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Factors associated with stunted growth in children below 11 years of age in Antioquia, Colombia, 2004

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SUMMARY

Objective: To explore some factors associated to stunted growth in children below 11 years of age in the Department of Antioquia.

Methodology: Cross-sectional study using the databases of alimentary and nutritional profiles in homes of Antioquia in 2004, based on a representative random sample of homes in the department (95% reliability and error margin of 3%). For this study, 100% of the records of children below 11 years of age were used. A model of generalized equations estimation was constructed for stunted growth classified by a Z score smaller than -2 standard deviation with respect to p 50 of the 1978 NCHS (Centro Nacional de Estadísticas de la Salud - National Center for Health Statistics). Data were analyzed using the GLIMMIX Procedure: SAS version 9.1.

Results: We found 18.6% of the children with stunted growth, 75% of the homes with male head of household, 70% of heads of household with maximum 5 years of schooling; 47% of homes were nucleated bi-parental, and 40% extensive with a 5-member median per home; 56.4% poor per unsatisfied basic needs, and 80% in alimentary insecurity. The factors associated to stunted growth were: female gender, 1-5 years of age, head of household with less than 6 years of schooling, more than 5 people in the home, more than two household members under 7 years of age, coming from a poor home per unsatisfied basic needs, belonging to a sub-region different from Medellín, food availability of less than 30 different foods per week, no production of food, and head of household under 40 years of age.

Conclusions: Herein, we show evidence of the magnitude of poverty and association of precarious socioeconomic conditions with stunted growth in Antioquia. The study shows the importance of considering the correlated nature of the data for the construction of the model.

Keywords: Children; Malnutrition; Poverty; Social inequity; Alimentary security; Antioquia; Colombia.

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Factores asociados con el retraso del crecimiento en menores de 11 años en Antioquia, Colombia, 2004

RESUMEN

Objetivo: Explorar algunos factores asociados con el retraso del crecimiento en menores de 11 años en Antioquia, Colombia.

Metodología: Estudio de corte transversal utilizando las bases de datos del perfil alimentario y nutricional de los hogares de Antioquia en el año 2004. Muestra representativa aleatoria de hogares por subregión del departamento (95% de confianza y error del 3%). Se tomó 100% de los registros de los menores de 11 años. Se construyó un modelo de estimación de ecuaciones generalizadas para el retraso del crecimiento clasificado por puntaje Z menor de -2 desviaciones estándar, con respecto al p 50 de la NCHS (Centro Nacional de Estadísticas de la Salud) 1978. Los datos se analizaron usando el procedimiento GLIMMIX: SAS versión 9.1.

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Resultados: Del total de niños, 18.6% tenían retraso del crecimiento, 75% de hogares con jefatura masculina, 70% de jefes con máximo 5 años de escolaridad; 47% de hogares nucleados biparental y 40% extensos, mediana de 5 integrantes por hogar; 56.4% pobres por necesidades básicas insatisfechas y 80% en inseguridad alimentaria. Los factores asociados con el retraso del crecimiento fueron: sexo femenino, edad entre 1 y 5 años, jefe con escolaridad menor de 6 años, más de 5 personas en el hogar, más de dos menores de 7 años en el hogar, provenir de un hogar pobre por necesidades básicas insatisfechas, pertenecer a una subregión diferente a Medellín, disponibilidad menor a 30 alimentos diferentes por semana, no producir alimentos y jefe de hogar menor de 40 años.

Conclusiones: Se evidenció la magnitud de la pobreza y la asociación de condiciones socioeconómicas precarias con el retraso del crecimiento en Antioquia. Se demostró la importancia de considerar la naturaleza correlacionada de los datos para la construcción del modelo.

Palabras clave: Niños; Desnutrición; Pobreza; Inequidad social; Seguridad alimentaria; Antioquia; Colombia.

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The dietary and nutritional improvement program in Antioquia (MANA, Governor's office of Antioquia) along with Universidad de Antioquia elaborated a descriptive study in 2004 to obtain the dietary and nutritional profile of homes in the department¹. In this study, it was found that the most affected anthropometric indicator in children below 11 years of age corresponded to height for age. Additionally, for the year before the study, malnutrition was the main cause of mortality in children from 1 to 4 years of age and in children under one year of age, malnutrition was among the first 5 causes of mortality.

