Cuban Experience Using Growth and Development as a Positive Indicator of Child Health

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ABSTRACT

Growth and development is considered the best positive indicator of children's quality of life and well-being. Studies have been carried out in Cuba since the early 20th century and large scale, periodic anthropometric surveys have been regularly conducted by its National Health System to chart modifications in growth patterns of children and adolescents. These surveys have produced national references for the anthropometric indicators most commonly applied in individual assessment of the health and nutritional status of children and adolescents in health care settings. These have also provided data for estimating the magnitude and characteristics of secular growth trends, and for comparing growth of Cuban children with that of children in other countries and with WHO's proposed growth standards. The data have also served as evidence of persisting social gradients. The most important results include, as positive data, the positive secular trend in school-aged children's growth of 9.7 cm between 1919 and 2005, with an average increase of 1.1 cm per decade, and, in preschool children, 1.9 and 1.8 cm in boys and girls, respectively, between 1972 and 2015. More recent studies have detected unfavorable changes associated with a marked increase in adiposity and, therefore, in the prevalence of excess weight and obesity. Another interesting result is the gradual movement toward WHO height-for-age standards in preschool children in Havana, verified in surveys conducted in 2005 and 2015.

KEYWORDS Growth and development, growth, child development, children, adolescents, nutrition, obesity, pediatrics, Cuba

INTRODUCTION

Increasing interest in anthropometric surveys in the coming decades will alert us to problems such as obesity and its unfavorable consequences for health. We have reached the stage in which we should not only "measure disease" but must also, at the same time, dedicate ourselves to "measuring health." (J. Jordán , 1979 .[1]*)*

One of the most interesting biological attributes of human beings is the change in their size, shape and functions from childhood to adulthood. This explains scientists' interest in children's growth throughout the 300-year history studying growth and development.[2] Developmental plasticity in response to environmental or ecological stressors has also aroused researchers' interest. It has long been known that a child may stop growing during situations of extreme deprivation followed by varying degrees of compensatory growth once deprivation is reversed.[3]

More recently, Barker's hypothesis about the developmental origins of health and disease introduced the concept of fetal programming in response to environmental insults and consequences in the cytoarchitecture, structure and functioning of different organs and systems.[4] There is substantial evidence that these effects may cause a broad range of dysfunctions that can generate multiple chronic non-communicable diseases affecting health, starting in the earliest stages of life. Growth monitoring starting in the antenatal period fulfills an important role in prevention of such illnesses.[2–5]

In recent decades, various academic groups and international organizations have insisted on the need to use positive health indicators, which presupposes a trend towards evidence to guide health-promoting behaviors and build healthier societies. Growth is the most important positive indicator of child health, since it combines three key factors: nutrition, health status and overall well-being. Psychomotor development of children at the population level has recently been included, based on evidence of measurement feasibility and the association of this with other development indicators.[6,7]

IMPORTANCE This paper presents convincing evidence that child growth and development surveys provide important, direct positive indicators contributing to health and well-being assessments of children in Cuba and can be important tools for other low- and middle-income countries.

Changes in Cuban health policy derived from the consolidation of the National Health System (SNS) and creation in 1970 of the Infant Mortality Reduction Program—with the primary objective of a 50% reduction in mortality in children aged <1 year by 1980—established the need to complement morbidity and mortality indicators with positive health indicators based on in-depth knowledge of the full growth and development process from birth through adolescence.[8]

That idea, which was quite advanced for its time, was promoted by Dr José A. Gutiérrez Muñiz, a prestigious figure in Cuban pediatrics and public health. To put it into practice, the Human Growth and Development Group was created in 1971 as part of the Research Division of the Childhood Institute, the institution then in charge of policy for comprehensive care of preschool children (and whose functions were later absorbed into the Institute of Health Development and then the Department of Human Growth and Development in the Julio Trigo López Medical Faculty at the Medical University of Havana).[9] Its mission was monitoring the growth of Cuban children using anthropometric population surveys, initially under the leadership of Cuban pediatrician José Jordán Rodríguez and later Gutiérrez Muñiz until his death in 2014. Together they initiated training of researchers in various disciplines who have sustained the Group's work to this day.[9]

Principal growth and development studies in Cuba The first recorded growth and development study was carried out by

