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

3. STATURE OF 12- TO 14-YEAR-OLD JUNIOR HIGH SCHOOL STUDENTS IN HIROSHIMA

原爆放射線のF_1世代への成長発育に及ぼす遺伝的影響に関する研究

3．広島の12歳から14歳までの中学生の身長について

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Note: The last two tables included in this report were inadvertently omitted from the previous report.[1]

注：末尾の二つの表は前回の報告[1]の際，不注意により省略されたので，今回の報告に加える．

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3．広島の12歳から14歳までの中学生の身長について

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SUMMARY

In a search for possible genetic effects of atomic bomb radiation on the stature of the offspring of A-bomb survivors a comparative study has been made of junior high school students 12 to 14 years of age born in Hiroshima to exposed and nonexposed parents.

The mean stature and variance of the offspring and the covariance and correlation between one parent or the sum for both parents and their children were compared. The observed differences were both positive and negative in sign, and only a few were statistically significant. No clear tendency was demonstrated. When one parent was exposed, seven variance values of the offspring were statistically significant and six were positive in sign. Regression analyses of the mean stature and variance of the offspring, or the covariance, and correlation between one parent or the sum for both parents and their offspring by parental radiation dose revealed no clear effects of exposure. Only a very few of the regression coefficients were significantly different from zero.

While genetic effects of A-bomb radiation on the stature of the children of exposed parents cannot be ruled out by this study, neither can such effects be unequivocally demonstrated.

要 約

広島の原爆被爆者及び非被爆者から生まれた12歳から14歳までの中学生の資料を用いて，原爆放射線が被爆者の子供の身長に及ぼす遺伝的影響を調べるため比較検討を行った．

被爆群と非被爆群について子の平均身長と分散及び片親と子又は両親と子の間の共分散と相関について比較検討した．両群間の差は正と負の両符号をもつが，統計的に有意なものは少なく，特定の傾向を示さない．片親被爆の場合，子の分散で統計的有意水準に達するものは七つで，そのうち六つは正の符号をもつ．更に，子の平均身長と分散及び片親と子又は両親の和と子の間の共分散と相関について，親の被曝線量への回帰係数を推定した．この場合も特定の傾向を示さず，有意水準に達するのはごく一部である．

以上のごとく，原爆放射線が身長に及ぼす遺伝的影響を明確に結論付けることも，その存在について証明することもできなかった．

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INTRODUCTION

The authors previously examined the stature, weight, sitting height, and chest circumference of Hiroshima senior high school students 15 to 17 years of age born to A-bomb survivors and nonexposed parents for possible genetic effects of A-bomb radiation on their growth and development.[1,2] No statistically significant effects were noted.

In the present study a similar analysis was made of the stature of junior high school students 12 to 14 years of age belonging to the same study population.

MATERIALS

The methods of data collection and analysis of stature were the same as those detailed previously.[1] Subjects were confined to those who from birth to the time of the survey had resided in Hiroshima City, excluding offspring of parents of consanguineous marriage, foreign nationals, twins, adopted children, and offspring of parents exposed in Nagasaki.

RESULTS

Mean and Variance of Offspring Stature, Parent-Offspring Covariance, and Correlation Coefficient by Parental Dose

Estimates of the mean stature and the variance in stature of offspring, and of the parent-offspring covariance and correlation coefficient by age and sex of the offspring, are shown for the combined parental radiation doses in Tables 1 and 2.

Because of the paucity of data for offspring born to exposed parents, they were compared with those of nonexposed parents by division into two groups: those with a parental dose of 1+rad and those with <1 rad. The results are shown in Table 3.

First, compared with the offspring of nonexposed parents the mean stature of 12-year-old males born to parents exposed to 1+rad was lower by 1.59 cm, and this difference is statistically significant (1% level). No other statistically significant differences nor specific trends occurred. The variance of stature of the two groups also showed no statistically significant differences. Parent-offspring covariance and correlation changed, as described in Report 1,[1] according to the father-mother correlation.

緒　言

著者らは前回の調査で原爆放射線の，成長発育に及ぼす遺伝的影響を検討するため，広島の被爆群と非被爆群の子の15歳から17歳までの高校生の身長，体重，座高及び胸囲を調査したが，[1,2] 統計的に有意な影響はみられなかった．

今回は，同じ調査集団の12歳から14歳までの中学生の身長について同様の分析を試みた．

資　料

資料収集及び身長解析の方法は前回述べたものと同様である．[1] 対象者は出生時から調査時点まで広島市内に居住していた者に限定し，そのうち，親が近親婚の者，外国人，双生児，養子，並びに親が長崎で被爆した者を除外した．

結　果

親の被曝線量別にみた子の身長の平均と分散，及び親子間の共分散と相関係数

両親の相加線量別にみた子の年齢別・性別の平均身長と分散，及び親子間の共分散と相関係数の推定値を表1及び表2に示す．

被爆群の資料が少ないため，ここでは，被爆群を両親の線量別に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に示す．

