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A SEARCH FOR EFFECTS OF ATOMIC BOMB RADIATION ON THE GROWTH AND DEVELOPMENT OF THE F_1 GENERATION

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SUMMARY

A comparative study to detect possible genetic effects of atomic bomb radiation on the growth and development of offspring of A-bomb survivors was made on a group of junior high school students 12 to 14 years of age born to exposed and to nonexposed parents in Hiroshima using as variables weight, sitting height, and chest circumference.

With data from offspring born to nonexposed parents, a regression analysis was made for the effect of parental age on the weight, sitting height, and chest circumference of the offspring, but no statistically significant relation was observed.

The mean values of weight, sitting height, and chest circumference of offspring of nonexposed parents were compared with those of offspring born to exposed fathers and nonexposed mothers, of exposed mothers and nonexposed fathers, and with those of offspring of parents both exposed. The differences showed no specific tendency and very few of them were statistically significant. Next, the variance values were compared, and some of the differences between the two groups of offspring were statistically significant; in every case the variance of offspring of exposed parents was larger, suggesting a genetic effect due to

要　約

広島の被爆者及び非被爆者から生まれた12歳から14歳までの中学生について体重，座高及び胸囲を変数として用い，原爆放射線が被爆者の子の成長発育に及ぼす遺伝的影響を調べるために比較検討を行った．

両親とも非被爆者である子の資料を用いて，親の年齢が子の体重，座高及び胸囲に及ぼす影響を調べる目的で，回帰分析を試みたが，統計的に有意な関係は認められなかった．

両親とも非被爆の子の体重，座高及び胸囲の平均値を，父被爆・母非被爆，母被爆・父非被爆，及び両親被爆の子のそれぞれの値と比較したが，必ずしも特定の傾向を示すとはいえず，統計的に有意なものはごく一部であった．次に分散値の比較でも両群間の差が統計的有意水準に達するものは一部であったが，いずれも被爆群の子の分散値の方が大きく，原爆放射

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exposure to A-bomb radiation. However, the sample of offspring born to exposed parents is small and the parent-offspring correlation is unknown for want of comparable measurements on the parents.

INTRODUCTION

Because of the great scientific interest in possible genetic effects of A-bomb radiation on the growth and development of offspring of A-bomb survivors in Hiroshima and Nagasaki, extensive studies were made during 1948-53.[1] As a follow-up, the present authors made comparative studies on the stature, weight, sitting height, and chest circumference of senior high school students between the ages of 15 and 17 and on the stature of junior high school students between the ages of 12 and 14 born to exposed and to nonexposed parents, with respect to the mean and variance of the offspring and the covariance and correlation between the parents and offspring.[2-8] We report here a similar analysis of weight, sitting height, and chest circumference for the same junior high school students, aged 12 through 14.

MATERIALS

This analysis concerns weight, sitting height, and chest circumference measurements of an offspring population described previously.[8] Measurements of offspring born to consanguineous parents or those who are twins, adopted children, foreign nationals, or who from birth to the time of this study grew up outside of Hiroshima City were excluded from this analysis.

RESULTS

Effect of Parental Age

To estimate the effect of parental age on the weight, sitting height, and chest circumference of the offspring, the distribution of these variables of offspring born to nonexposed parents was analyzed. The means and variances of weight, sitting height, and chest circumference of the offspring were obtained by sex and age of offspring and mid-age of the parents (father's age + mother's age / 2). The results showed hardly any effect of parental age (Table 1).

For a closer examination of the data, the regression of the mean values of weight, sitting height, and chest circumference of the offspring

線による遺伝的影響とも疑われるが，被爆群の調査例数が少ないこと，及び親の測定資料がないため，親子間の相関を究明することができなかった．

緒　言

広島及び長崎の原爆被爆者の子の身体発育に原爆放射線が及ぼす遺伝的影響の可能性について多大な学術的関心がもたれたことから，広範な調査が1948年から1953年の間に行われた．[1] その追跡調査の一つとして著者らは，既に被爆両親及び非被爆両親から生まれた15歳から17歳までの高校生の身長，体重，座高及び胸囲と，12歳から14歳までの中学生の身長について，その平均値と分散値，更に両親と子との間の共分散及び相関などについて比較検討を行った．[2-8] 今回は同じ対象集団である12歳から14歳までの中学生の体重，座高及び胸囲について同様の分析を試みたので報告する．

資　料

前回と同じ集団[8]における，子の体重，座高及び胸囲について解析を行った．今回の分析でも，両親が近親婚であるもの，また，双生児，養子，外国人，出生から本調査時まで広島市以外の地で成長した者は除外した．

結　果

親の年齢効果

子の体重，座高及び胸囲に及ぼす親の年齢効果を推定するために両親非被爆群の子の測定値のそれぞれの分布状態を検討した．子の体重，座高及び胸囲の平均値と分散値を子の性別，年齢別及び両親の平均年齢（父年齢＋母年齢／2）別に求めた．その結果，親の年齢効果はほとんど認められなかった（表1）．

この点について更に検討するため，両親の平均年齢に対する子の体重，座高及び胸囲の平均値の回帰分

by mid-age of the parents was analyzed. The weights of boys of every age all had a minus sign, otherwise no specific tendency was demonstrated. In every case, however, the differences from zero of the regression coefficients were short of statistical significance (Table 2).

析を試みたが，男の体重ではいずれの年齢でもすべて負の符号をもつが，その他は特定の傾向は認められなかった．しかし，上記いずれの場合も回帰係数の0からの差は統計的有意水準に達しなかった（表2）．

TABLE 1 MEANS AND VARIANCES OF WEIGHT, SITTING HEIGHT, & CHEST CIRCUMFERENCE FOR OFFSPRING BORN TO NONEXPOSED PARENTS BY SEX AND AGE OF OFFSPRING AND MID-AGE OF PARENTS

表1　非被爆両親から生まれた子の体重，座高，及び胸囲の平均値及び分散値，子の性別，年齢別及び親の平均年齢別

Offspring		Item	Total	Mid-Age of Parents				
Sex	Age			30-39	40-44	45-49	50-54	55 +
			WEIGHT					
Male	12	Number	1491	541	618	237	78	17
		Mean	37.8	38.0	37.7	37.4	38.2	36.1
		Variance	51.6	58.5	51.4	40.3	41.9	42.2
	13	Number	1749	466	744	370	138	31
		Mean	42.7	42.4	43.1	42.9	41.7	42.9
		Variance	57.0	57.3	57.1	55.8	52.5	82.8
	14	Number	2091	365	923	535	202	66
		Mean	47.9	47.7	48.1	47.8	47.6	48.6
		Variance	53.9	56.4	53.7	54.2	50.5	50.2
Female	12	Number	1686	582	693	296	93	22
		Mean	39.3	39.6	39.2	38.9	39.5	40.7
		Variance	44.6	47.7	41.8	45.8	43.4	42.7
	13	Number	1938	503	852	410	136	37
		Mean	43.3	43.2	43.1	43.9	43.6	43.3
		Variance	39.9	42.3	37.8	40.4	44.9	30.7
	14	Number	2314	417	996	595	226	80
		Mean	46.7	46.8	46.8	46.5	46.6	46.5
		Variance	40.7	37.3	41.6	38.5	50.1	39.4
			SITTING HEIGHT					
Male	12	Number	1491	541	618	237	78	17
		Mean	78.8	78.9	78.6	78.8	79.4	77.9
		Variance	16.5	18.1	16.8	12.7	15.4	13.8
	13	Number	1749	466	744	370	138	31
		Mean	82.0	81.9	82.2	82.1	81.6	82.5
		Variance	21.2	21.9	21.7	19.3	22.5	15.8
	14	Number	2091	365	923	535	202	66
		Mean	85.5	85.5	85.7	85.3	85.2	85.8
		Variance	17.1	17.4	16.6	18.0	17.0	15.1
Female	12	Number	1686	582	693	296	93	22
		Mean	80.7	80.7	80.7	80.5	80.2	80.7
		Variance	13.9	12.8	14.1	15.9	13.4	11.5
	13	Number	1938	503	852	410	136	37
		Mean	82.7	82.7	82.7	82.8	82.9	83.4
		Variance	10.2	10.3	10.6	9.6	9.6	11.4
	14	Number	2314	417	996	595	226	80
		Mean	84.0	84.2	83.9	84.0	84.1	84.3
		Variance	10.0	9.3	10.6	10.6	7.4	8.6

