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Original Article

Growth diagrams of Indonesian children The nationwide survey of 2005

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ABSTRACT

Background Reference curves of growth have been developed in many countries based on cross-sectional data. The World Health Organization (WHO) has recommended an international reference which is based on the growth standards developed within the United States during the 1970s. In general these growth references are used in Indonesian pediatric clinics although it is known that these references are not appropriate for this population with a different ethnic background. In order to evaluate reliably Indonesian children with growth disorders reference standards based on measurements in Indonesian children are necessary.

Objective To make a standard growth chart for Indonesian children especially with regards to height, weight, and head circumference from a healthy Indonesian infants and children, age 0-18 years. This standard charts were compared to CDC growth charts.

Methods Weight and height and head circumference were taken from children with age ranging from birth up to 18 years. All subjects were recruited from 7 different parts of Indonesia. The age grouping for children from 0-1 years old was based on 3-month interval, while for children older than 12 months was based on a 6-month interval. The study was cross sectional.

Results There were 34 800 children (17 229 boys and 17 571 girls) included in this study with age ranging from 0 up to 18 years. Graphs were presented for weight for age, supine length for age, head circumference for age in male and female infants, and weight for height and height for age in boys and girls 1-18 years. Comparson of the results of this study with the CDC data were presented as a graph.

Conclusion The standard charts for Indonesian children based on weight for height, supine length for height and head circumference for age were presented in graphs for children 0-1 year, weight for height and height for age for boys and girls 1-18 years old. All children were compared to CDC growth charts and there exists a mean difference of -1.47 SDS for boys and -1.43 SDS for girls.**[Paediatr Indones 2006;46:118-126].**

Keywords: *height, weight, head circumference, Indonesia*

Anthropometric reference data on a population enable paediatricians and other health workers to judge whether a child is atypical as compared to the reference population. The atypicality so found may be indicative of growth deficiency as it may occur in cases of illness, malnutrition, and psychosocial deprivation.

Patients and reference population must share, as much as possible, the same characteristics such as geographical and socio-economic background to allow a valid comparison. For that reason local reference values have an important meaning. Besides the possibility of comparing the individual patient with its reference population, a comparison can also be

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made between reference and other populations or between the same reference populations but with measurements taken at different times.

This study examines the most used anthropometric measurements, height, weight and head circumference. To obtain nationwide reference data, measurements were taken at seven different locations all over the country. Lacking Indonesian reference values the NCHS/CDC growth charts are used in Indonesian practice.[1,2] A comparison is made with the NCHS/CDC to show the importance of this nationwide study.

Methods

Study population

The study population consisted of 34800 children with age ranging from birth up to 18 years. The population was divided in 17 229 boys and 17 571 girls. All subjects were recruited from 7 different parts of Indonesia.

The age grouping for children from 0-1 years old was based on 3-month interval, while for children with an age equal to or older than 12 months, the chronological age grouping was based on a 6-month interval. The study was cross sectional.

Proportionate random sampling to sample size (PRS) was used with sub-district as the sampling unit. Infants and children under five have been measured at Posyandu (Community-based child health centers) and maternity hospitals or clinics. Pre-school and school children were measured at school (pre-school, elementary, junior high and senior highschools). In each district, the sites were randomly selected and consisted of private and government-related institutions.

Indonesia nationwide	Boys (n)	Girls (n)
Total number of children 0-1 yrs of age	2608	2594
Total number of children 1-18 yrs of age	14621	14977

Per region:		Boys	Girls
Jakarta:	0-1 yr of age	199	210
	1-18 yrs of age	1578	1606
Bandung:	0-1 yr of age	333	348
	1-18 yrs of age	2272	2448
Yogyakarta:	0-1 yr of age	407	428
	1-18 yrs of age	2372	2392
Palembang:	0-1 yr of age	460	425
	1-18 yrs of age	2154	2181
Makasar:	0-1 yr of age	396	393
	1-18 yrs of age	2082	2170
Kupang:	0-1 yr of age	415	382
	1-18 yrs of age	2088	2072
Borneo:	0-1 yr of age	398	408
	1-18 yrs of age	2075	2108

Data collection

Data were collected through interview with parents or children and anthropometric measurements. A pre-data collection questionnaire was developed to assess inclusion and exclusion. The anthropometric measurements consisted of weight and height. BMI was calculated as body weight in kilograms divided by standing height in square meters.