まず，非被爆群と比較すると，1 rad以上群の12歳男の平均身長の方が1.59㎝低く，この差は統計的に有意である（1％水準）．そのほかには統計的に有意な差又は特定の傾向も見られなかった．被爆群と非被爆群の身長分散も統計的有意水準に達しなかった．親子間の共分散及び相関は，第1報[1]に記したごとく，父母間の相関によって変動する．本資料の父母間の身長

Father-mother correlation of stature in the present data was r_{FM}=0.19～0.22 (average 0.20 ±0.01) in the offspring of nonexposed parents, r_{FM}=0.14～0.24 (average 0.19±0.03) in the offspring with parents exposed to 1+rad, and r_{FM}=0.11～0.34 (average 0.23±0.02) in the offspring with parents exposed to <1 rad, the averages all being statistically significant at the 5% level. Many of the parent-offspring covariance and correlation values of offspring of exposed parents tended to be larger than those of offspring of nonexposed parents. The difference between Z transformations of the correlation coefficients was not statistically significant, however.

相関は，非被爆群でr_{FM}＝0.19～0.22(平均0.20±0.01)，1 rad 以上群でr_{FM}＝0.14～0.24(平均0.19±0.03)及び1 rad 未満群でr_{FM}＝0.11～0.34(平均0.23±0.02)であり，いずれもその平均は5％水準で統計的に有意である．被爆群の親子間の共分散及び相関の方が非被爆群のそれに比べて，数字の上からは大きい傾向を示すものが多い．しかしながら，相関係数のZ変換による差は統計的に有意ではない．

A comparison of mean stature between offspring of parents exposed to <1 rad and offspring of nonexposed parents showed no statistically significant differences. Many of the variance values tended to be larger in the offspring of exposed parents than in the offspring of nonexposed parents for both sexes of every age, but the differences were not statistically significant. A comparison between offspring of exposed and of nonexposed parents, showed that the parent-offspring covariance values tended to be larger in the former. Correlation values, however, tended to be larger in the offspring of nonexposed parents, but without statistically significant differences.

1 rad 未満群と非被爆群の子の平均身長を比較すると統計的有意差は見られない．分散についてみると，男女ともいずれの年齢においてもすべて被爆群の子の方が非被爆群のそれに比べ大きい傾向を示すものが多いが，その差は統計的に有意ではない．被爆群と非被爆群の子を比較すると，親子間の共分散の数値は被爆群の方が大きい傾向を示す．しかしながら，相関は非被爆群の方がそれぞれ大きい傾向を示すものが多い．しかしそれは統計的に有意な差ではない．

Two weighted regression analyses were made for the combined parental doses by sex and age of the offspring, one using 0 rad as the dose for the nonexposed group and the other excluding all nonexposed parents. Further, because the RERF dose estimates of <1 rad for distally exposed survivors are treated as 0 rad, all offspring of parents in that category were excluded. The results of the two analyses are shown in Table 4. Only the correlation of 13-year-old girls is significantly different from zero. When modified by the correlation between father and mother, this estimate too is not statistically significant. The offspring variance and the covariance and correlation between parent and offspring exhibit no clear tendency, and none of the regression coefficients were significant.

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二つの方法で行った．一つは，非被爆群の被曝線量を0 rad とした場合で，もう一つは，非被爆群をすべて除外した場合である．更に，1 rad 未満の遠距離被爆者に対する放影研の線量推定値は0 rad として扱われているために，その範囲のものはすべて除外した．二つの解析の結果を表4に示す．13歳女の相関のみが0と有意に異なる．父母間の相関で補正した場合，この数値も統計的に有意水準に達しない．子の分散，親子間の共分散及び相関は明確な傾向を示さず，いずれの回帰係数も有意ではない．

Tables 5 and 6 show by age and sex of offspring the mean height and variance when only one parent was exposed. Also shown are the

表5及び表6は，片親のみが被爆の場合，平均身長と分散を子の年齢別・性別に示す．また，親子間の

covariance and correlation coefficients between parent and offspring and the values when adjusted for the correlation between parents.

The correlation of height between father and mother was r_{FM}=0.18~0.22 (average 0.20 ±0.01) in the nonexposed group, and −0.04~0.30 (average 0.12±0.07) in the 1+rad group when the father only was exposed. It was 0.06~0.29 (average 0.18±0.03) when the mother only was exposed. The combined averages were r_{FM} =0.17±0.03. In the <1 rad group, r_{FM}=0.08 ~0.55 (average 0.23±0.05) when the father alone was exposed and r_{FM}=0.09~0.38 (average 0.20±0.03) when only the mother was exposed. The average of these two was 0.20±0.03.

Tests of differences were made between the group with either father or mother exposed and the nonexposed group. Again, because of the small number in the exposed group, those with one parent exposed were divided into two groups according to dose (1+rad and <1 rad) and a test was made of the differences with the nonexposed group (Tables 7-10).