Hence, and given the availability of the dietary and nutritional profile done, it was necessary to advance on the explicative processes to explain the phenomenon of malnutrition in the department, evidencing its magnitude and determining the most important factors associated to the problem. Thus, this study seeks to determine demographic, socioeconomic, and dietary factors that explain stunted growth in children below 11 years of age in homes from different regions of Antioquia for 2004. Likewise, we expect this information becomes useful knowledge in decision making, and in this sense, in guiding public policy.

MATERIALS AND METHODS

Type of study. A transverse study was performed based on secondary sources using records from the data base in the project on «Dietary and nutritional profile in homes from the department of Antioquia»¹.

Sampling. The data base contained 3240 records of children below 11 years of age from 1658 homes distributed in the 9 sub-regions of the department of Antioquia and the city of Medellín, Colombia. Of the total number of records, 273 did not have information on height and/or age of the minors, which was indispensable to determine the nutritional state, therefore, these were excluded. After the exclusion of these data, there were 2967 records left of children from 1581 homes.

Given that the samples from the previous study were random and representative of homes per region in the department and that all the household members were surveyed, we verified if the number of records per region was close to the sample size that would have been required to study stunted growth in each sub-region. For this purpose, we used the formula for a proportion in finite population with a confidence level of 1- α =95% and 5% error. The formula for finite population was considered because the population of children below 11 years of age per sub-regions for 2004 was known.

According to results obtained, it was concluded that in all sub-regions the number of records from the data base was greater than the simple size required; thereby, the data permit approaching the prevalence of stunted growth per sub-regions in the department.

Variables. The dependent variable was the stunted growth, for this we used the *z* score from the NCHS/OMS reference norm². The independent variables were demographic, socioeconomic, and dietary in nature.

Statistical methods. Bearing in mind that the children's records were grouped by municipalities and that these are in turn within the sub-regions, we sought to construct a mixed generalized linear model. It was considered mixed because it contained fixed effects (sub-region) and random effects (municipalities). The model mentioned yielded an estimate of zero for the variation of the children in the municipalities; for this reason the consideration of the municipality level within the model was discarded.

After discarding the municipality level, a standard

logistic regression and a model of generalized equation estimation (GEE) were run. The latter model considered the nested structure of the children's data within the sub-regions. To define which of the two models presented a better adjustment, a comparison was made through the Akaike information criterion. According to this criterion, we selected the model showing the lowest Akaike score. The statistic values for the two models were: Standard logistic regression: 15844.43, GEE Model: 14787.60. This said, it was concluded that the most suitable model was the one bearing in mind the nested structure of the data (GEE).

Analysis. The univariate analysis used frequencies, percentages, and descriptive statistics; the bivariate analysis used statistical significance tests via Fisher's exact test, and the Odds Ratio (OR) was calculated along with its respective confidence intervals (CI). For the multivariate analysis, a GEE model was run by using the backward procedure.

Data processing. Done on SPSS version 11.5 and SAS version 9.1 GLIMMIX Procedure.

Limitations of the study. The previous research did not inquire on the health status of the children, especially that related to respiratory infection and diarrhea, which are variables that have been reported in literature as associated to the phenomenon. Likewise, although stunted growth is frequently used as proxy of chronic malnutrition, there are medical conditions affecting height and which were not inquired, such as endocrine and/or genetic disease.

Ethical considerations. According to article 11 of resolution N° 008430 of 4 October 1993 by the Ministerio de Salud de Colombia (Colombian Health Ministry), the current research was considered risk free given that it was based on secondary information sources and there was no direct contact with the individuals studied. The data base was only used for the objectives stated in the research and the identities of those registered therein were never divulged. Also, the use of the data bases was authorized by the institutions participating in the initial study.

RESULTS

Description of the population studied. We analyzed the records of 2967 children below 11 years of age located in 1581 homes from the nine sub-regions of

Antioquia and the city of Medellín.

