# A STUDY OF CHILDREN IN HOKKAIDO ORPHANAGES HEIGHTS, WEIGHTS AND DIETARY PATTERNS

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The remarkable increases in stature of Japanese youth in recent years would seem to be worthy of further study. MITCHELL in 1961[1] has called attention to the fact that the increments of increase in stature in Japan are greater than for most other countries and suggested that it may be related to better nutrition in the post war years. Both the Ministry of Education[2] and the Ministry of HEALTH and WELFARE[3] have published statistics on height, weight, sitting height and chest girth of hundreds of thousands of children. According to either set of data the 14 year-old boys are more than 8 cm. taller than they were 12 years ago and the 13 year-old girls are more than 7 cm. taller. These increments of increase raise the question as to what environmental factors may have been responsible for this change in the growth pattern. The average data for each prefecture are given along with the averages for all Japan and it is interesting to note the close agreement of the figures for Hokkaido children with the national averages.

It was suggested by MITCHELL[1] that a more intensive study of a small group of children might throw some light on the environmental factors especially if data on their food consumption could be obtained along with figures on height and weight. Furthermore institutions on limited budgets such as orphanages, are not always able to provide optimum nutrition. INOUE et al. in 1958[4] reported a study in which they found dietary deficiencies and growth retardation on children under institutional care. Thus it seemed worthwhile to see whether data from some institutions might be used for a study of present status of children.

The assistance of the Hokkaido Prefectural Government was sought and through their kind cooperation data from 22 Hokkaido orphanages were made available to us. These data included measurements of children for the years 1959, 1960 and 1961 and food records for the fiscal year 1960–1961. Body

[Journ. Facul. Agr., Hokkaido Univ., Sapporo, Vol. 52, Pt. 3, 1962]

measurements included 2350 heights and weights for boys and 1570 for girls from 3 to 16 years of age. Sitting heights had been measured on some of the children.

The data on both physical measurements and on food patterns from these 22 schools have been studied collectively and individually for each institution. In general the orphanage children tend to be shorter than the national averages for each age group and the weights show a wide spread with more children below than above average weight for age as would be expected in view of their short stature. These data may be summarized as follows:

| More than 5% | % of Total Boys | % of Total Girls |
|---|---|---|
| *Below* average *height* for age | 41% of 2351 | 37% of 1571 |
| *Above* average *height* for age | 3% of 2351 | 4% of 1571 |
| *Below* average *weight* for age | 57% of 2347 | 47% of 1573 |
| *Above* average *weight* for age | 15% of 2347 | 25% of 1573 |
| *Below* average *sitting height* for age | 36% of 1089 | 30% of 691 |
| *Above* average *sitting height* for age | 5% of 1089 | 4% of 691 |

The average height and weight figures for the orphanage children in each age group were compared with the national averages and expressed as ratios—school average : Japan average. These ratios were usually less than 100 but varied considerably by institutions and the range in each institution gives some general picture of the physical status of these children compared with the national average. However a few tall children might throw the average for one age group above the national average although many of the group were short.

Since the emphasis in this study was on stature rather than weight no attempt was made to determine how many or what proportion of the children were over- or under-weight for height. The fact that there was much greater variation in weight than in height and more over weight for age would seem to indicate that at least a proportion of the children were short and fat.

In some previous studies on growth of children it has been suggested that taller children have longer legs and that when children are stunted for any reason this is apt to result in shorter legs rather than shorter trunks.

A comparison of sitting height and standing height is one means of approaching this question. Theoretically, if children are short by virtue of shorter legs, then the standings height should show greater divergence from the norm or average than the sitting height. Sitting height figures were available from 16 of the 22 schools all or part of the children. These figures have been compared with the standing heights of the children in the same schools and the divergence from the average noted. Qf the 16 schools where sitting

height data were available, 10 of them showed a lower percentage of the children below average in sitting height than in standing height. However, the other six institutions showed about the same or even a higher percentage below average in sitting height than in standing height. Thus the total picture shows no significant trend to indicate whether stature differences might be due to shorter legs or shorter trunks or both.

