

RELATIONSHIP OF BODY WEIGHT AND HEIGHT TO THE EXPLANATORY FACTORS AMONG PRIMARY SCHOOL CHILDREN IN TAICHUNG CITY, TAIWAN

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This study employed a cross-sectional design to assess the body weight and body height of primary school students and to examine whether certain factors are associated with them. Data were available on 4740 students, 2368 boys and 2372 girls, from eight randomly selected primary school in Taichung city. Some results revealed as follows: (1) The annual gains in body weight and height were statistically significant both in girls and boys. (2) Boys of six, seven and eight years old are taller than girls; on the contrary, girls were significantly taller than boys from the age of 9. (3) Girls were

significantly heavier than boys at the age of 11. However, boys were heavier than girls before that age. (4) The girl and the boy students whose native place are Taiwan province were shorter and lighter than those of other provinces. (4) The girl and the boy students of the first or second birth order were slightly taller and heavier than those of the higher birth order. (5) Other demographic factors, such as: family size, urbanization level, and father's education level, affect the children's weight and height. However, the effect is not obvious and not all statistically significant in each age group.

Keywords: Body Weight, Body Height, Growth and Development

Introduction

The process of body growth and development is one of the most obvious changes from an infant to an adult for human being. There were research papers regarding the measurement of body growth and development in the past (1~7). These measurements such as: height, weight, chest and head circumference can provide us with the judgment of children's conditions in nutrition and health. They can also provide clinicians with a reference of diagnoses and treatments in various related diseases from body development (8~13). Moreover, The status of growth and development among children is an important indicator of the development of a nation.

Individual nutrition has called people's attention and has been improved in Taiwan for more than ten years. It has a great effect on the body growth, development, and health of children. Hence, there was an increasing trend in height and weight for the children in Taiwan (2,3,7). Moreover, children's care has also been improved substantially because of the stable society, blossomed economy, widespread education, increasing incomes, elevating standard of living, and continuous progress of medicine and nursing by the pass of time in Taiwan.

The process of body growth is very complicated, it is affected by many factors such as genetics, race, hormone, nutrition, social-economics, temperature, sunlight, and emotion (2).

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However, only few reports regarding the related factors of children's growth have been published in Taiwan. It is important for us to conduct one such study. Therefore, we conducted this study to evaluate the height, weight, and their associated factors among the children of primary school. The results may provide researchers of investigating children's growth and development with a reference.

Materials and methods

Taichung city is located in the center of Taiwan, there are eight administrative districts: Central Chu, East Chu, West Chu, South Chu, North Chu, West Tun-Chu, South Tun-Chu, and North Tun-Chu. Chu and Tun-Chu are defined as urban and rural area respectively. The total area of Taichung city is 1634,256 kilometers square. It has the convenient traffic, developing trade, and blossomed economy. Its population is increasing dramatically, for example, at the end of 1985 when we conducted our study, the total number of population was 674,936 including 343,587 males and 331,349 females, and the sex ratio of male to female was 1:1.04. In addition, the population density was 49,580.82 people per km².

Research subjects were the one- to six-grade students who were the R.O.C. citizens in primary schools located within the eight districts of Taichung city. The two-stage sampling was adopted. First, the stratified sampling was adopted to randomly select one elementary school within each of eight districts in Taichung City. Then, two classes were randomly selected for each grade in each selected school and all students in each of the selected classes were chosen as a sample of this study. Since 1 Oct 1985 to 27 Oct 1985, the trained nursing students did the measurement and filled the questionnaire. There were 4913 enrolled students, excluded 173 students who were below six years old or can not complete data, total

effective sample were 4740, male 2368 and female 2372. The means and standard deviations for height and weight by age and sex were used to describe the status of weight and height. The t tests were used to compare the difference between boys and girls within each age group and compare the difference between every adjacent age group. Moreover, every associated factor was divided into two levels, and the t tests were used to test the significant difference between those two levels.

Results

1. Means and standard deviations for height and weight by age and sex:

Table 1 shows that there were significant differences in body height and weight between each adjacent age group. In other words, the annual gains in body weight and height were statistically significant both in girls and boys. There were also significant differences in height and weight between boys and girls except those of age groups 7 and 10 in height; 9 and 10 in weight. The pattern of boy-girl differences in stature was inconsistent across age. The boys of six, seven, and eight years old were taller than girls, on the contrary, girls were significantly taller than boys from age 9; The girls were significantly heavier than boys at age 11, on the contrary, the boys were heavier than girls before that age.