Father Only Exposed. First, in a comparison between the 1+rad group and the nonexposed group many of the mean height values tended to be lower in the exposed group for boys, but the differences were not statistically significant. For girls, mean height tended to be higher in the exposed group in every age, but without statistically significant differences. Many of the variance values tended to be larger in the exposed group than in the nonexposed group for both sexes; the differences were statistically significant in 12-year-old boys at the level of 5%~10% and at 5% in those 13 years of age. In girls it was at the level of 1% in those 13 years of age. The correlation between father and 12-year-old girls of the exposed group had a minus sign and was statistically significant at the level of 5% compared with that of the nonexposed group. However, many of the other covariance and correlation values, compared with those of the nonexposed group, tended to be larger but in every case the difference was not statistically significant.

In a comparison between the <1 rad group and the nonexposed group, many of the mean height values were lower but not significantly so in the exposed group for both sexes. Variances tended to be larger in the exposed group than in the nonexposed for both sexes, and, of the differ-

共分散と相関係数及び父母間の相関で補正した場合の数値も示す.

ここで，父母間の身長相関についてみると，非被爆者群でr_{FM}=0.18~0.22(平均0.20±0.01)，1 rad 以上群で，父被爆の場合−0.04~0.30(平均0.12±0.07)，母被爆の場合0.06~0.29(平均0.18±0.03)である．両者の平均はr_{FM}=0.17±0.03である．また，1 rad 未満群で，父被爆の場合r_{FM}=0.08~0.55(平均0.23±0.05)，母被爆の場合r_{FM}=0.09~0.38(平均0.20±0.03)で，両者の平均は0.20±0.03である．

片親被爆群と非被爆群間の差の検定を行った．この場合も，被爆群の資料が少ないので，片親被爆群を線量によって 1 rad 以上群及び 1 rad 未満群の二つに分け，非被爆群との差を検定した(表 7−10)．

父のみ被爆． まず，1 rad 以上群と非被爆群の比較で，男は被爆群の方が平均身長は低い傾向を示すものが多いが，その差は統計的に有意ではない．女では，いずれの年齢においても被爆群の方が平均身長は高い傾向を示すが，統計的に有意な差はない．分散についてみると，被爆群の分散は男女とも非被爆群の分散に比べて大きい傾向を示すものが多く，そのうち，12歳の男では 5 %−10%水準，13歳では 5 % 水準，女の13歳では 1 %水準で統計的に有意である．被爆群の12歳女の父娘間の相関は負の符号をもち，非被爆群のそれに比べ 5 %水準で統計的に有意である．しかし，その他の共分散及び相関は非被爆群のそれに比べ，大きい傾向を示すものがやや多いが，いずれもその差は統計的に有意ではない．

1 rad 未満群と非被爆群の比較で，平均身長は被爆群の方が男女とも低いものが多いが，その差は有意ではない．分散は被爆群の方が非被爆群の分散に

ences, those for boys 12 and 13 years of age were statistically significant at the level of 1% and those for girls of 12 and 13 years of age, at 5% and 1%, respectively. Many of the covariance values between father and offspring were larger in the exposed group than in the nonexposed, but the differences were not statistically significant. The covariance and correlation values between mother and offspring were often larger in the exposed group than in the nonexposed but only in the correlation between mother and 13-year-old boys was the difference statistically significant.

比べ，男女とも大きい傾向を示し，そのうち，男の12歳と13歳では1%水準，女の12歳で5%水準，13歳で1%水準で統計的に有意である．父子間の共分散は被爆群の方が非被爆群に比べて大きいが，その差は統計的に有意ではない．母子間の共分散及び相関は被爆群の方が非被爆群に比べ大きいことが多いが，13歳男の母子間の相関においてのみ，その差は統計的に有意である．

Mother Only Exposed. In a comparison between the 1+rad group and the nonexposed group, many of the mean stature values tended to be lower in the offspring of exposed parents, but the differences were not statistically significant. Many of the variance values tended to be larger in the exposed group than in the nonexposed, but not significantly so. The covariance and correlation values between father and offspring tended to be larger in the exposed group than in the nonexposed, but the differences were not statistically significant. Many of the covariance values between mother and offspring tended to be smaller in the exposed group than in the nonexposed and many of the correlation values tended to be larger, but the differences were not statistically significant.

母のみ被爆．1 rad以上群と非被爆群の比較で，平均身長は被爆群の子の方が低い傾向を示すものが多いが，その差は統計的に有意ではない．分散は被爆群の方が非被爆群に比べ大きい傾向を示すものが多いが，それは有意ではない．父子間の共分散及び相関は被爆群の方が非被爆群に比べ大きい傾向を示すものが多いが，その差は統計的に有意ではない．母子間の共分散は被爆群の方が非被爆群に比べ小さい傾向を示すものが多く，相関は大きい傾向を示すものが多いが，その差は統計的に有意ではない．

Mean statures between the <1 rad group and the nonexposed group were not significantly different. Variances tended to be larger in the exposed group than in the nonexposed for both sexes, but the differences were not statistically significant. Many of the covariance values between father and offspring were larger in the exposed group than in the nonexposed, and the correlation values were smaller, but the differences were not statistically significant. The covariance and correlation values between mother and offspring were frequently larger in the offspring of exposed parents than of nonexposed parents, but the differences were not statistically significant.

