NUTRITIONAL ASPECTS OF THE ORPHANAGE CHILDREN IN HOKKAIDO IN 1970

Setsuko SANTO

Laboratory of Food and Nutrition Science, Faculty of Agriculture,
Hokkaido University, Sapporo, Japan

Received October 29, 1979

Introduction

The serial surveys on the nutrition of growing children in the orphanages in Hokkaido have been done by the authors at five-year intervals since 1960. In order to measure improvement of living environment, data collected as accurately as possible in each institution in small group level are interpreted here in references[14,15,16,21,22,23].

In a previous report[23], the author described as follows. The physical measurements (standing height, sitting height, chest girth and weight) of children in Hokkaido orphanages were compared with similar average measurements of all Japanese children. In general, it was apparent that these orphanage children had been gradually catching up to and even surpassing the national averages in the following order during the ten years 1960-1970: chest girth, weight, sitting height and standing height. It was also concluded that the rate at which the orphanage children reach the national averages was faster for younger children than for older ones and for girls than bodys. It seemd that the orphanage children were later than the national average in reaching the growth spurt.

The food intake of the orphanage children had been estimated from records or actual measurements and the nutrient value calculated. The nutrient intake had 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. The less desirable increases in sweets and snack foods such as soft drinks resulted from budget increases but poor control as to how the money was spent. There-fore, it was recommended that the Hokkaido Prefectural Government employ some dietitians to work on menu planning and food purchasing for these orphanages.

In order to clarify the relation between the growth retardation and their dietary intake, particularly of the older children, the results of analysis for

their individual physical measurements and the food consumption measured and weighed by the author and her assistants at all institutions in Hokkaido in 1970 are reported in this paper.

Subjects and Methods

Subjects

The subjects in this paper include 1446 children aged three to fourteen years at 24 orphanages scattered throught Hokkaido in 1970. Among these subjects, 1336 children in 22 orphanages (eliminating 2 orphanages without the younger group) consisting of four age-graoups have been chosen to be examined by the analysis of variance pertaining to the data. The division of age groups is as follows.

Group	Age (yrs)	Number of children	Note
A	3- 5	256	Preschool children
B	6- 8	288	Elementary school (lower graders)
C	9-11	361	Elementary school (higher graders)
D	12-14	431	Junior high school pupils

Methods

The seven physical measurements consisting of standing height, sitting hight, chest girth, weight, head circumference, upper arm circumference and skinfold thickness (triceps and subscapular) were collected by measuring and weighing each child by SANTO and her assistants in cooperation with the staff membres at each institution by using their equipments for height, sitting height and weight, a tape measure for chest girth, head circumference and upper arm circumference, and a Eiken calipers for the skinfold thickness of the triceps and subscapular of the subjects. For comparative purposes, the data from the Nutritional Aspects in Japan 1970[13] reported by the Ministry of Health and Welfare Japan involving preschool children, and the data from the School Health Statistical Report in 1970[11] given by the Ministry of Education Japan for school childern were used for the four measurements for height, weight, sitting height and chest girth. The relative physical measurements of height, weight, sitting height and chest girth were expressed as the precentages of each subject's measurements compared to the national averages of each age and sex. Then analysis of variance for the relative physical measurements among the four age groups and 22 institutions described previously was calculated.

The food consumption data were obtained according to the recipe meth-

od[7] except for head counting in the kitchem, then by weighing the plate contents actually eaten by each child in the dining room as a one-day record of individual dietary intake. The data of regular school lunch for those children in public schools on an examination day were collected by SANTO from the principal and the nutritionist of each school by the interview method.

From this quantitative information the nutrient intake per child per day was computed using tables of food composition[3,4,5,8,18,25]. The FAO/WHO 1965 method of protein scoring[9] was used for estimating the protein quality of the orphanage diets: the amino acid values of these diets were calculated using tables of amino acid composition[6,19]. The amino acid pattern of a whole egg was used as a reference evaluating the protein score.

According to the report of a Joint FAO/WHO Expert Group on "Requirements of vitamin A, thaimine, riboflavin and niacin"[10], 1 niacin equivalent is equal to 1 milligram of niacin or 60 milligrams of tryptophan. In order to evaluate whether an adequate diet was provided or not for subjects, the nutrient intakes were divided by the Recommended Dietary Allowances for Japanese (RDA) of the suitable items based on 10 nutrients. The nutrient adequacies were expressed by the percentages of the individual nutrient intake compared to the RDA of each age and sex[12]. Then analysis of variance for the nutrient adequacies among the four age groups and 22 institutions were computed.

FACOM 230-60 at the Computer Center of Hokkaido University was used for these calculations.

Results

Table 1 shows the mean values and standard deviations of the seven physical measurements for height, weight, sitting height, chest girth, head circumference, upper arm circumference and skin fold thickness (triceps+subscapular). Table 2 shows the relative physical measurement (RPM) of the orphanage subjects with national averages for height, weight, sitting height and chest girth. As a general tendency, it seems that the older children show less values than the younger ones. In order to obtain more distinct tendency, these children were divided into four age groups described in the Subjects above.

Figure 1 shows 95% confidence interval of mean value of the RPM for the four age groups. There are also indicated the results of analysis of variance for the RPM among the four age groups.

