

A SEARCH FOR GENETIC EFFECTS OF ATOMIC BOMB RADIATION ON THE GROWTH
AND DEVELOPMENT OF THE F₁ GENERATION

2. BODY WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF
15- TO 17-YEAR-OLD SENIOR HIGH SCHOOL STUDENTS
IN HIROSHIMA

原爆放射線の F₁ 世代への成長発育に及ぼす遺伝的影響に関する研究

2. 広島の高15歳から17歳までの高校生の体重・座高・胸囲について

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2. 広島市の15歳から17歳までの高校生の体重・座高・胸囲について

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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 senior high school students 15 to 17 years of age born to survivors and to nonexposed parents in Hiroshima using as variables weight, sitting height, and chest circumference.

Using data from students born to nonexposed parents, regression analysis was made to determine 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 and variance values of weight, sitting height, and chest circumference of offspring of nonexposed parents were compared to those of offspring born to exposed father and non-exposed mother, and of offspring born to exposed mother and nonexposed father, but very few statistically significant differences were found.

The mean and variance values of weight, sitting height, and chest circumference of offspring born to nonexposed parents were compared to those

要 約

広島市の被爆者および非被爆者から生まれた15歳から17歳までの高校生について、体重、座高およ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生徒の資料を用いて、親の年齢が子の体重、座高およ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、統計的に有意な関連性は認められなかった。

両親とも非被爆の子の体重、座高および胸囲の平均値と分散値を、父被爆・母非被爆の子および母被爆・父非被爆の子のそれぞれの値と比較したが、統計的な有意差はほとんど認められなかった。

両親とも非被爆の子と両親とも被爆の子について体重、座高および胸囲の平均値と分散値を比較したが、

of offspring born to parents both exposed, and again there were very few statistically significant differences. No specific tendency was observed in relation to the combined radiation dose of both 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 of senior high school students between the ages of 15 and 17 born to A-bomb survivors and to nonexposed parents with respect to the mean and variance of the offspring and the covariance and correlation between the parents and offspring.²⁻⁴ We report here a similar analysis made on weight, sitting height, and chest circumference for the same offspring population.

MATERIALS

This analysis concerns weight, sitting height, and chest circumference measurements of an offspring population described in a previous report,² but comparable measurements were not available for the parents. Measurements of offspring born to consanguineous parents or those 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 in relation to parental age was analyzed. The mean and variance values of weight, sitting height, and chest circumference of 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 (Tables 1A-C). For a closer examination of the data the regression of the mean values of weight, sitting height, and chest circumference of the offspring by mid-age of the parents was analyzed. No specific tendency was demonstrated, and the differences from zero of almost all regression coefficients but those for sitting heights of 16-year-old girls were short of statistical significance (Table 2).

やはり統計的な有意差はほとんど示唆されず、両親の相加被曝線量との関係において特定の傾向は認められなかった。

緒言

広島および長崎の原爆被爆者の子の成長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をもたれたことから、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、被爆両親および非被爆両親に生まれた15歳から17歳までの高校生の身長について、その平均値と分散値、さらに両親と子との間の共分散および相関について比較検討を行った。²⁻⁴ 今回は、同じ対象集団の子の体重、座高および胸囲について同様の解析を試みた。

資料

前回と同じ集団²について子の体重、座高および胸囲について解析を行ったが、両親の測定値については得られていない。今回の解析では両親が近親婚である者や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、座高および胸囲に及ぼす親の年齢効果を推定するために、子の測定値のそれぞれの分布状態を親の年齢別に検討した。子の体重、座高および胸囲の平均値と分散値を子の性別、年齢別、および両親の平均年齢(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1A-C)。この点についてさらに検討を加えるために、両親の平均年齢に対する子の体重、座高および胸囲の平均値の回帰分析を試みたが特定の傾向は認められず、16歳女の座高を除き、ほとんどすべて回帰係数の0からの差異は統計的に有意でなかった(表2)。

TABLE 1A MEAN AND VARIANCE OF WEIGHT FOR OFFSPRING BORN TO NONEXPOSED PARENTS BY SEX AND AGE OF OFFSPRING AND MID-AGE OF PARENTS

表 1 A 非被爆両親から生まれた子の体重の平均値および分散値，子の性別と年齢別，および親の平均年齢別

Offspring		Item	Total	Mid-Age of Parents				
Sex	Age			30-39	40-44	45-49	50-54	55+
Male	15	Number	3038	451	1192	806	433	156
		Mean	52.7	52.7	52.9	52.9	52.1	51.8
		Variance	49.5	51.7	48.9	51.9	44.5	47.7
	16	Number	3388	337	1320	980	492	259
		Mean	55.3	54.8	55.3	55.6	55.2	55.1
		Variance	44.3	37.0	43.4	49.7	44.3	38.2
	17	Number	3161	192	993	1025	640	311
		Mean	56.8	57.5	57.0	56.5	56.5	57.0
		Variance	42.8	52.5	47.7	40.4	38.2	38.5
Female	15	Number	2860	469	1134	772	341	144
		Mean	48.4	48.9	48.3	48.5	48.0	48.6
		Variance	35.3	34.5	36.5	32.5	38.4	36.7
	16	Number	3057	329	1211	859	438	220
		Mean	50.1	50.5	50.1	49.9	49.9	50.5
		Variance	35.7	37.2	38.2	31.5	35.7	36.1
	17	Number	2881	172	934	961	514	300
		Mean	50.6	50.3	50.5	50.6	50.9	50.7
		Variance	34.0	33.2	33.3	34.6	35.4	32.7