Exclusion criteria

All children suspected to have growth disorders due to pathologic causes such as primary growth abnormalities (intrauaterine growth retardation, skeletal displasias, Down syndrome), secondary growth disorders (malnutrition, congenital heart disease, congenital renal disease, thalassemia, tuberculosis) and endocrine disorders (hypothyroidism, diabetes mellitus, and growth hormone deficiency) were excluded.

Methods of measurements

Measurements were taken according to the methods as described by Gerver and de Bruin.[3]

Weight

Weight was measured using "Salter spring", weight measure for children under 6 years of age or SECA. Weight is calculated to the nearest 0.1 kg.

Height

Measurement of supine length was performed for children less than 2 years old. Standing height was used in older children. For measurement of supine length, a firm box was used with an inflexible board, against which the head lies and a moveable footboard on which the feet were placed perpendicular to the plane determined by the supine length of the infant. It was optimal when the child was relaxed, with the legs fully extended and the head positioned in the Frankfurt plane, whereby the line connecting the outer cantus of the eyes and the external auditory meatus was perpendicular to the long axis of the trunk. When child were old enough to stand, a wall

mounted Harpenden stadiometer was used. Standing height was recommended for children over the age 2-3 years.

After removing socks and shoes the child should stand straight ahead against the wall, with shoulder relaxed and heel firmly on the floor. The eyes and outer ears should be in the horizontal plane (Frankfurt plane). Then the child should breathe in whilst applying gentle pressure on the mastoid process, then out and observe the height. Read to the nearest millimeter.

Head circumference

To measure head circumference, a fiberglass-reinforced tape of non- stretchable material is used. The tape is placed around the head at the most protruding points of occiput and forehead. In younger children, the tape is placed just above the brow ridges. Trained enumerators performed all measurements.

Construction of the charts

The distribution of the different measurements for each age was assumed to be non- symmetrical. Therefore, for the construction of percentiles the following methods were applied. After sorting the n measurements of the population in ascending sequence of age, a moving frame consisting of 100 individuals is considered starting with index number 1,2,3,..,n-99. For each frame the modus is computed. On either side of the modus the population is considered separately and the data are transformed to a symmetrical distribution. The standard deviation is calculated for each. Next, all percentiles are computed from the median and standard deviation. Cubic spline approximation is used to smooth the calculated percentiles.[4]

All children were compared with the CDC growth charts by calculating their individual standard deviations out of the SD reference values for the American population. There exists a mean difference of -1.47 SDS for boys and -1.43 SDS for girls.

Results

Figures 1a and **1b** represent the graphs of weight for age, supine length for age, head circumference for age in male infants and weight for height and height for age in boys 1-18 years of age. **Figures 2a** and **2b** represent the same for female infants and girls 1-18 years of age. The layout of the graphs is made for daily practical use.

Figure 3 shows the comparison of the Indonesian nationwide references with the CDC data presented as a graph.

Discussion

Anthropometric reference values are important tools to evaluate the growth of individuals as well as the growth of populations as a whole. The parameters taken to obtain these reference values must comply with certain criteria. Firstly they must characterize the population in such a way that comparing individuals or other populations makes sense. Secondly, the parameters must have some meaning for both the investigator and the subject being investigated. Thirdly, the parameters must be relatively easy to obtain to enable more extensive population studies in different areas.

Lacking recent Indonesian reference values, this study was set up to get a number of anthropometric measurements representative for the Indonesia population. However, the subjects under examination were a mixture of children with different socio-economic backgrounds and of different geographic origins. This premise affects the reliability since this population will not characterize some of the single groups but only the population as a whole. The same applies to the worldwide used NCHS standards, which take into account a mixture of the American population. Nevertheless, when we consider the dispersion of the Indonesian population, there cannot be but minor differences between the different groups.

Out of all anthropometrical measurements, height, weight and head circumference are quite obviously those, which most answer the second criterion. Weight is often used to estimate the nutritional status of a child, height as the best indicator of growth and the same for head circumference especially during the first year.