According to Fig. 1 it is evident that the 95% confidence interval of height for the groups B, C and D are lower than 100% line, therefore the

TABLE 1. Body measurements of the orphanage children in Hokkaido in 1970

Sex	Age in Year	Number of Children	Height (cm)		Weight (kg)		Sitting Height (cm)		Chest Girth (cm)		Head Circumference (cm)		Upper Arm Circumference (cm)		Skinfold Thickness (mm)	
			M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Boy	3	45	96.9	4.4	15.5	1.7	56.8	2.9	54.6	2.1	50.0	1.3	16.9	1.3	22.5	5.4
	4	67	102.1	4.7	16.9	1.8	58.9	2.8	55.8	2.4	50.0	1.5	17.2	1.2	22.5	5.9
	5	36	108.5	5.0	18.9	2.0	62.1	2.8	57.3	2.3	50.8	1.4	17.7	1.4	22.1	6.1
	6	67	114.1	5.0	20.9**	2.6	64.3	2.5	58.9**	2.7	51.2	1.6	18.1	1.0	21.6	6.7
	7	57	118.6*	5.4	22.5	3.1	66.4	2.8	60.9**	3.5	51.4	1.5	18.5	1.3	21.9	6.2
	8	68	123.9**	4.5	25.0	2.8	68.9	2.8	62.4**	2.9	52.0	1.5	19.0	1.3	23.4	7.1
	9	84	129.0*	5.9	27.8	3.3	70.8**	3.0	64.8**	3.2	52.1	1.6	20.1	1.3	24.9	6.8
	10	75	133.3**	5.3	30.2	3.7	72.8**	3.0	67.1**	3.4	52.7	1.6	20.6	1.5	26.3	7.9
	11	108	139.0*	7.0	33.9	4.3	75.4	2.9	69.6**	3.8	53.0	1.8	21.6	1.4	28.8	7.1
	12	100	144.7**	8.2	37.4	6.0	77.8**	4.1	72.2**	4.1	53.3	2.0	22.2	1.7	29.5	8.2
	13	108	150.5**	8.0	42.7	6.9	80.7**	4.4	75.6	4.6	53.7	1.6	23.6	2.1	31.2	8.5
	14	100	156.6**	7.0	47.8**	6.2	84.3**	3.9	79.4	4.5	54.3	1.6	25.0	2.0	34.2	8.8
Girl	3	31	96.0	5.1	15.5	1.9	55.8	2.5	53.3	2.7	48.6	1.3	17.1	1.1	25.9	5.1
	4	37	102.6	3.3	17.1	1.8	59.0	2.0	55.0	2.6	50.0	1.5	17.4	1.3	24.4	5.2
	5	40	108.7	4.2	19.1	2.3	61.5	2.7	56.6	2.3	50.6	1.3	17.8	1.7	24.8	6.1
	6	31	114.1	4.6	20.5*	2.1	64.0	2.4	57.5**	2.6	50·6	2.0	17.9	1.2	24.2	6.1
	7	38	120.3	5.5	23.1**	2.5	67.1	2.5	59.3**	2.7	50.7	1.4	18.4	1.2	24.6	5.6
	8	46	123.3	6.1	24.3	2.9	68.3	3.4	60.5	3.1	50.9	1.2	18.7	1.3	27.1	5.7
	9	44	128.4	5.4	27.7	3.7	70.9	3.2	63.2*	3.6	51.8	1.7	19.7	1.8	30.4	11.1
	10	46	135.0	6.5	31.3	4.7	74.3	3.4	65.7	4.8	52.3	1.4	20.2	1.8	29.5	9.3
	11	49	141.8	5.9	36.7	4.7	77.1	4.5	70.4	3.8	52.7	1.2	22.0	1.5	36.1	8.9
	12	58	146.5*	8.2	42.2	8.2	79.7*	4.3	74.3	6.4	53.6	1.8	23.0	2.9	42.3	11.4
	13	60	149.7**	4.8	46.0	6.6	81.9*	2.8	77.6*	4.8	53.8	1.5	24.4	2.3	46.6	12.6
	14	71	151.8**	4.2	49.1	5.1	83.1**	2.8	79.9	4.0	54.1	1.6	25.4	1.9	51.5	9.8

M: Mean value, SD: Standard deviation. * or ** represents that the confidence interval of mean value does not include the national average at 5% or 1% level respectively.

groups B, C and D are shorter than the national averages of the same age groups in height. Similarly the groups A and B are heavier than average children in weight. The group A surpass and the groups C and D are shorter than those of national averages for sitting height. All of the four age groups show broader chest girth than those of national ones.

Figure 1 also explains that the group D show less RPM than those of

TABLE 2. Relative physical measurements of the orphanage children in Hokkaido in 1970

Sex	Age (Year)	Numbe of Children	*Height*		*Weight*		Sitting Height		Chest Girth	
			M	SD	M	SD	M	SD	M	SD
Boy	3	45	101	5	106	12	102	4	103	4
	4	67	99	5	103	11	100	5	102	4
	5	36	99	5	102	11	100	5	103	4
	6	67	100	4	104**	13	100	4	103**	5
	7	57	99*	5	100	14	99	4	103**	6
	8	68	99**	4	100	11	99	4	102**	5
	9	84	99*	5	101	12	99**	4	102**	5
	10	75	99**	4	99	12	99**	4	102**	5
	11	108	99*	5	100	13	99	4	102**	6
	12	100	98**	6	97	16	99**	5	101**	6
	13	108	98**	5	98	16	98**	5	101	6
	14	100	98**	4	96**	12	98**	5	101	6
Girl	3	31	102	5	111	13	102	5	104	5
	4	37	101	3	106	11	102	3	103	5
	5	40	100	4	106	13	100	4	104	4
	6	31	100	4	105*	11	100	4	103**	5
	7	38	101	5	106**	11	101	4	103**	5
	8	46	99	5	100	12	99	5	101	5
	9	44	99	4	102	14	99	4	102*	6
	10	46	99	5	101	15	100	5	101	7
	11	49	99	4	103	13	100	5	102	5
	12	58	99*	6	104	20	99*	5	102	9
	13	60	98**	3	102	15	99*	3	102*	6
	14	71	98**	3	102	11	99**	3	101	5

The figures represent the ratios (%) of physical measurements for Hokkaido orphanage children to the national averages in 1970. M: Mean, SD: Standard deviation. * $P<0.05$, ** $P< 0.01$: These signs were copied from Table 1.