→

TABLE 1 (Continued 続き)

Offspring Sex	Age	Item	Total	Mid-Age of Parents 30-39	40-44	45-49	50-54	55 +
			CHEST CIRCUMFERENCE					
Male	12	Number	1491	541	618	237	78	17
		Mean	69.9	70.0	69.9	69.8	70.3	68.6
		Variance	29.7	30.2	30.1	30.4	20.6	29.8
	13	Number	1749	466	744	370	138	31
		Mean	73.6	73.1	73.8	74.1	73.2	73.7
		Variance	29.1	29.3	29.5	27.8	26.2	38.0
	14	Number	2091	365	923	535	202	66
		Mean	77.0	76.9	77.2	77.0	76.6	77.1
		Variance	27.4	27.6	28.4	25.8	28.6	21.9
Female	12	Number	1686	582	693	296	93	22
		Mean	71.8	72.0	71.5	71.6	72.2	73.9
		Variance	35.2	35.5	34.2	34.9	40.2	36.3
	13	Number	1938	503	852	410	136	37
		Mean	74.8	74.8	74.6	75.0	75.3	74.6
		Variance	29.4	28.9	29.4	30.8	30.5	18.1
	14	Number	2314	417	996	595	226	80
		Mean	77.3	77.3	77.4	77.1	77.0	77.2
		Variance	26.8	26.0	27.2	26.8	26.8	26.4

TABLE 2 REGRESSION COEFFICIENT FOR MEAN OF WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF OFFSPRING BORN TO NONEXPOSED PARENTS BY SEX AND AGE OF OFFSPRING

表2 非被爆両親から生まれた子の体重，座高，及び胸囲の平均値に対する回帰係数，子の性別及び年齢別

Age of Offspring	Male Constant (1)	Male Slope (2)	Male Test (2) (d.f.=3)		Female Constant (1)	Female Slope (2)	Female Test (2) (d.f.=3)	
			Weight					
12	39.3	−.03738	1.11	N.S.	40.2	−.02097	.51	N.S.
13	43.5	−.01728	.32	N.S.	41.6	.04056	1.32	N.S.
14	47.9	−.00010	.00	N.S.	47.6	−.02195	1.78	N.S.
			Sitting Height					
12	78.7	.00094	.04	N.S.	81.6	−.02393	2.20	N.S.
13	81.9	.00426	.19	N.S.	81.8	.02186	2.44	N.S.
14	86.2	−.01658	.78	N.S.	83.9	.00189	.12	N.S.
			Chest Circumference					
12	70.3	−.00802	.34	N.S.	71.6	.00304	.06	N.S.
13	72.0	.03732	.79	N.S.	73.9	.02058	.93	N.S.
14	77.6	−.01317	.72	N.S.	78.4	−.02670	2.20	N.S.

Comparison of the Means and Variances of Weight, Sitting height, and Chest Circumference between the Offspring of Nonexposed Parents and those with both Parents or One Parent Exposed

Test of Differences between Offspring of Non-

両親とも非被爆の子と両親あるいは片親のみ被爆の子との体重，座高及び胸囲の平均値と分散値の比較

両親とも非被爆の子と片親のみ被爆の子との差の

exposed Parents and those with One Parent Exposed. Although the offspring of exposed parents should be compared with those of nonexposed parents by parental exposure dose in this analysis, owing to the paucity of data, the comparison was made by dividing the offspring of exposed parents by parental exposure dose into those born to parents exposed to 1 rad or more and those born to parents exposed to less than 1 rad. The results are shown in Tables 3-4.

Nonexposed Father × Exposed Mother. In case of maternal exposure to 1 rad or more, the means of weight of offspring of this group compared with those of offspring of nonexposed parents showed small differences for both boys and girls, all of which were short of statistical significance. Variance of weight of offspring of this group, likewise compared, showed the value of 13-year-old girls to be larger than that of offspring of nonexposed parents and the difference to be statistically significant at the 5% level, but no other differences showed any specific tendency and were not statistically significant. In the case of maternal exposure to less than 1 rad, the mean values of weight compared with those of offspring of nonexposed parents showed for both boys and girls of every age differences which were not statistically significant. Variance of weight of offspring of this group, similarly compared, showed the value of 13-year-old girls to be smaller and the difference statistically significant at the level of 5%, and the value of 14-year-old girls to be larger and the difference statistically significant at the 1% level, but the other differences were all small and not significant.

Next, in case of maternal exposure to 1 rad or more the mean sitting height of 14-year-old boys of this group was smaller than that of the offspring of nonexposed parents and the difference was statistically significant at the 5% level, but the other differences between the two groups of offspring were remarkably small and again not significant. Variances of sitting height of 14-year-old boys and 12-year-old girls of this group were larger than those of the offspring of nonexposed parents, and the differences were all significant at the 5% level, but the other differences were not. In case of maternal exposure to less than 1 rad, the mean sitting height of 14-year-old boys was larger than that of offspring of nonexposed parents and the difference was statistically significant at the 5% level. Other-

検定: この解析は，被爆群と非被爆群を親の被曝線量別に比較すべきであるが，被爆群の資料が少ないため，本研究では被爆群を親の被曝線量別に 1 rad 以上群と 1 rad 未満群に分けて非被爆群と比較した．その結果を表 3 と表 4 に示す．

父非被爆×母被爆. 父非被爆・母被爆群と両親非被爆群の子の比較で，1 rad 以上群の場合の被爆群と非被爆群に比べ男女とも体重の平均値の差は小さく，いずれも統計的有意水準に達しなかった．体重の分散値は13歳女で被爆群の方が非被爆群に比べ大きく，その差は5％水準で統計的に有意であるが，その他は特定の傾向を示さず，統計的有意水準に達しなかった．1 rad 未満群の場合の被爆群と非被爆群の子の体重の平均値との比較では男女ともいずれの年齢においてもその差は統計的有意水準に達しない．体重の分散値は被爆群の子の方が非被爆群の子に比べ，13歳女では小さく，その差は5％水準で統計的に有意であり，14歳女では大きく，その差は1％水準で統計的に有意であったが，その他はいずれもその差は小さく，統計的有意水準に達しない．

次に座高を比較すると，1 rad 以上群の場合の14歳男の座高の平均値は非被爆群のそれに比べ小さく，その差は5％水準で統計的に有意である．その他の両群間の差は著しく小さく，いずれも統計的有意水準に達しない．座高の分散値は被爆群の14歳男と12歳女は非被爆群のそれに比べて大きく，その差はいずれも5％水準で統計的に有意であった．その他では統計的有意水準に達するものはなかった．