Comparing height of the Indonesian with the American population there exists a mean difference of -1.47 SDS for boys and -1.43 SDS for girls. The difference is at age 1 year more than at the age of about 4 years. Thereafter it is remarkable

that boys are becoming increasingly smaller compared to their American peers while the girls show a sudden increase in height at age 12. This suggests an earlier puberty growth spurt in girls resulting in the end of growing at an earlier age too. In boys this phenomenon is not clear. Both sexes end with a small height as an adult compared to the American population.

The nutritional status is compatible with the American population when weight is related to height. The Indonesian children are just somewhat smaller but have the same weight in proportion.

Acknowledgments

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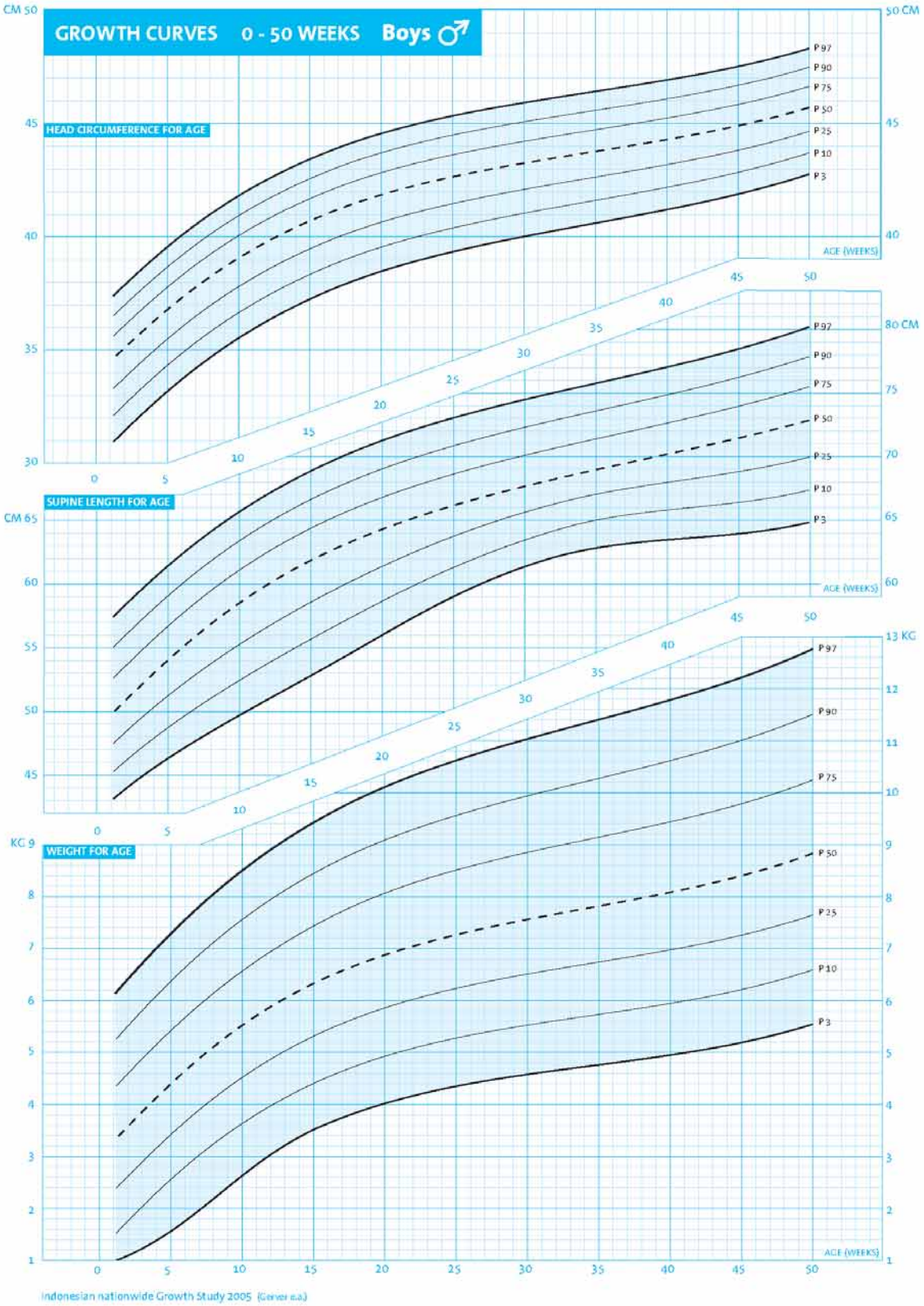