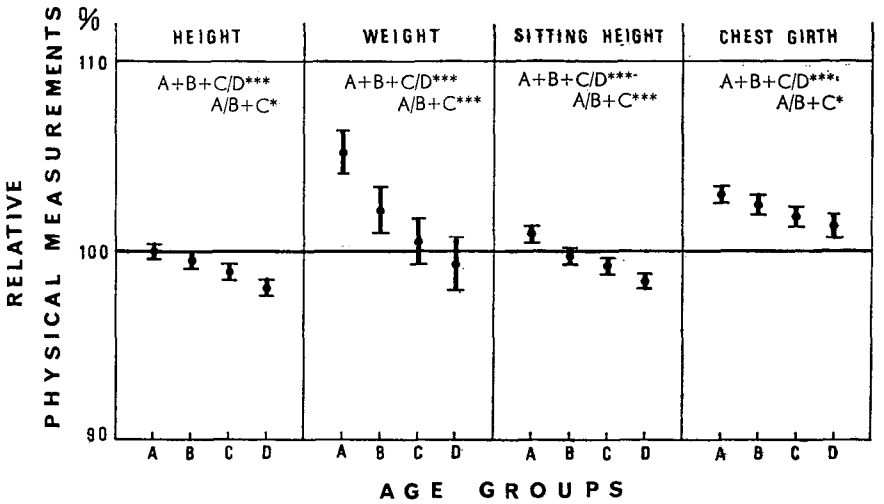

Fig. 1. Relative physical measurements for height, weight, sitting height and chest girth of Hokkaido orphanage children in 1970. Means and their 95% confidence intervals are shown. *P<0.05, **P<0.01, ***P<0.005: Significant differences between two groups. The division of age groups is as follows (A: 256 preschool children for 3–5 years of age; B: 288 lower graders of elementary school for 6–8 years of age; C: 361 higher graders of elementary school for 9–11 years of age; D: 431 junior high school pupils for 12–14 years of age). The relative physical measurements are expressed as the percentages of each subject's measurements compared to the National Averages of each age and sex.

younger children (the groups A, B and C) in hieght, weight, sitting height and chest girth; the groups B and C show less RPM than those of the group A in four measurements.

Summarizing the conclusion for the relative physical measurements of Hokkaido orphanage children, there are, in general, trends of gradual decrease among four age groups with age, and growth retardation in height and sitting height among elementary and junior high schoolers.

Tables 3 and 4 show the number of those examined, the mean values and standard deviations of food amounts consumed, 14 nutrient intakes, protein score and food expenditure per child per day of each age and sex for the subjects. The most limiting amino acid for these groups was either sulfur containing amino acid or isoleucin.

The percentages represent the nutrient adequacies as shown in Table 5 to indicate the mean values and standard deviations.

Figures 2 and 3 show 95% confidence interval of mean values on the nutrient adequacies (NA) for the four age groups described previously.

TABLE 3. Nutrient intake per capita per day of the orphanage children in Hokkaido in 1970

Sex	Age in Year	Number of Children	Amount (g)		Food Energy (Cal)		Protein (g)		Protein Score		Fat (g)		Carbo-Hydrate (g)		Calcium (mg)		Phospho-rus (mg)		Iron (mg)	
			M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Boy	3	45	980	169	1594	271	50.0	6.4	83	3	48.7	11.0	238.3	53.3	480	121	934	137	8.9	1.8
	4	67	984	210	1655	362	51.2	9.0	84	2	49.3	13.4	252.2	66.8	467	126	927	169	9.0	2.0
	5	36	1127	227	1893	241	56.4	6.6	84	3	56.3	11.7	292.2	49.0	554	127	1067	143	9.9	1.6
	6	67	1323	215	2118	359	68.6	10.9	82	3	57.0	15.0	329.3	68.1	709	155	1320	255	12.0	2.3
	7	57	1353	202	2236	311	71.1	8.1	82	3	58.7	15.9	356.1	53.0	725	136	1354	211	12.5	2.4
	8	68	1366	240	2243	321	72.3	14.1	81	3	58.8	15.6	354.0	56.2	737	167	1361	249	12.2	2.1
	9	84	1454	262	2514	386	76.9	12.9	82	3	63.1	17.4	407.3	68.8	775	165	1487	248	13.9	3.9
	10	75	1510	199	2557	290	79.1	12.5	82	3	59.8	13.8	422.5	59.2	768	162	1507	245	13.3	2.6
	11	108	1563	263	2626	425	80.1	13.5	82	3	65.2	17.9	429.0	78.2	791	167	1575	325	14.0	3.3
	12	100	1580	290	2846	467	85.8	16.3	83	2	66.7	17.4	475.7	86.8	768	180	1612	327	15.7	4.0
	13	108	1690	329	3109	564	92.6	17.5	83	3	73.0	18.5	517.9	109.0	806	190	1744	334	15.5	2.6
	14	100	1710	310	3182	549	93.0	19.4	83	2	69.6	19.3	541.4	102.3	821	171	1762	350	16.2	3.5
Girl	3	31	866	162	1429	226	47.4	7.4	83	3	44.3	11.5	216.6	43.9	482	106	860	122	8.6	2.1
	4	37	1008	169	1635	285	51.9	7.7	82	4	50.8	15.0	242.8	49.4	534	150	961	146	9.2	2.2
	5	40	1074	191	1728	296	54.4	7.5	82	4	54.2	15.3	256.9	53.0	567	148	1015	155	9.8	2.0
	6	31	1239	224	1927	309	66.5	11.7	81	3	57.3	17.2	289.4	53.6	736	170	1230	231	11.2	2.4
	7	38	1247	198	2043	300	69.3	10.6	81	3	56.0	14.8	316.2	55.2	724	148	1282	180	12.4	2.6
	8	46	1332	170	2079	223	69.7	10.3	81	3	55.5	13.8	323.8	42.6	740	132	1300	183	12.5	2.5
	9	44	1379	215	2172	333	73.4	9.7	81	3	57.5	15.2	337.1	56.0	749	141	1383	206	12.9	3.1
	10	46	1407	241	2282	323	75.7	11.4	81	3	62.3	16.4	347.9	50.7	749	170	1402	215	13.2	3.1
	11	49	1465	244	2357	335	78.3	13.1	82	3	60.2	16.0	373.4	62.2	780	156	1446	249	13.6	2.7
	12	58	1514	336	2583	390	87.0	15.3	81	3	66.6	19.3	406.9	77.5	754	210	1557	304	16.0	4.9
	13	60	1465	316	2513	522	82.0	19.1	82	3	64.7	23.4	400.4	86.8	742	219	1475	356	14.8	4.1
	14	71	1515	372	2537	481	84.3	16.9	81	3	69.6	25.3	392.2	82.3	762	231	1514	318	15.2	4.3