TABLE 3 COMPARISON OF MEANS AND VARIANCES OF WEIGHT, SITTING HEIGHT, & CHEST CIRCUMFERENCE OF OFFSPRING BORN TO NONEXPOSED FATHER AND EXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表3 父非被爆・母被爆の子と両親とも非被爆の子の体重，座高，及び胸囲の平均値及び分散値の比較

Offspring Sex	Offspring Age	Item	Parental Exposure: Father→	Nonexp.	Nonexp.	Test	Nonexp.	Test
			Mother→	Nonexp. (1)	<1 rad (2)	(1) : (2)	1 or more rad (3)	(1) : (3)
				WEIGHT				
Male	12	Number		1491	169		113	
		Mean		37.75	36.94	1.37 N.S.	36.92	1.35 N.S.
		Variance		51.57	53.08	1.03 N.S.	38.53	.75 N.S.
	13	Number		1749	233		125	
		Mean		42.74	43.12	.73 N.S.	43.60	1.29 N.S.
		Variance		57.01	56.01	.98 N.S.	51.71	.91 N.S.
	14	Number		2091	275		156	
		Mean		47.92	48.50	1.17 N.S.	47.68	.37 N.S.
		Variance		53.86	60.87	1.13 N.S.	60.16	1.12 N.S.
Female	12	Number		1686	199		115	
		Mean		39.30	39.13	.35 N.S.	38.69	.94 N.S.
		Variance		44.65	43.02	.96 N.S.	45.30	1.03 N.S.
	13	Number		1938	239		154	
		Mean		43.34	43.82	1.01 N.S.	43.52	.31 N.S.
		Variance		39.91	49.24	1.23 P<.05	48.34	1.21 P<.05
	14	Number		2314	311		177	
		Mean		46.67	47.01	.78 N.S.	45.93	1.52 N.S.
		Variance		40.73	53.07	1.30 P<.01	38.95	.96 N.S.
				SITTING HEIGHT				
Male	12	Number		1491	169		113	
		Mean		78.76	78.26	1.30 N.S.	78.27	1.29 N.S.
		Variance		16.53	23.09	1.40 P<.05	15.00	.91 N.S.
	13	Number		1749	233		125	
		Mean		82.03	82.44	1.23 N.S.	82.52	1.29 N.S.
		Variance		21.18	23.22	1.10 N.S.	16.59	.78 N.S.
	14	Number		2091	275		156	
		Mean		85.50	86.07	2.01 P<.05	84.70	2.12 P<.05
		Variance		17.09	18.99	1.11 N.S.	20.90	1.22 P<.05
Female	12	Number		1686	199		115	
		Mean		80.65	80.47	.66 N.S.	80.57	.20 N.S.
		Variance		13.89	13.08	.94 N.S.	16.95	1.22 P<.05
	13	Number		1938	239		154	
		Mean		82.73	82.84	.47 N.S.	82.88	.52 N.S.
		Variance		10.24	11.75	1.15 N.S.	11.79	1.15 N.S.
	14	Number		2314	311		177	
		Mean		84.01	83.79	1.05 N.S.	83.90	.51 N.S.
		Variance		9.99	12.41	1.24 P<.05	7.64	.76 N.S.
				CHEST CIRCUMFERENCE				
Male	12	Number		1491	169		113	
		Mean		69.91	69.73	.41 N.S.	69.50	.86 N.S.
		Variance		29.66	28.98	.98 N.S.	23.20	.78 N.S.
	13	Number		1749	233		125	
		Mean		73.64	73.88	.60 N.S.	73.79	.31 N.S.
		Variance		29.07	32.87	1.13 N.S.	27.74	.95 N.S.

→

TABLE 3 (Continued 続き)

Offspring Sex	Age	Item	Parental Exposure: Father→ Nonexp. / Mother→ Nonexp. (1)	Nonexp. < 1 rad (2)	Test (1) : (2)	Nonexp. 1 or more rad (3)	Test (1) : (3)
	14	Number	2091	275		156	
		Mean	77.02	77.72	1.97 P<.05	76.62	.91 N.S.
		Variance	27.40	31.28	1.14 N.S.	28.32	1.03 N.S.
Female	12	Number	1686	199		115	
		Mean	71.75	71.45	.62 N.S.	71.17	1.08 N.S.
		Variance	35.20	42.00	1.19 P<.05	30.93	.88 N.S.
	13	Number	1938	239		154	
		Mean	74.78	75.44	1.70 Sugg.	74.63	.28 N.S.
		Variance	29.42	32.55	1.11 N.S.	40.65	1.38 P<.01
	14	Number	2314	311		177	
		Mean	77.25	77.20	.15 N.S.	76.80	1.12 N.S.
		Variance	26.80	33.06	1.23 P<.05	26.59	.99 N.S.

wise, the differences between the two groups of offspring were remarkably small and none were statistically significant. Comparison of the variances of sitting height showed the values for 12-year-old boys and 14-year-old girls born to nonexposed fathers and exposed mothers to be larger than those of offspring born to nonexposed parents and the differences to be statistically significant at the 5% level. Other differences between the two groups of offspring were not significant.

Comparison of chest circumference showed, in case of maternal exposure to 1 rad or more, the means for boys and girls of every age to differ remarkably little from those of offspring of nonexposed parents and the differences to be nonsignificant. The variance of chest circumference of 13-year-old girls born to nonexposed fathers and exposed mothers was larger than that of offspring of nonexposed parents and the difference was statistically significant at the 1% level. Other differences were not remarkable. In case of maternal exposure to less than 1 rad, the mean chest circumference of 14-year-old boys was larger than that of offspring of nonexposed parents and the difference was statistically significant at the 5% level, but the other differences were short of statistical significance. Comparison of the variances of chest circumference showed the values for 12-year-old and 14-year-old girls to be larger than those of the offspring born to nonexposed parents and the differences statistically significant at the 5% level, but the other differences were not significant.

1 rad未満群の場合の14歳男の座高の平均値は非被爆群のそれに比べて大きく，その差は5％水準で統計的に有意である．その他の両群間の差は著しく小さく，統計的有意水準に達しなかった．座高の分散値の比較では被爆群の12歳男，14歳女では非被爆群のそれに比べて大きく，その差はいずれも5％水準で統計的に有意であったが，その他の両群間の差は統計的有意水準に達しなかった．

また，胸囲の比較では，1 rad以上群の場合の被爆群と非被爆群の子の胸囲の平均値との差は男女ともいずれの年齢においても著しく小さく，統計的有意水準に達しない．胸囲の分散値は被爆群の13歳女では非被爆群のそれに比べて大きく，その差は1％水準で統計的に有意であった．その他は統計的有意水準に達しなかった．1 rad未満群の場合の被爆群の14歳男の胸囲の平均値は非被爆群のそれに比べて大きく，その差は5％水準で統計的に有意であったが，その他は統計的有意水準に達しなかった．胸囲の分散値は被爆群の12歳女，14歳女が非被爆群に比べて大きく，その差はいずれも5％水準で統計的に有意であったが，その他は統計的有意水準に達しなかった．

TABLE 4 COMPARISON OF MEAN AND VARIANCE OF WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF OFFSPRING BORN TO EXPOSED FATHER AND NONEXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表4　父被爆・母非被爆の子と両親とも非被爆の子の体重，座高，及び胸囲の平均値及び分散値の比較