2. Body height, body weight, and their associated factors:

(1) Father's Native Place: Table 2 shows that boy students of other provinces were significantly taller and heavier than those of Taiwan province except those of age groups 11 in height; 8 and 11 in weight. Table 2 also shows that girl students of other provinces were significantly taller and heavier than those of Taiwan province except those of age groups 7, 8, and 9 in both height and weight.

(2) Health Status: Health status is divided into two

categories according to the condition of being hospitalized or not. Table 3 indicates that healthy students were not significantly taller or heavier than unhealthy ones. (3) Family Size: Family size is divided into small and large categories using the criteria of the number of generations living together. Table 4 shows that students from small size family were slightly taller and heavier than those from large size family. (4) Birth Order: Table 5 reveals that girl students of the first or second birth order were slightly taller and heavier than those of the higher birth order for all age groups. The similar results were appeared among boy students except those of age group 11 in both height and weight. (5) Urbanization Level: Table 6 shows that students from urban area were slightly taller and heavier than those from rural area. (6) Father's Education Level: The means of body weight and height of boys from high educated father were slightly heavier than those from low educated father for each age groups.

Discussion

The boy and the girl students significantly increased body weight and height year by year from six years old to eleven years old. However, timing and duration of some stages of growth may be different in boy and girl students. As we expect, the inconsistency in boy-girl stature differences across age was found in our study, girls were significantly taller than boys from age 9 and significantly heavier than boys at age 11. A similar pattern was found in other's study (14).

In this study, Taiwanese students were relatively short and light. Although body stature may reflect a lot of factors, the relatively short and light stature of Taiwanese students may has been attributed to genetically determined maturational factors; Birth order also is an important factor related to the birth weight (15). However, little is known on the relationships between birth weight

and further development. This study revealed that birth order had only slightly but not significantly affected on weight and height. The factor of birth order may not a strong one, other factors such as nutrition and medical care might be much important. The growth and development of children will be influenced by the factor of health status (10,11,13). However, It could not be found in this study. Probably, the definition of health status is not clear in this study, measurement error might be an other explanation, moreover, the continuous progress of medical care might dilute the effect of this factor.

Other demographic factors such as family size, urbanization level, and father's education level also affect the children's growth. In Taiwan, when socioeconomic conditions began to improve 20 years ago, It seems that the phenomenon of urbanization brought about a change in life-style which involving family size, nutritional level, and educational level and that it simultaneously influenced growth and development. It is difficult for us to explore the effect individually, moreover, the level of urbanization was not obvious within whole Taichung city. Therefore, the effects of those demographic factors were not obvious, and were not all statistically significant in every age group in this study.

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Table 1: Body weight and height by sex and age

Weight(kg.)		Boys		Girls		
Age groups	Number	Mean	S.D.	Number	Mean	S.D.
6-7b	395	20.82	3.40	398	19.85	2.99
7-8a,b	375	22.67	4.11	413	21.55	3.39
8-9a,b	420	25.56	5.20	423	23.85	4.07
9-10a	415	27.47	5.07	377	27.00	4.99
10-11a	384	31.16	6.92	418	30.81	6.66
11-12a,b	379	33.21	6.66	343	34.83	7.22

Height(cm.)		Boys		Girls		
Age groups	Number	Mean	S.D.	Number	Mean	S.D.
6-7b	395	118.21	5.50	398	116.49	5.19
7-8a	375	122.52	4.99	413	121.95	5.04
8-9a,b	420	127.57	5.43	423	126.20	5.39
9-10a	415	131.95	5.52	377	132.04	6.25
10-11a,b	384	136.67	6.57	418	138.27	7.54
11-12a,b	379	141.76	6.32	343	144.58	6.93

a: Significant difference as compared with the group of one year younger ($P < 0.05$).

b: Significant difference between boys and girls within the same age ($P < 0.05$).

Table 2. Body weight and height by age, sex and race

Weight	Boys					Girls						
		Taiwanese		Others		P		Taiwanese		Others		P
Age	No	Mean ±SD		No	Mean ±SD		No	Mean ±SD		No	Mean ±SD	
6-7	340	20.67 ±3.35		55	21.72 ±3.59	0.034	357	19.72 ±2.85		41	21.00 ±3.86	0.045
7-8	326	22.44 ±3.94		49	24.22 ±4.83	0.017	349	21.44 ±3.38		64	22.19 ±3.39	0.103
8-9	369	25.43 ±5.14		51	26.49 ±5.61	0.172	383	23.84 ±4.08		40	23.95 ±4.09	0.877
9-10	356	27.21 ±5.03		59	28.98 ±5.09	0.013	324	26.98 ±5.01		53	27.11 ±4.94	0.857
10-11	303	30.57 ±6.12		81	33.38 ±9.02	0.009	322	30.08 ±6.18		96	33.26 ±7.61	0.000
11-12	305	32.93 ±6.72		74	34.34 ±6.29	0.101	262	34.04 ±7.36		81	37.36 ±8.47	0.002

