  $-0.225$  and ceased to be significant ( $P = .161$ ). For the medium- and low-poverty strata, ethnicity was not a significant predictor of z score for height, either before or after adjustment. Household poverty was negatively related to height in all models but was significant only in the medium-poverty level.

## DISCUSSION

Chilean history texts describe the Mapuches as being stocky in build and short in stature, with males averaging no more than 1.62 meters in height and females no more than 1.45 meters.<sup>12</sup> Studies published in Chile over the last few years report that Mapuches living in the “reservations” of the Araucania are shorter than the average Chilean of Spanish or mixed ancestry.<sup>13</sup> Only a few studies of Mapuche children have been carried out, but all report that indigenous children are shorter than the general Chilean population. During the 1980s, one study found that about a third of Mapuche children

were stunted ( $<90\%$  of height-for-age).<sup>14</sup> Finally, 2 UNICEF studies found that the prevalence of growth retardation in the geographical zone inhabited by the Mapuche was the highest in Chile.<sup>8,15</sup> In our study, the prevalence of stunting (z score  $< -2$ ) was 17.4% and 3.6%, respectively, among Mapuche children of extreme- and low-poverty strata, compared with the national average of 4.6%.<sup>15</sup>

Previously, it was not possible to establish whether the short stature of Mapuche children, or of other children of indigenous ancestry in Latin America, is due to genetics or to poverty. In this report, we show that in the case of the Mapuche, it is poverty and not ancestry that causes stunting.

A strength of this study is the use of careful criteria for defining indigenous and nonindigenous ancestry. The use of surnames to identify ethnicity is a practical and valid approach in the Chilean context. Although there is no pretense of “racial purity” in the groups defined, the use of surnames undoubtedly improved the classification of ethnicity. Another strength of the study is the inclusion of children from extreme-, medium-, and low-poverty strata. This classification was developed by UNICEF for program planning use in Chile<sup>8</sup>; its validity was confirmed in our study by the fact that the percentage of poor households, defined in terms of data we collected for each household, varied as expected by poverty strata. For example, for the Mapuche sample, the percentage of poor households was 91%, 52%, and 16%, respectively, for extreme-, medium-, and low-poverty strata.

Limitations of the study include the lack of a well-to-do sample of Mapuche children from Santiago. Few Mapuche children live in the expensive neighborhoods of Santiago. In fact, it proved extremely difficult to find Mapuche children at all in 75 schools from low- to middle-class neighborhoods of Santiago; only 90 children met the Mapuche definition. Also, schoolchildren were chosen for the study because it was easy to locate and measure them. Ideally, younger children should have been targeted, because growth retardation mainly occurs before 2 years of age. However, stunting among young schoolchildren is known to reflect prior malnutrition.<sup>3</sup> Finally, household poverty was measured at school age, about 5 years after the period of growth failure. Al-

though changes may have occurred, it is unlikely that these were marked, because the poverty index is partly dependent on parental and household characteristics (parental education, size and type of home, water supply, and sewage), which are less likely to change in a 5-year period.

Three hypotheses were tested. First, we predicted that child stature would increase across the poverty gradient. We found this to be the case for both Mapuche and non-Mapuche groups. While the relationship between growth retardation and poverty is well established in the literature,<sup>16,18</sup> few studies have controlled for differences in ethnicity across socioeconomic groups. Because we used careful definitions of ethnicity, our results are less subject to this bias and permit us to assess the negative effect of poverty on child stature, independent of ethnicity.

Our second prediction was that there would be no differences in child stature between Mapuche and non-Mapuche children within poverty strata. Between the 2 groups, however, we found important differences in the percentage of poor households, even within poverty levels. In all 3 strata, the Mapuche were always the poorest. Consequently, ethnic comparisons of child stature within strata were adjusted for levels of household poverty. These analyses found that Mapuche and non-Mapuche children were similar within poverty strata. In the extreme-poverty group, the Mapuche children were shorter ( $z$  score =  $-0.225$ ), but this difference was not significant. For medium- and low-poverty strata, the differences favored the Mapuche children ( $z$  score =  $0.157$  and  $0.218$ , respectively), but those differences were not statistically significant.

Our third prediction was that among children in Santiago, the heights of both Mapuche and non-Mapuche children would not differ from that of the reference population (i.e., from 0). We found that the mean height-for-age  $z$  score in Santiago was  $-0.21$  for Mapuche children and  $-0.37$  for non-Mapuche children. These values were significantly different from 0 only for non-Mapuche children. By contrast, mean  $z$  scores for the extreme-poverty groups were  $-1.1$  and  $-0.7$ , respectively, for Mapuche and non-Mapuche groups, and values have been reported to be as high

as  $-3.0$  for indigenous groups in other parts of Latin America.<sup>19</sup>

What do we make of the fact that children measured in Santiago had negative scores? We think that these low- to middle-class children may have experienced mild growth retardation. Other studies have shown that the mean height-for-age  $z$  scores of Chilean children who attend private schools are in fact greater than 0.<sup>20</sup> As conditions in Santiago continue to improve, we would expect this minor deficit to eventually disappear among all classes.

## CONCLUSION

Our study shows that the most important indigenous group in Chile, the Mapuche, has the potential to achieve heights similar to those of the reference population at ages 6 to 9 years. Thus, this is the first study to demonstrate that the short stature that had been observed in the past among Mapuche children<sup>14</sup> is due to poverty. On the other hand, this finding should not be extrapolated to growth during puberty, because we did not include adolescents in our study.

Our study supports the recommendation of Habicht et al.<sup>4</sup> that international reference data are appropriate for assessing the growth of young children worldwide, including the indigenous peoples of the Americas. We do not know whether our findings apply to all indigenous groups in the continent, but we believe that this should be assumed, unless subsequent studies show otherwise. The high levels of stunting generally found in the indigenous peoples of the Andean region and in Mesoamerica should be interpreted as reflective of their poverty, which leads to poor growth on account of poor diets, frequent infections, and deficient child care, and not as a genetic trait. For this reason, the high level of stunting found in indigenous peoples should be viewed as a marker of the need for socioeconomic development programs and effective public health measures. ■

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## Contributors

P. Bustos and H. Amigo were responsible for conception and design of the study and were involved in collecting information, analyzing data, and writing the paper. S. R. Muñoz planned the study and processed and analyzed the data. R. Martorell participated in discussing the results and wrote the paper.

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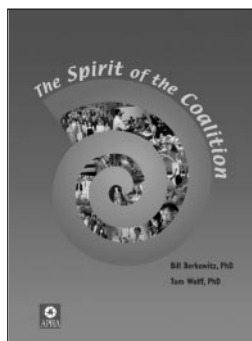
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