Offspring		Item	Parental Exposure						
			Father→	Nonexp.	< 1 rad	Test	1 or more rad	Test	
Sex	Age		Mother→	Nonexp. (1)	Nonexp. (2)	(1):(2)	Nonexp. (3)	(1):(3)	
				WEIGHT					
Male	12	Number		1491	88		22		
		Mean		37.75	39.14	1.45 N.S.	35.41	1.81	Sugg.
		Variance		51.57	78.14	1.52 P < .01	36.12	.70	N.S.
	13	Number		1749	81		38		
		Mean		42.74	41.63	1.21 N.S.	41.31	1.10	N.S.
		Variance		57.01	65.46	1.15 N.S.	62.97	1.10	N.S.
	14	Number		2091	112		40		
		Mean		47.92	46.68	2.06 P < .05	49.50	1.38	N.S.
		Variance		53.86	37.54	.70 N.S.	51.82	.96	N.S.
Female	12	Number		1686	88		37		
		Mean		39.30	37.99	1.78 Sugg.	40.31	.87	N.S.
		Variance		44.65	45.41	1.02 N.S.	48.89	1.10	N.S.
	13	Number		1938	101		41		
		Mean		43.34	45.31	2.77 P < .01	44.08	.65	N.S.
		Variance		39.91	48.97	1.23 N.S.	52.83	1.32	N.S.
	14	Number		2314	138		52		
		Mean		46.67	46.58	.15 N.S.	47.26	.70	N.S.
		Variance		40.73	49.44	1.21 N.S.	35.99	.88	N.S.
				SITTING HEIGHT					
Male	12	Number		1491	88		22		
		Mean		78.76	79.33	1.07 N.S.	77.65	1.32	N.S.
		Variance		16.53	23.88	1.44 P < .01	15.32	.93	N.S.
	13	Number		1749	81		38		
		Mean		82.03	81.88	.27 N.S.	81.24	1.03	N.S.
		Variance		21.18	24.81	1.17 N.S.	21.70	1.02	N.S.
	14	Number		2091	112		40		
		Mean		85.50	85.65	.41 N.S.	85.88	.53	N.S.
		Variance		17.09	14.29	.84 N.S.	20.02	1.17	N.S.
Female	12	Number		1686	88		37		
		Mean		80.65	79.96	1.55 N.S.	80.78	.26	N.S.
		Variance		13.89	16.65	1.20 N.S.	8.86	.64	N.S.
	13	Number		1938	101		41		
		Mean		82.73	82.98	.69 N.S.	82.87	.23	N.S.
		Variance		10.24	12.69	1.24 N.S.	14.45	1.41	P < .05
	14	Number		2314	138		52		
		Mean		84.01	84.03	.08 N.S.	84.47	1.23	N.S.
		Variance		9.99	7.90	.79 N.S.	7.05	.71	N.S.
				CHEST CIRCUMFERENCE					
Male	12	Number		1491	88		22		
		Mean		69.91	70.72	1.29 N.S.	68.29	1.94	Sugg.
		Variance		29.66	33.09	1.12 N.S.	14.91	.50	N.S.
	13	Number		1749	81		38		
		Mean		73.64	72.87	1.32 N.S.	72.50	1.24	N.S.
		Variance		29.07	26.41	.91 N.S.	31.60	1.09	N.S.

→

TABLE 4 (Continued 続き)

Offspring Sex	Age	Item	Parental Exposure: Father→	Nonexp.	< 1 rad	Test		1 or more rad	Test	
			Mother→	Nonexp. (1)	Nonexp. (2)	(1) : (2)		Nonexp. (3)	(1) : (3)	
	14	Number		2091	112			40		
		Mean		77.02	76.48	1.22	N.S.	78.30	1.46	N.S.
		Variance		27.40	20.49	.75	N.S.	30.44	1.11	N.S.
Female	12	Number		1686	88			37		
		Mean		71.75	70.95	1.35	N.S.	72.70	1.03	N.S.
		Variance		35.20	28.97	.82	N.S.	30.51	.87	N.S.
	13	Number		1938	101			41		
		Mean		74.78	76.30	2.33	P<.05	75.29	.53	N.S.
		Variance		29.42	41.31	1.40	P<.01	37.09	1.26	N.S.
	14	Number		2314	138			52		
		Mean		77.25	76.86	.82	N.S.	77.88	.81	N.S.
		Variance		26.80	29.78	1.11	N.S.	31.14	1.16	N.S.

Exposed Father X Nonexposed Mother. Comparison of mean and variance of weight of offspring born to fathers exposed to 1 rad or more and nonexposed mothers with those of offspring born to nonexposed parents showed no significant differences between boys or girls of any age. The mean weight of offspring born to fathers exposed to less than 1 rad, and nonexposed mothers was, compared with that of offspring born to nonexposed parents, smaller in 14-year-old boys and the difference was statistically significant at the 5% level, and larger in 13-year-old girls and the difference was statistically significant at the 1% level. Other differences were not remarkable. Variance of weight of 12-year-old boys born to exposed fathers and nonexposed mothers was larger than that of offspring born to nonexposed parents and the difference was statistically significant at the 1% level, but the other differences were not significant.

Next, comparison of sitting height between offspring born to exposed fathers and nonexposed mothers and offspring born to nonexposed parents showed, in case of paternal exposure to 1 rad or more, the differences of mean values between the two groups of offspring to be short of the statistically significant level for both boys and girls of every age. Variance of sitting height of 13-year-old girls born to exposed fathers and nonexposed mothers was larger than that of offspring born to nonexposed parents and the difference was statistically significant at the

父被爆×母非被爆. 父被爆・母非被爆群と両親非被爆群の子を比較すると，1 rad 以上群の場合の被爆群と非被爆群の子の体重の平均値及び分散値は男女ともいずれの年齢においてもその差は統計的有意水準に達しなかった．1 rad 未満群の場合，被爆群の子の体重の平均値は非被爆群のそれと比べ，14歳男児では小さくその差は5％水準で有意であり，13歳女では大きくその差は1％水準で統計的に有意であった．その他は顕著な傾向を認めなかった．体重の分散値では，被爆群の12歳男が非被爆群に比べて大きく，その差は1％水準で統計的に有意であるが，その他は統計的有意水準に達しなかった．

次に座高を比較すると，1 rad 以上群の場合の被爆群と非被爆群の子の座高の平均値では男女ともいずれの年齢においても両群間の差は統計的有意水準に達しなかった．座高の分散値は被爆群の13歳女が非被爆群に比べて大きく，その差は5％水準で統計的に有意であったが，その他は統計的有意水準に達しなかった．1 rad 未満群の場合の被爆群の子の

5% level; no other difference was significant. Comparison of mean sitting height between offspring born to fathers exposed to less than 1 rad, and nonexposed mothers and offspring born to nonexposed parents revealed no significant differences. Variance of sitting height of 12-year-old boys born to exposed fathers and nonexposed mothers was significantly larger (1%) than that of offspring born to nonexposed parents. The other differences were not statistically significant.

The differences in the means and variances of chest circumference between offspring born to fathers exposed to 1 rad or more and nonexposed mothers and offspring born to nonexposed parents were short of statistical significance for both boys and girls of every age. In case of paternal exposure to less than 1 rad, both mean and variance of chest circumference demonstrated no specific tendency, but in 13-year-old girls born to exposed fathers and nonexposed mothers the mean was larger compared with that of offspring born to nonexposed parents and the difference statistically significant at the 5% level and the variance was also significantly larger (1%). Other differences were not significant.

