CEPHALIC MEASURES IN NORMAL PRE-SCHOOL CHILDREN 3 to 7-YEARS OF AGE

A. J. DIAMENT *
F. W. RODRIGUES **

In a study designed to determine the normal standards for an Evolutive Neurological Examination [7] certain measures of the head were taken in order to study growth and shape of children's heads.

METHODOLOGY AND CASUISTICS

Head measures were taken in 200 children, half from each sex, with in each one of the five age groups 3-7 years consisting of 40 children.

This group was selected among 755 normal pre-school age children. The criteria for selection was both anamnestic and clinic [2, 7].

The following measures were obtained: cephalic perimeter, biauricular and anterior-posterior distances following the sistematization already established [2], using a fiber-glass tape measure. The new cephalic index (nCI) was determined as the ratio of the biauricular distance by the anterior-posterior [2].

For each one of those measures and within each category (sex, age) the mean (X), standard deviation (S) and tolerance limits (TL) were calculated. For the new cephalic index (nCI) we used the Kruskal-Wallis test [10] and the differences among the ten groups were not significant. This indicates that, at least within those age limits, the nCI appears not to be associated with age or sex. Therefore we decided to use all 186 measures (14 were lost due to technical difficulties) to find a unique tolerance region for the 3-7 age group independently of sex.

RESULTS

The means, standard deviations (SD) and tolerance limits (TL) for each one of the measures can be found in tables 1, 2 and 3. Table 4 shows the same values for the nCI. Looking at these tables we can see that the largest values of S for the cephalic perimeter were found for five-years old boys and seven-years old girls.

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* Assistant-Professor, Department of Neurology, School of Medicine, University of São Paulo (Brasil); ** Assistant-Professor of Statistics, Institute of Mathematic and Statistic, University of São Paulo (Brasil).

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Age	3 y		4 y		5 y		6 y		7 y	
Sex	M	F *	M	F	M	F	M	F	M	F
Mean	49,90	50,16	51,40	49,56	51,75	51,30	52,11	51,22	52,15	51,28
S.D.	1,21	1,29	1,22	1,67	2,11	1,10	1,29	1,28	1,24	2,01
T.R.	46,57 to 53,23	46,57 to 53,75	48,04 to 54,76	44,96 to 54,16	45,95 to 57,55	48,27 to 54,33	48,56 to 55,66	47,70 to 54,74	48,73 to 55,57	45,75 to 56,81

*Table 1 — Cephalic perimeters in cm (mean, S.D. and T.R.) for groups of age and sex: S.D. = Standard desviation; T.R. = Tolerance region; F = female; M = male; Y = years; * (in 19 cases).*

Age	3 y		4 y		5 y		6 y		7 y	
Sex	M	F *	M	F	M	F	M *	F **	M **	F *
Mean	28,82	28,28	29,90	28,87	30,12	30,05	30,92	29,95	30,60	29,57
S.D.	1,71	0,81	1,72	1,66	1,44	1,00	2,34	1,81	1,17	2,77
T.R.	24,12 to 33,52	26,00 to 30,56	25,17 to 34,63	24,30 to 33,40	26,16 to 34,08	27,30 to 32,80	24,32 to 37,52	24,91 to 34,99	27,33 to 33,87	21,77 to 37,37

*Table 2 — Biauricular distance in cm (mean, S.D. and T.R.) for groups of age and sex: * (in 18 cases); ** (in 19 cases).*

Age	3 y		4 y		5 y		6 y		7 y	
Sex	M	F *	M	F	M	F	M *	F **	M **	F *
Mean	31,12	30,58	32,37	30,72	32,35	32,02	33,37	32,37	32,63	31,95
S.D.	2,23	1,46	2,34	2,02	1,81	1,16	1,92	2,40	1,97	2,35
T.R.	24,99 to 37,25	26,46 to 34,70	25,93 to 38,81	25,16 to 36,28	27,34 to 37,34	28,82 to 35,22	27,96 to 38,78	25,67 to 39,07	27,13 to 38,13	25,33 to 38,57

*Table 3 — Anterior-posterior distance in cm (mean S.D. and T.R.) for groups of age and sex: * (in 18 cases); ** (in 19 cases).*

Age	3 y		4 y		5 y		6 y		7 y	
Sex	M **	F *	M **	F	M **	F	M *	F ***	M **	F *
Mean	0,922	0,930	0,919	0,940	0,925	0,933	0,926	0,917	0,934	0,912
S.D.	0,063	0,046	0,046	0,040	0,042	0,035	0,039	0,039	0,045	0,039
T.R.	0,747 to 1,097	0,802 to 1,058	0,791 to 1,047	0,830 to 1,050	0,809 to 1,041	0,837 to 1,029	0,817 to 1,035	0,806 to 1,028	0,808 to 1,060	0,803 to 1,021

*Table 3 — Anterior-posterior distance in cm (mean, S.D. and S.D. and T.R.): * (in 18 cases); ** (in 19 cases); *** (in 17 cases).*

Since the sample size is practically the same for each group, those differences in variability are responsible for the different sizes of the tolerance intervals. This explains a larger letf-end point for 4-years old when compared with the 5-years old boys. For the 3 years old age group the mean of the cephalic perimeter is slightly larger for girls than for boys.

Although no statistical tests were made we believe this difference to be not significant. Discrepancies of the same type found in other measures (Tables 2 and 3) can probably be explained in the same way.