It may be pertinent to observe here that when the statistics for all Japanese children are studied with respect to changes in standing height and sitting height over a ten year period, trunk and legs have not increased at uniform rates. For boys the increments of increase are greater in leg length than in trunk from 6–12 years and less in legs than in trunk from 13 to 17 years. For girls there is a similar trend i.e. a greater increments of increase in leg length from 6–11 years and greater in trunk from 12–17 years. One may wonder whether this could be the "Late Effects of Early Nutrition" among the teenagers as suggested by GYÖRGY[5]. He feels that there is a strong possibility that growth retardation at an early age may prevent the full potential of growth from ever being realized. If this is the case the pattern may change within the five or ten years when the present day preschool age children who are probably better nourished become teenagers.

In order to compare the status of the children in the different institutions with the national averages and to compare the several orphanages with each other some arbitrary classifications have been established. The heights and weights of the children from each school were recorded by age and sex and the average for each group calculated. The number of children in each group who were more than 5 percent below or above the Japan average in height or weight were recorded and calculated as percentages for comparative purposes. Then the orphanages have been classified on the basis of the percentage of the children that were more than 5 percent below the Japan averages, as follows:

| | On the basis of height | Number of orphanages |
|---|---|---|
| A (H) | Less than 40% of children under average height for age | 11 |
| B (H) | 40–50% of children under average height for age | 9 |
| C (H) | Over 50% of children under average height for age | 2 |
| | On the basis of weight | |
| A (W) | Less than 40% of children under average weight for age | 5 |
| B (W) | 40–60% of children under average weight for age | 10 |
| C (W) | More than 60% of children under average weight for age | 7 |

When all of the children from the 22 orphanages were classified by age

TABLE I. Hokkaido Orphanages Grouped on the Basis of Height and Weight of Ghildren Compared with Japan Averages

HEIGHT

| Group | Boys | | | | Girls | | |
|---|---|---|---|---|---|---|---|
| | Institution | Number Measured | Below 5% | Above 5% | Number Measured | Below 5% | Above 5% |
| A (H) Less than 40% of children below average height for age | 1 | 128 | 30 | 10 | 76 | 25 | 6 |
| | 2 | | | | 118 | 35 | 0 |
| | 6 | 122 | 33 | 3 | 36 | 9 | 0 |
| | 9 | 135 | 39 | 7 | 23 | 4 | 2 |
| | 10 | 110 | 21 | 5 | | | |
| | 14 | 164 | 70 | 7 | 99 | 25 | 7 |
| | 15 | 127 | 51 | 1 | 47 | 12 | 6 |
| | 19 | 75 | 10 | 4 | 60 | 15 | 6 |
| | 20 | 129 | 49 | 0 | 69 | 25 | 2 |
| | 21 | 81 | 27 | 4 | 50 | 14 | 0 |
| | 22 | 92 | 39 | 4 | 66 | 23 | 3 |
| B (H) 40-50% of children below average height for age | 3 | 61 | 38 | 0 | 68 | 21 | 2 |
| | 5 | 160 | 37 | 1 | 61 | 21 | 2 |
| | 8 | 208 | 103 | 1 | 75 | 30 | 1 |
| | 11 | 69 | 32 | 1 | 28 | 8 | 1 |
| | 12 | | | | 307 | 142 | 19 |
| | 13 | 75 | 33 | 2 | 48 | 20 | 0 |
| | 16 | 98 | 48 | 1 | 33 | 18 | 0 |
| | 17 | 144 | 76 | 1 | 95 | 36 | 3 |
| | 18 | 113 | 47 | 10 | 66 | 27 | 4 |
| C (H) More than 50% of children below average height for age | 4 | 125 | 67 | 2 | 60 | 35 | 1 |
| | 7 | 135 | 75 | 4 | 78 | 45 | 0 |

groups, the preschool groups, ages 3–5 for both boys and girls, had the highest proportion of children below average in both height and weight.