Comparison between Offspring of Nonexposed Parents and Offspring with both Parents Exposed

The means and variances of weight, sitting height, and chest circumference were obtained for offspring of nonexposed parents and offspring of exposed parents by combined dose of both parents and by sex and age of the offspring (Table 5).

Comparison of Means and Variances

The values of offspring of exposed parents, divided into those born to parents exposed to 1 rad or more and to parents exposed to less than 1 rad by combined exposure dose of the parents were compared with the values of offspring of nonexposed parents (Table 6).

Comparison of the mean values of weight, sitting height, and chest circumference between offspring of parents exposed to 1 rad or more and offspring of nonexposed parents showed the values of 12-year-old boys born to exposed parents to be smaller than those of the offspring of nonexposed parents and the differences to be statistically significant at the 5% level. Other-

座高の平均値は非被爆群との間の差では男女ともいずれの年齢群においても統計的有意水準に達しなかった．座高の分散値は12歳男で被爆群の方が非被爆群に比べて大きく，その差は1％水準で統計的に有意であった．その他はいずれも統計的有意水準に達しなかった．

また，胸囲を比較すると，1 rad以上群の場合の被爆群と非被爆群の胸囲の平均値及び分散値は男女ともいずれの年齢においてもその差は統計的有意水準に達しなかった．1 rad未満群の場合，胸囲の平均値及び分散値とも特定の傾向は示さないが，被爆群の13歳女では非被爆者のそれに比べ，胸囲の平均値では大きくその差は5％水準で有意であり，胸囲の分散値でも大きくその差は1％水準で統計的に有意であったが，その他は統計的有意水準に達しなかった．

両親とも非被爆の子と両親とも被爆の子との比較

両親とも非被爆者及び両親とも被爆者の子の体重，座高及び胸囲の平均値と分散値を両親の相加線量別，子の性別，年齢別に求めた（表5）．

平均値と分散値の比較

両親の相加線量別に1 rad以上群と1 rad未満群に分けて，それぞれ非被爆両親の子と比較した（表6）．

まず，1 rad以上群と非被爆群の子の体重，座高及び胸囲の平均値の比較を行うと，被爆群の12歳男では，体重，座高及び胸囲の平均値とも非被爆群のそれに比べて小さく，その差はいずれも5％水準で統計的に有意であった．しかし，その他は男女とも

TABLE 5 MEANS AND VARIANCES OF WEIGHT, SITTING HEIGHT, & CHEST CIRCUMFERENCE BY COMBINED EXPOSURE DOSE OF PARENTS

表 5　両親の相加線量別の体重，座高，及び胸囲の平均値及び分散値

Offspring		Item	Non-exposed	Radiation Dose in rad							
Sex	Age			< 1	1-9	10-19	20-39	40-99	100-199	200+	1 or more rad
				WEIGHT							
Male	12	Number	1491	226	37	53	23	33	15	22	183
		Mean dose	0.00	0.00	4.71	14.43	27.00	67.18	129.25	644.00	107.48
		Mean	37.75	37.56	34.94	37.67	36.30	37.94	34.51	36.07	36.54
		Variance	51.57	60.99	33.56	41.05	50.07	45.75	17.63	89.08	45.72
	13	Number	1749	273	74	46	29	32	20	22	223
		Mean dose	0.00	0.00	4.80	14.11	27.69	63.13	141.85	382.55	67.07
		Mean	42.74	42.82	41.45	43.67	40.72	42.71	43.48	45.50	42.58
		Variance	57.01	60.90	52.53	53.43	71.49	51.50	45.62	139.38	63.44
	14	Number	2091	336	79	64	38	46	28	28	283
		Mean dose	0.00	0.00	4.99	14.66	27.18	61.60	141.04	400.62	72.87
		Mean	47.92	48.13	48.61	47.16	47.12	48.57	48.48	46.90	47.89
		Variance	53.86	56.31	60.44	70.33	44.09	43.60	28.08	91.03	57.13
Female	12	Number	1686	246	64	37	21	43	19	19	203
		Mean dose	0.00	0.00	4.85	13.92	29.81	64.42	135.53	486.95	80.65
		Mean	39.30	38.94	38.81	40.35	38.75	38.83	38.14	38.83	39.03
		Variance	44.65	44.35	36.25	67.06	47.17	37.24	37.91	28.97	42.06
	13	Number	1938	291	88	53	31	40	19	26	257
		Mean dose	0.00	0.00	5.02	14.11	28.19	64.05	135.58	467.31	75.26
		Mean	43.34	44.00	44.27	42.72	43.25	43.77	43.41	44.41	43.70
		Variance	39.91	49.92	49.81	53.90	35.20	49.17	80.01	39.39	49.36
	14	Number	2314	376	88	59	39	61	33	38	318
		Mean dose	0.00	0.00	5.38	15.02	29.69	63.10	139.12	489.21	92.13
		Mean	46.67	47.13	46.65	46.95	46.43	46.21	47.23	47.81	46.79
		Variance	40.73	52.61	47.93	37.25	43.16	42.35	41.11	44.67	42.76
				SITTING HEIGHT							
Male	12	Number	1491	226	37	53	23	33	15	22	183
		Mean dose	0.00	0.00	4.71	14.43	27.00	67.18	129.25	644.00	107.48
		Mean	78.76	78.52	77.09	78.80	77.51	78.85	77.28	78.10	78.09
		Variance	16.53	23.23	11.65	12.01	22.57	20.06	8.29	28.20	16.43
	13	Number	1749	273	74	46	29	32	20	22	223
		Mean dose	0.00	0.00	4.80	14.11	27.69	63.13	141.85	382.55	67.07
		Mean	82.03	82.31	81.40	82.17	80.32	82.91	82.27	81.91	81.77
		Variance	21.18	24.19	27.81	19.58	16.73	18.51	17.11	17.52	21.50
	14	Number	2091	336	79	64	38	46	28	28	283
		Mean dose	0.00	0.00	4.99	14.66	27.18	61.60	141.04	400.62	72.87
		Mean	85.50	85.99	85.14	84.42	85.36	85.35	85.64	84.86	85.06
		Variance	17.09	17.91	25.60	15.43	17.25	25.34	11.18	21.87	20.16
Female	12	Number	1686	246	64	37	21	43	19	19	203
		Mean dose	0.00	0.00	4.85	13.92	29.81	64.42	135.53	486.95	80.65
		Mean	80.65	80.36	80.83	80.86	80.48	79.89	81.34	80.79	80.64
		Variance	13.89	14.13	13.21	15.07	23.59	14.54	12.94	9.46	14.35
	13	Number	1938	291	88	53	31	40	19	26	257
		Mean dose	0.00	0.00	5.02	14.11	28.19	64.05	135.58	467.31	75.26
		Mean	82.73	82.75	83.12	82.26	82.35	82.87	82.85	83.42	82.82
		Variance	10.24	12.06	11.93	13.98	14.18	12.05	14.04	9.94	12.51
	14	Number	2314	376	88	59	39	61	33	38	318
		Mean dose	0.00	0.00	5.38	15.02	29.69	63.10	139.12	489.21	92.13
		Mean	84.01	83.90	84.11	84.53	84.06	83.99	84.23	85.08	84.29
		Variance	9.99	11.46	6.50	7.59	10.18	11.39	6.72	9.14	8.41