Height	Boys					Girls						
		Taiwanese		Others		P		Taiwanese		Others		P
Age	No	Mean ±SD		No	Mean ±SD		No	Mean ±SD		No	Mean ±SD	
6-7	340	117.88 ±5.38		55	120.25 ±5.83	0.003	357	116.34 ±5.13		41	117.87 ±5.54	0.072
7-8	326	122.10 ±4.75		49	125.32 ±5.70	0.000	349	121.79 ±5.10		64	122.86 ±4.65	0.117
8-9	369	127.36 ±5.43		51	129.06 ±5.24	0.036	383	126.14 ±5.36		40	126.78 ±5.75	0.475
9-10	356	131.70 ±5.41		59	133.46 ±5.94	0.023	324	131.84 ±6.03		53	133.24 ±7.37	0.200
10-11	303	136.17 ±6.24		81	138.51 ±7.43	0.011	322	137.41 ±7.27		96	141.16 ±6.95	0.000
11-12	305	141.47 ±6.25		74	142.97 ±6.52	0.066	262	143.96 ±8.90		81	146.60 ±6.68	0.003

Table3. Body weight and height by age, sex and health status

Weight	Boys					Girls				
	Health		Unhealth		P	Health		Unhealth		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD	
6-7	365	20.87 ±3.40	30	20.18 ±3.31	0.287	380	19.87 ±2.98	18	19.53 ±3.25	0.640
7-8	337	22.69 ±3.88	38	22.56 ±5.80	0.890	387	21.53 ±3.40	26	21.81 ±3.30	0.691
8-9	363	25.51 ±5.31	57	25.89 ±4.45	0.600	393	23.80 ±4.09	30	24.23 ±3.87	0.344
9-10	365	27.38 ±4.82	50	28.06 ±6.63	0.489	353	27.12 ±5.00	24	25.23 ±4.60	0.073
10-11	322	30.91 ±6.37	62	32.49 ±9.23	0.199	393	30.86 ±6.67	25	29.98 ±6.64	0.524
11-12	324	32.96 ±6.45	55	34.64 ±7.66	0.085	321	34.73 ±6.95	22	36.20 ±10.50	0.523

Height	Boys					Girls				
	Health		Unhealth		P	Health		Unhealth		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD	
6-7	365	118.30 ±5.55	30	117.34 ±4.81	0.371	380	116.53 ±5.24	18	115.64 ±4.02	0.478
7-8	337	122.59 ±5.00	38	121.89 ±5.06	0.418	387	121.89 ±5.04	26	122.89 ±5.01	0.327
8-9	363	127.50 ±5.50	57	128.01 ±5.00	0.507	393	126.04 ±5.34	30	128.38 ±5.66	0.021
9-10	365	131.99 ±5.40	50	131.64 ±6.38	0.681	353	132.10 ±6.07	24	131.11 ±8.48	0.453
10-11	322	136.51 ±6.22	62	137.48 ±8.16	0.378	393	138.27 ±7.21	25	138.34 ±9.57	0.973
11-12	324	141.61 ±6.43	55	142.69 ±5.58	0.241	321	144.54 ±6.82	22	145.13 ±8.62	0.701

Table 4. Body weight and height by age, sex family size

Weight	Boys					Girls				
	Small family		Others		P	Small family		Others		P
Age	No	Mean \pm SD	No	Mean \pm SD		No	Mean \pm SD	No	Mean \pm SD	
6-7	286	20.93 \pm 3.44	109	20.52 \pm 3.26	0.286	266	19.90 \pm 3.06	132	19.76 \pm 2.85	0.663
7-8	259	22.82 \pm 4.26	116	22.34 \pm 3.74	0.301	285	21.58 \pm 3.46	128	21.49 \pm 3.22	0.798
8-9	290	25.89 \pm 5.29	130	24.82 \pm 4.94	0.052	291	23.89 \pm 4.29	132	23.78 \pm 3.56	0.776
9-10	292	27.50 \pm 4.90	123	27.37 \pm 5.47	0.821	259	27.09 \pm 5.10	118	26.80 \pm 4.74	0.596
10-11	291	30.86 \pm 6.37	93	32.09 \pm 8.39	0.197	311	30.97 \pm 6.65	107	30.32 \pm 6.70	0.381
11-12	288	33.52 \pm 7.06	91	32.22 \pm 5.10	0.056	277	34.89 \pm 7.40	66	34.54 \pm 6.48	0.720