M: Mean, SD: Standard deviation.

TABLE 4. Nutrient intake and food expenditure per capita per day of tne orphanage children in Hokkaido in 1970

Sex	Age in Year	Numbey of Children	Vitamin A (IU)		Vitamin D (IU)		Thiamine (mg)		Riboflavin (mg)		Niacin (mg)		Niacin Equivalent (mg)		Ascorbic Acid (mg)		Food Expenditure (¥)	
			M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Boy	3	45	1680	849	73	73	1.01	0.60	1.04	0.30	8.5	2.0	19.5	2.7	58	29	187	38
	4	67	1431	768	70	67	0.95	0.40	0.97	0.26	8.6	2.0	20.0	3.2	52	31	187	39
	5	36	1851	1429	99	129	0.99	0.41	1.10	0.28	9.2	1.9	21.5	2.6	61	32	212	33
	6	67	2055	1304	92	113	1.35	0.97	1.40	0.39	11.6	3.1	26.7	5.0	81	27	217	36
	7	57	1895	995	88	80	1.29	0.76	1.40	0.32	13.0	3.0	28.3	5.3	88	29	219	36
	8	68	1877	908	93	88	1.39	0.77	1.42	0.36	12.3	3.1	28.1	5.6	87	40	231	47
	9	84	2167	1729	90	87	1.66	1.05	1.53	0.50	14.1	4.3	31.2	6.3	88	34	244	43
	10	75	2096	1316	91	115	1.69	1.09	1.48	0.37	13.8	3.4	31.0	5.5	106	37	247	41
	11	108	2210	1191	77	92	1.72	1.03	1.54	0.37	14.4	4.0	32.0	6.3	101	37	252	48
	12	100	2229	1714	111	118	1.70	1.18	1.52	0.49	16.4	5.3	35.2	8.1	94	51	280	51
	13	108	2139	1258	138	152	2.34	1.62	1.54	0.47	18.0	4.5	38.6	7.8	107	41	302	50
	14	100	2091	1264	103	108	2.31	1.64	1.57	0.46	18.1	4.9	38.3	7.8	106	44	296	48
Girl	3	31	1526	852	93	70	0.91	0.56	0.97	0.29	8.0	1.8	18.5	3.0	41	22	172	31
	4	37	1710	1290	95	114	0.89	0.35	1.02	0.27	8.8	1.8	20.1	2.6	58	28	192	39
	5	40	1614	983	86	78	0.82	0.35	1.04	0.28	8.9	2.0	21.1	3.0	65	21	197	42
	6	31	1714	1046	93	83	1.05	0.70	1.32	0.42	10.4	2.8	25.1	5.1	74	27	213	39
	7	38	1686	1125	94	60	1.17	0.79	1.34	0.39	11.4	2.9	26.6	4.6	73	30	216	34
	8	46	1866	1083	84	77	1.24	0.63	1.37	0.33	11.6	3.0	27.2	4.5	90	24	212	36
	9	44	2017	1304	90	77	1.27	0.85	1.47	0.41	12.2	3.8	28.1	5.4	84	25	229	36
	10	46	2187	1484	116	116	1.28	0.60	1.48	0.34	12.9	3.7	28.9	5.6	86	30	231	40
	11	49	2158	1039	103	93	1.28	0.67	1.53	0.37	1.32	4.0	31.1	6.0	92	32	249	48
	12	58	2470	2128	140	141	1.24	0.52	1.60	0.55	16.1	5.6	34.7	8.1	88	40	269	53
	13	60	2108	1508	120	119	1.30	0.69	1.49	0.52	14.2	5.0	32.0	8.5	84	38	259	54
	14	71	2404	2075	133	163	1.22	0.41	1.54	0.49	14.4	4.8	32.9	7.3	86	32	261	53

M: Mean, SD: Standard deviation.

TABLE 5. Nutrient adequacies (percentage of the nutrient intake of Hokkaido orphanage children in 1970 compared with the Recommended Daily Dietary Allowances revised 1969)

