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A Study on Relationships Between Nutritional Status and Psychological Functionings of Elementary School Children in Seoul*

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영양 상태와 인지 및 인성 기능과의 상관성에 관한 연구

-국민학교 아동을 대상으로-

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□국 문 초 록□

본 연구는 국민학교 어린이를 대상으로 식품 및 영양소 섭취량 조사, 신체 및 임상 검사, 그리고 인지 및 인성검사를 실시하여 영양 섭취 상태와 인지 및 인성 기능과의 상관관계를 조사하였다.

조사 결과를 요약하면 다음과 같다.

1) 경제적으로 중류 이상의 생활을 하고 있는 Y국민학교 어린이가 대체로 경제적 환경이 중류 이하인 B국민학교 어린이보다 인지 능력이 유의적으로 높으며 신장 및 체중 평균치도 Y국민학교 어린이가 높게 나타났다.

2) 영양소 섭취량과 인지 기능과의 관계에 있어서 조사된 각 영양소(동물성단백질, 지방, 비타민 A, 리보플라빈 등)와 인지 기능 변인(IQ, 수리력, 공간지각능력, 지각속도, 도형추리력 등)에 따라 차이는 있으나 유의적인 양의 상관관계를 보였다. 그러나 인성 기능과의 상관성은 거의 보이지 않았다.

3) 대부분의 영양소 섭취량과 신장, 체중 및 두위와의 관계에서는 유의적으로 양의 상관관계를 보였으며 이는 영양 섭취상태와 신체발달과 밀접한 관계임을 보여주고 있다.

4) 식습관 균형 정도에 의해 분류된 집단간의 인지 및 인성기능과의 차이를 검증한 결과, 균형된 식사를 하고 있는 집단일수록 인지 및 인성기능이 우수하게 나타났다.

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ABSTRACT

The relationships between nutritional status and psychological functionings in elementary school children were studied using dietary survey, physical and biochemical examinations and psychological measures of both cognitive and personality traits.

The results obtained are as follows: (1) Performance of Y school (higher economic class) children on the tests of cognitive functionings, was generally higher than that of B school (lower economic class) children. The means of all anthropometric measurements were also higher in Y than B school children. (2) Nutrient intakes were found to be positvely correlated with the psychological functionings of the children to the varing degrees depending on the variables tested. However, the correlations between the physical measures and psychological functionings were low. (3) Most nutrient variables showed positive correlations with body size. (4) The positive correlations found between Food Habit Scores (a test of balanced diet) and psychological functionings of both cognitive and personality traits are of utmost importance reflecting the positive effects of balanced diet on behavior.

Key words: Nutritional status. Psychological functionings. Elementary school children. Physical examination. Food habit scores.

INTRODUCTION

It is widely claimed that nutritional status of children in the formative years has important bearings on their psychological functionings at later years[1-3]. Undernutrition not only affects physical and mental development but also productivity and the span of working years all of which clearly influence the economic potential of man[4]. However, the mechanism underlying the relationships between nutritional status and psychological functionings has not been clearly understood.

Investigators in several countries[5-7] have demonstrated that undernutrition during the early years of life, when couples with all the other socioeconomic deprivations, is associated with retarded brain growth and mental development which persist throughout life span. Cravioto and Delicardie[6] suggested three sets of associated factors to be considered in studies of a causal relationship between malnutrition and its consequences in infants and young children. They were availability of nutrients to the body tissues, features of health and disease which directly or indirectly affect dietary intake and nutritional status, and general social character including socioeconomic status, educational background of parents, and patterns of child care. Richardson[7] stated in his Jamaica and West Indies study that "when malnutrition occurs under the condition of an unfavorable social background and for children who achieve poor physical growth at school age, the malnutrition may play a contributary role in intellectual impairment, but not under conditions of favorable physical growth and social background." Psycho-educational stimulation to health care and nutritional supplementation is known to be associated with a substantial increase in the level of cognitive functioning. Experience in India has shown that nutritional supplementation is less costly than medical care in reducing post-neonatal and 1-3 year child mortality[8].

Although research methods, subjects, and duration of malnutrition have varied from study to

study, the studies have fairly consistently indicated that previously malnourished children had many weaknesses more than did well nourished children[9-11]. There has been relatively little research on children suffering from moderate or mild malnutrition.

The present study is an attempt to gain knowledge about the relationship between nutritional status psychological functionings of Korean elementary school children, with social environmental conditions adding to the set of independent variables. The specific focus of the study is description of correlationships between nutrient intake level, food habit, and body size on one hand and cognitive and personality functionings of children on the other. The results of the study of this kind would bring forth knowledge base for deciding priority in policy making concerning formulation of social programmes to combat against mulnutrition of children.