1 rad未満群と非被爆群の平均身長は統計的差異を示さない．分散は男女とも被爆群の方が非被爆群に比べて大きい傾向を示すが，その差は統計的に有意ではない．父子間の共分散は被爆群の方に非被爆群に比べ大きいものが多く，相関は小さいが，その差は統計的に有意ではない．母子間の共分散及び相関は被爆群の方が非被爆群に比べ大きい場合が多いが，その差は統計的に有意ではない．

Weighted regression analyses were made where one parent was exposed and the other not (i.e., father exposed X mother not exposed and vice versa) by sex and age of the offspring. Two analyses were made, one using and the other excluding the 0 rad dose component of the both parents not exposed group. The results are

子の年齢別・性別に，片親被爆(父被爆×母非被爆及びその逆)の場合の加重回帰分析を試みた．分析は，両親非被爆群の0 rad被曝線量を用いた場合と除外した場合の2とおりの方法で行った．結果を表11－

shown in Tables 11-14.

Father Exposed X Mother not Exposed. When the both-parents-not-exposed group was used, many of the regression coefficients of mean stature and variance of offspring and of correlation between father and offspring and between mother and offspring had a plus sign, but none were statistically significant. When the both-parents-not-exposed group was excluded, many of the regression coefficients of mean stature of offspring had a plus sign, the regression coefficients of variance presented no specific tendency, and none were statistically significant. Many of the regression coefficients of correlation between father and offspring had a plus sign, and, among them, that for 13-year-old boys was significant at the 1% level. The regression coefficients of correlation between mother and offspring presented no specific tendency, but that for 12-year-old boys had a plus sign and was statistically significant at the 1% level.

Father not Exposed X Mother Exposed. When the both-parents-not-exposed group was used, the regression coefficients of mean stature and variance of offspring and of correlation between father and offspring and between mother and offspring presented no specific tendency for signs, but, among them, that of mean stature of 12-year-old boys had a minus sign and was statistically significant at the 1% level. That of variance also had a minus sign and was statistically significant at the 5% level. The regression coefficients of correlation between mother and offspring had a minus sign in 12- and 14-year-old offspring and a plus sign in 13-year-old offspring, and all were statistically significant at the 1% level. When the both-parents-not-exposed group was excluded, the regression coefficients of mean stature and variance of offspring and of correlation between father and offspring and between mother and offspring presented no specific tendency for signs. But, among them, that of mean stature of 12-year-old boys had a minus sign and was statistically significant at the 2% level. The correlations between father and offspring and between mother and offspring also had minus signs and were statistically significant at the 1% level. The correlation between mother and offspring 13 years of age had a plus sign and was statistically significant at the 1% level, while that for 14 years of age had a minus sign and was statistically significant at the 5% level.

表14に示す．

父被爆×母非被爆． まず，両親非被爆群を用いた場合，子の平均身長，分散及び父子間と母子間の相関の回帰係数は正の符号をもつものが多いが，いずれも統計的に有意ではない．次に両親非被爆群を除外した場合，子の平均身長の回帰は正の符号をもつものが多く，分散では特定の傾向を示さず，いずれも統計的に有意ではない．父子間の相関の回帰係数は正の符号をもつものが多く，その中で13歳男では１％水準で有意である．母子間の相関の回帰係数は特定の傾向を示さないが，12歳男児では正の符号をもち１％水準で統計的に有意である．

父非被爆×母被爆． 両親非被爆群を用いた場合，子の平均身長，分散及び父子間と母子間の相関の回帰係数は符号の上から特定の傾向を示さないけれども，これらのうち，12歳男の平均身長の回帰係数は負の符号をもち，１％水準で統計的に有意である．分散の回帰係数も負の符号をもち，５％水準で統計的に有意である．母子間の相関の回帰係数で，12歳と14歳では負の符号，13歳では正の符号をもち，いずれも１％水準で統計的に有意である．次に両親非被爆群を除外した場合，子の平均身長，分散及び父子間と母子間の相関の回帰係数は符号の上から特定の傾向を示さない．しかしこのうち，12歳男の平均身長の回帰係数は負の符号をもち２％水準で統計的に有意である．父子間及び母子間の相関も負の符号をもち，１％水準で有意である．13歳の母子間の相関は正の符号をもち，１％水準で統計的に有意であり，14歳の母子間の相関は負の符号をもち，５％の水準で統計的に有意である．

DISCUSSION

The data analyzed here were obtained on junior high school students of Hiroshima City between the ages of 12 and 14. Growth in stature in the junior high school period is marked and the variance is large. This period, of course, corresponds to the prepubertal rapid growth period. Further, the correlation of stature between parent and offspring by age of offspring[3-7] is commonly low in the junior high school ages. After World War II the period of rapid growth in stature has shifted with time to the younger age stratum. These facts must be borne in mind in the study of growth in these ages.