Georges Rouma, a Belgian anthropologist who gathered information about growth of school-aged children in Havana in 1919.[10] A few studies were carried out in the 1950s, but important information about child growth in Cuba was not obtained again until the 1960s, from studies addressed by anthropologists of the European socialist bloc countries in collaboration with Cuban anthropologists.The most important of these was conducted in 1963 by Polish anthropologist Laska-Mierzejewska, who researched not only the physical development of school-aged children and adolescents in Havana, but also, for the first time in Cuba, their pubertal development.[11]

In 1972, Jordán led the Growth and Development Survey of the Cuban Population, carried out in consultation with James Tanner and Harvey Goldstein, prestigious researchers of the Institute of Child Health of University College London (Tanner is reported to have described it as "one of the most complete carried out in any country").[9] At the time, only a few nationwide studies based on representative population samples had been conducted: Holland in 1955, 1965 and 1980; and Czechoslovakia in 1951, 1961, 1971 and 1981. Whole-country studies were done in Hungary in 1981 and 1985; and the USA since the 1960s.[1,2]

In 1982, the Second National Survey on Growth and Development of the Cuban Population was carried out as part of an international consensus recommending periodic child growth surveys at approximate ten-year intervals to assess changes in child health. The Survey's results also provided references for new nutritional assessment indicators.[12]

During the 1990s, national surveys could not be continued due to the economic crisis in Cuba after the collapse of the socialist bloc. Provincial surveys were conducted instead, such as the 1993 growth and development survey in City of Havana Province (hereinafter Havana), which was the most feasible and appropriate place to obtain information concerning child growth at the time, because the study population was accessible to researchers, the province included approximately one fifth of the Cuban population, and Havana was also the main destination for internal migration. That survey included only basic anthropometric indicators, age at menarche and some socioeconomic variables. Based on its results, a similar study was repeated in Havana five years later, in 1998, followed by a new study in 2005.[13]

In 2002, as part of the provincial-study strategy, a growth and development survey was carried out in Guantánamo, one of the least socioeconomically developed provinces in Cuba. The sample design, data gathering, processing and analysis techniques were similar to those applied in previous surveys, so results could be compared with those previously obtained for Guantánamo Province in the national surveys and with results of the Havana surveys.[13]

In 2015, as part of a project between the National Hygiene, Epidemiology and Microbiology Institute and the Growth and Development Group, a survey was conducted to determine the ages at which a set of psychomotor development milestones were met in a representative sample of children aged <6 years in Havana. Weight and height values obtained from that study were used to determine secular growth trends in preschool children.[14]

In addition to the studies described—all of them cross-sectional—several longitudinal studies have been conducted, such as the 17-year, Perinatal Research Cohort Study that gathered valuable information about the Cuban population (still not fully utilized) related with Barker's hypothesis.[15] Longitudinal studies in children aged <2 years with low birth weight,[16] have also contributed valuable knowledge on the growth of these Cuban children.

Contribution of growth and development studies to assessment of Cuban child health and well-being These studies have provided national references for monitoring growth and nutrition, used since 1984 at all levels of the SNS. Thus, each new indicator assessed in the different studies included diagnostic and monitoring references. One example is waist circumference for age, which since 2016 has been included as standard practice throughout Cuba as an indicator of visceral adiposity, a diagnostic criterion for metabolic syndrome in children.[16,17]

Secular trends *Height* The most visible expression of secular growth trends in children is intergenerational height variation resulting from changes in living conditions.[18,19] Cuban studies have always shown a positive secular trend for this variable. Height values from the 1982 national survey exceeded 1972 values by 0.6 cm, on average, in both sexes. These differences did not occur at all ages; the greatest differences occurred in the prepubertal age group and were greater in children from lower socioeconomic strata living in rural areas, who benefited the most from changes in living conditions and nutrition during that decade.[12]

Comparison of Havana studies reveals a similar phenomenon. The 1963 Havana survey found a positive secular trend in childhood growth compared to Rouma's study,[10] with an average height increase of 1.4 cm/decade. In 2005, children of comparable age to those studied by Rouma were 9.7 cm taller, representing an average increase of 1.1 cm per decade. This trend has been seen in all studies carried out in Havana: in 2005, children and adolescents in Havana were, on average, 2.0 cm (boys) and 2.1 cm (girls) taller than in 1972; 1.4 cm taller (both sexes) than in 1993; and 0.6 and 0.9 cm taller (boys and girls, respectively) than in 1998. In the 2015 study, a positive secular trend was also observed in preschool children compared to 1972, with a height increase of 1.9 and 1.8 cm (0.4 cm per decade) in boys and girls, respectively.[13]