Sex	Age in Year	Number of Children	Food Energy		Protein		Calcium		Iron		Vitamin A		Vitamin D		Thiamine		Riboflavin		Niacin		Niacin Equivalent		Ascorbic Acid	
			M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
	3	45	118	20	111	14	120	30	111	22	112	57	18	18	168	101	149	49	77	18	177	25	145	72
	4	67	110	24	114	20	117	31	112	25	95	51	18	17	134	59	121	32	72	17	167	27	131	78
	5	36	118	15	113	13	111	25	124	21	123	95	25	32	142	59	137	36	71	15	165	20	152	81
	6	67	125	21	137	22	142	31	134	26	121	77	23	28	169	122	156	43	83	22	191	36	202	68
	7	57	124	17	129	15	145	27	139	27	111	59	22	20	161	95	155	35	87	20	189	35	219	72
Boy	8	68	118	17	131	26	123	28	136	24	110	53	23	22	154	86	142	36	82	20	187	37	218	100
	9	84	126	19	128	21	129	27	139	39	108	86	22	21	184	116	153	50	88	27	195	39	220	84
	10	75	122	14	113	18	128	27	133	26	105	66	23	29	169	109	134	34	81	20	182	32	264	93
	11	108	117	19	107	18	99	21	140	33	111	60	19	23	172	103	140	34	80	22	178	35	254	93
	12	100	119	19	101	19	96	22	131	33	111	86	28	29	155	107	127	41	86	28	185	43	236	126
	13	108	120	22	103	19	90	21	130	22	107	63	35	38	195	135	119	36	90	23	193	39	268	102
	14	100	118	20	103	22	91	19	135	29	105	63	26	27	192	137	112	33	82	22	174	35	264	110
	3	31	110	17	119	18	120	27	107	25	102	57	23	17	152	93	139	42	72	16	168	27	102	55
	4	37	117	20	115	17	133	38	116	28	114	86	24	28	148	59	145	39	80	16	183	24	144	71
	5	40	119	20	121	17	113	30	122	24	108	66	21	19	116	49	148	41	74	17	176	25	162	52
	6	31	124	20	133	23	147	34	125	26	101	62	23	21	151	101	165	53	80	21	193	39	185	68
	7	38	124	18	139	21	145	30	137	29	99	66	23	15	146	99	168	48	88	22	205	35	184	75
Girl	8	46	119	13	116	17	123	22	138	27	110	64	21	19	155	79	153	37	83	21	194	32	226	60
	9	44	111	17	113	15	125	24	129	31	101	65	22	19	141	94	146	41	81	25	187	36	209	64
	10	46	111	16	108	16	94	21	132	31	109	74	29	29	142	67	147	34	76	22	170	33	215	74
	11	49	107	15	104	18	97	20	136	27	108	51	26	23	128	67	139	33	73	22	173	33	204	70
	12	58	110	17	109	19	94	26	107	33	124	106	35	35	112	48	133	46	85	30	184	42	195	88
	13	60	103	21	109	25	82	24	99	27	105	75	30	30	118	63	124	43	71	25	160	42	186	85
	14	71	104	20	112	23	85	26	101	29	120	104	33	41	111	37	128	41	72	24	164	37	190	71

M: Mean, SD: Standard deviation.

According to Fig. 2 and 3, there are distinct shortage of calcium for the group D and considerable low intake of vitamin D for each of the four age groups since those 95% confidence intervals of mean values of the NA are below 100% of the RDA. In Fig. 2 and 3, it is also evident that the group D show less NA than those of the younger children (the groups A, B and C) for seven nutrients which imply food energy, protein, calcium, iron, thiamine, riboflavin and niacin equivalent; the group A show less NA than those of the groups B and C in five nutrients i. e. protein, iron, riboflavin, niacin equivalent and ascorbic acid; between the groups B and C, the

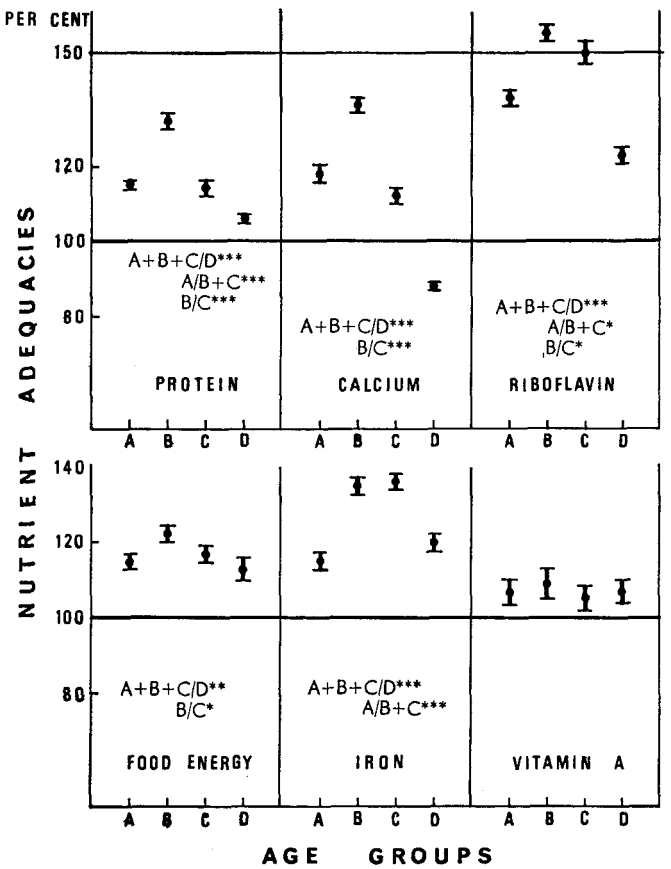

Fig. 2. Nutrient adequacies for food energy, protein, calcium, iron, vitamin A and riboflavin of Hokkaido orphanage children in 1970. The legends are the same as in Fig. 1. The nutrient adequacies are expressed as the percentages of the individual nutrient intake compared to the Recommended Daily Dietary Allowances for Japanese of each age and sex.

