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# Growth parameters of Inuit children in coastal Labrador

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Abstract

Objective and methods: To develop age- and sex-specific profiles of growth parameters of Inuit children using a retrospective, chart-based study of public health growth records. All children (137) and "even numbered" children from the birth registers (121/231) in the communities of Hopedale and Nain on the northern coast of Labrador, respectively, were used from Jan. 1, 1988, to April 30, 1995.

Intervals selected were as follows: around the time of birth, 3, 6, 12 and 18 months and 4 years. Children within these intervals were selected once by predefined selection criteria. Data were collected for the variables of sex, age, height, weight and head circumference. Sex-specific plots of height, weight, head circumference by age, and weight for height were developed.

Results: At birth, Inuit children are not significantly different ($p > 0.02$ by the Wilcoxon signed rank test) from National Center for Health Statistics (NCHS) data for all of the variables. Between 6 and 12 months of age both height and weight diverge from the NCHS percentiles. Weight for height diverges significantly and shows the cumulative effect of decreased height and increased weight (compared with the NCHS data) characteristic of Inuit children. Head circumference is not significantly different from the NCHS data.

Conclusion: Used appropriately and in conjunction with the NCHS reference curves, these data can help the clinician make the appropriate adjustments when interpreting the growth patterns of Inuit children in Labrador.

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Résumé

Objectif et méthodes : Établir des profils particuliers à l'âge et au sexe des paramètres de croissance des enfants inuit en effectuant une étude rétrospective de dossiers de croissance de la santé publique. On a utilisé, du 1er janvier 1988 au 30 avril 1995, tous les enfants (137) et les enfants «pairs» tirés des registres des naissances (121/231) dans les localités de Hopedale et Nain, respectivement, sur la côte nord du Labrador.

Les intervalles choisis étaient les suivants : au moment de la naissance environ, à 3, 6, 12 et 18 mois, et à 4 ans. On a choisi les enfants qui se trouvaient dans ces intervalles une fois au moyen de critères de sélection prédéterminés. On a recueilli des données sur les variables sexe, âge, taille, poids et circonférence du crâne. On a ensuite tracé des courbes, particulières à chaque sexe, de la taille, du poids, de la circonférence du crâne selon l'âge et du poids en fonction de la taille.

Résultats : À la naissance, les enfants inuit ne sont pas très différents ($p < 0,02$ selon le test de Wilcoxon pour observations appariées) des données de l'Institut canadien d'information sur la santé (ICIS) pour toutes les variables. Entre 6 et 12 mois, la taille et le poids s'écartent des percentiles de l'ICIS. La courbe du poids en fonction de la taille diverge considérablement et montre l'effet cumulatif de la diminution de la taille et de l'augmentation du poids (comparativement aux données de l'ICIS) caractéristiques des enfants inuit. La circonférence du crâne ne présente pas de différence significative par rapport aux données de l'ICIS.

Conclusion : Utilisées comme il se doit et de concert avec les courbes de référence de l'ICIS, ces données peuvent aider le clinicien à apporter les ajustements nécessaires pour interpréter les tendances de la croissance chez les enfants inuit du Labrador.

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## Introduction

Measurements of physical growth are used by clinicians to evaluate growth patterns in children and to compare an individual child's development in relationship to accepted norms. Although other methods of nutritional assessment involving laboratory techniques are often used, the adequacy of growth may be the single most valuable indicator of nutritional and general health.1

Historically, anthropometry was important as proof of the equality of Europeans and North Americans.1 In the 19th century, stature implied moral and social value rather than health. The first growth charts were developed in 1877 by H.P. Bowditch, Dean of Harvard Medical School, for the average height and weight of US school children.1 His studies served as models for many subsequent studies, and over the next century, data from cross-sectional and longitudinal studies were used to formulate charts and tables depicting height-weight-age relationships. The results of many of these studies experienced only local or short-term use because of the nature of the population sample, lack of expert agreement on broad applicability or limited distribution.2

The National Center for Health Statistics (NCHS) prepared new percentile curves for a growth chart that could be used for the population as a whole.2 The curves were formulated from data collected during the Health Examination Survey (HES) and were supplemented with age-appropriate sets of the height and weight data of infants and children from the Fels Research Institute of Ohio.3 These sex-specific percentile curves purportedly represent the varied pediatric population of the United States. They make more uniform clinical appraisal of growth and nutritional status possible and they simplify comparative interpretation of growth data from differing populations around the world.2

From data currently available, adult Inuit show considerable variation in growth parameters relative to their European counterparts. Adult Inuit are usually shorter and heavier for their height

than white people.4-6 According to a recent study of Labrador youth by Zammit, Kalra and Winters,4 male and female heights lie between the 10th and 50th percentile of US standards. Inuit weight for age lies between the 50th and 75th percentile and weight for height lies between the 75th and 90th percentile for both boys and girls. However, this study was based on a small sample size (n = 100) and did not include the ages from birth to 5 years old.