The findings for each orphanage are reported on a standard form which shows the standing of the institution according to the above scale and the status of the children in each institution.

An accurate survey of the food intake of children in these institutions was impossible but some idea of the dietary pattern could be obtained from the

TABLE I. (cont.)

WEIGHT

| Group | Boys | | | | Giris | | |
|---|---|---|---|---|---|---|---|
| | Institution | Number Measured | Below 5% | Above 5% | Number Measured | Beolw 5% | Above 5% |
| A (W) Less than 40% of children below average weight for age | 1 | 128 | 51 | 38 | 76 | 25 | 20 |
| | 2 | | | | 118 | 46 | 25 |
| | 6 | 122 | 31 | 36 | 36 | 9 | 0 |
| | 15 | 126 | 67 | 25 | 47 | 20 | 16 |
| | 19 | 75 | 26 | 15 | 60 | 26 | 15 |
| B (W) 40-60% of children below average weight for age | 5 | 160 | 104 | 16 | 61 | 25 | 17 |
| | 9 | 136 | 68 | 23 | 23 | 8 | 9 |
| | 10 | 110 | 56 | 29 | | | |
| | 12 | | | | 307 | 126 | 103 |
| | 14 | 164 | 91 | 26 | 99 | 44 | 17 |
| | 17 | 144 | 93 | 13 | 95 | 49 | 30 |
| | 18 | 113 | 57 | 23 | 74 | 32 | 23 |
| | 20 | 129 | 79 | 8 | 69 | 38 | 11 |
| | 21 | 80 | 45 | 12 | 51 | 20 | 16 |
| | 22 | 92 | 40 | 25 | 66 | 32 | 18 |
| C (W) More than 60% of children below average weight for age | 3 | 61 | 46 | 3 | 68 | 37 | 14 |
| | 4 | 126 | 84 | 17 | 60 | 29 | 16 |
| | 7 | 135 | 108 | 6 | 78 | 62 | 1 |
| | 8 | 207 | 132 | 19 | 75 | 41 | 16 |
| | 11 | 69 | 52 | 7 | 28 | 13 | 7 |
| | 13 | 73 | 51 | 9 | 49 | 32 | 8 |
| | 16 | 98 | 66 | 7 | 33 | 16 | 8 |

food records which had been kept in each institution, (three days each four times during 1960 fiscal year, May, Aug. Nov. and Feb.). In estimating the per capita food consumption, the total food used by each school was divided by the number of children fed per day. In estimating the adequacy of the food served it was necessary to calculate the average age of the children in each school (as of April 1, 1960) and compare the nutrients supplied per capita with the Recommended Dietary Allowances[6] for children of that age and sex. Such a procedure is subject to serious criticism because of the many assumptions that have to made in arriving at an estimate of food consumed. Very little information was given about the variety and quality of foods listed and the

only possible procedure was to calculate food values from standard tables[7,8,9,10]. Thus the data on foods used in any institution gives only a very rough estimate of the nutrients consumed by each child.

The average per capita nutrient intake per day for each institution was calculated along with an average for all the institutions. In order to compare the estimated nutrient intake with the Recommended Dietary Allowances, the ratio of the estimated intake to the recommended for each nutrient was calculated as shown in Table II. It would appear that *calories*, *iron*, *thiamine* and *niacin* were adequate in most institutions. The average for all institutions was equal to or more than the recommended. The *total protein*, *calcium*, *vitamin A*,