TABLE 1B MEAN AND VARIANCE OF SITTING HEIGHT FOR OFFSPRING BORN TO NON-EXPOSED PARENTS BY SEX AND AGE OF OFFSPRING AND MID-AGE OF PARENTS

表 1 B 非被爆両親から生まれた子の座高の平均値および分散値，子の性別と年齢別，および親の平均年齢別

Offspring		Item	Total	Mid-Age of Parents				
Sex	Age			30-39	40-44	45-49	50-54	55+
Male	15	Number	3038	451	1192	806	433	156
		Mean	87.8	87.9	87.8	87.8	87.8	87.4
		Variance	12.1	14.3	11.1	11.5	12.2	16.9
	16	Number	3388	337	1320	980	492	259
		Mean	89.0	88.8	89.1	89.0	89.0	89.0
		Variance	10.1	11.4	9.4	10.1	10.5	11.5
	17	Number	3161	192	993	1025	640	311
		Mean	89.7	89.5	89.7	89.7	89.6	90.0
		Variance	8.5	7.7	8.8	8.7	8.7	7.1
Female	15	Number	2860	469	1134	772	341	144
		Mean	84.5	84.8	84.5	84.5	84.4	84.6
		Variance	7.7	7.0	7.3	8.4	8.1	8.1
	16	Number	3057	329	1211	859	438	220
		Mean	84.8	85.1	84.9	84.8	84.8	84.6
		Variance	7.2	6.8	7.3	7.1	7.5	6.4
	17	Number	2881	172	934	961	514	300
		Mean	84.8	84.8	84.8	84.8	84.7	84.7
		Variance	7.0	8.2	7.0	7.2	6.9	6.2

TABLE 1C MEAN AND VARIANCE OF CHEST CIRCUMFERENCE FOR OFFSPRING BORN TO NONEXPOSED PARENTS BY SEX AND AGE OF OFFSPRING AND MID-AGE OF PARENTS

表 1 C 非被爆両親から生まれた子の胸囲の平均値および分散値, 子の性別と年齢別, および親の平均年齢別

Offspring		Item	Total	Mid-Age of Parents				
Sex	Age			30-39	40-44	45-49	50-54	55+
Male	15	Number	3038	451	1192	806	433	156
		Mean	81.0	81.0	81.2	81.0	80.7	81.3
		Variance	25.3	27.2	25.7	25.6	21.6	24.8
	16	Number	3388	337	1320	980	492	259
		Mean	83.2	83.0	83.1	83.4	83.1	83.2
		Variance	23.4	25.8	21.5	25.4	23.0	23.0
	17	Number	3161	192	993	1025	640	311
		Mean	84.8	85.0	85.1	84.5	84.7	84.6
		Variance	22.6	26.9	25.3	21.4	20.4	19.6
Female	15	Number	2860	469	1134	772	341	144
		Mean	79.2	79.7	79.2	79.1	78.8	79.3
		Variance	24.2	23.7	25.3	22.5	24.8	24.7
	16	Number	3057	329	1211	859	438	220
		Mean	80.5	80.8	80.5	80.3	80.6	81.1
		Variance	23.7	22.9	25.5	21.5	23.1	24.1
	17	Number	2881	172	934	961	514	300
		Mean	81.3	81.6	81.2	81.2	81.6	81.6
		Variance	23.0	25.0	23.7	22.4	22.5	22.1

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, および胸囲の平均値に対する回帰係数, 子の性別および年齢別

Age of Offspring	Male			Female		
	Constant (1)	Slope (2)	Test (1):(2)	Constant (1)	Slope (2)	Test (1):(2)
Weight						
15	54.4	-.03897	1.500 NS	49.5	-.02487	1.189 NS
16	54.7	.01244	.579 NS	50.6	-.01247	.616 NS
17	58.0	-.02632	.994 NS	49.5	.02340	2.687 Sugg
Sitting Height						
15	88.3	-.01009	1.604 NS	85.2	-.01493	1.717 NS
16	88.9	.00177	.209 NS	85.7	-.01905	5.674 P<.02
17	89.1	.01217	1.219 NS	85.1	-.00659	1.985 NS
Chest Circumference						
15	81.5	-.01078	.648 NS	80.7	-.03403	2.282 NS
16	82.7	.00982	.758 NS	80.4	.00385	.177 NS
17	86.1	-.02747	1.381 NS	80.5	.01762	1.071 NS

TABLE 3A COMPARISON OF MEAN AND VARIANCE VALUES OF WEIGHT OF OFFSPRING BORN TO NONEXPOSED FATHER AND EXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 3 A 父非被爆・母被爆者の子と両親とも非被爆者の子の体重の平均値および分散値の比較

Offspring		Item	Parental Exposure					
Sex	Age		Father→	Nonexp.	Nonexp.	Test (1):(2)	Nonexp.	Test (1):(3)
			Mother→	Nonexp. (1)	<1 rad (2)		1 or more rad (3)	
Male	15	Number		3038	220		185	
		Mean		52.70	53.08	.76 NS	52.13	1.14 NS
		Variance		49.47	51.97	1.05 NS	43.30	1.14 NS
	16	Number		3388	226		219	
		Mean		55.28	56.41	2.16 *	55.74	.96 NS
		Variance		44.29	59.21	1.34 **	48.33	1.09 NS
	17	Number		3161	218		183	
		Mean		56.79	57.66	1.79 Sugg	57.96	2.19 *
		Variance		42.82	48.02	1.12 NS	49.94	1.17 NS
Female	15	Number		2860	280		197	
		Mean		48.43	49.07	1.68 Sugg	48.00	1.05 NS
		Variance		35.34	36.53	1.03 NS	31.56	1.12 NS
	16	Number		3057	243		211	
		Mean		50.06	50.09	.07 NS	49.36	1.70 Sugg
		Variance		35.70	44.49	1.25 *	33.06	1.08 NS
	17	Number		2881	227		199	
		Mean		50.60	50.71	.27 NS	49.71	2.13 *
		Variance		34.01	38.83	1.14 NS	32.28	1.05 NS