Demographic characteristics. Regarding the gender of the children below 11 years of age, a similar proportion of boys and girls were found. The average age of the boys was 5 years with a standard deviation of 3.1 years. Regarding the gender of the heads of the households, it was determined that there is predominance of male heads of household (75.1%). The ages of the heads of household ranged between 15 and 89 years of age, with an average of 43.2 years and a standard deviation of 13.6 years. The years of schooling ranged between 0 and 18 years, with an average of 4.5 years and a standard deviation of 3.7 years.

Socioeconomic characteristics. In reference to the place of residence of the minors, there were similar proportions of urban and rural homes. Most of the homes of the children in the study (87.2%) were classified into two groups according to the typology of the home: 47.2% lived in nucleated homes with both parents and 40% came from extensive homes. The number of individuals in the home ranged from 2 to 14 people, with an average of 5 people and a standard deviation of 2 people. Regarding the number of children below 7 years of age, the homes had between 0 and 6 children within this age range, with an average of 1.3 children and a standard deviation of 1 child. According to the indicator of unsatisfied basic needs (UBN), it was found that 43.6% of the homes of the minors were poor and among these, 12.8% were under conditions of misery.

Nutritional and dietary characteristics. An 18.6% prevalence of stunted growth was found. The number of different foods available for a week ranged between 1 and 87, with an average of 31.8 food items/week and a standard deviation of 13.3 food items/week. Some 53.3% of the homes were under energetic insufficiency, indicating that the availability *per capita* of calories/day was lower than the recommended amount. A total of 78% of the homes were perceived under dietary insecurity. With respect to the production of foods from a crop or animal breeding, it was determined that 40.5% of the homes reported the production of food.

Exploration of the association between stunted growth and demographic, socioeconomic, and feeding variables. Upon analyzing the behavior of stunted growth in the different sub-regions of Antioquia, it was determined that Bajo Cauca, North, and Urabá were

Table 1
Distribution of stunted growth according to demographic characteristics of children below 11 years of age and their homes. Antioquia, 2004

Variable	Category	Stunted growth		% of Stunted growth	F	p	OR (CI 95%)
		Yes	No				
Sub-region	Valle de Aburrá	31	216	12.6	5.6	0.0001 ^b	1.09 (0.63-1.87)
	East	47	222	17.5			1.61 (0.97-2.65)
	Southeast	36	222	14.0			1.23 (0.73-2.01)
	West	40	203	16.5			1.50 (0.89-2.50)
	North	81	284	22.2			2.16 (1.37-3.43)
	Northeast	49	208	19.1			1.79 (1.09-2.94)
	Magdalena Medio	38	234	14.0			1.23 (0.73-2.07)
	Urabá	80	297	21.2			2.04 (1.29-3.24)
	Bajo Cauca	120	310	27.9			2.94 (1.89-4.57)
	Medellín ^a	29	220	11.6			1
Sex of child	Male ^a	235	1267	15.6	21.26	0.0001 ^b	1.57 (1.30-1.91)
	Female	316	1149	21.6			
Age of the child	< 1 ^a	27	236	10.3	6.13	0.0022 ^b	1
	1-5	273	1090	20.0			2.13 (1.39-3.25)
	6-10	251	1090	18.7			1.97 (1.29-3.01)
Sex of head of household	Male ^a	407	1809	18.4	0.49	0.4836	1.08 (0.87-1.34)
	Female	144	607	19.2			
Age of head of household	<30	106	383	21.7	3.94	0.0196 ^b	1.38 (1.06-1.78)
	30-39	184	737	20.0			1.27 (1.02-1.57)
	>39 ^a	261	1296	16.8			1
Education of head of household	<6	477	1807	20.9	33.75	0.0001 ^b	2.16 (1.67-2.81)
	≥6 ^a	74	609	10.8			

F: Fisher test OR: Odds Ratio CI: confidence interval

a. Reference Category b. Value of p <0.05 indicates statistically significant association

those presenting the greatest prevalence of stunted growth; the lowest corresponded to Medellín, Valle de Aburrá, Southeast, and Magdalena Medio. When assessing the magnitude of the stunted growth in the different sub-regions, it was noted that children belonging to the sub-regions of the North and Urabá have approximately twice the chance of experiencing the event than those living in Medellín. It should be stressed that for Bajo Cauca, the opportunity is tripled (Table 1).