TABLE II. Ratio of Estimated Nutrient Intake to Recommended Dietary Allowances

| Institution | Calories | Protein | Calcium | Iron | Vitamin A | Thia-mine | Ribo-flavin | Niacin | Ascorbic Acid |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.02 | 0.98 | 0.68 | 1.20 | 0.80 | 0.89 | 0.70 | 1.35 | 0.73 |
| 2 | 1.12 | 1.39 | 1.17 | 1.31 | 1.58 | 1.11 | 1.18 | 1.45 | 2.05 |
| 3 | 1.24 | 1.49 | 1.19 | 1.35 | 1.03 | 1.23 | 1.17 | 1.64 | 1.16 |
| 4 | 1.04 | 1.11 | 0.98 | 1.07 | 0.49 | 1.01 | 1.03 | 1.30 | 0.72 |
| 5 | 1.52 | 1.41 | 1.58 | 1.60 | 0.92 | 1.60 | 1.47 | 2.67 | 1.61 |
| 6 | 0.93 | 0.66 | 0.46 | 1.24 | 0.64 | 1.11 | 0.71 | 1.54 | 0.91 |
| 7 | 1.18 | 1.21 | 0.68 | 1.55 | 1.13 | 1.37 | 0.97 | 1.80 | 1.87 |
| 8 | 1.21 | 1.12 | 0.79 | 1.50 | 0.61 | 1.34 | 1.10 | 1.91 | 0.81 |
| 9 | 0.92 | 0.70 | 0.51 | 1.25 | 0.73 | 1.02 | 0.64 | 1.54 | 0.78 |
| 10 | 1.03 | 0.73 | 1.71 | 1.03 | 0.79 | 0.84 | 0.68 | 1.24 | 0.68 |
| 11 | 1.07 | 0.98 | 1.06 | 1.24 | 1.26 | 1.03 | 1.15 | 1.36 | 1.01 |
| 12 | 0.99 | 0.94 | 0.91 | 1.07 | 0.89 | 0.87 | 1.03 | 0.24 | 1.07 |
| 13 | 1.15 | 1.05 | 0.67 | 1.37 | 0.78 | 0.93 | 0.73 | 1.70 | 1.07 |
| 14 | 1.12 | 1.17 | 0.84 | 1.02 | 0.96 | 0.84 | 0.66 | 1.23 | 0.65 |
| 15 | 1.10 | 0.86 | 0.42 | 1.12 | 0.36 | 0.91 | 0.50 | 1.42 | 0.61 |
| 16 | 1.09 | 0.98 | 0.56 | 1.25 | 1.03 | 1.04 | 0.60 | 1.66 | 0.76 |
| 17 | 0.98 | 1.02 | 0.95 | 1.45 | 1.25 | 1.04 | 1.10 | 1.53 | 1.14 |
| 18 | 1.13 | 1.01 | 1.06 | 1.25 | 0.98 | 1.13 | 0.88 | 1.70 | 0.88 |
| 19 | 1.06 | 1.02 | 0.85 | 1.20 | 1.27 | 1.17 | 0.83 | 1.51 | 1.08 |
| 20 | 1.07 | 1.31 | 1.05 | 1.43 | 0.60 | 0.82 | 0.66 | 1.41 | 0.54 |
| 21 | 1.09 | 1.01 | 1.06 | 1.43 | 0.52 | 1.00 | 0.87 | 1.57 | 0.65 |
| 22 | 1.19 | 1.08 | 1.24 | 1.64 | 2.07 | 1.42 | 1.15 | 2.02 | 1.51 |
| Average Ratios | 1.08 | 1.00 | 0.81 | 1.12 | 0.80 | 0.98 | 0.81 | 1.53 | 0.80 |

*riboflavin* and *ascorbic acid* were below 75 percent of the recommended allowances in 3, 7, 7, 9 and 7 schools respectively. Such figures are of doubtful significance since we have no information about what each child really ate. The fact that none of the above nutrients seem to show serious deficiency should not give a false sense of security without a more intensive survey.

The ratio of animal protein to total protein was below 30 percent in half of the schools and the average for all of the 22 institutions was 29.2 percent of the total protein as given in Table III. Thus the limitation in animal protein would seem to be the most serious one in the food patterns as calculated. When the protein scores for the 22 schools were calculated they ranged from 67 to 74 with tryptophane and the sulfur-containing the limiting amino acids.