There are significant differences of growth among populations.7,8 It is these differences that eventually give rise to the population differences seen in adults. Growth is influenced by many factors, including genetics and environmental influences. Genetic factors may predispose a population to a certain body shape or even to be more sensitive to environmental influences. Environmental factors such as nutrition, disease, socioeconomic status, urbanization, physical activity, psychological stress, season of the year and climate also affect growth.7 Changing environmental factors, such as increasing socioeconomic status and decreased disease, have revealed a trend toward increasing height and earlier puberty.9,10 This trend has also been demonstrated in the adult Inuit population.4,5

In 1987, the Canadian Paediatric Society (CPS) addressed the issue of subpopulation growth charts, specifically with regard to the North American Indian and Inuit populations, and concluded that, because of regional variation and small population size, a single growth curve could not be developed for all native children.11 The CPS stated that individual growth charts would be needed for each of the different tribal and cultural areas and that the small numbers would make the results unreliable.

However, physicians working daily in these various regions have to adjust mentally to how they interpret the plot of a child's growth, based on their impression of variations from the norm in their locale. They are basing this on assumptions, because very few of these populations have been evaluated systematically. The CPS recommended: "Health care workers . . . must be made aware of local variations in weight or head circumference as part of their orientation." Although the NCHS reference curves should continue to be used in these areas, having reference data unique to each population can provide better information upon which to base the adjustment needed for interpreting a child's growth pattern.

This present study reports on the analysis of anthropometric data collected on Inuit children aged 0 to 5 years in the communities of Nain and Hopedale on the northern coast of Labrador. The purpose of the study was to describe, by age and sex, the growth profiles of Inuit children in the 2 communities and to compare these profiles to the NCHS curves.

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## Methods

Charts located in the nursing stations of Nain and Hopedale, on the northern coast of Labrador,

were examined retrospectively. Only children recognized as Inuit by the Labrador Inuit Association (LIA) were sampled. Identity was established either by consultation with the community health nurse, who was familiar with membership status, or by cross-referencing a child's name with LIA numbers available at the nursing stations. In Hopedale, the sample included all measurements on all available children (n = 137) born between Jan. 1, 1988, and April 30, 1995. In Nain, even-numbered LIA children (n = 121/231) were selected from the birth registry for this same time period. If the chart was not available or could not be found, the next chart was selected.

## Data

Details of height, weight and head circumference, as measured by the public health nurse or the public health nurse assistant at the nursing stations, were collected. Measurements are made routinely at approximately 0, 3, 6, 12 and 18 months of age, as well as at 3 and 4 years of age and are part of the routine health survey performed. Measurements were routinely plotted on NCHS reference curves.

## Data selection

Time intervals were selected around each of the routine measuring times. These were birth, 2 to 4 months, 5 to 7 months, 10 to 14 months, 16 to 20 months and 3 to 5 years. Some children were measured on more than 1 occasion within each of these time frames. In that case, the value closest to the median of the interval was selected. If 2 measurements were 0.1 months equidistant from the median time interval, the measurement with the fewest missing values was selected. If there were equal missing values the first measurement was selected. For the last time interval, the record closest to 4 years was chosen (Table 1).

## Development of percentiles

Narrow time intervals were selected around the median age of each measuring time, and intervals were selected so that the sex-specific mean height and weight were not significantly different ($p > 0.05$ by the 2-tailed independent t-test) on either side of the median age interval. Sex-specific values of the variables of height, weight and head circumference were then arranged in ascending order, and percentiles were calculated from the observed data. Weight for height was calculated in a similar fashion. Height intervals were selected in which weight did not change significantly on either side of the median height (Table 2). Only data sets with complete height and weight measurements were included in the analysis. Percentile lines for Inuit children were produced from the data and compared to NCHS reference data2,3 for the 10th and 90th percentiles. Median Inuit data were also compared to NCHS data for height, weight and head circumference for the intervals from birth to 18 months. Significance was tested by comparing percentiles at the median value of each interval with the Wilcoxon signed rank test ($p < 0.02$). Each sex and variable was compared independently.

Sex-specific graphs of height, weight, head circumference and weight for height for LIA members of Nain and Hopedale were drawn from the data. For each of these variables we

developed percentile curves and curves depicting the comparison of Inuit at the 10th and 90th percentiles with the corresponding NCHS percentiles (Figs. 1 to 14).