When exploring the association of stunted growth with some demographic characteristics, it was found that girls, children below 1 to 5 years of age, and children from homes whose heads of household were

younger than 30 years of age had a greater opportunity of experiencing the event (Table 1).

For the association of stunted growth with the socioeconomic characteristics studied, it was found that children living in rural areas, in homes with more than four members, with more than two children younger than 7 years of age, and poor per Unsatisfied Basic Needs (UNB) had greater probabilities of having stunted growth (Table 2).

On the association of stunted growth with dietary characteristics, we could determine that the minors living in homes with availability of less than 30 different food items, with energetic insufficiency, and with

Table 2
Distribution of stunted growth according to socioeconomic characteristics of children under 11 years of age and their homes. Antioquia, 2004

Variable	Category	Stunted growth		% of Stunted growth	F	p	OR (CI 95%)
		Yes	No				
Area of residence	Urban ^a	239	1214	16.4	9.23	0.0024 ^b	1.34 (1.11-1.62)
	Rural	312	1202	20.6			
	Extensive ^a	209	995	17.4			
Typology of home	NUM	45	198	18.5	2.57	0.0527	1
	Biparental	259	1123	18.7			
	NUF or Mixed	38	100	27.5			
Number of members	< 5 ^a	103	741	12.2	28.51	0.0001 ^b	1.89 (1.49-2.38)
	≥5	448	1675	21.1			
Number of children <7 years	0 ^a	48	341	12.3	21.21	0.0001 ^b	1
	1-2	337	1636	17.1			
	>2	166	439	27.4			
Poverty per UBN	Yes	437	1523	22.3	55.12	0.0001 ^b	2.34 (1.87-2.92)
	No ^a	114	893	11.3			

F: Fisher test OR: Odds Ratio CI: confidence interval a. Reference category

b. Value of p<0.05 indicates statistically significant association

NUM: Nucleated single-parental mother family NUF: Nucleated single-parental father family

perception of dietary insecurity had greater probability of having stunted growth (Table 3).

Determination of demographic, socioeconomic, and alimentary factors associated to stunted growth in children below 11 years of age. In the exploration, the model suggests that of the variables available, the ones best explaining stunted growth are: sub-region, gender and age of the child, age and schooling of the head of the household, the number of people in the home, the number of children below 7 years of age, poverty per unsatisfied basic needs (UBN), the number of different foods available in the home, production of food from crops or animal breeding. In addition to the aforementioned, an interaction term was found between gender and the age of the child (Table 4).

DISCUSSION

As shown by the results of the study, there are differences in the opportunity of presenting stunted growth according to the sub-region of the department where the children below 11 years of age are living. And, as observed in the model, these differences at the

regional level coexist with other differences observed in the homes. Likewise, in a study on inequities in health in Colombia, Flórez³ also found an effect of the region in the development of stunted growth in children below 5 years of age.

Based on the results of the model, in the sub-regions of Bajo Cauca, North, Urabá, and Northeast the opportunity for stunted growth in minors is greater in comparison with Medellín. As acknowledged by some researchers, these regions share precarious socioeconomic conditions^{4,5}.

As a biological variable, the child's gender was related to stunted growth. This has also been related in other research; however, the results are contradictory. Herrán *et al.*⁶, found that the male sex is a risk factor for stunting, thus is the case in other studies^{7,8}. Nevertheless, other research^{9,10}, like this one, shows that women have a greater probability for stunting than men. This finding suggests the need to explore and delve deeper into the cultural patterns that could be generating differential treatment towards girls during their first years of life.