Comparison of the mean and variance values of weight, sitting height, and chest circumference between the offspring of nonexposed parents and those of exposed parents

Comparison between offspring of nonexposed parents and those with one parent exposed. As classification by dose of the offspring with only one parent exposed would seriously deplete the number in each dose group, they were classified broadly into less than 1 rad group and 1 rad or more group. The mean and variance values were compared for weight, sitting height, and chest circumference of offspring born to nonexposed father and exposed mother, and those of offspring born to nonexposed parents. Few of the differences between these two groups were statistically significant (Tables 3A-C). The data for offspring born to nonexposed parents and offspring born to exposed father and nonexposed mother were similarly analyzed and very few of the differences between the two groups were statistically significant (Tables 4A-C).

両親とも非被爆の子と両親とも被爆の子との体重、座高およ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比較。片親のみ被爆の子を線量別に分類すると、各線量群の例数が極めて少なくなるので、大きく 1 rad 未満群と 1 rad 以上群に分類して、父非被爆・母被爆の子と両親とも非被爆の子の体重、座高および胸囲の平均値および分散値を比較した。両者間の差が統計的有意水準に達するものはほとんどなかった(表 3 A-C)。両親とも非被爆の子と父被爆・母非被爆の子についても同様に検討したが、両者の間に統計的有意差はほとんど認められなかった(表 4 A-C)。

TABLE 3B COMPARISON OF MEAN AND VARIANCE VALUES OF SITTING HEIGHT OF OFFSPRING BORN TO NONEXPOSED FATHER AND EXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 3 B 父非被爆・母被爆者の子と両親とも非被爆者の子の座高の平均値および分散値の比較

Offspring		Item	Parental Exposure				
			Father→	Nonexp.	Nonexp.	Nonexp.	Test
Sex	Age		Mother→	Nonexp. (1)	<1 rad (2)	1 or more rad (3)	Test (1):(3)
Male	15	Number		3038	220	185	
		Mean		87.79	87.89	87.66	.55 NS
		Variance		12.14	10.67	9.33	1.30 NS
	16	Number		3388	226	219	
		Mean		89.01	89.28	89.17	.71 NS
		Variance		10.12	11.99	10.34	1.02 NS
	17	Number		3161	218	183	
		Mean		89.70	89.99	89.82	.50 NS
		Variance		8.51	11.44	9.98	1.17 NS
Female	15	Number		2860	280	197	
		Mean		84.53	85.06	84.54	.02 NS
		Variance		7.67	6.61	6.92	1.11 NS
	16	Number		3057	243	211	
		Mean		84.84	85.07	84.69	.82 NS
		Variance		7.17	6.43	7.32	1.02 NS
	17	Number		2881	227	199	
		Mean		84.76	85.14	84.70	.31 NS
		Variance		7.02	6.72	6.36	1.10 NS

Comparison between offspring of nonexposed parents and those with both parents exposed. The mean and variance values of weight, sitting height, and chest circumference were obtained for offspring of nonexposed parents and for offspring of exposed parents by combined dose of both parents (Tables 5A-C). On the basis of these results a study was made of the respective mean and variance values of offspring of nonexposed parents and those of exposed parents. First, classification was made into less than 1 rad group and 1 rad or more group using the combined dose of both parents and these were each compared with those of nonexposed parents. Only a very few of the mean values were statistically significant and no specific tendency was observed in relation to dose (Tables 6A-B). The variance values compared between offspring of nonexposed parents and offspring of less than 1 rad parents and between offspring of nonexposed parents and offspring of 1 rad or more parents show that the number of significant values was greater in offspring of exposed parents. Next, regression

両親とも非被爆の子と両親とも被爆の子との比較。両親とも非被爆者および両親とも被爆者の子の体重、座高および胸囲の平均値と分散値を両親の相加線量別に求めた(表 5 A-C)。これらの結果から、両親とも非被爆者および両親とも被爆者である場合の子の各平均値と分散値を検討した。まず、両親の相加線量別に 1 rad 未満群と 1 rad 以上群に分類して、それぞれ非被爆両親の子と比較した。平均値は統計的有意水準に達するものはごく一部で、線量に関する特定の傾向は認められなかった(表 6 A-B)。非被爆両親の子と 1 rad 未満被爆両親の子および非被爆両親の子と 1 rad 以上被爆両親の子の分散値について比較したが、有意な値の多くは被爆両親の子の方が大きかった。次に、被爆両親の子の体重、座高

TABLE 3C COMPARISON OF MEAN AND VARIANCE VALUES OF CHEST CIRCUMFERENCE OF OFFSPRING BORN TO NONEXPOSED FATHER AND EXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 3 C 父非被爆・母被爆者の子と両親とも非被爆者の子の胸囲の平均値および分散値の比較