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## Results

### Weight for age (Figs. 1, 2, 3, 4)

At birth, Inuit weight appears to be the same as that illustrated by the NCHS data. However, by 6 months of age Inuit weight begins to increase in both males and females. At 48 months the male 90th percentile appears to converge; however, there is a significant difference in the percentiles overall (Wilcoxon signed rank test $p < 0.02$). This convergence is probably a result of the small sample size.

### Height for age (Figs. 5, 6, 7, 8)

At birth, Inuit height appears to be the same as that illustrated by the NCHS data. By 12 months, for both males and females, Inuit become significantly shorter relative to the NCHS data (Wilcoxon signed rank test $p < 0.02$).

### Head circumference for age (Figs. 9, 10, 11, 12)

Although Inuit head circumference is slightly larger than noted in the NCHS data, the difference is not significant.

### Weight for height (Figs. 13 and 14)

For both males and females the weight for height is significantly skewed upward for all heights greater than 60 cm (Wilcoxon signed rank test $p < 0.02$). These graphs show the combined effects of the shorter stature and the increased weight of the Inuit compared with NCHS data.

### Comparison of males and females

Males are significantly taller, heavier and have larger head circumferences ($p < 0.05$) than females at all ages except birth.

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## Discussion

These are the first recent population data on growth parameters for the Inuit pediatric population. They are the only available data illustrating growth profiles for Inuit children of Labrador. The curves we present are not meant to replace the NCHS growth curves. Rather, these data can be used by clinicians caring for Inuit children in Labrador, and perhaps Inuit children elsewhere, as a means of objectifying the subjective mental shifts that these clinicians usually make when

interpreting growth parameters in these children.

The data can be used to compare individuals with their peers and as an adjunct to the NCHS curves to follow the growth and development of Inuit children.

From these data it is clear that the Inuit of Labrador are at, or near, the NCHS reference data at birth for all 3 variables of height, weight and head circumference. However, soon after birth (between 9 and 12 months for height and about 3 months for weight) Inuit children tend to grow in a manner consistent with their final status as adults. This is consistent with the findings of Heller, Scott and Hammes,6 who also showed that there was no difference between height and weight at birth when compared with Falkner's growth reference of whites, but that the differences became evident soon after birth. Heller, Scott and Hammes,6 however, found that weight deviated at 18 months, whereas our data suggest that this change occurs far earlier and is evident soon after birth.

It should be noted that there is skewing of the data in the percentile curves. This is likely due to the small population sample as well as the fact that the percentiles are based on the observed cumulative frequency of the variables and not on normalized curves, as is the case with the NCHS percentiles.

These charts must be used appropriately in the clinical setting. There are a number of factors that may affect the accuracy of the percentiles. First, the data were analysed around the expected time intervals in which the children are normally measured. This variation around the expected target age will increase the variability of the percentile estimates.10 Predictably, children who varied from the population had measuring times that also did not correspond to those of the population and therefore they were excluded in the analysis because they did not fall within the sampling time frames. Second, there are missing values: children who were not measured within the proper time frame and children who had missing measurements for 1 of the variables. These children may be dissimilar to the measured population. Third, the number of measurements for each interval is less than the number of individuals recommended by the World Health Organization as necessary to develop a standard.12 And, finally, the measurements were made by a number of different health care professionals in a clinical rather than a research setting, where there was unlikely to be clear standardization of the process of measurement. Despite these factors, our data provide a much better basis on which clinicians can base an interpretation of growth patterns of Inuit children than the general impressions on which they previously had to depend.

Future studies, with larger sample sizes and using a standardized means of measurement should be done to provide more accurate growth curves. As well, Inuit children in other areas of the North should be studied to add to the amount of data available in order to get an even more accurate portrayal of the anthropometric norms of this unique population.

Another possibility for further study that should be considered is whether or not these data reflect

a nutritional problem that has led to the diversion away from the NCHS norms. It is important that we not lose sight of this possibility. However, lack of food would presumably cause short stature and low weight, whereas overeating would be expected to lead to "normal" height and increased weight. Since the pattern is one of decreased height with increased weight one would expect that genetic factors are at least part of the explanation.

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## Conclusions

Because Inuit data for height, weight and head circumference virtually parallel those of the NCHS, it appears that the NCHS data are suitable for the evaluation of body size. What these population-specific data allow a clinician to do, is to make an appropriate adjustment based on anthropometric profiles for this population. Whereas previously these adjustments were based on general impressions, the degree and direction of the differences have now been determined, and a more accurate approach can be taken.

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