For the department, we found stunted growth at 18.6% in children below 11 years of age in which the

Table 3
Distribution of stunted growth according to alimentary characteristics of children below 11 years of age and their homes. Antioquia, 2004

Variable	Category	Stunted growth		% of Stunted growth	F	p	OR (CI 95%)
		Yes	No				
Number of different foods	<30	342	1168	22.6	31.12	0.0001 ^b	1.73 (1.43-2.10)
	≥30 ^a	209	1248	14.3			
Food production in the home	Yes ^a	211	1015	17.2	1.20	0.2731	1.12 (0.92-1.36)
	No	340	1401	19.5			
		358	1411	20.2	9.12	0.0026 ^b	1.36 (1.11-1.66)
Energetic insufficiency	Yes	193	1005	16.1	22.18	0.0001 ^b	2.01 (1.50-2.69)
	No ^a	493	1946	20.2			
Perception of dietary insecurity	Yes	58	470	11.0			
	No ^a						

F: Fisher test OR: Odds Ratio CI: confidence interval a. Reference category

b. Value of $p < 0.05$ indicates statistically significant association

prevalence increases with age. Through this study, we noted that those younger than one year of age had a lower probability of stunted growth than those 1-4 years of age or 5-10 years of age. In 2005, the nation established a prevalence of chronic malnutrition of 12.0% in children below 5 years of age and of 12.6% for those between 5 and 9 years of age; for Antioquia the figures were 11.4% and 11.1%, respectively. This contrasts with only 6% stunted growth in children younger than one year of age for the nation⁸. Hence, this study shows a more acute situation than the studies mentioned. Additionally, the fact that the opportunity for stunting increases with age, suggests that stunted growth is the result of an accumulative process of socioeconomic privations. This finding is, furthermore, worrisome because, by stunted growth being a basically irreversible alteration, the height and health conditions of future generations are being compromised.

The heads of household were mostly 40 years old or more. Only 15.8% were younger than 30 years of age. Also, it was found that children from homes with heads of household who were below 30 years of age had 50% greater probability of stunted growth. This may possibly be indicating that in homes with young heads of household there may be greater labor instability, homes in the starting stage, or in expansion with very few possibilities of other contributors¹¹. Furthermore, it has

been shown that there is lesser probability of falling into poverty levels for elderly heads of household¹². All this is related to the possibilities of providing resources for the necessary food and the rearing of the minors.

Schooling is an indicator of the individual's competitiveness and of his/her human capital¹², in this sense; it contributes to improving employment possibilities, better income, and better family care guidelines. Therein, the greater number of years of schooling by the head of the household, the lower the opportunity for stunted growth; this finding is similar to that of Herrán *et al.*⁶

In the homes studied, an average of 5.3±2 members were found, whereas National Survey on Demographics and Health¹³, reported an average size of 4.1 members for Colombia. The average size of the homes has direct repercussions on the dietary and nutritional security of its members: homes with lower numbers of individuals have greater possibilities of attaining quality and quantity of the required diet, better opportunities of health care and self care, and lower risk of overcrowding, among others.

Just as this study reveals that as the number of children below 7 years of age increases, the opportunity for stunted growth will be greater, other studies have reported this same finding^{6,14}. A greater proportion of children younger than 7 years of age in the home represents a greater economic load and a lower possibility of guaranteeing an

Table 4
Model of generalized equations estimation (GEE)