METHOD AND PROCEDURE

A. Subjects

Subjects were children selected from the fourth grade elementary school who were able to answer various questions on food and nutrition intake, and on tests of psychological funtionings. B elementary school children belong to a low socioeconomic class and Y elementary school children belong to a relatively high socioeconomic class in Seoul. The total number of subjects of two areas were 175 (male: 91, female: 84) for B school and 116 (male: 68, female: 48) for Y school respectively

B. Methods

1) Dietary Survey

a) a special questionnaire was designed to find out the family background and food habits of subjects. Food habit scores were measured by using a modified form originally used by the Ministry of Public Health, Japan[12].

b) Forty children randomly selected from two areas were subjected to the precise weighing method. The survey team was composed of 20 senior and graduate students of the Department of Food & Nutrition, Yonsei University. Each member of the survey team was assigned to make home visits in order to obtain information on families and amounts of food consumed for two days. Food consumption was calculated by weighing the food items before and after cooking and by measuring the amount of food eaten by the family. The average intake of nutrient taken by a school child was determined by reconverting the adult unit of nutrient intake obtained from the dietary survey on nutrient intakes by each family member[13][14].

2) Physical and Biochemical Examinations

Height, weight, chest and head circumference, and skinfold thickness[15] were measured for all children. Detailed examinations including blood tests for hemoglobin, hematocrit, red blood cell count, serum protein, etc. were carried out and test samples were analyzed at the Yonsei Midical Center.

3) Psychological Measures

Cognitive measures used include Diagnostic intelligence Test-Revised[16] (Form-122) (DIT-R, Split-half reliability; 0.78), numerical reasoning, figure reasoning[17], digit span[18] and a finger dexterity test[19-22].

Personality measures used were the standardized Personality Inventory[2] (PI, Split-half reliability; 0.73-0.91). Children received the DIT-R and PI on the first day and the tests for numerical

reasoning, figure reasoning, digit span, and finger dexterity on the second day. The testing required a total of about 120 minutes.

The collected data was analyzed using the SPSS (Statistical Package for the Social Sciences) computer program.

RESULTS AND DISCUSSION

A. General Characteristics of the Family

The educational level of the children's parents are presented in Table 1. The parents who had college or graduate school level education were found to comprise 70% (mother) and 94% (father) in Y and 1% (mother) and 12% (father) in B elementary school.

Table 1 shows the income status and the expenses for foods between the two areas. Twenty-one percent of B school families belong to the monthly income level below 150000Won. According to the Korea Statistical yearbook (1981)[24], the family who earns below 150000Won

Table 1. General characteristics of parents

Characteristics	B School		Y School	
	Father No. (%)	Mother No. (%)	Father No. (%)	Mother No (%)
Educational level				
Graduate school	0 (0)	0 (0)	21 (19)	11 (10)
University	16 (12)	1 (1)	79 (75)	67 (60)
Higher school	62 (49)	28 (23)	6 (6)	33 (30)
Middle school	34 (27)	56 (46)	0 (0)	0 (0)
Elementary school	15 (12)	37 (30)	0 (0)	0 (0)
Income (US $)				
〉1,000* (〉1,275)	2 (1)		35 (32)	
1,000— 700 (—893)	3 (2)		41 (37)	
700— 400 (— 510)	42 (26)		32 (29)	
400— 150 (— 192)	82 (50)		2 (2)	
〈 150 (〈 191)	34 (21)		0 (0)	
Expense for food				
〉 301 (〉 382)	11 (7)		41 (36)	
300— 201 (—256)	23 (14)		44 (39)	
200— 101 (—129)	86 (52)		25 (22)	
100— 51 (— 65)	36 (22)		3 (3)	
〉50 (〈 64)	8 (5)		0 (0)	

* Unit : 1,000won.