FIGURE 1A. THE GRAPHS OF WEIGHT FOR AGE, SUPINE LENGTH FOR AGE, HEAD CIRCUMFERENCE FOR AGE IN MALE INFANTS.

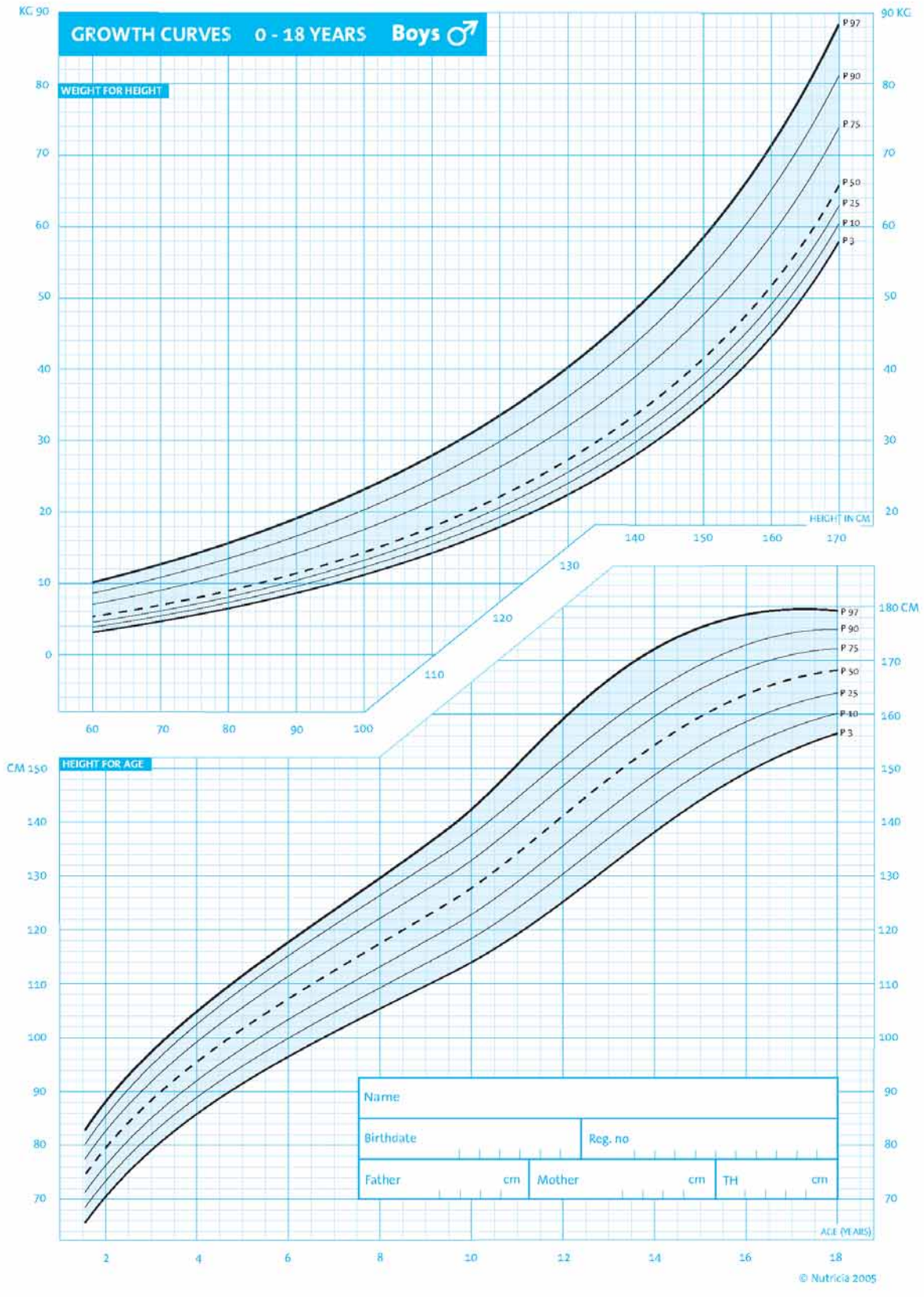

FIGURE 1B. THE GRAPHS WEIGHT FOR HEIGHT AND HEIGHT FOR AGE IN BOYS 1-18 YEARS OF AGE.