Offspring		Item	Parental Exposure					
Sex	Age		Father→	Nonexp.	Nonexp.	Test (1):(2)	Nonexp.	Test (1):(3)
			Mother→	Nonexp. (1)	<1 rad (2)		1 or more rad (3)	
Male	15	Number		3038	220		185	
		Mean		81.04	81.24	.55 NS	80.62	1.26 NS
		Variance		25.26	26.48	1.05 NS	19.89	1.27 NS
	16	Number		3388	226		219	
		Mean		83.19	83.98	2.22 *	83.85	1.88 Sugg
		Variance		23.39	27.18	1.16 NS	25.23	1.08 NS
	17	Number		3161	218		183	
		Mean		84.76	85.36	1.86 Sugg	85.84	2.97 **
		Variance		22.61	21.08	1.07 NS	22.86	1.01 NS
Female	15	Number		2860	280		197	
		Mean		79.23	79.65	1.37 NS	79.02	.60 NS
		Variance		24.23	24.78	1.02 NS	21.52	1.13 NS
	16	Number		3057	243		211	
		Mean		80.52	80.37	.43 NS	80.05	1.39 NS
		Variance		23.68	28.11	1.19 *	23.35	1.01 NS
	17	Number		2881	227		199	
		Mean		81.34	81.30	.12 NS	80.68	1.86 Sugg
		Variance		22.96	24.84	1.08 NS	23.13	1.01 NS

analysis was made of the mean and variance values of weight, sitting height, and chest circumference of offspring of exposed parents in two ways: one including the nonexposed group and the other excluding the nonexposed group (0 rad) (Tables 7A-B). Only a very few of the regression coefficients for the mean values were statistically significant, and the signs of the regression coefficients did not necessarily present a specific tendency. The variance values showed a similar tendency with nothing of statistical importance.

The regression coefficients for mean values of chest circumference of 17-year-old boys are significant at the 5% level and have a plus sign when offspring of nonexposed parents are included, but as mentioned earlier, few are statistically significant. The variance values, on the other hand, showed a marked variation. As a tendency, many had a minus sign, but this did not pose any problem, none being statistically significant.

および胸囲の平均値と分散値について、非被爆群 (0 rad) を入れた場合と除いた場合の二つの方法で回帰分析を試みた (表 7 A-B)。平均値の回帰係数が統計的有意水準に達するものはごく一部であり、回帰係数の符号も必ずしも一定の傾向を示さなかった。分散値についても同様の傾向を示し、統計学上特に問題とする重要な点はみられなかった。

非被爆両親の子供を入れた場合、17歳男の胸囲の平均値に対する回帰係数は正の符号をもって5%の水準で有意であったが、すでに述べたごとく、統計的有意水準に達するものは極めて少ない。これに反して、分散値は著しい変動を示した。傾向としては多くの負符号を認めたが、いずれも統計的に問題となる有意性は示唆されなかった。

TABLE 4A COMPARISON OF MEAN AND VARIANCE VALUES OF WEIGHT OF OFFSPRING BORN TO EXPOSED FATHER AND NONEXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 4 A 父被爆・母非被爆者の子と両親とも非被爆者の子の体重の平均値および分散値の比較

Offspring		Item	Parental Exposure					
Sex	Age		Father→	Nonexp.	<1 rad	Test (1):(2)	1 or more rad	Test (1):(3)
			Mother→	Nonexp. (1)	Nonexp. (2)		Nonexp. (3)	
Male	15	Number		3038	58		48	
		Mean		52.70	51.97	.86 NS	51.97	.83 NS
		Variance		49.47	40.38	1.23 NS	35.76	1.38 NS
	16	Number		3388	73		72	
		Mean		55.28	56.11	1.10 NS	54.77	.49 NS
		Variance		44.29	41.21	1.07 NS	77.22	1.74 **
	17	Number		3161	63		74	
		Mean		56.79	56.42	.44 NS	56.70	.11 NS
		Variance		42.82	42.10	1.02 NS	47.73	1.11 NS
Female	15	Number		2860	54		57	
		Mean		48.43	46.68	2.44 *	49.37	1.09 NS
		Variance		35.34	26.94	1.31 NS	42.28	1.20 NS
	16	Number		3057	66		56	
		Mean		50.06	50.04	.03 NS	49.22	1.00 NS
		Variance		35.70	34.63	1.03 NS	38.53	1.08 NS
	17	Number		2881	66		38	
		Mean		50.60	49.24	1.68 Sugg	51.24	.52 NS
		Variance		34.01	42.42	1.25 NS	58.29	1.71 **

DISCUSSION

The study by Neel and Schull¹ using a massive volume of data is, as is generally known, the only study that has been made on the genetic effects of radiation on anthropometric measurements of man. In their study no statistically significant differences were demonstrated between the offspring of the nonexposed parents and those of the exposed parents in the anthropometric values observed 9 months after birth. According to published reports⁵⁻⁸ the parent-offspring correlation using anthropometric values at this neonatal period is markedly lower than those obtained on completion of growth, indicating the great influence of environmental factors on growth and development during childhood.