(Note : US $ 1.00≒785won at the time of the study)

Table 2. Average nutrient intake by precise weighing method in two different areas per child per day (N = 34)

Nutrient	B school	Y school	Significance
	Mean ± SD	Mean ± SD	
Calorie (Kcal)	1,500 ± 227 (87)[1]	1,830 ± 381 (102)	P <0.01
Protein (gm)	53 ± 13.8 (96)	78 ± 17 (142)	"
Fat (gm)	22.41 ± 9.1	46 ± 19	"
Carbohydrate (gm)	266 ± 53.7	274 ± 55	n.s.
Calcium (mg)	407 ± 204 (81)	817 ± 351 (163)	P <0.01
Iron (mg)	9.4 ± 2.5 (94)	18.7 ± 6.3 (187)	"
Vitamin A (R.E.[2])	534 ± 390 (107)	1,143 ± 541 (229)	"
Thiamin (mg)	1.10 ± 0.29 (122)	1.73 ± 0.56 (192)	"
Riboflavin (mg)	0.99 ± 0.37 (90)	1.93 ± 0.48 (175)	"
Niacin (mg)	14.9 ± 8.0 (124)	24.9 ± 7.7 (208)	"
Ascorbic acid (mg)	47 ± 30 (118)	78 ± 31 (195)	"

1 : Percentage of Recommended Dietary Allowance, 1985.
2 : Retinol Equivalent.
n.s. : Not significant.

Table 3. Food habit score

Group	B school	Y school
	Number (%)	Number (%)
Excellent	3 (2)	27 (23)
Good	61 (35)	67 (58)
Fair	84 (48)	22 (19)
Poor	27 (15)	0 (0)
Total	175 (100)	116 (100)

per month was classified as a low income level family and over 1000000Won per month as high income level. Thirty-two percent of Y school families belonged to a high income level.

B. Dietary Survey on Intake of Nutrients

1) Average Intake of Nutrients

Average intakes of nutrients per day in each study area were presented in Table 2. The nutrient intakes of children in the B area were generally lower than those in the Y area. There were statistically significant differences in all the nutrients except in carbohydrates.

2) Food Habit Score

The dietary habits of children were examined by grading their food habit records according to the following order of "Excellent", "Good", "Fair" and "Poor". The score of the result was presented in Table 3. The differences of mean scores between two study areas were found to be statistically significant. The percentage of the "Excellent" group was 23% for Y and only 2% for

Table 4. Anthropometric measurements in two areas

Content	B school		Y school	
	Male	Female	Male	Female
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Height (cm)	131.2 ±.5.3	131.2 ± 6.2	135.3*± 5.2	134.8*± 4.8
Weight (kg)	26.0 ± 4.0	26.1 ± 5.3	30.3*± 5.7	28.5*± 4.3
Chest circumference (cm)	63.1 ± 3.5	61.9 ± 4.9	64.0 ± 4.2	63.1 ± 4.2
Head circumference (cm)	52.0 ± 1.3	50.9 ± 1.8	53.4 ± 1.2	52.4 ± 1.5
Triceps skinfold thickness (mm)	9.8 ± 7.0	11.9 ± 7.9	10.9 ± 3.9	12.4 ± 3.5
Kaup index	1.51 ±0.15	1.50 ±0.24	1.64**± 0.26	1.56 ±0.19

* $p < 0.05$ ** $p < 0.01$

Table 5. Blood findings for B school children

Test content	Male	Female
	Mean ± SD	Mean ± SD
RBC count (10^6/ml)	4.6 ± 0.18	4.5 ± 0.22
Hemoglobin (g/100ml)	12.8 ± 0.71	12.8 ± 0.66
Hematocrit (%)	37.8 ± 1.8	38.0 ± 1.8
Total serum protein (g/100ml)	7.4 ± 0.37	7.6 ± 0.41
WBC count (10^3/ml)	7.3 ± 1.49	8.4 ± 1.60
MCV (fl)	80.1 ± 3.7	82.7 ± 2.4
MCHC (%)	31.8 ± 0.20	31.9 ± 0.31
MCH (pg)	27.8 ± 1.19	28.4 ± 0.90

B school, respectively. Although the majority of Y school children belonged to the "Good" group (58%), the majority of B school children belonged to the "Fair" group (43%).

The mean hemoglobin concentration was found to be 12.8gm/100ml. Sexual difference was not shown. According to WHO standards[25], 10% of the children belonged to the anemic group. The mean hemoglobin concentrations of all subjects fall within the acceptable category classified by ICNND (Interdepartmental Committee on Nutrition for National Defense)[26]. The mean hematocrit values were 37.8% for male and 38.0% for female children. Thus, no difference was found in hematocrit values between sexes, and they were considered normal. Seventeen percentage of children fall under the anemic category when based on WHO standards[25]. MCHC levels were 31.8% for male and 31.9% for female children which also fall within the normal range. Other measurements were included in Table 5. No sex differences were found in these values.