TABLE III. Protein Quality and Scores

| Item / Institution | Animal Protein / Total Protein (%) | Protein Score | Limiting Amino Acids | |
|---|---|---|---|---|
| | | | Tryptophan | Sulfur-containing |
| 1 | 31.4 | 69 | × | |
| 2 | 38.7 | 70 | × | |
| 3 | 37.5 | 71 | × | |
| 4 | 28.9 | 70 | | × |
| 5 | 30.2 | 70 | | × |
| 6 | 23.3 | 70 | | × |
| 7 | 36.1 | 69 | × | |
| 8 | 23.2 | 70 | | × |
| 9 | 26.3 | 74 | | × |
| 10 | 27.3 | 70 | × | |
| 11 | 32.0 | 71 | | × |
| 12 | 33.2 | 74 | × | |
| 13 | 30.7 | 71 | × | |
| 14 | 23.7 | 70 | × | |
| 15 | 18.1 | 68 | × | |
| 16 | 18.6 | 68 | × | × |
| 17 | 37.7 | 72 | × | |
| 18 | 26.1 | 71 | × | |
| 19 | 35.6 | 71 | × | |
| 20 | 34.8 | 67 | × | |
| 21 | 22.0 | 74 | × | × |
| 22 | 25.6 | 71 | × | |
| Average | 29.2 | 73 | × | × |

While it is scarcely justifiable to calculate protein scores on food data of the type we had available, nevertheless the general finding of relatively low protein scores for all institutions and the same two limiting factors makes these figures suggestive of the type of nutritional improvement which might be recommended. Thus a list of foods which would tend to correct the limiting factors in each school will be provided through the Prefectural Governmment Office. It should be noted that in the Japanese recommended allowances for protein for the early teenage children it is stipulated that the protein score should be 80 or above for the recommendations as stated or if the scores are lower, then the amount of protein should be greater. It would seem that the quality of protein for the teen age group especially was on the borderline of being poor, a situation which might well be designated as a protein limitation.

When the physical status measurements for each institution were considered in relation to the food pattern of that institution no conclusions could be drawn as to any direct relationship between possible nutritional limitations and the growth pattern of the children in that school. In view of the limited nature of the data on food consumption this is not surprising and it would be dangerous to draw any conclusions from a study of such limited scope.

## Summary

In general children in the 22 orphanages of Hokkaido tend to be shorter than the national averages for each age group. Body weight figures show a wider spread from the averages than height figures with more children below than above average weight for age.

The food patterns in the 22 orphanages showed calories, iron, thiamine and niacin close the recommended allowances. The total protein, vitamin A, riboflavin and ascorbic acid were below 75 percent of the recommended allowance in several of the school. The animal protein was less than 30 percent of the total protein in half of the schools and seems to be the most serious nutritional limitation.

## REFERENCES CITED

1) MITCHELL, H. S.: Nutrition in relation to stature. Hokkaido Food and Nutrition Society #7, 1961.
2) Ministry of Education of Japan. Report of School Hygiene Statistics, 1959.
3) Ministry of Health and Welfare of Japan. Nutrition in Japan 1961.
4) INOUE, GORO et al.: On dietary deficit and growth retardation of children under institutional care. Report of the Science of Living Department, Osaka City University 1958.

5) GYÖRGY, P.: The late effects of early nutrition. Am. J. Clinical Nutrition 8, 344 1960.
6) Ministry of Health and Welfare of Japan. Recommended Dietary Allowances, 1961.
7) Committee on Food Composition, Resources Council, Prime Minister's Office Standard Tables of Food Composition, 1954.
8) HAYAMI, et al.: Food Composition Tables, 1960.
9) Kokumin Eiyo Shinkoka: National Institute of Nutrition. Tables of Food Composition for Japan, 1960.
10) U. S. Department of Agriculture, Composition of Foods, Raw, Processed and Preserved. Agriculture Handbook #8.
11) M. L. ORR and B. K. WATT.: U. S. D. A. Amino Acid Content of Foods.