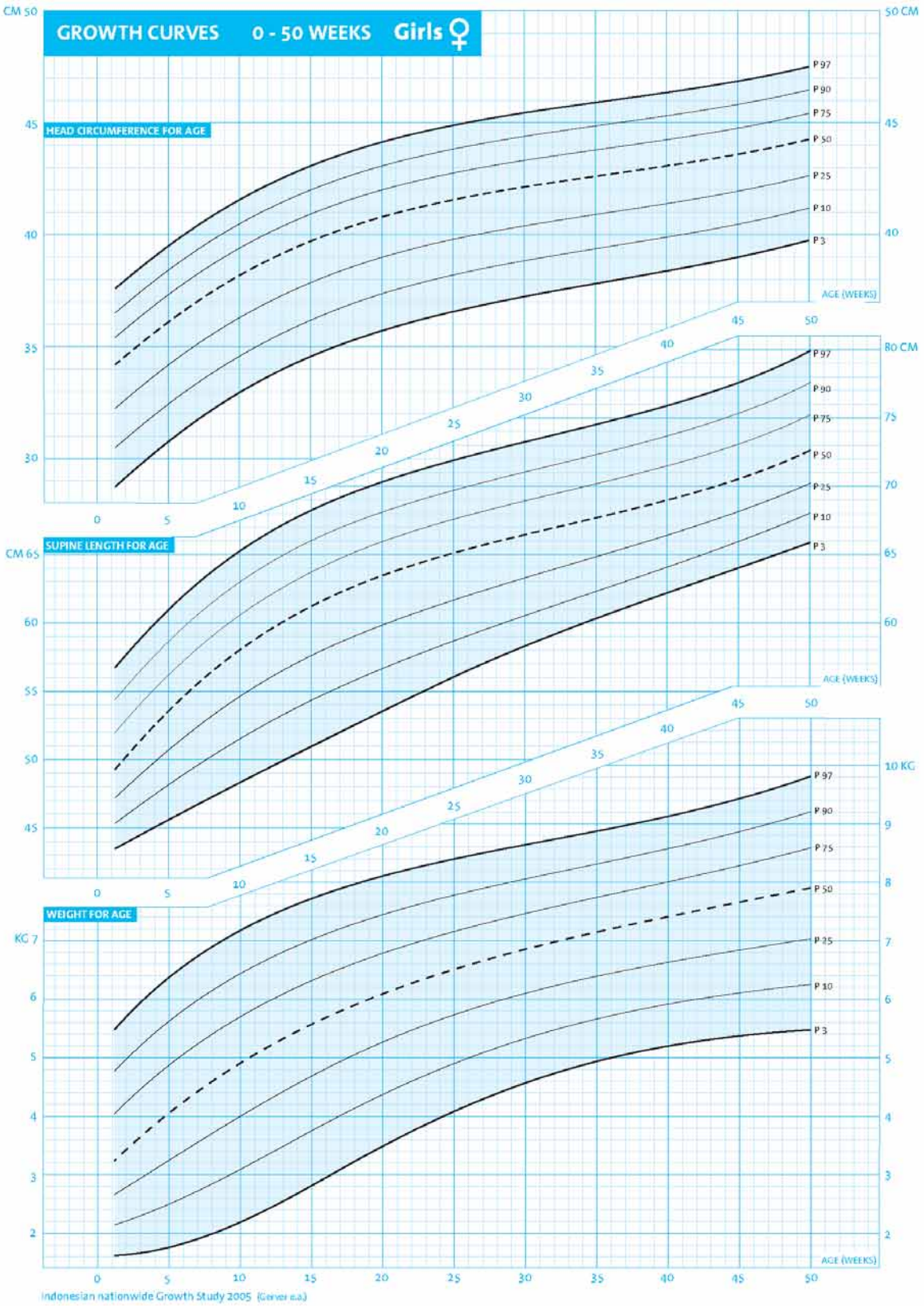

FIGURE 2A. THE GRAPHS OF WEIGHT FOR AGE, SUPINE LENGTH FOR AGE, HEAD CIRCUMFERENCE FOR AGE IN FEMALE INFANTS.

