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<td>SANTO, Setsuko; Mitchell, Helen S.</td>
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NUTRITIONAL STATUS OF HOKKAIDO ORPHANAGE CHILDREN 1960–1970

Setsuko SANTO* and Helen S. MITCHELL**

Received June 12, 1974)

INTRODUCTION

A cross-sectional study of the growth of Japanese youth during a period of 60 years (1900–1960) showed a gradual increase in stature up to 1939, a loss in stature at every age level 1939–1948 and a rapid increase in growth after 19501). These findings prompted an inquiry into the changes in food patterns during the war and since. Data on food consumption was limited but pointed to the probability that protein limitation during the war and a more adequate supply 1950–1960 was significant.

The desirability of studying the growth of children who might still be retarded in growth by an inadequate diet prompted an inquiry into the situation in the orphanages in Hokkaido. The prefectural Government of Hokkaido kindly cooperated in providing data on the physical measurements of children in 22 orphanages for the years 1959, 1960 and 1961. It appeared from these data that the stature of the orphanage children was significantly less on the average than that for Hokkaido children of the same age2,3).

These observation prompted an inquiry into the food patterns of these orphanage children. Foods served in these institutions had been recorded for three-day periods during four seasons 1960–1961. The food patterns as analysed showed adequate calories but some borderline levels of protein, vitamin A, calcium, riboflavin and ascorbic acid intake. The quality of the protein was questioned particularly and it was found that animal protein constituted from 18.1 to 38.7 percent (average 29.2 percent) of the total protein in 1960 with a protein score averaging 732). It seemed possible that protein quality might have been the crucial factor influencing growth-preventing, some children from realizing their full inherited potential. In visiting the orphanages in 1961 the authors noted that the children appeared to be well but seemed short and stocky in build.

* Laboratory of Home Economics, Faculty of Agriculture, Hokkaido University, Sapporo, Japan.
** Formerly Exchange Professor of Nutrition from The University of Massachusetts to Hokkaido University.
The published report of these findings brought the problem to the attention of the Governor and Hokkaido Prefectural Government. They subsequently voted to provide 180 g of milk per child per day beginning 1964. At about the same time the National Government provided for an annual increase in the food budgets for all orphanages in Japan. This increase in food budgets made possible more protein foods as well as the milk allowance. Thus it seemed appropriate to make a second survey of the institutions in 1965 to see whether the physical status of the children had improved. These findings published by SANTO in 1968 showed encouraging results.

The increments of increase in stature for both boys and girls were greater than those recorded for Hokkaido children especially for adolescent girls.

The continued increase in food budgets for the orphanages and the provision of an egg a day per child in 1968 meant a considerable improvement in the quality of protein available. A third survey of the nutritional status of the children in the 24 orphanages was therefore done in 1970. This makes possible a comparison of data over a period of ten years, which is reported in this paper.

SUBJECTS OF STUDY AND METHODS

These surveys were made of the orphanages of Hokkaido 1960, 1965 and 1970, the number of institution and the total children from 1 to 17 years of age included in each survey are shown in the following table I.

<table>
<thead>
<tr>
<th>Survey number</th>
<th>Year</th>
<th>Number of orphanages</th>
<th>Number of boys</th>
<th>Number of girls</th>
<th>Number of total children</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1960</td>
<td>22</td>
<td>877</td>
<td>592</td>
<td>1469</td>
</tr>
<tr>
<td>2</td>
<td>1965</td>
<td>23</td>
<td>954</td>
<td>544</td>
<td>1498</td>
</tr>
<tr>
<td>3</td>
<td>1970</td>
<td>24</td>
<td>993</td>
<td>594</td>
<td>1587</td>
</tr>
</tbody>
</table>

The location of the 24 orphanages is shown on the accompanying map Fig. I. The physical measurements included in each survey were standing height, sitting height, chest girth and weight. In order to compare the data on physical measurements of the orphanage children with the national averages, the data of the School Health Statistical Report, Ministry of Education Japan was used. This report gives the best data on Japanese youth ranging from 5 to 21 years of age and therefore the age groups...
charted Fig. IIb and Fig. IIg the elementary school age group, 6 to 11 years old, and the junior high group, 12 to 14 years old, were chosen with statistical consideration. The significance of the differences is tested by the following "t-distribution formula" and 5% and 1% significant levels are shown the sign of * and ** respectively.

\[
t_{(m+n-2)} = \frac{|\bar{x} - \bar{y}|}{s} \sqrt{\frac{mn}{m+n}}
\]

\[
s^2 = \frac{(m-1)s_x^2 + (n-1)s_y^2}{m+n-2}
\]

\(m\); Number of examinees of national children.
\(n\); Number of examinees of orphanage children in Hokkaido.
\(\bar{x}\); Mean value of national children.
\(\bar{y}\); Mean value of orphanage children in Hokkaido.
\(s_x\); Standard deviation of national children.
\(s_y\); Standard deviation of orphanage children in Hokkaido.