To detect genetic effects of A-bomb radiation on the growth and development of the F_1 generation the following must be considered:

The results of comparison of stature between the offspring of exposed parents and the offspring of nonexposed parents are influenced by the presence or absence of dominant genes in the system of genes governing stature. However, it is believed that the polygenic system governing stature probably has an additive gene action with hardly any dominant gene action.[1,4,6-8]

If some of the polygenes are located on the X-chromosome, a radiation effect would probably differ according to sex. If X-linked genes were involved, the expected order of the correlations between parent and offspring would be $r_{FS} < r_{MD} < r_{FD} = r_{MS}$ where F, M, D, S are father, mother, daughter, son respectively. The order of the correlations in Table 5 are $r_{FS} = 0.16 \sim 0.19$ (average 0.17 ± 0.01) $< r_{MS} = 0.18 \sim 0.21$ (average 0.19 ± 0.01) $< r_{FD} = 0.18 \sim 0.29$ (average 0.25 ± 0.01) $< r_{MD} = 0.22 \sim 0.31$ (average 0.27 ± 0.01), and this does not conform to the hypothesis of sex-linked inheritance. This is in agreement with the previous report.[1] Thus, the genes in the polygenic systems governing stature probably act additively and are located on autosomes.

It was seen that the mean stature of 12-year-old boys with both parents exposed to 1+rad is 1.59cm lower than that of offspring of nonexposed parents and that this difference is statistically significant at the 1% level (Table 3). Further, in the case of father not exposed ×

考　察

ここで分析した資料は12歳から14歳の広島市の中学生から入手したものである．中学生期の身長発育は著しく，分散も大きい．この時期は，もちろん前思春期の急成長期に該当する．また，子の年齢別，親子間の身長相関[3-7]は一般に，この中学生期の年齢では低い．第二次世界大戦後，この身長激増期は，時代の推移に伴なって若年齢層に移行している．この年齢層の成長に関する研究においては，これらの事実に留意しなければならない．

原爆放射線がF_1世代の身長発育に及ぼす遺伝的影響を検出するには，下記のことを検討すべきである．

身長を支配する遺伝子系に優性遺伝子が存在するかどうかによって，被爆群と非被爆群の子の身長の比較結果が左右される．しかし，身長を支配するポリジーン系は，ほとんど優性効果のない，相加的作用をすると考えられている．[1,4,6-8]

ポリジーンのうち一部がX染色体上に坐位するなら，性によって放射線の影響が異なるであろう．もし，X染色体関連遺伝子が関与しているとすれば，親子間の相関関係の期待される順位は$r_{FS} < r_{MD} < r_{FD} = r_{MS}$（F, M, D, Sはそれぞれ父，母，娘，息子）である．表5の相関の順位を見ると，$r_{FS} = 0.16 \sim 0.19$（平均0.17 ± 0.01）$< r_{MS} = 0.18 \sim 0.21$（平均$0.19 \pm 0.01$）$< r_{FD} = 0.18 \sim 0.29$（平均$0.25 \pm 0.01$）$< r_{MD} = 0.22 \sim 0.31$（平均$0.27 \pm 0.01$）で，伴性遺伝の仮説に適合しない．これは前回の報告[1]と一致する．以上のことから，身長を支配するポリジーン系は相加的作用をし，常染色体上に坐位するものと思われる．

両親被爆群の1 rad以上群の12歳男では非被爆群に比べ1.59cm低く，この差は1％水準で有意であることが認められている（表3）．また，父非被爆×

mother exposed, the regression coefficient of mean stature of 12-year-old boys upon dose was negative irrespective of whether the offspring of nonexposed parents were or were not included. At other ages, however, the same regression coefficients were very similar for both boys and girls and were not statistically significant. If stature is governed by genes which act additively and are located on autosomes as our results suggest, hardly any change would be expected in the mean stature of offspring as an effect of radiation, but environmental factors could have a substantial effect.[7-10] Thus, the decreased stature of 12-year-old boys born to exposed parents may be due to causes other than A-bomb radiation.

母被爆の場合，12歳男の平均身長の被曝線量への回帰係数は非被爆群を入れる入れないにかかわらず陰性である．しかし，その他の年齢では男女とも，同じ回帰係数はよく類似し，統計的に有意ではない．結果が示すとおり，身長は相加的に作用し，常染色体上に坐位する遺伝子に支配されるとすれば，放射線の影響を受けても子の平均身長にはほとんど変動を及ぼさないことが期待され，環境要因の方が実質的な影響力をもつであろう．[7-10] 以上のように，被爆者群の12歳男での平均身長の低下は，原爆放射線以外の原因によるものではないかと思われる．

It is probably more appropriate to search for genetic effects of radiation by comparing the variance of offspring of exposed and of nonexposed parents and the correlations between parent and offspring. Genetically, a larger variance and smaller parent-offspring correlation would be expected in the offspring of exposed parents than in those of nonexposed parents. In almost all cases the variance of offspring of parents exposed to <1 rad was larger than that of offspring of nonexposed parents, but the former exhibited no consistent effects when compared to the variance of offspring of parents exposed to 1+rad (Table 3,4,7-14). However, statistically significant differences were seen in seven cases when the offspring of the two groups of exposed parents were combined and in six of them the offspring variance was larger when the parents were exposed.