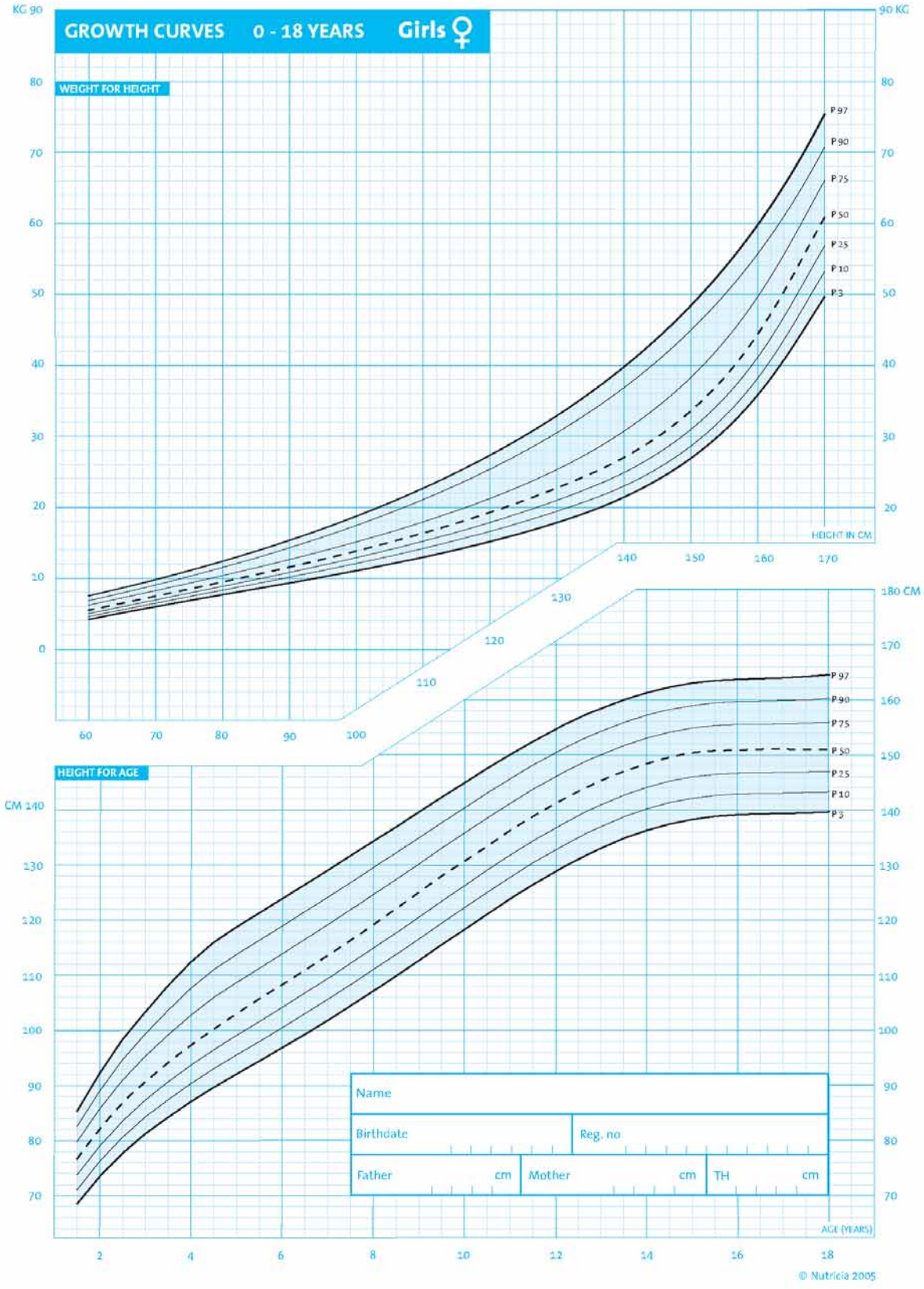

FIGURE 2B. THE GRAPHS WEIGHT FOR HEIGHT AND HEIGHT FOR AGE IN GIRLS 1-18 YEARS OF AGE.