The estimates of food consumption were based on food records of the supervisors in each orphanage for 1960 and 1965. The 1970 survey for physical measurements and food consumption was conducted by SANTO and her assistants who weighed and measured all the children and did one day
survey of food intake by using weighing method of individual child for all subjects. The data on regular school lunch in public school were collected by SANTO from the principal and nutritionist of each school by interview method.
The nutrient intake per child per day was calculated from the food consumption data by using "Composition of Foods in Japan 3rd ed." and other food composition tables. The recommended dietary allowances for children of each age were applied on a proportional basis according to the numbers of each age and sex in each institution in order to estimate nutrients which should be recommended for each orphanage. The estimated nutrient intake for each orphanage was then compared with the recommended figure for that orphanage. The FAO/WHO 1965 method of protein scoring was used in 1960, 1965 and 1970 for estimating the protein quality of the orphanage diets. The amino acid value of these diets was calculated from "The Amino Acid Composition of Foods in Japan".

RESULTS AND DISCUSSION

Fig. IIb (boys) and Fig. IIg (girls) show the differences of the mean value on physical measurements of these orphanage boys and girls from the national averages in each age group in 1960, 1965 and 1970.

According to Fig. IIb, the orphanage boys were significantly smaller than national averages in standing height, sitting height and weight in 1960. In subsequent surveys, 1965 and 1970, the differences decreased to the extent that standing height for 6 year old boys and sitting height for 6, 7, 8 and 11 years olds were not significantly below national averages. Chest girth for orphanage boys was not far below national averages for any age group except the teen agers in 1960 and by 1970 chest girths were equal to or above national averages for all age groups. The body weight of orphanage boys which were significantly below national averages in 1960 caught up to national figures for the boys 11 years old and younger but not for the older boys. The slower improvement of the older boys may reflect their retardation in earlier years and is likely to show progressive improvement in future years.

According to Fig. IIg it is evident that in 1960 the orphanage girls, like the boys, were significantly behind the national averages in standing height, sitting height and weight for the 9 to 12 year olds. Only the 12 year olds were significantly below national average in chest girth.

The growth changes 1960 to 1970 for the girls were similar to the boys, but the girls tended to approach the national average more rapidly than the boys in both standing and sitting height and exceeded national figures in chest girth and weight. The junior high orphanage girls were still significantly shorter than the national averages in 1970 as were the boys.

The food consumption data for the same three periods 1960, 1965 and
1970 show some striking changes due to improvement in food budgets and special provisions by the Government for extra milk and eggs.

Table II gives an estimate of each class of foods consumed by the orphanage children during the three different years. The four-fold increase in milk consumption between 1960 and 1965 was due to the milk allowance of 180 g per day in addition to that already being used. The increase in egg consumption between 1965 and 1970 was due to the provision in 1968 of an egg per day per child. Other major increases in foods were largely due to the more generous food budgets permitting purchase of more fish, meat, vegetables and fruits. The less desirable increases in sweets and snack foods such as soft drinks were made possible by budget increases but poor control as to how the money was spent.

In comparing the food nutrients supplied in each orphanage with the Japanese RDA revised in 1969 the percentages in each survey were given in Table III. Since the recommendations are calculated to be generous and not minimum, 80% of the recommendation may be taken as level below which the nutrient supply may be considered inadequate or at least subject to improvement, and therefore the value below 80% were shown as a bold type in Table III. From Table III it would appear that the orphanage food provided adequate calories, iron and thiamine in all orphanages for the three surveys 1960, 1965 and 1970. Protein intake has improved in quality as well as quantity animal protein constituted 29.2% in 1960, 36.5% in 1965 and 46.3% in 1970. Calcium and riboflavin intakes have also improved since 1965 by reason of the milk provision. Vitamin A was still low in half of the institutions in 1970 because the children dislike certain green and yellow vegetables and partly due to poor planning by the food managers. The niacin RDA for 1969 is relatively high and therefore difficult to meet. The improvement in ascorbic acid intake was due to more fruits and fresh vegetables in season but not consistently throughout the year. Vitamin D showed the poorest intake among 10 nutrients tabulated in Table III.
### TABLE III. Percentage of Nutrient Intake to Recommended Dietary Allowances 1960–1970