Height	Boys					Girls				
	Small family		Others		P	Small family		Others		P
Age	No	Mean \pm SD	No	Mean \pm SD		No	Mean \pm SD	No	Mean \pm SD	
6-7	286	118.25 \pm 5.56	109	118.10 \pm 5.37	0.807	266	116.68 \pm 5.49	132	116.13 \pm 4.52	0.288
7-8	259	122.77 \pm 5.03	116	121.95 \pm 4.89	0.142	285	122.11 \pm 5.20	128	121.61 \pm 4.66	0.357
8-9	290	127.93 \pm 5.44	130	126.76 \pm 5.34	0.042	291	126.20 \pm 5.49	132	126.21 \pm 5.19	0.980
9-10	292	132.17 \pm 5.52	123	131.42 \pm 5.50	0.212	259	132.42 \pm 6.29	118	131.20 \pm 6.09	0.079
10-11	291	136.61 \pm 6.60	93	136.83 \pm 6.51	0.774	311	138.42 \pm 7.51	107	137.86 \pm 6.91	0.496
11-12	288	141.96 \pm 6.53	91	141.12 \pm 5.60	0.268	277	144.45 \pm 6.97	66	145.15 \pm 9.80	0.458

Table 5. Body weight and height by age, sex and birth order

Weight	Boys					Girls				
	Birth order 1,2		Others		P	Birth order 1,2		Others		P
	No	Mean \pm SD	No	Mean \pm SD		No	Mean \pm SD	No	Mean \pm SD	
6-7	277	21.07 \pm 3.56	118	20.23 \pm 2.89	0.016	264	20.19 \pm 3.26	134	19.18 \pm 2.23	0.000
7-8	274	23.02 \pm 4.44	101	21.74 \pm 2.85	0.001	284	21.80 \pm 3.55	129	21.01 \pm 2.93	0.019
8-9	278	25.49 \pm 5.00	142	25.70 \pm 5.62	0.696	290	24.10 \pm 4.23	133	23.31 \pm 3.66	0.063
9-10	269	27.39 \pm 4.85	146	27.61 \pm 5.46	0.677	241	27.38 \pm 5.18	136	26.33 \pm 4.57	0.051
10-11	249	31.09 \pm 6.44	135	31.29 \pm 7.75	0.796	279	31.15 \pm 6.60	139	30.12 \pm 6.76	0.139
11-12	222	32.94 \pm 6.17	157	33.58 \pm 7.29	0.370	220	34.94 \pm 7.33	123	34.63 \pm 7.05	0.703

Height	Boys					Female				
	Birth order 1,2		Others		P	Birth order 1,2		Others		P
	No	Mean \pm SD	No	Mean \pm SD		No	Mean \pm SD	No	Mean \pm SD	
6-7	277	118.72 \pm 5.65	118	117.00 \pm 4.95	0.004	264	116.97 \pm 5.04	134	115.56 \pm 5.37	0.010
7-8	274	122.84 \pm 5.07	101	121.65 \pm 4.68	0.041	284	122.07 \pm 5.03	129	121.69 \pm 5.06	0.468
8-9	278	127.50 \pm 5.22	142	127.70 \pm 5.83	0.722	290	126.42 \pm 5.30	133	125.74 \pm 5.57	0.229
9-10	269	132.16 \pm 5.46	146	131.56 \pm 5.62	0.290	241	132.56 \pm 6.26	136	131.12 \pm 6.13	0.032
10-11	249	136.86 \pm 6.14	135	136.30 \pm 7.31	0.450	279	138.53 \pm 7.46	139	137.76 \pm 7.14	0.318
11-12	222	141.53 \pm 5.99	157	142.09 \pm 6.76	0.397	220	144.89 \pm 7.00	123	144.03 \pm 6.79	0.268

Table 6. Body weight and height by age, sex and urbanization level

Weight		Boys				Girls					
		City		County		P	City		County		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD		
6-7	241	20.94 ±3.38	154	20.62 ±3.42	0.366	221	24.08 ±2.91	177	19.56 ±3.07	0.082	
7-8	232	22.71 ±4.17	143	22.61 ±4.01	0.810	221	21.91 ±3.71	192	21.14 ±2.93	0.020	
8-9	246	25.96 ±5.74	174	24.99 ±4.28	0.046	214	24.46 ±4.28	209	23.44 ±3.81	0.038	
9-10	232	27.76 ±5.02	183	27.09 ±5.12	0.178	242	27.20 ±5.02	135	26.64 ±4.93	0.299	
10-11	211	32.17 ±7.56	173	29.93 ±5.85	0.001	241	31.67 ±6.46	177	29.63 ±6.77	0.002	
11-12	217	33.89 ±6.99	162	32.29 ±6.08	0.020	221	35.24 ±6.48	122	34.07 ±8.37	0.179	