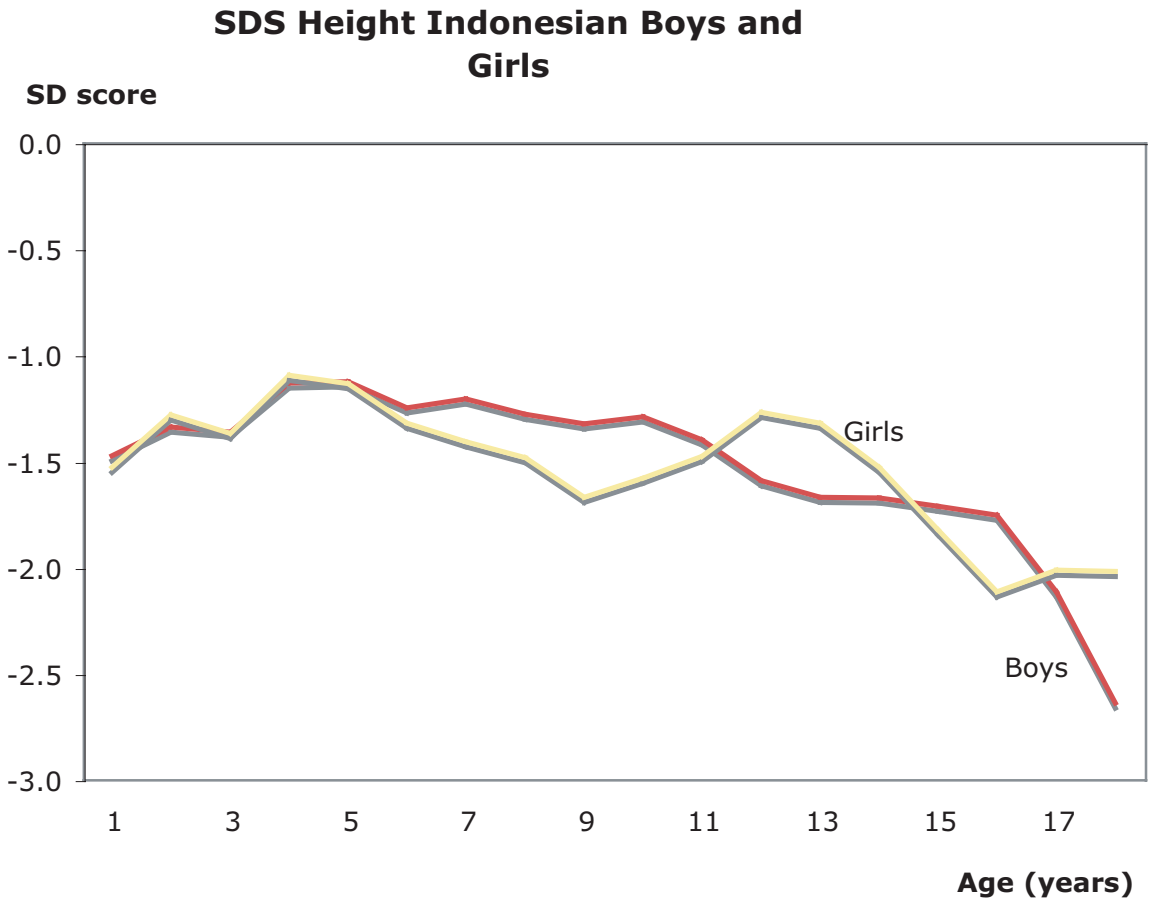

FIGURE 3. THE COMPARISON OF THE INDONESIAN NATIONWIDE REFERENCES WITH THE CDC DATA.