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Calcium</th>
<th>Iron</th>
<th>Vitamin A</th>
<th>Vitamin D</th>
<th>Thiamine</th>
<th>Riboflavin</th>
<th>Niacin</th>
<th>Ascorbic Acid</th>
<th>Below 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>60</td>
<td>65</td>
<td>70</td>
</tr>
<tr>
<td>Protein</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>60</td>
<td>65</td>
<td>70</td>
</tr>
<tr>
<td>Calcium</td>
<td>105</td>
<td>112</td>
<td>25</td>
<td>84</td>
<td>107</td>
<td>90</td>
<td>72</td>
<td>102</td>
<td>96</td>
</tr>
<tr>
<td>Iron</td>
<td>121</td>
<td>126</td>
<td>11</td>
<td>19</td>
<td>21</td>
<td>73</td>
<td>171</td>
<td>73</td>
<td>105</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>131</td>
<td>132</td>
<td>120</td>
<td>85</td>
<td>123</td>
<td>60</td>
<td>135</td>
<td>16</td>
<td>31</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>143</td>
<td>145</td>
<td>145</td>
<td>144</td>
<td>144</td>
<td>144</td>
<td>144</td>
<td>144</td>
<td>144</td>
</tr>
<tr>
<td>Thiamine</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>151</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
</tr>
<tr>
<td>Niacin</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>Below 80</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>
There were no orphanages that met the vitamin D RDA except one in 1970. The calcium and riboflavin (V-B2) intake was improved between 1960 and 1965 due mainly to 180 g of milk per child per day since 1964 and also the vitamin A intake met the RDA in 1970 due to the provision since 1968 of an egg per day per child. The vitamin D intake has not been improved at all for the ten years. According to the report of YAMAKAWA, 107 IU of vitamin D per capita per day (about one fourth of the RDA) could be supplied by sea food in Japan. The orphanage children had had approximately the same amount of vitamin D as that calculated by YAMAKAWA. HIRO et al. 17 had written that during winter time in Hokkaido a dose of 5 mg of vitamin D a month for early child or infant could prevent rickets. Therefore it is recommended that unless enough vitamin D is to be expected from their foods during the winter months, medical authorities should provide some supplementary source of vitamin D for the infants and younger children in the institutions of Hokkaido. High thiamin (V-B1) ratio in 1970 was due to the use of enriched rice in several institutions shown by the values of 2 to 4 times of the thiamin RDA in TABLE III.

These nutrients were calculated from the food consumption of the subjects by using food composition tables as raw foods. In consequence nutrient losses in preparation were not considered and therefore the vitamin intake of the children must be lower than the values given.

In order to obtain the nutrient pattern of the diets the percentage of nutrient intake from different foods is shown in FIG. III. The amount of animal foods such as milk, eggs, meat and fish had been increasing gradually i.e. 13% in 1960, 27% in 1965 and 33% in 1970 while grains had decreased year by year. The greater part of food energy came from grains, mainly rice i.e. 70% in 1960, 60% in 1965 and 50% in 1970 as a round numbers. For protein, approximately 50% in 1960, 40% in 1965 and 30% in 1970 was derived from grains and about 30% in 1960, 35% in 1965 and 45% in 1970 from animal foods. The protein scores were 73 in 1960, 79 in 1965 and 82 in 1970. For calcium, about 30% in 1960, 45% in 1965 and over 45% in 1970 was from milk. These figures show that milk is an important source of calcium in the diets. As to iron, grains, legumes and vegetables were superior sources in three period surveys. The greater part of vitamin A, 80% in 1960 and 60% in 1965, was derived from vegetables while vitamin A from animal foods was less than 20% in 1960 and 40% in 1965 but in 1970 55% of the vitamin A came from animal foods approximately. Vitamin D was obtained exclusively from fish in these diets i.e. 98% in 1960, 97% in 1965 and 90% in 1970. Over 50% of thiamine
was supplied by grains. Riboflavin derived from animal foods was 50% in 1960, 55% in 1965 and 70% in 1970 (milk supplied about 30–40% of riboflavin intake in these diets). Niacin was mostly from plant foods i.e.
75% in 1960, 70% in 1965 and 65% in 1970. A major sources of niacin were grains and fish in 1960 and 1965 and grains, meat and fish in 1970. Approximately 75% of the ascorbic acid was from vegetables in three period surveys.

**SUMMARY**

Physical measurements (standing height, sitting height, chest girth and weight) of children in Hokkaido orphanages have been made at five year intervals. These data have been compared with similar measurements for all Japanese children. In general it is apparent that these orphanage children have gradually caught up to and even surpassed the national averages in the following order; chest girth, weight, sitting height and standing height during the ten years 1960–1970. It is also concluded that the rate at which the orphanage children reach the national averages is faster for younger children than for older ones and for girls than for boys. It seems that the orphanage children are later than the national average in reaching the spurt of growth.

The food intake of the orphanage children has been estimated from records or actual measurements and nutrient value calculated. The nutrient intake has improved considerably during the ten years 1960–1970. But vitamin A, vitamin D and niacin were still low in over a half of all institutions and the less desirable increases in sweets and snack foods such as soft drinks were made possible by budget increases but poor control as to how the money was spent. Therefore it is recommended that the Hokkaido Prefectural Government ought to employ some dietitians to work on menu planning and food purchasing for these orphanages. It would be helpful if Japanese food composition tables could include the vitamin D content of foods other than fish, shell fish and certain meats.

The authors record their grateful thanks to Mr. Kingo Machimura, Hokkaido Governor 1959–1971, the late Mrs. Hisa Mizushima, member of Hokkaido Diet, and all orphanage directors in Hokkaido for their willing cooperation. We also thank Assistant professor Kaneyuki Yamamoto of mathematics, Hokkaido University for the interest shown in our work.

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