放射線による遺伝的影響は，被爆群と非被爆群の子の分散や親子間の相関の比較から検出する方がより妥当と思われる．遺伝的には非被爆群に比べ，被爆群の子の分散は大きく，親子間の相関は小さくなることが期待される．1 rad未満群では，被爆群の子の分散の方が非被爆群のそれに比べて大きいものがほとんどであるが，1 rad以上群の分散と比較した場合，1 rad未満群の子の分散は一貫した影響を示さない（表3，4，7－14）．しかし，両群を合わせて評価すると，統計的に有意な差が七つに認められ，このうち六つは親が被爆している場合の方が子の分散は大きい．

Parent-offspring correlations for offspring of exposed and of nonexposed parents have also been compared in Tables 3,4, and 7-14. The correlation between the sum for both parents and offspring for the 1+rad group was $r_{F+M\cdot O}$ = 0.20 ~ 0.42 (average 0.31 ± 0.02), higher than the correlation $r_{F+M\cdot O}$ = 0.22 ~ 0.38 (average 0.29 ± 0.01) for the nonexposed group. Further, the parent-offspring correlation $r_{F+M\cdot O}$ = 0.20 ~ 0.41 (average 0.30 ± 0.02) of the <1 rad group was also high. These findings do not conform to the genetic hypothesis.

被爆群と非被爆群の親子間の相関の比較については，すでに表3，4と表7－14に示した．1 rad以上群の両親の和と子の間の相関は $r_{F+M\cdot O}$ = 0.20～0.42（平均0.31±0.02）で，非被爆群の相関 $r_{F+M\cdot O}$ = 0.22～0.38（平均0.29±0.01）に比べて高い．また，1 rad未満群の親子間の相関 $r_{F+M\cdot O}$ = 0.20～0.41（平均0.30±0.02）も高い．このような知見は遺伝仮説に合致しない．

When one parent was exposed, if genetic effects of A-bomb radiation were to appear, the correlations to be expected by parent-offspring combination are $r_{F'S} < r_{MS}$ and $r_{F'D} < r_{MD}$ if the father alone was exposed and $r_{M'S} < r_{FS}$ and

片親被爆の場合，もし原爆放射線による遺伝的影響が現われるならば，親子の組合せ別に期待される相関は，父のみ被爆の場合，$r_{F'S} < r_{MS}$ 及び $r_{F'D} < r_{MD}$，

$r_{M'D} < r_{FD}$ when the mother only was exposed (where F,M,D, and S are as before and the prime indicates the parent to have been exposed). The observed correlations when paternal exposure was 1+rad are $r_{F'S} = 0.17 \pm 0.10 > r_{MS} = 0.16 \pm 0.10$ and $r_{F'D} = 0.19 \pm 0.08 < r_{MD} = 0.23 \pm 0.08$ and in case of maternal exposure are $r_{M'S} = 0.16 \pm 0.05 < r_{FS} = 0.17 \pm 0.05$ and $r_{M'D} = 0.27 \pm 0.04 < r_{FD} = 0.31 \pm 0.04$. Three of the four correlations conform to the genetic hypothesis. Since the correlation of stature did not conform to the hypothesis of sex-linked inheritance, the correlation of $r_{P'O} = 0.22 \pm 0.04 < r_{PO} = 0.23 \pm 0.04$ was obtained on summary of the above, which conforms to the genetic hypothesis, but none of the differences are statistically significant. In case of paternal exposure to <1 rad, $r_{F'S} = 0.24 \pm 0.07 > r_{MS} = 0.22 \pm 0.08$ and $r_{F'D} = 0.25 \pm 0.07 > r_{MD} = 0.23 \pm 0.07$ and in case of maternal exposure to same, $r_{M'S} = 0.15 \pm 0.04 > r_{FS} = 0.10 \pm 0.04$ and $r_{M'D} = 0.34 \pm 0.04 > r_{FD} = 0.25 \pm 0.04$, which, in summary, gives $r_{P'O} = 0.25 \pm 0.03 > r_{PO} = 0.19 \pm 0.04$: every result is contrary to the genetic hypothesis, but none of the differences are statistically significant. Finally, although some correlations between parents and offspring were statistically significant in the regression analysis, the signs of the regression coefficients exhibited no noteworthy tendency.

As described above, possible genetic effects of A-bomb radiation on stature were studied by examining the difference in the variances of offspring and parent-offspring correlations when the parents were and were not exposed. Very few of these differences were statistically significant and the signs of those short of statistical significance were not remarkable. Comparison of the correlations between father and offspring and mother and offspring when one parent was exposed to 1+rad, generally conformed with genetic expectations but were not significantly different. All other comparisons were contrary to the genetic hypothesis. Thus, no compelling evidence of a genetic effect ascribable to A-bomb radiation has emerged from this analysis.