Table 6. Mean scores and standard deviations of psychological functionings in two different areas

Variables	B school	Y school	Significance
	Mean ± SD	Mean ± SD	
I. Cognition			
1. Perceptual speed	47.25 ± 7.6	53.3 ± 7.5	$p < 0.01$
2. Space perception	53.6 ± 13.0	67.2 ± 9.3	"
3. Reasoning	47.1 ± 10.3	58.6 ± 11.0	"
4. Numerical ability	49.8 ± 11.3	60.5 ± 10.3	"
5. Memory	44.9 ± 10.2	53.0 ± 9.5	"
6. Verbal ability	48.4 ± 8.5	54.8 ± 6.9	"
7. IQ	108.7 ± 17.6	131.6 ± 12.9	"
8. Numerical reasoning	57.1 ± 9.4	60.7 ± 10.8	"
9. Figure reasoning	57.7 ± 9.1	67.3 ± 6.8	"
10. Digit span	5.0 ± 1.1	6.2 ± 1.6	"
11. Finger dexterity A	14.1 ± 3.9	16.9 ± 4.2	"
12. Finger dexterity B	17.0 ± 4.7	19.4 ± 5.0	"
II. Personality			
13. General activity	11.2 ± 4.9	11.3 ± 5.2	n.s.
14. Dominance	9.9 ± 4.3	9.7 ± 4.6	"
15. Emotional stability	10.9 ± 4.3	11.7 ± 5.3	"
16. Impulsiveness	10.0 ± 4.7	10.0 ± 4.3	"
17. Reflectiveness	13.2 ± 7.0	14.5 ± 3.8	$p < 0.05$
18. Sociability	13.4 ± 5.1	14.1 ± 4.6	n.s.

n.s. : Not significant

C. Anthropometric Measurements and Blood Examination

All the mean values of anthropometric measurements were appeared to be higher in Y than B school.

D. Geographical Differences on Psychological Functioning Tests

One important result obtained was that Y school children were superior to B school children in all of the cognitive functionings measured by the intelligence test, whereas, Y children were similar to B children in all personality traits, except the trait of reflectiveness (Table 6).

E. Relationships among Nutrient Variables, Anthropometric Measures, and Psychological Functionings

The psychological functionings were found to be positively related to the nutrient intakes. IQ assessed by DIT-R and each scores of its subvariables were positively correlated with the intakes of animal protein, fat, vitamin A, riboflavin, and vitamin C. Numerical and figure reasoning were positively correlated with intakes of calorie, vitamin A, animal protein, fat, calcium, and riboflavin (Table 7-a). Less pronounced yet substantial correlations were found

Table 7-a. Correlations between nutrient intakes assessed by precise weighing method and cognitive functionings

	Perceptual speed	Space perception	Reasoning	Numerical ability	Memory	Verbal ability	IQ	Numerical reasoning	Figure reasoning	Digit span
Calorie	.3313*	.4195**	.3457*	.4368**	.1168	.1466	.4228**	.5979**	.3747*	.0990
Animal protein	.3784*	.4355**	.5401**	.6582**	.2465	.3367*	.5981**	.4904**	.4275**	.2874*
Vegetable protein	.0768	.0710	−.1087	−.1753	−.0997	−.2624*	.0844	.0076	−.1364	−.1863
Fat	.5712**	.3859*	.4386**	.5577**	.2137	.3248*	.5337**	.5695**	.4682**	.1731
Carbohydrate	.0614	.2085	.0417	.0835	−.0448	−.1032	.0856	.3181*	.0648	−.0794
Calcium	.4569**	.3240*	.3031*	.4698**	.1743	.2071	.4312**	.4671**	.3531*	.2568
Iron	.3102*	.4920**	.4403**	.5057**	.3759*	.2322	.5522**	.5035**	.2545	.3403*
Vitamin A	.4102**	.5114**	.4476**	.4056**	.4350**	.3019*	.5375**	.3935**	.4720**	.2548
Thiamin	.3667*	.3110*	.2216	.5102**	.0494	.0416	.3654*	.4779**	.2278	.1573
Riboflavin	.5394**	.5173**	.4584**	.5668**	.3396*	.3305*	.5923**	.5185**	.4094**	.2571
Niacin	.3656*	.3846*	.3815*	.4016**	.2085	.1326	.4713**	.2084	.2190	.0910
Vitamin C	.5309**	.3980**	.3235*	.3214*	.3411*	.3080*	.4274**	.0868	.3437	.3258