→

TABLE 5 (Continued 続き)

Offspring Sex	Age	Item	Non-exposed	Radiation Dose in rad < 1	1-9	10-19	20-39	40-99	100-199	200+	1 or more rad
				CHEST CIRCUMFERENCE							
Male	12	Number	1491	226	37	53	23	33	15	22	183
		Mean dose	0.00	0.00	4.71	14.43	27.00	67.18	129.25	644.00	107.48
		Mean	69.91	69.92	67.94	70.02	69.23	69.18	69.37	68.33	69.09
		Variance	29.66	30.29	24.77	25.19	27.36	26.26	14.17	33.48	25.58
	13	Number	1749	273	74	46	29	32	20	22	223
		Mean dose	0.00	0.00	4.80	14.11	27.69	63.13	141.85	382.55	67.07
		Mean	73.64	73.72	72.59	74.30	72.25	72.41	73.93	73.57	73.09
		Variance	29.07	33.23	27.26	25.10	44.06	34.72	15.02	28.00	29.03
	14	Number	2091	336	79	64	38	46	28	28	283
		Mean dose	0.00	0.00	4.99	14.66	27.18	61.60	141.04	400.62	72.87
		Mean	77.02	77.49	77.66	76.62	76.04	76.87	77.40	76.11	76.90
		Variance	27.40	28.78	25.53	38.74	29.62	23.10	21.53	37.08	29.27
Female	12	Number	1686	246	64	37	21	43	19	19	203
		Mean dose	0.00	0.00	4.85	13.92	29.81	64.42	135.53	486.95	80.65
		Mean	71.75	71.37	70.91	72.92	71.90	71.89	70.06	70.98	71.51
		Variance	35.20	38.81	25.25	44.35	21.31	30.97	15.18	24.29	28.60
	13	Number	1938	291	88	53	31	40	19	26	257
		Mean dose	0.00	0.00	5.02	14.11	28.19	64.05	135.58	467.31	75.26
		Mean	74.78	75.46	75.12	74.11	75.05	75.21	74.52	74.95	74.85
		Variance	29.42	35.86	46.04	34.64	22.61	37.41	45.69	27.86	37.14
	14	Number	2314	376	88	59	39	61	33	38	318
		Mean dose	0.00	0.00	5.38	15.02	29.69	63.10	139.12	489.21	92.13
		Mean	77.25	77.39	77.52	77.30	77.10	76.97	77.13	78.21	77.37
		Variance	26.80	33.40	33.36	26.72	28.65	27.29	21.47	34.89	29.02

wise, however, the differences between the two groups of offspring were, for both boys and girls, very small and not statistically significant.

Comparison of the variances for weight, sitting height, and chest circumference of the offspring of exposed parents with those of the offspring of nonexposed parents showed the variances of weight of 13-year-old girls, of sitting height of 13-year-old girls and 14-year-old boys, and of chest circumference of 13-year-old girls to be larger and the differences statistically significant at the 5% level, but the other differences were not remarkable.

Comparison of the means of weight, sitting height, and chest circumference between offspring of parents exposed to less than 1 rad and offspring of nonexposed parents showed the mean of sitting height of 14-year-old boys born to exposed parents to be somewhat larger than that of the offspring of nonexposed parents and the difference statistically significant at the 5% level, but otherwise the differences were very

両群間の差は極めて小さく，いずれも統計的有意水準に達しなかった．

また，被爆群の子の体重，座高及び胸囲の分散値は非被爆群のそれに比べ，13歳女の体重，13歳女と14歳男の座高及び13歳女の胸囲の分散値が大きく，その差はいずれも5％水準で統計的に有意であったが，その他は顕著ではなかった．

次に，1 rad未満群と非被爆群の子の体重，座高及び胸囲の平均値を比較すると，被爆群の14歳男の座高の平均値は非被爆群のそれに比べてやや大きく，その差は5％水準で統計的に有意であったが，その他は両群間の差は極めて小さく，統計的有意水準に

TABLE 6 COMPARISON OF MEANS & VARIANCES FOR NONEXPOSED PARENTS VS <1 RAD PARENTS AND NONEXPOSED PARENTS VS 1 OR MORE RAD PARENTS

表6　両親とも非被爆の子と両親の相加線量が1 rad未満の子，及び両親とも非被爆の子と両親の相加線量が1 rad以上の子の各測定平均値及び分散値の比較

Offspring		Nonexposed vs < 1 rad				Nonexposed vs 1 or more rad			
Sex	Age	Nonexp.	<1 rad	Test		Nonexp.	1 or more rad	Test	
				MEANS					
				Weight					
Male	12	37.75	37.56	.34	N.S.	37.75	36.54	2.27	P<.05
	13	42.74	42.82	.16	N.S.	42.74	42.58	.28	N.S.
	14	47.92	48.13	.50	N.S.	47.92	47.89	.06	N.S.
Female	12	39.30	38.94	.79	N.S.	39.30	39.03	.56	N.S.
	13	43.34	44.00	1.51	N.S.	43.34	43.70	.78	N.S.
	14	46.67	47.13	1.16	N.S.	46.67	46.79	.31	N.S.
				Sitting Height					
Male	12	78.76	78.52	.71	N.S.	78.76	78.09	2.11	P<.05
	13	82.03	82.31	.88	N.S.	82.03	81.77	.79	N.S.
	14	85.50	85.99	1.98	P<.05	85.50	85.06	1.56	N.S.
Female	12	80.65	80.36	1.13	N.S.	80.65	80.64	.04	N.S.
	13	82.73	82.95	.09	N.S.	82.73	82.82	.39	N.S.
	14	84.01	83.90	.59	N.S.	84.01	84.29	1.60	N.S.
				Chest Circumference					
Male	12	69.91	69.92	.03	N.S.	69.91	69.09	2.05	P<.05
	13	73.64	73.72	.22	N.S.	73.64	73.09	1.44	N.S.
	14	77.02	77.49	1.50	N.S.	77.02	76.90	.35	N.S.
Female	12	71.75	71.37	.90	N.S.	71.75	71.51	.60	N.S.
	13	74.78	75.46	1.83	Sugg.	74.78	74.85	.18	N.S.
	14	77.25	77.39	.44	N.S.	77.25	77.37	.37	N.S.
				VARIANCES					
				Weight					
Male	12	51.57	60.99	1.18	P<.05	51.57	45.72	.89	N.S.
	13	57.01	60.90	1.07	N.S.	57.01	63.44	1.11	N.S.
	14	53.86	56.31	1.05	N.S.	53.86	57.13	1.06	N.S.
Female	12	44.65	44.35	.99	N.S.	44.65	42.06	.94	N.S.
	13	39.91	49.92	1.25	P<.01	39.91	49.36	1.24	P<.05
	14	40.73	52.61	1.29	P<.01	40.73	42.76	1.05	N.S.
				Sitting Height					
Male	12	16.53	23.23	1.41	P<.01	16.53	16.43	.99	N.S.
	13	21.18	24.19	1.14	N.S.	21.18	21.50	1.02	N.S.
	14	17.09	17.91	1.05	N.S.	17.09	20.16	1.18	P<.05
Female	12	13.89	14.13	1.02	N.S.	13.89	14.35	1.03	N.S.
	13	10.24	12.06	1.18	P<.05	10.24	12.51	1.22	P<.05
	14	9.99	11.46	1.15	N.S.	9.99	8.41	.84	N.S.
				Chest Circumference					
Male	12	29.66	30.29	1.02	N.S.	29.66	25.56	.86	N.S.
	13	29.07	33.23	1.14	N.S.	29.07	29.03	1.00	N.S.
	14	27.40	28.78	1.05	N.S.	27.40	29.27	1.07	N.S.
Female	12	35.20	38.81	1.10	N.S.	35.20	28.60	.81	N.S.
	13	29.42	35.86	1.22	P<.05	29.42	37.14	1.26	P<.05
	14	26.80	33.40	1.25	P<.05	26.80	29.02	1.08	N.S.