Taking this into consideration, the authors made an analysis of anthropometric measurements of children 15-17 years of age near the time of completion of growth. In view of the reported correlation between anthropometric values of

考 察

ヒトの身体測定値における放射線の遺伝的影響に関する研究は、周知のとおり、莫大な資料を用いた Neel と Schull¹ の研究が唯一のものである。彼らの研究では、非被爆両親の子と被爆両親の子の生後 9 か月時の身体測定値に関して統計的な有意差は認められなかった。新生児期の身体測定値を用いた親子相関は子が発育完了期の測定値を用いた親子相関よりも著しく低く、小児期の成長発育には環境要因の影響が大きいことは多くの研究報告⁵⁻⁸ によって知られている。

著者らはこの点を考慮して、発育完了期に近い15歳から17歳までの子の身体測定値を解析した。子の身体測定値と出生時の親の年齢との間に相関関係が

TABLE 4B COMPARISON OF MEAN AND VARIANCE VALUES OF SITTING HEIGHT OF OFFSPRING BORN TO EXPOSED FATHER AND NONEXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 4 B 父被爆・母非被爆者の子と両親とも非被爆者の子の座高の平均値および分散値の比較

Offspring		Item	Parental Exposure					
Sex	Age		Father→ Mother→	Nonexp. Nonexp. (1)	<1 rad Nonexp. (2)	Test (1):(2)	1 or more rad Nonexp. (3)	Test (1):(3)
Male	15	Number		3038	58		48	
		Mean		87.79	88.04	.54 NS	87.45	.76 NS
		Variance		12.14	12.60	1.04 NS	9.17	1.32 NS
	16	Number		3388	73		72	
		Mean		89.01	89.43	1.31 NS	88.94	.20 NS
		Variance		10.12	7.06	1.43 NS	10.37	1.03 NS
	17	Number		3161	63		74	
		Mean		89.70	89.61	.25 NS	89.89	.59 NS
		Variance		8.51	7.91	1.08 NS	7.12	1.20 NS
Female	15	Number		2860	54		57	
		Mean		84.53	83.91	1.59 NS	84.49	.11 NS
		Variance		7.67	8.15	1.06 NS	9.52	1.24 NS
	16	Number		3057	66		56	
		Mean		84.84	84.44	1.17 NS	84.25	1.56 NS
		Variance		7.17	7.88	1.10 NS	8.00	1.12 NS
	17	Number		2881	66		38	
		Mean		84.76	85.02	.73 NS	84.86	.19 NS
		Variance		7.02	8.67	1.24 NS	10.74	1.53 *

offspring and parental age at time of birth, this point was considered in the regression analysis by using the mean values of weight, sitting height, and chest circumference of offspring of the nonexposed parents by the mid-age of parents. The results of this regression analysis presented hardly any statistically significant relation (Table 2).

Next, a comparative study was made of the mean and variance values of weight, sitting height, and chest circumference of offspring of the non-exposed parents and those of the exposed parents. Very few of the differences between offspring with only one parent exposed and offspring of nonexposed parents were statistically significant. Because exposure of the mother to A-bomb radiation might demonstrate a greater genetic effect, a careful analysis of offspring born to exposed father and nonexposed mother and of offspring born to exposed mother and nonexposed father was made but no difference could be demonstrated between the two.

みられるとの報告もあるので、この点については、非被爆両親の子の体重、座高および胸囲の平均値を用いて両親の平均年齢による回帰分析によって考慮した。その結果、統計的に有意な関係はほとんど認められなかった(表2)。

次に、非被爆両親の子と被爆両親の子の体重、座高および胸囲の平均値および分散値について比較検討した。片親のみ被爆の子と両親とも非被爆の子の間に有意な差は統計的にほとんど認められなかった。母の原爆被爆はより大きい遺伝的影響を現すかも知れないので、父被爆・母非被爆の子と母被爆・父非被爆の子について慎重な解析を行ったが、両者間に差は認められなかった。

TABLE 4C COMPARISON OF MEAN AND VARIANCE VALUES OF CHEST CIRCUMFERENCE OF OFFSPRING BORN TO EXPOSED FATHER AND NONEXPOSED MOTHER VS OFFSPRING BORN TO NONEXPOSED PARENTS

表 4 C 父被爆・母非被爆者の子と両親とも非被爆者の子の胸囲の平均値および分散値の比較

Offspring		Item	Parental Exposure				
			Father→	Nonexp.	<1 rad	1 or more rad	Test
Sex	Age		Mother→	Nonexp. (1)	Nonexp. (2)	Test (1):(2)	Test (1):(3)
Male	15	Number		3038	58		48
		Mean		81.04	80.69	.54 NS	80.81
		Variance		25.26	24.22	1.04 NS	21.88
	16	Number		3388	73		72
		Mean		83.19	83.11	.15 NS	83.19
		Variance		23.39	22.82	1.03 NS	36.90
	17	Number		3161	63		74
		Mean		84.76	85.08	.53 NS	84.82
		Variance		22.61	22.53	1.00 NS	21.21
	15	Number		2860	54		57
		Mean		79.23	78.43	1.35 NS	79.92
		Variance		24.23	18.37	1.32 NS	20.43
Female	16	Number		3057	66		56
		Mean		80.52	80.71	.33 NS	79.50
		Variance		23.68	20.29	1.17 NS	21.31
	17	Number		2881	66		38
		Mean		81.34	81.01	.48 NS	80.80
		Variance		22.96	30.04	1.31 NS	36.77

In almost all cases where the differences between the offspring of nonexposed parents and those with only one parent exposed were significant, both the mean and variance presented a higher value in offspring with only one parent exposed than in those of nonexposed parents, but, as stated earlier, very few of the differences between the two were statistically significant. Thus, no conclusion can be made from these data on the genetic effect of maternal exposure, or on the effects of radiation on the mean and variance values.

Finally, analysis of data obtained from offspring born to parents both exposed revealed that very few differences in both mean and variance values of weight, sitting height, and chest circumference between the offspring of nonexposed parents and offspring of parents both exposed were statistically significant by age and sex. Furthermore, no specific tendency was observed in relation to the combined dose of both parents.