* $p < 0.05$ ** $p < 0.01$

between general activity and calorie, fat, carbohydrate and thiamin intakes; sociability and vitamin C; impulsiveness and calorie and carbohydrate. On the basis of these results, it can be said that the better the children's nutrition status is, the higher their cognitive performance is. Children whose nutritional status were good tended to act energetically and efficiently had higher

Table 7-b. Correlations between nutrient intakes assessed by precise weighing method and personality traits

	General activity	Dominance	Emotional stability	Impul-siveness	Reflect-iveness	Sociability
Calorie	.3670*	-.1332	-.0299	.3180*	.0582	-.0317
Animal protein	.1831	-.1770	-.0138	.0165	-.0015	.2087
Vegetable protein	.1349	.0041	.0438	.1942	.0726	-.1315
Fat	.2944*	-.1131	-.0373	.2279	.0315	.0641
Carbohydrate	.3316*	.0146	-.0042	.3558	.0975	-.1035
Calcium	.0266	-.3285*	.1103	-.0888	.1962	.1491
Iron	-.0961	-.1777	.1027	.0129	.1547	.2183
Vitamin A	.0175	-.1453	.1335	.0335	.0154	.2097
Thiamin	.3653*	-.1329	.0204	.1212	.1666	.0971
Riboflavin	.1465	-.1219	.0642	.0568	.2065	.1949
Niacin	-.0425	-.1181	.0613	-.2701	.0370	.2286
Vitamin C	-.1635	-.0304	.1878	-.1231	.0851	.3227*

* $p < 0.05$

Table 8. Correlations between nutrient intakes assessed by precise weighing method and anthropometric measures

	Height	Weight	Head circumference	Skinfold thickness
Calorie	.38*	.37*	.54*	.08
Total protein	.41**	.43**	.06	.20
Animal protein	.48**	.52**	.69**	.23
Vegetable protein	-.02	.04	.08	.00
Fat	.45**	.40**	.53**	.07
Carbohydrate	.11	.08	.24	-.02
Calcium	.30*	.17	.32*	-.12
Iron	.29*	.42**	.42**	.16
Vitamin A	.22	.22	.23	.21
Thiamin	.40**	.31**	.58**	-.04
Riboflavin	.55**	.46**	.57**	.07
Niacin	.26	.40**	.46**	.25
Vitamin C	.24	.09	.18	-.11

* $p < 0.05$ ** $p < 0.01$

Table 9. Correlations between anthopometric measures and psychological functionings

	Height	Weight	Head circumference	Skinfold thickness
Perceptual speed	.00	.01	−.13	.03
Space perception	−.03	−.02	−.20	−.11
Reasoning	−.02	.06	.03	.27*
Numerical ability	−.04	−.06	−.10	.09
Memory	−.04	.07	.00	.03
Verbal ability	.21	.19	.11	.04
IQ	.04	.09	.11	.16
Numerical reasoning	−.09	−.09	.15	.15
Figure reasoning	−.06	−.12	.02	−.13
Digit span	.24*	.20	.17	.19
Finger dexterity A	.33**	.25*	.01	.31**
Finger dexterity B	.33**	.21*	.05	.18
General activity	.08	−.01	.01	−.25*
Dominance	.31**	.14	.06	−.06
Emotional stability	.18	.19	−.12	.06
Impulsiveness	.09	.02	.08	−.14
Reflectiveness	.18	.09	.05	−.04
Sociability	.20	.15	−.21*	.17

* $p < 0.05$ ** $p < 0.01$

achievement motivation, and enjoyed working. Goodwin et. al[27]. also observed that poor cognitive functioning may contribute to inadequate dietary intake and subsequent nutritional deficiencies rahter than the reverse.

Even though physical measures showed generally low correlations with psychological measures, height was siginificantly correlated with variables such as dominance, finger dexterity, and digit span (Table 9).

Most nutrient variables were positively correlated with body size which implies that the intakes of most nutrients are related to the needs for maintenance of body mass (Table 8).

Champakam, Srikantia and Gopalan[28] reported that for children who experienced malnutrition earlier, weight reduction was more pronounced as compared to normal children. According to studies done for 15 years by Stoch and Symthe[2], the clear effect of undernutrition during early years on subsequent brain growth and intellectual development was found. It is generally accepted, however, that there is no correlation between head circumference and IQ.

F. Relationship between Food Habit Score and Psychological Functionings

To assess the effects of balanced food intake on psychological functionings, one-way ANOVA test was performed on each psychological functioning item with food habit score.