The trend's magnitude varies with age and is greatest in early adolescence, possibly due to the accelerated rhythm of maturation at that stage. It is also influenced by economic conditions: In 1993, during a period of drastic economic decline, increases in height were small compared to the 1972 value (0.2 and 0.3 cm/decade in boys and girls, respectively), whereas in 1993–2005, coinciding with the period of economic recovery, a 1.2 cm/decade increase was found in both sexes. These results highlight the value of Tanner's often-quoted designation of growth as a mirror that reflects a society's health and changing living conditions.[20]

Weight This indicator has shown positive secular trends, similar to those for height, except when comparing 1993 values with those of 1972: weight declined, fundamentally in school-aged children and adolescents, as a result of the economic crisis of the early 1990s, which also had a negative impact on body mass index and skinfold thickness. Subsequently, in 1993–2005 the weight again increased with the economic recovery of the country and reached gradients of 1.2 and 0.8 kg/decade in boys and girls respectively. Marked increases in prevalence of overweight and obesity in chil-

dren and adolescents were seen, increasing the risk of chronic non-communicable disease beginning in the earliest stages of life. Preschool children also showed weight gains in 2015 compared to 1972 with average values of 0.9 and 0.7 kg in boys and girls, respectively, equivalent to 0.2 kg per decade.[13]

Age of menarche Median age of menarche in adolescent girls in Havana (with their respective standard deviation, SD) were: 12.6 (0.06) in 1972, 12.4 (0.14) in 1993, 12.9 (0.09) in 1998, and 12.5 (0.09) in 2005. This temporal pattern of change, showing delayed sexual maturation of girls during the economic crisis of the 1990s and subsequent recovery, demonstrates the association between pubertal development and living conditions.[13]

Social gradients In growth and development studies, social gradients are the differences in body size and maturation among children from different socioeconomic groups within the same country. In the Cuban population, differences in growth were found between boys and girls living in the eastern province of Guantánamo, characterized by lower socioeconomic development, and their counterparts in Havana. Average height of boys and girls in Guantánamo was 98.5% and 98.7%, respectively, of height of children in Havana, and average weight of children in Guantánamo was 93.6% and 94% of weight of boys and girls in Havana.[13] These results are very useful for setting policies aimed at the most vulnerable populations; however, particular attributions of causality can only be determined with further studies.

Population differences Variations in growth are expressed as a result of the interaction—mediated by epigenetic factors—between genetic factors and the environment in which children develop. One example of these differences is seen in Cuban height and weight references, whose values are lower than WHO's proposed standards in the lowest weight percentiles and in the height-for-age indicator, which leads to differences in results of nutritional assessment in children.[21,22] The 2005 and 2015 surveys carried out in Havana offer an interesting result associated with those standards: initially negative height-for-age z-scores gradually approach positive values as age increases.[14,22] This differs from results reported in more than 50 low- and middle-income countries in which z-scores in this dimension moved quickly and progressively down from WHO standards up to age 2 years, and then rose, but always maintaining z-scores under −0.25.[23] Median z-scores for children aged 0–5 years, (with their respective SD) were −0.07 (1.08) in the 2005 survey and 0.02 (1.17) in the 2015 survey.[14]

CONCLUSIONS

Cuba is one of the few countries in the western hemisphere with reliable population-wide growth references, despite many years of economic hardship. Study results demonstrate positive changes in Cuban children's and adolescents' physical development, such as the positive secular trend in height. They also show other less favorable changes, such as increased adiposity, which raises the risk of chronic non-communicable diseases starting early in life. Finally, they reveal regional differences between sociodemographic groups that have to be confirmed with more comprehensive studies including a broad set of health, economic and social variables, and that should be addressed through strategies to benefit the most vulnerable. The research presents convincing evidence that child growth and development surveys provide important, direct positive indicators contributing to health and well-being assessments of children in Cuba and can be important tools for other low- and middle-income countries.

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