small between the two groups of offspring and not significant. Variances of weight of 12-year-old boys and 13- and 14-year-old girls, of sitting height of 12-year-old boys and 13-year-old girls, and of chest circumference of 13- and 14-year-old girls were larger than those of the offspring of nonexposed parents and the differences were statistically significant at the 1%-5% level. Other variances of offspring of exposed parents tended to be larger than those of the offspring of nonexposed parents, but the differences were short of the statistically significant level.

Weighted Regression Analysis by Combined Dose of both Parents

Weighted regression analysis by combined dose of both parents was made by age and sex of offspring. The analysis was made in two ways, one considering the exposure dose of nonexposed parents to be 0 rad and the other excluding the nonexposed group. Further, all offspring of parents exposed to less than 1 rad were excluded from the analysis because the estimated radiation dose of such parents is treated as 0 rad. The results of the analysis are shown in Table 7.

Both with the offspring of nonexposed parents included and with them excluded, the regression coefficients for the mean values of weight and sitting height of 14-year-old girls were positive and statistically significant at the level of 5%, but the regression coefficients for other mean values were almost all short of statistical significance. The regression coefficients for the variances presented no specific tendency, and only a very few of them were statistically significant. The regression coefficients for the variances of weight of 13-year-old boys with inclusion of offspring of nonexposed parents and of weight of 12- and 13-year-old boys with exclusion of offspring of nonexposed parents had a plus sign and were all statistically significant at the level of 5%. As above, the signs of the regression coefficients on the combined dose of both parents for the means and variances of weight, sitting height, and chest circumference of offspring did not necessarily present a fixed tendency, nor was there any point of importance which particularly posed a problem from the viewpoint of statistics.

DISCUSSION

It has been reported[9,10] that the parent-offspring correlation for anthropometric measurements is

達しなかった．また，分散値では12歳男，13歳と14歳女の体重，12歳男と13歳女の座高及び13歳と14歳女の胸囲の分散値は非被爆群に比べて大きく，その差は1％－5％水準で統計的に有意であった．その他もほとんど被爆群の子の分散値が非被爆群のそれに比べて大きい傾向を示したが，その差は統計的有意水準に達しなかった．

両親の相加線量による加重回帰分析

子の年齢別・性別に，両親の相加線量による加重回帰分析を試みた．分析は，非被爆群の被曝線量を0 radとした場合と非被爆群を除外した場合の二つの方法で行った．更に1 rad未満の者は線量推定値が0 radとして扱われているのですべて除外した．分析の結果は表7に示す．

非被爆両親の子を入れた場合と除いた場合について，14歳女の体重と座高の平均値に対する回帰係数は，いずれも正の符号をもって5％水準で統計的に有意であったが，その他の平均値に対する回帰係数はほとんど統計的有意水準に達しなかった．また，分散値に対する回帰係数は特定の傾向を示さず，統計的有意水準に達するものはごく一部であった．すなわち，非被爆群を入れた場合13歳男の体重，非被爆群を除いた場合12歳と13歳の男の体重の分散値に対する回帰係数は正の符号をもち，いずれも5％水準で統計的に有意であった．以上のごとく子の体重，座高及び胸囲の平均値と分散値の両親の相加線量への回帰係数の符号は必ずしも一定の傾向を示さず，また，統計学上特に問題とする重要な点は見られなかった．

考　察

身体計測値の親子間の相関は，子の発育年齢期を

TABLE 7 REGRESSION COEFFICIENT OF WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF OFFSPRING BY COMBINED DOSE GROUP & PARENTAL EXPOSURE STATUS

表7 両親の相加線量及び被爆状態別の子の体重，座高，及び胸囲の回帰係数

Offspring		Nonexposed & Exposed Parents				Exposed Parents			
Sex	Age	Constant	Slope	T-Test (d.f.=5)		Constant	Slope	T-Test (d.f.=4)	
BY COMBINED DOSE GROUP									
				Weight					
Male	12	37.60	−0.00493	1.06	N.S.	36.37	−0.00134	0.34	N.S.
	13	42.68	0.00583	1.18	N.S.	41.98	0.00964	2.01	N.S.
	14	47.93	−0.00046	0.18	N.S.	48.09	−0.00123	0.41	N.S.
Female	12	39.27	−0.00149	1.11	N.S.	38.97	−0.00063	0.45	N.S.
	13	43.36	0.00225	1.51	N.S.	43.59	0.00159	1.00	N.S.
	14	46.66	0.00222	2.93	P<.05	46.57	0.00249	2.96	P<.05
				Sitting Height					
Male	12	78.68	−0.00180	0.74	N.S.	78.03	−0.00008	0.04	N.S.
	13	82.00	0.00008	0.03	N.S.	81.68	0.00133	0.49	N.S.
	14	85.46	−0.00126	0.68	N.S.	85.01	0.00064	0.39	N.S.
Female	12	80.65	0.00027	0.28	N.S.	80.64	0.00029	0.26	N.S.
	13	82.73	0.00140	1.72	N.S.	82.74	0.00137	1.47	N.S.
	14	84.02	0.00210	3.72	P<.05	84.14	0.00175	3.08	P<.05
				Chest Circumference					
Male	12	69.84	−0.00263	1.39	N.S.	69.24	−0.00121	0.72	N.S.
	13	73.59	−0.00021	0.08	N.S.	73.10	0.00183	0.65	N.S.
	14	77.03	−0.00169	0.90	N.S.	77.12	−0.00209	0.96	N.S.
Female	12	71.72	−0.00250	1.18	N.S.	71.44	−0.00160	0.68	N.S.
	13	74.78	0.00040	0.40	N.S.	74.83	0.00027	0.24	N.S.
	14	77.24	0.00150	2.27	Sugg.	77.18	0.00172	2.30	Sugg.
BY PARENTAL EXPOSURE STATUS									
				Weight					
Male	12	50.31	0.04875	1.73	N.S.	37.08	0.07628	3.87	P<.05
	13	56.34	0.17648	3.87	P<.05	49.09	0.20538	4.38	P<.05
	14	53.83	0.05594	1.17	N.S.	53.43	0.05745	1.04	N.S.
Female	12	44.73	−0.03433	1.17	N.S.	45.61	−0.03715	1.12	N.S.
	13	40.93	0.01794	0.49	N.S.	50.97	−0.01327	0.43	N.S.
	14	40.94	0.00778	0.81	N.S.	43.05	0.00157	0.16	N.S.
				Sitting Height					
Male	12	16.31	0.01686	1.86	N.S.	14.00	0.02166	2.35	Sugg
	13	21.31	−0.01371	1.00	N.S.	22.65	−0.01908	1.26	N.S.
	14	17.39	0.00938	0.52	N.S.	20.54	−0.00278	0.15	N.S.
Female	12	14.02	−0.00738	0.86	N.S.	15.48	−0.01199	1.33	N.S.
	13	10.49	0.00207	0.30	N.S.	13.04	−0.00583	1.84	N.S.
	14	9.83	−0.00243	0.44	N.S.	8.21	0.00235	0.47	N.S.
				Chest Circumference					
Male	12	29.20	0.00208	0.20	N.S.	24.34	0.01221	1.68	N.S.
	13	29.12	−0.00780	0.33	N.S.	29.74	−0.01024	0.38	N.S.
	14	27.50	0.01580	0.81	N.S.	28.58	0.01165	0.52	N.S.
Female	12	34.76	−0.03245	1.32	N.S.	29.83	−0.01682	0.68	N.S.
	13	30.34	0.00498	0.17	N.S.	39.40	−0.02319	1.02	N.S.
	14	26.97	0.01278	1.31	N.S.	28.59	0.00798	0.76	N.S.