In table 4 we may observe that the nCI shows almost uniform variabiltiies the only exception being the 3-years old boys which shows a value slightly above the rest. This homogeneity of variances makes a stronger case for the hypothesis of no association of the nCI with age and sex (within the 3-7 limits). The tolerance interval for the nCI in the entire 3-7 age group is the interval 0,848-1,002. This means that we have 95% confidence that, independently of sex, this interval covers 90% of the population of normal children in this age group.

COMMENTS

For cephalic perimeters, in Brazil, an other reference in the literature is Marcondes & col.[8] where tolerance limits were found for the cephalic perimeters of children up to three years of age. In the 3-years old age group the means of the cephalic perimeter were 48.90 for boys and 47.87 cm for girls against our results of 49.90 and 50.16 respectively. Their tolerance intervals were 45.77-52.04 cm for boys and 44.83-50.90 cm for girls[8]. Those discrepancies can be explained by the larger variability of our estimate of σ^2 since Marcondes & col.[8] worked with a much larger sample size. We decided not to discuss results obtained in other countries since the results are possibly not comparable. For example with respect to the Nelhaus grafic Marcondes & col.[8] observe that rigorously it should not be considered international and interracial since it lacks observations from both Africa and Latin-America. In our cases the means of the cephalic perimeter was smaller than in other countries[9, 12]. However they are quite close to the values reported by Watson & Lowrey[11] for north-american children of both sexes. For the 3-years old our means are larger than the ones reported by Karlberg[6] and are similar to Falkner[5]. With the excepction of Barber & col.[1] nobody else measured both anterior-posterior and biauricular distances. Barber & col.[1] used an anthropological compass and the biauricular distance for them is the maximal distance between the parietal eminences. The classical cephalic index (CI) was also obtained and according to it individuals were classified as meso, brachy and dolychocephalics.

The CI also shows considerable differences according to age and sex. In order to conciliate these differences with the alometric law of growth of Huxley (which is supposed to be valid for perpendicular distances) Barber & col.[1] used mathematical formulas envolving derivatives of functions. The nCI expresses more directly the harmony of growth of two perpendicular distances and constitutes a good example for an extension of Huxley's previsions for Coelenterates. The tolerance region for the nCI is larger than the one we found before for the first year of age[2]. The larger difference is in the left-end point from 0,88416 for the first year to 0,848 for the 3-7,

a difference of 0,03616. One possible explanation could be that heads of small children are more uniform. As time passes the head starts to take its definite form appearing then a large number of dolychocephalics due to a slightly large rate of growth of the antero-posterior distance. The nCI for the first year was already used in a study of precocious craniostenosis [4] and it has proved to be very effective in detecting changes in head-shape [3]. For all cases, below one year the nCI was either above the maximum or below the minimum [4]. Also as an indicator of changes in head shape it is much simpler to work with, than the measures suggested by Zuchowicz [13]. We are now working in a small ruler that will allow a practicioner given the two measures, to decide if a given individual has or not alterations in head shape.

SUMMARY

In a study designed to determine standards for the Developmental Neurological Examination (DNE) several measures of the head were also recorded. The study consisted in the examination of 200 children, half from each sex, 40 from each age group (3 to 7-years of age). These children were selected among 755 normal pre-school-age children, living in the city of São Paulo (Brazil). The criteria for selection were both anamnestic and clinic.

The following measures of the head were recorded: cephalic perimeter, biauricular and antero-posterior distances (Diament, 1967). A new cephalic index (nCI) was also determined (Diament, 1968). This index is useful in detecting changes in head shape mainly in cases of precocious cranioestenosis (Diament, 1968; Facure, 1972).

The statistical analysis consisted in determining means and standard errors for each measure. For the new cephalic index it was shown through the Kruskal-Wallis test that there were no significant difference between age and sex. Therefore we considered all groups together to find out the tolerance region for the new index which turned out to be given by the interval: 0.848-1.002. This result is based in 186 cases since 14 were excluded because of some problems in the recording process. Therefore we expect with a confidence of 95% that the above interval covers 90% of the population, in the 3 to 7 years age-groups independently of sex.

RESUMO

Medidas cranianas em crianças pré-escolares normais de 3 a 7 anos

As medidas da cabeça — perímetro craniano e distâncias bi-auricular e ântero-posterior — foram estudadas em 200 crianças, metade de cada sexo, 40 para cada grupo etário de pré-escolares normais de 3 a 7 anos de idade. A análise estatística consistiu em se determinar médias, desvios-padrões e limites de tolerância (LT) para cada medida. Utilisando as duas distâncias (BA e AP) determinou-se um Indice Cefálico novo (ICn), para o qual tam-

bém se calculou médias, desvios-padrões e LT para cada idade e sexo. Pelo teste de Kruskal-Wallis verificou-se não haver diferenças significantes entre idade e sexo para o ICn. Então, considerou-se todo o grupo etário em conjunto para achar uma única região de tolerância, dada pelo intervalo: 0,848-1,002, resultado baseado em 186 medidas (excluídas 14, por problemas técnicos). Portanto, espera-se, com uma confiança de 95% de que o intervalor cubra 90% desta população, independentemente do sexo. O mesmo índice já havia sido determinado por um dos autores para crianças normais no primeiro ano de vida, servindo para detectar precocemente alterações na forma do crânio, principalmente cranioestenose precoce.

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Clínica Neurológica — Hospital das Clínicas, Faculdade de Medicina da Universidade de São Paulo — Caixa Postal 3461 — 01000 São Paulo, SP — Brasil.