母のみ被爆の場合 $r_{M'S} < r_{FS}$ 及び $r_{M'D} < r_{FD}$ である（F, M, D及びSは前述どおりで，符号′は被爆した親を示す）．1 rad 以上群の父被爆の場合，$r_{F'S} = 0.17 \pm 0.10 > r_{MS} = 0.16 \pm 0.10$，及び $r_{F'D} = 0.19 \pm 0.08 < r_{MD} = 0.23 \pm 0.08$，母被爆の場合 $r_{M'S} = 0.16 \pm 0.05 < r_{FS} = 0.17 \pm 0.05$，及び $r_{M'D} = 0.27 \pm 0.04 < r_{FD} = 0.31 \pm 0.04$ の相関がみられた．四つの相関のうち三つは遺伝仮説に合致する．身長は伴性遺伝の仮説に合致しなかったので，上記をまとめると，$r_{P'O} = 0.22 \pm 0.04 < r_{PO} = 0.23 \pm 0.04$ となり，遺伝仮説に適合するが，その差はいずれも統計的に有意ではない．1 rad 未満群の父被爆の場合，$r_{F'S} = 0.24 \pm 0.07 > r_{MS} = 0.22 \pm 0.08$，及び $r_{F'D} = 0.25 \pm 0.07 > r_{MD} = 0.23 \pm 0.07$，母被爆の場合，$r_{M'S} = 0.15 \pm 0.04 > r_{FS} = 0.10 \pm 0.04$，及び $r_{M'D} = 0.34 \pm 0.04 > r_{FD} = 0.25 \pm 0.04$ となり，これをまとめると $r_{P'O} = 0.25 \pm 0.03 > r_{PO} = 0.19 \pm 0.04$ が得られ，すべて遺伝仮説と逆の結果となるが，いずれもその差は統計的に有意ではない．最後に，親子間の相関の回帰分析でも統計的に有意なものもあるが，回帰係数の符号に顕著な傾向はみられない．

以上のごとく，両親が被爆している場合としていない場合の子の分散と親子間の相関における差を調べることによって，原爆放射線の身長に及ぼす遺伝的影響について検討した．これらの差のうち統計的に有意なものはごく一部であり，かつ統計的有意に達しないものの符号も顕著ではない．片親が 1 rad 以上に被曝している場合の父子間と母子間の相関の比較では，遺伝的期待にほぼ合致するが，有意な差はない．その他の比較はすべて遺伝仮説とは逆になった．以上のように，この解析から，原爆放射線による遺伝的影響を決定付ける証拠は見いだせなかった．

TABLE 1 MEAN, VARIANCE, COVARIANCE, & CORRELATION COEFFICIENT BY PARENTAL RADIATION DOSE (FATHER + MOTHER)

表 1　親の被曝線量別平均，分散，共分散，及び相関係数(父＋母の線量)

Item	Non-exposed	Radiation Dose in rad							
		<1	1-9	10-19	20-39	40-99	100-199	200+	1+
Boys Aged 12 Years									
No. of offspring	1501	229	38	54	23	34	16	22	187
Mean dose ($\bar{D}$)	0.00	0.00	4.71	14.43	27.00	67.18	129.25	644.00	107.48
Mean (M_O)	146.00	145.72	142.19	145.91	143.86	146.34	142.77	143.37	144.41
Variance (V_O)	56.39	70.57	45.50	48.96	90.12	70.96	36.17	65.02	59.24
Covariance ($W_{F+M\cdot O}$)	18.18	22.84	15.94	24.03	4.68	28.43	26.04	15.72	20.50
Correlation ($r_{F+M\cdot O}$)	.287	.274	.295	.384	.063	.430	.446	.191	.308
$r^*_{F+M\cdot O}$	.242	.204	.331	.309	.052	.440	.299	.120	.263
Boys Aged 13 Years									
No. of offspring	1761	276	76	46	29	32	20	22	225
Mean dose ($\bar{D}$)	0.00	0.00	4.80	14.11	27.69	63.13	141.85	382.55	67.07
Mean (M_O)	152.90	153.44	151.87	152.27	150.44	154.86	154.03	153.61	152.56
Variance (V_O)	64.96	65.82	70.86	55.20	59.03	53.30	67.73	54.51	62.24
Covariance ($W_{F+M\cdot O}$)	19.77	19.73	8.00	16.56	8.82	10.35	36.77	11.60	14.07
Correlation ($r_{F+M\cdot O}$)	.289	.269	.130	.280	.140	.161	.537	.213	.225
$r^*_{F+M\cdot O}$	.242	.209	.130	.257	.120	.121	.448	.165	.198
Boys Aged 14 Years									
No. of offspring	2105	338	79	65	38	47	28	29	286
Mean dose ($\bar{D}$)	0.00	0.00	4.99	14.66	27.18	61.60	141.04	400.62	72.87
Mean (M_O)	159.18	159.47	159.48	158.27	158.27	159.76	159.96	158.76	159.07
Variance (V_O)	51.35	58.27	53.76	45.77	53.90	53.83	30.70	59.59	49.88
Covariance ($W_{F+M\cdot O}$)	16.38	17.66	24.75	18.23	17.78	24.99	−12.01	33.95	19.22
Correlation ($r_{F+M\cdot O}$)	.265	.256	.356	.326	.270	.434	−.201	.585	.309
$r^*_{F+M\cdot O}$	.217	.207	.292	.303	.210	.385	−.122	.484	.252
Girls Aged 12 Years									
No. of offspring	1700	248	65	37	21	43	19	20	205
Mean dose ($\bar{D}$)	0.00	0.00	4.85	13.92	29.81	64.42	135.53	486.95	80.68
Mean (M_O)	147.53	147.01	147.62	147.96	147.17	146.92	148.46	148.48	147.65
Variance (V_O)	37.33	40.47	31.52	39.86	81.07	31.97	33.31	29.62	37.43
Covariance ($W_{F+M\cdot O}$)	15.92	18.07	16.56	13.10	18.60	18.77	40.21	3.30	17.06
Correlation ($r_{F+M\cdot O}$)	.314	.343	.396	.221	.249	.398	.539	.071	.316
$r^*_{F+M\cdot O}$	.259	.288	.376	.173	.278	.314	.346	.066	.265
Girls Aged 13 Years									
No. of offspring	1949	296	88	53	31	41	19	26	258
Mean dose ($\bar{D}$)	0.00	0.00	5.02	14.11	28.19	64.05	135.58	467.31	75.26
Mean (M_O)	151.25	150.70	151.79	150.37	150.62	151.38	151.38	152.12	151.30
Variance (V_O)	30.78	33.16	33.38	45.71	32.71	39.06	40.08	28.00	36.36
Covariance ($W_{F+M\cdot O}$)	17.63	21.81	20.68	14.54	27.30	25.79	17.48	34.13	21.55
Correlation ($r_{F+M\cdot O}$)	.392	.457	.406	.314	.544	.483	.417	.710	.430
$r^*_{F+M\cdot O}$	.327	.412	.320	.272	.522	.364	.428	.472	.348
Girls Aged 14 Years									
No. of offspring	2336	380	90	60	39	61	33	38	321
Mean dose ($\bar{D}$)	0.00	0.00	5.38	15.02	29.69	63.10	139.12	489.21	92.13
Mean (M_O)	153.45	153.31	153.46	153.51	152.51	153.46	153.35	154.79	153.50
Variance (V_O)	26.41	28.21	27.01	22.63	17.61	35.49	25.84	39.51	27.90
Covariance ($W_{F+M\cdot O}$)	19.19	21.03	23.84	19.82	11.93	22.56	24.35	33.83	22.64
Correlation ($r_{F+M\cdot O}$)	.460	.447	.564	.489	.316	.414	.586	.580	.496
$r^*_{F+M\cdot O}$	.383	.360	.470	.393	.270	.324	.493	.552	.416