両親とも非被爆者の子と片親のみ被爆者の子との間に有意差が認められた場合にはほとんど片親のみ被爆者の子の方が両親とも非被爆者の子よりも高い平均値と分散値を示したが、先に述べたごとく、両者間の差はほとんど統計的に有意ではなかった。したがって、母被爆の遺伝的母体効果、つまり平均値および分散値に及ぼす放射線の影響に関するこれら資料の分析結果では結論を得ることができなかった。

最後に、両親とも被爆者の子から入手した資料の解析から、両親とも非被爆者の子と両親とも被爆者の子の年齢別・性別の体重、座高、胸囲の平均値と分散値に対する両者間の差にはほとんど統計的有意差は認められず、また両親の相加線量に対する特定の傾向も観察されなかった。

TABLE 5A MEAN AND VARIANCE OF WEIGHT BY COMBINED EXPOSURE DOSE OF PARENTS

表 5 A 両親の相加線量別の体重の平均値および分散値

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
Male	15	Number	3038	368	140	68	39	41	22	32	342
		Mean dose	0.0	0.0	4.0	14.3	28.1	66.4	139.5	398.1	61.8
		Mean	52.7	52.7	52.4	51.7	53.3	51.1	50.4	52.9	52.1
		Variance	49.5	49.8	54.9	35.9	49.2	44.9	27.2	34.3	45.6
	16	Number	3388	419	172	90	42	59	27	30	420
		Mean dose	0.0	0.0	4.1	14.8	27.9	64.9	134.1	484.1	60.1
		Mean	55.3	55.9	55.7	55.6	55.1	53.9	55.7	54.8	55.3
		Variance	44.3	56.4	53.0	71.5	34.7	29.4	64.1	45.2	51.8
	17	Number	3161	399	174	79	40	59	38	43	433
		Mean dose	0.0	0.0	3.8	14.4	29.6	62.8	134.5	367.3	63.7
		Mean	56.8	57.2	57.2	57.5	57.1	58.2	58.1	57.0	57.5
		Variance	42.8	46.6	49.2	55.9	31.5	52.3	40.8	39.2	47.2
Female	15	Number	2860	435	146	64	45	52	35	32	374
		Mean dose	0.0	0.0	3.8	14.5	29.1	64.2	138.5	407.3	64.2
		Mean	48.4	48.5	48.1	48.5	48.5	48.6	47.9	48.8	48.3
		Variance	35.3	35.9	35.0	30.4	29.9	32.2	36.7	48.4	34.1
	16	Number	3057	427	158	79	48	51	39	27	402
		Mean dose	0.0	0.0	4.2	14.7	27.9	62.2	143.5	440.6	59.1
		Mean	50.1	49.9	49.5	49.5	50.1	49.2	49.8	50.1	49.6
		Variance	35.7	42.8	36.9	34.6	26.2	38.0	42.0	47.4	36.1
	17	Number	2881	440	153	70	46	59	37	30	395
		Mean dose	0.0	0.0	3.8	14.4	28.5	69.9	128.7	418.0	61.5
		Mean	50.6	50.3	50.4	49.8	49.1	51.1	49.9	50.7	50.2
		Variance	34.0	37.5	42.4	31.9	33.5	44.0	31.6	32.1	37.8

TABLE 5B MEAN AND VARIANCE OF SITTING HEIGHT BY COMBINED EXPOSURE DOSE OF PARENTS

表 5 B 両親の相加線量別の座高の平均値および分散値

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
Male	15	Number	3038	368	140	68	39	41	22	32	342
		Mean dose	0.0	0.0	4.0	14.3	28.1	66.4	139.5	398.1	61.8
		Mean	87.8	87.9	87.7	87.7	88.2	87.0	87.7	88.9	87.8
		Variance	12.1	11.2	10.6	9.3	9.3	9.3	11.8	8.3	10.0
	16	Number	3388	419	172	90	42	59	27	30	420
		Mean dose	0.0	0.0	4.1	14.8	27.9	64.9	134.1	484.1	60.1
		Mean	89.0	89.2	89.3	89.0	89.3	88.6	88.5	88.4	89.0
		Variance	10.1	10.3	9.6	11.3	7.2	8.2	8.8	11.0	9.6
	17	Number	3161	399	174	79	40	59	38	43	433
		Mean dose	0.0	0.0	3.8	14.4	29.6	62.8	134.5	367.3	63.7
		Mean	89.7	89.9	90.1	90.4	89.8	90.0	89.7	89.7	90.0
		Variance	8.5	10.0	10.2	8.8	5.9	9.4	7.2	9.3	9.1

TABLE 5B Continued 続き

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
Female	15	Number	2860	435	146	64	45	52	35	32	374
		Mean dose	0.0	0.0	3.8	14.5	29.1	64.2	138.5	407.3	64.2
		Mean	84.5	84.8	84.7	85.0	84.8	84.7	84.4	84.1	84.7
		Variance	7.7	7.6	7.5	7.2	8.1	8.9	5.8	8.3	7.6
	16	Number	3057	427	158	79	48	51	39	27	402
		Mean dose	0.0	0.0	4.2	14.7	27.9	62.2	143.5	440.6	59.1
		Mean	84.8	84.9	84.6	84.6	85.0	84.9	84.2	84.8	84.6
		Variance	7.2	7.0	9.4	5.7	7.3	5.7	8.2	9.3	7.8
	17	Number	2881	440	153	70	46	59	37	30	395
		Mean dose	0.0	0.0	3.8	14.4	28.5	69.9	128.7	418.0	61.5
		Mean	84.8	85.1	84.8	84.6	84.7	84.8	85.3	84.9	84.8
		Variance	7.0	6.9	8.0	7.2	6.6	5.6	9.5	11.3	7.7