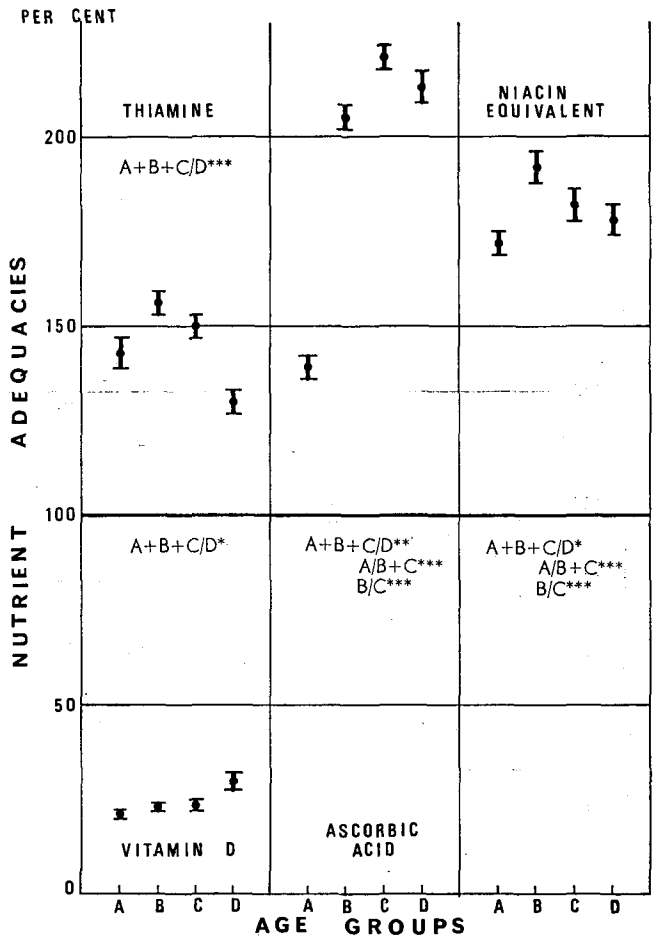

Fig. 3. Nutrient adequacies for vitamin D, thiamine, ascorbic acid and niacin equivalent of Hokkaido orphanage children in 1970. The legends are the same as in Fig. 1. The nutrient adequacies are expressed as the percentages of the individual nutrient intake compared to the Recommended Daily Dietary Allowances for Japanese of each age and sex.

group B has more NA than those of the group C for five nutrients: food energy, protein, calcium, riboflavin and niacin equivalent. In general, among the four age groups, it is evident that the group B i. e. lower graders of elementary school shows the highest adequacies in over a half of the ten nutrients, on the contrary, the group D namely junior high schoolers indicates the lowest adequacies in several nutrients, particularly the insufficient calcium intake; and special mention must be made of a considerably low adequacies of vitamin D for every age group.

Table 6 shows the percentage of food expenditure by age and sex in relation to the food budget. The values under 100% occurred in those under 11 years of age among all of the groups of both boys and girls.

According to the results of analysis of variance for the nutrient adequacies by institutions and age groups, it is evident that there are significant differences among the 22 institutions and the four age groups (except for vitamin A and D) at 0.5% level respectively.

TABLE 6. The ratios (%) of food expeniture to the budget in 1970

Sex	Age in Year	Number of Children	Ratio Exp/Bud (%)	
			M	SD
Boy	3	45	72	14
	4	67	72	15
	5	36	82	13
	6	67	83	14
	7	57	84	14
	8	68	89	18
	9	84	94	16
	10	75	95	16
	11	108	97	18
	12	100	108	20
	13	108	116	19
	14	100	114	18
Girl	3	31	66	12
	4	37	74	15
	5	40	76	16
	6	31	82	15
	7	38	83	13
	8	46	82	14
	9	44	88	14
	10	46	89	15
	11	49	96	18
	12	58	103	20
	13	60	100	21
	14	71	101	20

M: Mean, SD: Standard deviation.

Discussion

In order to obtain some information of direct relationship between possible nutritional limitations and the growth pattern of the children in the institution, the 1970 survey for physical measurement and food consumption was conducted by SANTO and her assistants who weighed and measured all the children and did a one-day survey of the food which an individual child really ate. The data of regular school lunch were collected by SANTO from the principal and the nutritionist at each school where the orphanage children attended.

For the purposes of comparison and inquiry into those measurement data by eliminating of the factors on sex and age, their relative physical measurements and nutrient adequacies as described previously have been calculated. If the 95% confidence interval of each mean value does not include the corresponding national average or RDA, it may be reasonable to make some inference about the difference between both values.

According to Fig. 1, the tendency of growth retardation appears more in the older children than in the younger ones in height and sitting height. Thus, concerning those orphanage children, the tendency mentioned above may indicate that considerable undernourishment during their early childhood causes them to be late in reaching the growth spurt. Therefore it is urgent to provide the diet at least to meet 100% of the RDA for those children so that they can catch up to the national physical averages.

According to Fig. 2 and 3, it is obvious that the nutrient adequacy for calcium of junior high school pupils and vitamin D of children of four age groups indicate a rate below 100% of the RDA. Among them those children of elementary and junior high schools are exposed to sunshine on the way to and from school, so that the exact vitamin D deficincy is difficult to estimate. Preschool children, however, are prone to stay indoors most of the long winter months in Hokkaido. To provide sufficient vitamin D for such children, special menu planning as well as certain hours of daily outdoor exercise should be carried out. Otherwise it may necessitate their taking vitamin D pills under a doctor's supervision. The low niacin adequacy formerly reported was inaccurate because the niacin equivalent adequacy turned out to be rather high. Total niacin equivalent equal the preformed niacin plus the niacin equivalents available protein : 60 mg. of tryptophan are equivalent to 1 mg. of niacin.

Water soluble vitamins (thiamine, riboflavin and ascorbic acid) lost in the preparation process is a fact to be considered. Enriched rice contains

much of thiamine and cooking does not destroy it. The previous report[23] shows the percentage of nutrient intake from different food-stuffs. The remaining sources of thiamine (with the exception of grains) constitute 40% of which 20% is presumed to be lost in the cooking process[1,2,20], in other words, the thiamine residue is roughly estimated at 90%. Therefore the thiamine adequacy of the children of all ages indicates it to be over 100%.