not constant throughout the period of growth of the offspring, but that it follows a nonlinear pattern. As is generally known, at the junior high school age of 12-14 years the amount of annual growth is especially remarkable compared with that at other ages, the variance is also larger, and the parent-offspring correlation is markedly lower. This is also indicative of susceptibility to the effects of environmental factors.

In view of the reported correlation between anthropometric values of offspring and parental age at the time of birth, this point was considered in the regression analysis of the weight, sitting height, and chest circumference of children 12 to 14 years of age by using the mean values of weight, sitting height, and chest circumference of offspring of nonexposed parents by the mid-age of those parents, but no statistically significant relation was found (Table 2).

Next, a comparative study was made of the means and variances of weight, sitting height, and chest circumference of offspring of the nonexposed parents and those of the exposed parents. Comparison with regard to offspring with only one parent exposed and offspring of nonexposed parents showed very few of the differences to be statistically significant, and the differences between the two groups did not necessarily present a specific tendency. However, in all cases where the differences of variance values between the two groups of offspring were statistically significant, the values of those offspring with one parent exposed were larger. Because exposure of the mother to A-bomb radiation might create a greater genetic effect, analysis of offspring born to exposed fathers and nonexposed mothers and of offspring born to exposed mothers and nonexposed fathers was made.

Of the differences that were statistically significant, those of the means did not necessarily present any specific tendency, but of the differences in variances, 4 were of offspring born to exposed fathers and nonexposed mothers and 10 were of offspring born to exposed mothers and nonexposed fathers. In an analysis of data on offspring with both parents exposed, comparison was made of the means of weight, sitting height, and chest circumference by age and sex of offspring with both parents exposed and offspring of nonexposed parents, and the

通じて恒常的ではなく，非直線型に従うことは既に報告したが，[9,10] 特に12—14歳の中学生期には他の年齢期に比べて年間発育量が著しく，分散も大きく，親子間の相関が著しく低いことは周知のとおりである．このことは環境要因の影響を受けやすいことを示している．

子の身体計測値と出生時の親の年齢との間に相関関係が見られるとの報告もあることから，非被爆両親の子の体重，座高及び胸囲の平均値を用いて，両親の平均年齢別に12—14歳の体重，座高及び胸囲の回帰分析する際にはこの点を考慮したが，統計的に有意な関係は全く見られなかった（表2）．

次に，非被爆群と被爆群の子の体重，座高及び胸囲の平均値及び分散値について比較検討した．まず，片親のみ被爆群と両親とも非被爆群の子について比較したところ，平均値の差で統計的有意水準に達するものはごく一部であり，かつ，両群間の差は必ずしも一定の傾向を示さないが，これに反して分散値では両群間の差が統計的有意水準に達するものは，すべて被爆群の子の方が大きい．母の原爆被爆はより大きい遺伝的影響を現すかもしれないので，父被爆・母非被爆と母被爆・父非被爆の子についても解析を行った．

統計的有意水準に達するもののうち，平均値では両者間で必ずしも特定の傾向は見られなかったが，分散値で統計的有意水準に達するもののうち，父被爆・母非被爆の場合4で，母被爆・父非被爆の場合は10であった．次に，両親とも被爆群の子から入手した資料の解析から，両親とも被爆群の子と両親とも非被爆群の子の年齢別，性別の体重，座高

results showed only a very few statistically significant differences between the two groups of offspring.

Of the 36 differences in variances between the two groups of offspring, 11 were statistically significant, and in every case the variance of offspring of exposed parents was larger. Further, in the analysis of regression to exposure dose of the means and variances of weight, sitting height, and chest circumference of offspring, differences from zero of regression coefficients of a statistically significant level, though very few, all had a plus sign.

As described above, a comparison was made of the means and variances of weight, sitting height, and chest circumference between offspring of exposed parents and offspring of nonexposed parents, and the results showed the differences in means between the two groups of offspring which were of a statistically significant level to be very few and showed no specific tendency. As reported,[8,10] changes in means were more often due to environmental factors, and hence, even if differences in means should be found between the two groups of offspring, it would not be appropriate to attribute this to A-bomb radiation per se. If there should be any genetic effects at all of A-bomb radiation, the effects could be expected to appear in the variances of offspring and the parent-offspring correlation.

Although these findings cannot completely negate genetic effects of A-bomb radiation, the study sample of offspring born to exposed parents was not large, more of the differences were short of the statistically significant level, and comparable measurements were not available for the parents although parent-offspring correlation should also have been considered in order to support the presence of genetic effects of A-bomb radiation. We should be discreet therefore in speaking about genetic effects of A-bomb radiation from just these results alone. We have not gone beyond presenting the results of the analysis here as it is planned to analyze the data on 6- to 11-year-old children of Hiroshima in the near future and at that time to review the data on 6- to 17-year-old children.

及び胸囲の平均値の比較を行った結果，両群間の差が統計的有意水準に達するのはごく一部であった．

また分散値では両群間の差が統計的有意水準に達するのは36のうち11であり，これらは被爆群の子の分散値の方がいずれも大きい．なお，子の体重，座高及び胸囲の平均値と分散値の被曝線量への回帰分析で，回帰係数の0からの差が統計的有意水準に達するのはいずれもごく一部であったが，いずれも正の符号をもっている．

以上のごとく，被爆群と非被爆群の子の体重，座高及び胸囲の平均値と分散値について比較検討を試みたが，両群間の平均値の差が統計的有意水準に達するのはごく一部であり，またこれらは必ずしも一定の傾向を示さない．既に報告したように，[8,10] 平均値への変動は環境要因による場合の方が多く，したがって仮に両群間の平均値に差が見られたとしても，直ちに原爆放射線のみによる影響と判定することはできないであろう．もし原爆放射線による遺伝的影響があるとすれば，むしろ子の分散や親子間の相関などに効果的に影響すると期待される．

これらの所見を通じて，原爆放射線による遺伝的影響が全くないとは言えないかもしれないが，被爆群の調査例数も必ずしも多いとは言えず，かつまた統計的有意水準に達するものもごく一部であり，更には原爆放射線による遺伝的影響を裏付けるには親子間の相関についても十分に検討すべきであるが，本資料では親については測定されていない．したがってこれだけの結果から原爆放射線による遺伝的影響を論じることは慎むべきであろう．今後広島の6－11歳の資料についても近く分析を行う予定であるので，その時改めて6－17歳の資料について詳細に再検討する予定であるので，本報告書では分析結果を述べるにとどめたい．

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