TABLE 5C MEAN AND VARIANCE OF CHEST CIRCUMFERENCE BY COMBINED EXPOSURE DOSE OF PARENTS

表 5 C 両親の相加線量別の胸囲の平均値および分散値

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
Male	15	Number	3038	368	140	68	39	41	22	32	342
		Mean dose	0.0	0.0	4.0	14.3	28.1	66.4	139.5	398.1	61.8
		Mean	81.0	81.0	80.8	80.7	80.9	79.7	80.5	81.5	80.7
		Variance	25.3	26.3	26.3	17.7	23.9	28.0	13.3	20.7	23.0
	16	Number	3388	419	172	90	42	59	27	30	420
		Mean dose	0.0	0.0	4.1	14.8	27.9	64.9	134.1	484.1	60.1
		Mean	83.2	83.4	83.7	84.4	83.5	82.1	83.9	83.2	83.6
		Variance	23.4	26.4	26.0	34.5	23.6	19.7	24.7	29.0	27.0
	17	Number	3161	399	174	79	40	59	38	43	433
		Mean dose	0.0	0.0	3.8	14.4	29.6	62.8	134.5	367.3	63.7
		Mean	84.8	85.2	85.3	85.2	85.5	85.3	86.4	86.0	85.5
		Variance	22.6	23.6	21.7	20.8	23.8	32.1	23.2	22.9	23.3
Female	15	Number	2860	435	146	64	45	52	35	32	374
		Mean dose	0.0	0.0	3.8	14.5	29.1	64.2	138.5	407.3	64.2
		Mean	79.2	79.4	78.6	79.2	79.2	79.6	79.1	79.0	79.0
		Variance	24.2	23.2	22.0	19.8	20.5	18.7	25.7	29.7	21.8
	16	Number	3057	427	158	79	48	51	39	27	402
		Mean dose	0.0	0.0	4.2	14.7	27.9	62.2	143.5	440.6	59.1
		Mean	80.5	80.3	79.9	80.3	80.0	79.4	80.8	80.3	80.1
		Variance	23.7	27.1	22.2	27.2	16.8	25.8	30.1	31.2	24.2
	17	Number	2881	440	153	70	46	59	37	30	395
		Mean dose	0.0	0.0	3.8	14.4	28.5	69.9	128.7	418.0	61.5
		Mean	81.3	81.0	80.7	80.7	80.2	82.0	80.6	80.9	80.8
		Variance	23.0	23.5	29.1	28.3	19.0	29.7	16.9	15.0	25.6

TABLE 6A COMPARISON OF MEAN VALUES FOR NONEXPOSED PARENTS VS <1 RAD PARENTS AND NONEXPOSED PARENTS VS 1 OR MORE RAD PARENTS

表 6 A 両親とも非被爆者の子と両親の相加線量が 1 rad 未満の子および両親とも非被爆者の子と両親の相加線量が 1 rad 以上の子の各測定平均値の比較

Offspring		Nonexposed vs <1 rad			Nonexposed vs 1 or more rad		
Sex	Age	Nonexp.	<1 rad	Test	Nonexp.	1 or more rad	Test
Weight							
Male	15	52.7	52.7	.000 NS	52.7	52.1	1.551 NS
	16	55.3	55.9	1.561 NS	55.3	55.3	.000 NS
	17	56.8	57.2	1.108 NS	56.8	57.5	2.000 P<.05
Female	15	48.4	48.5	.325 NS	48.4	48.3	.311 NS
	16	50.1	49.9	.598 NS	50.1	49.6	1.570 NS
	17	50.6	50.3	.963 NS	50.6	50.2	1.220 NS
Sitting Height							
Male	15	87.8	87.9	.539 NS	87.8	87.8	.000 NS
	16	89.0	89.2	1.205 NS	89.0	89.0	.000 NS
	17	89.7	89.9	1.201 NS	89.7	90.0	1.949 Sugg
Female	15	84.5	84.8	2.113 P<.05	84.5	84.7	1.318 NS
	16	84.8	84.9	.730 NS	84.8	84.6	1.356 NS
	17	84.8	85.1	2.229 P<.05	84.8	84.8	.000 NS
Chest Circumference							
Male	15	81.0	81.0	.000 NS	81.0	80.7	1.091 NS
	16	83.2	83.4	.756 NS	83.2	83.6	1.499 NS
	17	84.8	85.2	1.554 NS	84.8	85.5	2.835 P<.01
Female	15	79.2	79.4	.805 NS	79.2	79.0	.774 NS
	16	80.5	80.3	.749 NS	80.5	80.1	1.534 NS
	17	81.3	81.0	1.211 NS	81.3	80.8	1.853 Sugg

TABLE 6B COMPARISON OF VARIANCE VALUES FOR NONEXPOSED PARENTS VS <1 RAD PARENTS AND NONEXPOSED PARENTS VS 1 OR MORE RAD PARENTS

表 6 B 両親とも非被爆者の子と両親の相加線量が 1 rad 未満の子および両親とも非被爆者の子と両親の相加線量が 1 rad 以上の子の分散値の比較

Offspring		Nonexposed vs <1 rad			Nonexposed vs 1 or more rad		
Sex	Age	Nonexp.	<1 rad	Test	Nonexp.	1 or more rad	Test
Weight							
Male	15	49.5	49.8	1.01 NS	49.5	45.6	1.09 NS
	16	44.3	56.4	1.27 P<.001	44.3	51.8	1.17 P<.001
	17	42.8	46.6	1.09 NS	42.8	47.2	1.10 NS
Female	15	35.3	35.9	1.02 NS	35.3	34.1	1.04 NS
	16	35.7	42.8	1.20 P<.05	35.7	36.1	1.01 NS
	17	34.0	37.5	1.10 NS	34.0	37.8	1.11 P<.05