As shown in Table 10, each group tended to show statistically significant differences except for variables such as general activity and impulsiveness. On the whole, the "Excellent" group who ate balanced food showed higher mean scores for almost all psychological functionings than either

Table 10. Mean scores and standard deviations of psychological functionings by food habit score

Variables \ Groups	Poor	Fair	Good	Excellent
	M ± SD	M ± SD	M ± SD	M ± SD
I. Cognition				
1. Perceptual speed	45.0 ± 5.3	48.7 ± 7.8*	50.4 ± 8.2*	54.5 ± 8.1***
2. Space perception	48.0 ±12.2	59.4 ±12.6*	61.3 ±13.5**	64.7 ±10.6**
3. Reasoning	41.9 ± 7.4	50.1 ±11.9*	53.7 ±11.9**	57.8 ± 9.6**
4. Numerical ability	45.3 ±14.1	52.7 ±11.0*	55.9 ±11.7**	59.3 ±10.7**
5. Memory	41.0 ± 8.8	47.3 ± 9.6*	49.5 ±11.4**	51.9 ± 9.7***
6. Verbal ability	44.1 ± 7.4	50.2 ± 9.1*	52.4 ± 8.2*	53.2 ± 5.2*
7. IQ	98.9 ±15.3	125.2 ± 9.2*	121.6 ±18.3*	130.2 ±12.1***
8. Numerical reasoning	52.4 ± 9.7	59.1 ± 9.5*	59.1 ±10.3*	59.9 ±10.3*
9. Figure reasoning	53.6 ± 8.1	59.9 ± 9.4*	61.4 ± 8.1*	61.2 ± 7.2*
10. Digit span	4.9 ± 0.9	5.4 ± 1.4	5.6 ± 1.4*	5.9 ± 1.7*
11. Finger dexterity A	11.8 ± 2.8	15.1 ± 4.6*	15.5 ± 3.9*	17.4 ± 3.7**
12. Finger dexterity B	15.3 ± 4.2	17.6 ± 5.3*	18.2 ± 4.7*	20.2 ± 4.3***
Ⅱ. Personality				
13. General activity	11.2 ± 4.2	10.9 ± 5.1	11.5 ± 5.0	11.1 ± 5.8
14. Dominance	7.7 ± 3.6	9.1 ± 4.3	10.5 ± 4.3**	11.3 ± 4.8**
15. Emotional stability	9.1 ± 3.6	11.0 ± 4.9	11.3 ± 5.2	13.3 ± 4.9***
16. Impulsiveness	10.5 ± 4.5	9.9 ± 4.7	10.0 ± 4.6	9.6 ± 4.3
17. Reflectiveness	11.3 ± 2.9	13.3 ± 8.6*	14.3 ± 3.4*	15.0 ± 5.9
18. Sociability	11.2 ± 3.6	13.5 ± 5.9*	13.9 ± 4.3*	15.5 ± 4.1*

*significantly different when compared with 'Poor' group at $p < 0.05$
**significantly different when compared with 'Poor' and 'Fair' groups at $p < 0.05$
***significantly different when compared with 'Poor', 'Fair' and 'Good' groups at $p < 0.05$

the "Fair" or "Poor" group.

It should be noted that no significant difference was found when previously compared between nutrient variables and personality traits (Table 7-b). Since Food Habit Score is a test of the degree of balance in food intake, the positive correlations shown between Food Habit Score and psychological functionings of both cognitive and personality traits are of utmost importance reflecting the positive effect of balanced diet on behavior.

IV. SUMMARY

1) Parents who had college or graduate school level education were found to comprise 70-94% in Y school and less than 12% B school (low economic class) areas. Y Families showed higher income and higher expenses for foods than B families.

2) Judging from the correlations between nutrient intakes and anthropometric measurements, most nutrient variables showed positive correlations with body size, which clearly indicated that most nutrients are related to the needs for growth and maintenance of body mass.

3) Performance of Y school children on the tests of congnitive functionings were generally higher than those of B school children.

The means of all anthropometric measurements were also higher in Y than B school children.

4) Even though physical measures showed generally low correlations with psychological measures, height was significantly correlated with variables such as dominance, finger dexterity, and digit span.

5) The positive correlations found between Food Habit Scores which is a test of balanced diet and psychological functionings of both cognitive and personality traits are of utmost importance reflecting the positive effect of balanced diet on behavior.

It is necessary to extend the present investigation further to include follow-up evaluations of the undernourished population measuring intellectual, social, and family patterns. This kind of project will shed light on the role played by the mother-child relationship in early development of children and on the clearer interaction between nutrition and behavior.

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