Forty percent of riboflavin comes from milk; the residue of 60% of which 20% is lost in cooking[24], so that residue of riboflavin is 88%. Thus, the riboflavin adequacy of the subjects of all ages is above the RDA.

The loss through preparation of potatoes and vegetables which consists of 85% of the ascorbic acid source is supposed to be 47%[17]. The ascorbic acid adequacy of preschool children is 83%; other groups show over 100%. Special attention pertaining to ascorbic acid intake for preschool children including infants is urgent, because of the problem of feeding vegetables to such youngsters who generally dislike certain vegetables.

It is fact that there is a low calcium adequacy which is below 100% of the RDA for junior high schoolers in relation to their height and sitting height. This fact suggests the importance of an increases in calcium intake necessary for their physical growth and development. According to the previous report[23], it is evident that over 45% of calcium comes from milk, so that for these older children described previously, it is advisable to provide them 110 cc. of milk per child per day in addition to their routine diet. This conclusion arises from the fact that their calcium adequacy is 88%, the remaining 12% of calcium RDA, namely, 108 mg. of calcium is considered as a requisite.

Before the survey began the author had been in connection with each institution being careful about the examination day. Namely, the day was not to be a special day but rather a day when the children lived in just an ordinary way. The meals served to the subjects on the examination day was supposed to be what they had usually had. However, in spite of this warning, a special meal served to subjects at some institutions due to psychological influences. Although at least the author acquired their food consumption records as accurate information as possible for the examination day, it seems to be difficult to obtain their exact information pertaining to the routine diet through a one-day survey. It is considered possible to collect more confirmable data involving food consumption by continuing such repeated series of surveys.

The food expenditure is affected by variation in the menu from day to day. The data of food expenditure are shown in the final coulmn of Table

4. The ratio of the food expenditure calculated to the food budget provided is shown in Table 6. It shows a tendency to increase considerably as the children grew older. Since the budget plan takes no account of the ages, it is only natural that less would be spent for the younger children and more for the older ones. Thus, there are natural differences in food costs for the different age groups but these differences do not seem to warrant any mathematical discussion. Perhaps those data suggest that budgets should be made out taking age groups into consideration.

According to a general view in Fig. 2 and 3 on the nutrient adequacies, it is evident that age group B or the group C shows the maximum nutrient adequacies of 9 items except for vitamin D, and the group D shows the minimum ones of several items. The reason for the phenomenon seems to be due to excess food regardless of their RDA which was the outcome of the regular school lunch and their ordinary meal at the institutions for the groups B and C, although over a half of the group D were given no benefit of the regular school lunch and received less food for their RDA. From what the author has observed, it is obvious that the cause of the low rate of nutrient adequacy of group D and the high rates of groups B and C were due to the fact that a single helping of the main dish consisted of not much difference in quantity regardless of RDA: although rice, miso soup and pickles were served ad libitum. To prevent surplus or leftover food at almost all institutions, the cooks served the amount per dish to suit the appetite of the preschool children first, then the remaining food was roughly distributed evenly for the older children (elementary and junior high schoolers); though it was often too much for elementary groups (groups B and C) and not enough most of the time for the older children (group D). These differences are indicated in Figures 2 and 3. Therefore it is considered that nutrition education is required for the cooks and the other staff members such as people in charge who are certified in child welfare in these institutions. These people must assume the responsibility of feeding children more properly to fulfill the needs of development as children brought up by parents.

Studies have revealed height retardation and frequent cases of less nutrient adequacy than those of groups B and C, especially of calcium and vitamin D insufficiency in relation to those of group D. In relation to nutrition the stage of puberty is when children are most sensitive during their growth and development, so that they require more food than the other groups, this fact explains their being called the vulnerable groups.

Summary

In 22 institutions in Hokkaido, growth retardation of height and sitting height, and shortage of vitamin D and calcium were found evident for junior high school pupils in comparison with the national averages and the recommended daily dietary allowances. Vitamin D and ascorbic acid for preschool children should be considered, bearing in mind of influencial effect by exposure sunshine and loss in preparation and cooking. It was also obvious that considerably low adequacy of vitamin D was found in elemantary schoolers.

Therefore, it is advisable that those institutions ought to be done about following two points.

1. Providing 110 milliliters of milk more for junior high schoolers.
2. Distributing food to meet the recommended dietary allowances for each age group.

It is also recommended that the National and Hokkaido Prefectural Government should consider some points described as follows.

1. Employing at least one competent dietitian regardless of the accommodation capacity in each institution to assume responsibility in menu planning, food purchasing and nutrition education to improve the standards for orphanage children, or employing one supervisor for two or three neighboring institutions if finances made it imposible to employ one dietitian in each institution.
2. Making an allowance for a regular school lunch for the junior high school pupils as most of the elementary school children are served at present.

Acknowledgement

The author wishes to express her gratitude to Dr. Helen S. MITCHELL, Dean Emeritus of the School of Home Economics, the University of Massachusetts, former exchange professor to Hokkaido University 1960–1962, for editing this manuscript and making valuable suggestions, and to Dr. Chikahiro TSUDA, Professor, Faculty of Agriculture, Hokkaido University for his helpfil advice in computing the data, and to Mrs. Ayako KOHNO for her interest in this work.