TABLE 6B Continued 続き

Offspring		Nonexposed vs <1 rad			Nonexposed vs 1 or more rad		
Sex	Age	Nonexp.	<1 rad	Test	Nonexp.	1 or more rad	Test
Sitting Height							
Male	15	12.1	11.2	1.08 NS	12.1	10.0	1.21 P<.001
	16	10.1	10.3	1.02 NS	10.1	9.6	1.05 NS
	17	8.5	10.0	1.18 P<.05	8.5	9.1	1.07 NS
Female	15	7.7	7.6	1.01 NS	7.7	7.6	1.01 NS
	16	7.2	7.0	1.03 NS	7.2	7.8	1.08 NS
	17	7.0	6.9	1.01 NS	7.0	7.7	1.10 NS
Chest Circumference							
Male	15	25.3	26.3	1.04 NS	25.3	23.0	1.10 NS
	16	23.4	26.4	1.13 P<.05	23.4	27.0	1.15 P<.001
	17	22.6	23.6	1.04 NS	22.6	23.3	1.03 NS
Female	15	24.2	23.2	1.04 NS	24.2	21.8	1.11 NS
	16	23.7	27.1	1.14 P<.05	23.7	24.2	1.02 NS
	17	23.0	23.5	1.02 NS	23.0	25.6	1.11 NS

TABLE 7A REGRESSION COEFFICIENT OF WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF OFFSPRING BY PARENTAL EXPOSURE STATUS

表 7 A 両親の被爆状態別の子の体重、座高、および胸囲の回帰係数

Offspring		Nonexposed & Exposed Parents			Exposed Parents		
Sex	Age	Constant	Slope	Test df 5	Constant	Slope	Test df 4
Weight							
Male	15	52.6	-.00155	.532 NS	52.0	.00088	.327 NS
	16	55.3	-.00181	.883 NS	55.2	-.00159	.699 NS
	17	56.9	.00198	.966 NS	57.4	-.00033	.225 NS
Female	15	48.4	.00053	.533 NS	48.3	.00103	1.006 NS
	16	50.0	-.00085	.433 NS	49.6	.00120	1.106 NS
	17	50.6	-.00039	.177 NS	50.1	.00144	.735 NS
Sitting Height							
Male	15	87.8	.00224	1.929 NS	87.6	.00283	2.406 Sugg
	16	89.0	-.00157	1.846 NS	89.1	-.00201	2.314 Sugg
	17	89.7	.00019	.146 NS	90.1	-.00141	1.970 NS
Female	15	84.5	-.00076	.831 NS	84.8	-.00184	3.909 P<.02
	16	84.8	-.00048	.563 NS	84.7	.00000	.005 NS
	17	84.8	.00055	.900 NS	84.8	.00076	1.115 NS
Chest Circumference							
Male	15	81.0	.00027	.182 NS	80.6	.00160	1.245 NS
	16	83.2	-.00023	.097 NS	83.6	-.00136	.551 NS
	17	84.8	.00429	2.590 P<.05	85.3	.00244	2.571 Sugg
Female	15	79.2	-.00014	.007 NS	79.0	.00073	.116 NS
	16	80.4	-.00087	.410 NS	80.0	.00114	.855 NS
	17	81.3	-.00120	.694 NS	80.7	.00055	.362 NS

TABLE 7B REGRESSION COEFFICIENT OF WEIGHT, SITTING HEIGHT, AND CHEST CIRCUMFERENCE OF OFFSPRING BY COMBINED DOSE GROUP

表 7B 両親の相加線量別の子の体重, 座高, および胸囲の回帰係数

Offspring		Nonexposed & Exposed Parents			Exposed Parents		
Sex	Age	Constant	Slope	Test df 5	Constant	Slope	Test df 4
Weight							
Male	15	49.5	-.06594	1.961 NS	46.8	-.05435	1.467 NS
	16	44.3	-.01554	.355 NS	44.7	-.01692	.340 NS
	17	42.8	-.00658	.279 NS	48.8	-.02815	1.559 NS
Female	15	35.3	.01202	.586 NS	33.4	.02463	1.384 NS
	16	35.7	.01601	.586 NS	33.9	.02497	.910 NS
	17	34.0	-.00207	.072 NS	37.9	-.01739	.653 NS
Sitting Height							
Male	15	12.1	-.01270	1.558 NS	10.2	-.00487	1.620 NS
	16	10.1	-.00396	.569 NS	9.3	.00034	.051 NS
	17	8.5	-.00084	.077 NS	9.5	-.00775	.761 NS
Female	15	7.7	-.00316	.895 NS	7.4	-.00179	.487 NS
	16	7.2	.00207	.196 NS	7.8	-.00157	.139 NS
	17	7.0	.00527	.808 NS	7.2	.00404	.552 NS
Chest Circumference							
Male	15	25.3	-.08500	5.238 P<.01	24.5	-.07835	3.781 P<.02
	16	23.4	.00931	.658 NS	25.5	.00270	.195 NS
	17	22.6	.00298	.351 NS	22.0	.00555	.621 NS
Female	15	24.2	.00322	.181 NS	20.9	.01946	2.229 Sugg
	16	23.7	.00823	.321 NS	21.6	.02135	.965 NS
	17	23.0	-.01988	1.237 NS	27.3	-.03511	2.642 Sugg

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