Height		Boys				Girls					
		City		County		P	City		County		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD		
6-7	241	118.28 ±5.56	154	118.09 ±5.42	0.741	221	116.73 ±5.52	177	116.19 ±4.74	0.296	
7-8	232	122.49 ±4.76	143	122.57 ±5.37	0.873	221	123.05 ±5.23	192	120.69 ±4.50	0.000	
8-9	246	127.94 ±5.74	174	127.04 ±4.92	0.084	214	126.77 ±5.65	209	125.62 ±5.06	0.029	
9-10	232	132.33 ±5.67	183	131.46 ±5.31	0.111	242	132.06 ±6.33	135	132.05 ±6.11	0.988	
10-11	211	137.03 ±6.56	173	136.22 ±6.58	0.234	241	139.14 ±7.63	177	137.10 ±6.82	0.005	
11-12	217	141.93 ±6.21	162	141.54 ±6.48	1.560	221	145.13 ±6.57	122	143.59 ±7.47	0.050	

Table 7. Body weight and height by age, sex and father's educational level

Weight		Boys				Girls					
		Higher		Lower		P	Higher		Lower		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD		
6-7	201	21.12 ±3.57	194	20.50 ±3.19	0.068	201	20.15 ±2.94	197	19.55 ±3.01	0.044	
7-8	186	22.98 ±3.93	189	22.37 ±4.26	0.147	202	22.02 ±3.45	211	21.10 ±3.27	0.005	
8-9	206	26.08 ±5.47	214	25.06 ±4.89	0.046	184	24.12 ±4.31	239	23.65 ±3.87	0.246	
9-10	166	28.32 ±5.60	249	26.90 ±4.60	0.007	159	27.42 ±4.94	218	26.69 ±5.01	0.160	
10-11	164	32.37 ±7.64	220	30.26 ±6.20	0.004	178	31.67 ±6.59	240	30.16 ±6.66	0.022	
11-12	145	34.53 ±7.04	234	32.38 ±6.28	0.002	138	35.05 ±6.72	205	34.67 ±7.55	0.636	

Height		Boys				Girls					
		Higher		Lower		P	Higher		Lower		P
Age	No	Mean ±SD	No	Mean ±SD		No	Mean ±SD	No	Mean ±SD		
6-7	201	118.66 ±5.50	194	117.74 ±5.48	0.096	201	117.18 ±4.92	197	115.79 ±5.40	0.008	
7-8	186	123.26 ±4.84	189	121.78 ±5.04	0.004	202	122.64 ±4.90	211	121.30 ±5.09	0.007	
8-9	206	128.53 ±5.27	214	126.64 ±5.43	0.000	184	126.80 ±5.68	239	125.74 ±5.12	0.046	
9-10	166	132.84 ±5.32	249	131.35 ±5.58	0.007	159	132.95 ±5.96	218	131.37 ±6.38	0.015	
10-11	164	137.58 ±6.79	220	135.98 ±6.33	0.018	178	139.75 ±7.18	240	137.18 ±7.31	0.000	
11-12	145	142.80 ±6.56	234	141.12 ±6.35	0.011	138	145.06 ±6.82	205	144.26 ±7.00	0.292	

台中市國民小學學童身高、體重及其相關因素之研究

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本橫斷研究之目的，為評估國小學童身高、體重的發展，並探討其相關因素。從台中市8區域中的所有小學學校中各隨機抽取1所學校，並從樣本學校各年級中隨機抽取2班，班上所有學童均量其身高及體重，並以問卷獲得相關人口學資料，計得有效問卷4740份，男學童2368份、女學童2372份。研究結果如下：(1)男、女學童身高及體重均隨年齡之增加而顯著增加。(2)就身高而言：6、7、8歲年齡層之男學童身高均比女學童高，但9、10、11歲年齡層之男學童身高卻比女學童矮；就體重而言：10歲以前各年齡層之男學童體重均比女學童重，但11歲年齡層之男學童體重卻比女學童輕。(3)本省籍學童比其他籍貫之學童體重較輕、身高較矮。(4)出生胎次第一、二胎之學童比其他胎次學童身高較高、體重較重。(5)其他人口學因素，諸如：家庭人口數、都市化程度、父、母親教育水準等都會影響學童之身高、體重，但其效果並未達統計顯著水準。

關鍵詞：體重，身高，生長與發育

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