Variable	Coef.	Standard error	DF	T	p	OR (CI 95%)
Intercept	-5.671	0.5648	2.576	-10	0.0001 ^a	
Sub-region (Medellín)	0					1
Sub-region (Valle de Aburrá)	0.2273	0.2772	501	0.82	0.4126	1.26 (0.73-2.16)
Sub-region (East)	0.4938	0.2560	534	1.93	0.0542	1.64 (0.99-2.71)
Sub-region (Southeast)	0.1411	0.2665	534	0.53	0.5967	1.15 (0.68-1.94)
Sub-region (West)	0.4719	0.2724	543	1.73	0.0837	1.60 (0.94-2.74)
Sub-region (North)	0.6127	0.2445	580	2.51	0.0125 ^a	1.85 (1.14-2.98)
Sub-region (Northeast)	0.5603	0.2601	548	2.15	0.0316 ^a	1.75 (1.05-2.92)
Sub-region (Magdalena Medio)	0.2172	0.2735	545	0.79	0.4274	1.24 (0.73-2.13)
Sub-region (Urabá)	0.5617	0.2331	522	2.41	0.0163 ^a	1.75 (1.11-2.77)
Sub-region (Bajo Cauca)	0.8648	0.2267	492	3.81	0.0002 ^a	2.37 (1.52-3.71)
Sex of child	1.7746	0.5336	2.707	3.33	0.0009 ^a	5.90 (2.07-16.8)
Age of child (<1)	0					1
Age of child (1-5)	1.4341	0.4860	2.587	2.95	0.0032 ^a	2.64 (1.53-4.56)
Age of child (6-10)	2.0316	0.4842	2.596	4.20	0.0001 ^a	2.92 (1.68-5.07)
Age of head of household (>39)	0					1
Age of head of household (30-39)	0.2930	0.1153	2.786	2.54	0.0111 ^a	1.34 (1.07-1.68)
Age of head of household (<30)	0.3994	0.1463	2.659	2.73	0.0064 ^a	1.49 (1.12-1.99)
Education of head of household	0.5724	0.1519	2.690	3.77	0.0002 ^a	1.77 (1.32-2.39)
Number of individuals in the home	0.3962	0.1380	2.867	2.87	0.0041 ^a	1.49 (1.13-1.95)
Number <7 years (0)	0					1
Number <7 years (1-2)	0.2243	0.1850	2.849	1.21	0.2253	1.25 (0.87-1.80)
Number <7 years (>2)	0.5557	0.2142	2.859	2.59	0.0095 ^a	1.74 (1.15-2.65)
Poverty per UBN	0.3383	0.1350	2.764	2.5	0.0123 ^a	1.40 (1.08-1.83)
Number of different foods available	0.2661	0.1074	2.798	2.48	0.0133 ^a	1.31 (1.06-1.61)
Food production in the home	0.3940	0.1082	2.461	3.64	0.0003 ^a	1.48 (1.20-1.83)
Gender (female)* Age of child (<1)	0					5.90 (2.07-16.8)
Gender (female)* Age of child (1-5)	-0.939	0.5535	2.711	-1.70	0.0004 ^a	2.31 (1.73-3.08)
Gender (female)* Age of child (6-10)	-1.946	0.5534	2.720	-3.52	0.0899	0.84 (0.63-1.12)

Akaike information criteria: 14787.60

a. Value of p <0.05 indicates statistically significant association

adequate diet for these children. These resources are not solely economic but also in terms of time and attention for the minor¹⁵. Regarding poverty measured by Unsatisfied Basic Needs (UBN), there are great differences among what was found through the research (56.4%) and the official reports for Antioquia that speak of 31% for the same year.

Although in this field there are methodological discussions on the limitations on how to measure poverty

and its scope^{16,17}, the relationship of stunted growth with poverty per UBN (understood as structural poverty)¹⁸, implies that the approach to the problem should be more integral if looking to overcome the issue of malnutrition.

The diversity of food available in the home is an indicator of the dietary quality, and, furthermore, it could be a suitable predictor of the energetic sufficiency in the homes¹⁹. The variety of foods guarantees the

adequate supply of micro and macronutrients, avoiding alterations like deficiencies or metabolic problems through excess. For this, it is necessary to not only consume foods from the groups, but to have a variety of foods within each group; nevertheless, it has been found that the availability of foods from all the food groups does not guarantee dietary security in the homes, given that a low variety may be available within each group or low availability *per capita*/day¹⁹. This research reveals that the production of foods is a factor that protects the against the appearance of stunted growth in children below 11 years of age, and this is then, adjusting for condition of poverty, what becomes an important fact within the framework of dietary sovereignty.

From the methodological point of view, it is relevant to highlight the importance of considering the correlated structure of the data when constructing an explicative model. Given that the original sampling was representative per sub-regions of the department, it may be considered that each of them functions as a cluster and, therefore, the observations could be correlated, *i.e.*, there is no independence of the observations inasmuch as there are contextual factors that may equally influence upon the children within a same sub-region.

All the aforementioned permits evidencing the weight of the socioeconomic conditions and particularly of structural poverty in stunted growth, which is important to insist on the need for integral policies to overcome such. These policies should consider a broad perspective of dietary safety that includes stimulus to food production for self-consumption articulated to regional development policies that improve access to foods, health conditions, and housing. Within these, we suggest considering a component aimed at homes with Youngheads of household (below 30 years of age), which seek to improve their formal education and labor preparation.

Conflict of interests. No conflicts of interest arose during the development of this research and in the publication of the results.

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