Literature Cited

1. ASHIKAGA, C. and KOSHIMIZU, M.: The changes of vitamin B_1 contents of vegetables during the process of cooking (IV), *J. Vitamin Soc. Japan*, **4**: 110–113. 1951

2. ARIMA, N., KATO, S., WATANABE, M., OSHIKA, J., KOIKE, G. and KAGAWA, A.: Studies on the loss of vitamin B_1 in raw fish and pork by cooking, *J. Japanese Soc. Food and Nutrition*, **9**: 310-312. 1956
3. ARIMOTO, K., IWAO, H., NAGAI, S., TAKAI, Y., KIRIYAMA, S., MIME, A., SHIRATORI, K., HOSHIKAWA, K., DAIDOJI, R., KAMOMAE, K., SUZUKI, T., IWATANI, Y., SAITO, M., TABATA, T., YAMASHITA, T. and IWAHASHI, T.: Food analysis No. 25, *Report of National Institute of Nutrition Japan, Supplement in 1964*, p. 1-24. 1966
4. ARIMOTO, K., IWAO, H., NAGAI, S., TAKAI, Y., KIRIYAMA, S., MIME, A., SHIRATORI, K., HOSOKAWA, K., DAIDOJI, R., SUZUKI, T., IWATANI, Y., KITANI, I., OKADA, S., YAMASHITA, T., SAITO, M. and IWAHASHI, T.: Food analysis No. 27, *Report of National Institute of Nutrition Japan, Supplement in* 1965, p. 6-31. 1967
5. CHATFIELD, C.: Food composition tables for international use —1949, 1954—, translated into Japanese by NATURAL RESOURCES BUREAU, SCIENCE and TECHNOLOGY AGENCY JAPAN, p. 163. Daiichi Shuppan, Tokyo. 1956
6. FOOD POLICY and FOOD SCIENCE, NUTRITION DIVISION, FAO: Amino acid content of foods and biological data on proteins, translated into Japanese by OISO, T., p. 110. Daiichi Shuppan, Tokyo. 1975
7. INTERDEPARTMENTAL COMMITTEE on NUTRITION for NATIONAL DEFENSE, National Institute of Health, Bethesda, Md.: Manual for Nutrition Surveys, second ed., p. 327. U. S. Government Printing Office, Washington D. C.. 1963
8. IWAO, H., NAGAI, S., TAKAI, Y., KIRIYAMA, S., MIME, A., SHIRATORI, K., DAIDOJI, R., SUZUKI, T., IWATANI, Y. M., OTANI, I., OKADA, S., YAMASHITA, T. and SAITO, M.: Food analysis No. 26, *Report of National Institute of Nutrition Japan, Supplement in 1965*, p. 1-5. 1967
9. Joint FAO/WHO EXPERT GROUP: Protein requirements, *WHO Tech. Rep. Ser. 301. 1965., FAO Nutrition Meetings Rep. Ser. 37. 1965.*, translated into Japanese by ESSENTIAL AMINO ACID RESEARCH COMMITTEE JAPAN, p. 95. Daiichi Shuppan, Tokyo. 1965
10. Joint FAO/WHO EXPERT GROUP: Requirements of vitamin A, thiamine, riboflavin and niacin, *WHO Tech. Rep. Ser. 362, 1965., FAO Nutrition Meetings Rep. Ser. 41. 1965.*, translated into Japanese by OISO, T. 106. Daiichi Shuppan, Tokyo. 1968
11. MINISTRY of EDUCATION JAPAN: School health statistical report in 1970, MJE 6798, p. 348. Ministry of Finance Printing Office, Tokyo. 1971
12. MINISTRY of HEALTH and WELFARE JAPAN: Reccommended dietary allowances for Japanese, p. 59. Ministry of Finance Printing Office, Tokyo. 1969
13. MINISTRY of HEALTH and WELFARE JAPAN: Nutritional aspect in Japan, 1969, 1970 and 1971, p. 325. Daiichi Shuppan, Tokyo. 1973
14. MITCHELL, H. S.: Nutrition in relation to stature, *J. Am. Dietetic Assoc.*, **40**: 521-524. 1962
15. MITCHELL, H. S. and SANTO, S.: A study of children in Hokkaido orphanages height, weight and dietary patterns, *J. Fac. Agr.Hokkaido Univ.*, **52**: 483-491. 1962

16. MITCHELL, H. S. and SANTO, S.: Nutritional improvement in Hokkaido orphanage children —1960–1970, *J. Am. Dietetic Assoc.*, **72**: 506–509. 1978
17. MIYAGAWA, K., OKUMURA, Y. and MURATA, K.: The intake of vitamin C from daily meals, it's loss in cooking, and the ratio to the calculated values, *J. Japanese Soc. Food and Nutrition*, **12**: 261–264. 1959
18. NATURAL RESOURCES BUREAU, SCIENCE and TECHNOLOGY AGENCY JAPAN: Standard tables of food composition in Japan 3rd ed., p. 118. Ministry of Finance Printing Office, Tokyo. 1963
19. NATURAL RESOURCES BUREAU, SCIENCE and TECHNOLOGY AGENCY JAPAN: The amino acid composition of foods in Japan, p. 65. Ministry of Finance Printing Office, Tokyo. 1966
20. OGAWA, Y. and TAKEDA, M.: Thiamine contents of recooked pork, *J. Japanese Soc. Food and Nutrition*, **10**: 149–151. 1957
21. SANTO, S.: Physical status of Hokkaido orphanage children —height and weight—, *J. Hokkaido Soc. Food and Nutrition*, **10**: 31–40. 1964
22. SANTO, S.: Nutritional status of children Hokkaido orphanages —comparison of 1965 and 1960 data—, *J. Fac. Agr. Hokkaido Univ.*, **56**: 31–44. 1968
23. SANTO, S. and MITCHELL, H. S.: Nutritional status of Hakkaido orphanage children 1960–1970, *J. Fac. Agr. Hokkaido Univ.*, **58**: 1–12. 1975
24. TAKAGI, S.: The changes of riboflavin content of meats during the cooking, *J. Japanese Soc. Food and Nutrition*, **10**: 288–291. 1957
25. WATT, B. K. and MERRILL, A. L.: Composition of foods —raw, processed, prepared—, *Agriculture Handbook No. 8*, p. 189. U. S. Department of Agriculture, Washington D. C.. 1963