TABLE 2 COVARIANCE & CORRELATION COEFFICIENT OF STATURE BETWEEN PARENTS & OFFSPRING CORRECTED FOR CORRELATION BETWEEN PARENTS

表 2　両親の相関で補正した親子の身長の共分散及び相関係数

Item	Radiation Dose in rad								
	Nonexposed	<1	1-9	10-19	20-39	40-99	100-199	200+	1+
Boys Aged 12 Years									
No. of offspring	1501	229	38	54	23	34	16	22	187
Mean Dose ($\bar{D}$)	0.00	0.00	4.71	14.43	27.00	67.18	129.25	644.00	107.48
Variance (V_O)	56.39	70.57	45.50	48.96	90.12	70.96	36.17	65.02	59.24
Variance (V_{F+M})	71.21	98.74	63.99	79.97	61.86	61.45	94.30	104.53	74.61
Covariance ($W_{F+M\cdot O}$)	18.18	22.84	15.94	24.03	4.68	28.43	26.04	15.72	20.50
Correlation coefficient ($r_{F+M\cdot O}$)	.2869	.2736	.2954	.3841	.0627	.4304	.4459	.1907	.3084
Correlation coefficient (r_{FM})	.1849	.3391	−.1065	.2428	.2148	−.0227	.4931	.5938	.1740
$r^*_{F+M\cdot O}$	.2422	.2043	.3306	.3091	.0516	.4404	.2986	.1197	.2627
W^*	15.34	17.05	17.84	19.34	3.85	29.08	17.44	9.87	17.46
W^{**}	15.34	17.06	17.84	19.34	3.85	29.09	17.44	9.86	17.46
$\bar{W}^*$	15.34	17.06	17.84	19.34	3.85	29.09	17.44	9.87	17.46
Boys Aged 13 Years									
No. of offspring	1761	276	76	46	29	32	20	22	225
Mean Dose ($\bar{D}$)	0.00	0.00	4.80	14.11	27.69	63.13	141.85	382.55	67.07
Variance (V_O)	64.96	65.82	70.86	55.20	59.03	53.30	67.73	54.51	62.24
Variance (V_{F+M})	72.21	81.86	53.19	63.19	67.71	77.08	69.27	54.63	62.69
Covariance ($W_{F+M\cdot O}$)	19.77	19.73	8.00	16.56	8.82	10.35	36.77	11.60	14.07
Correlation coefficient ($r_{F+M\cdot O}$)	.2887	.2688	.1302	.2803	.1396	.1614	.5368	.2125	.2253
Correlation coefficient (r_{FM})	.1919	.2836	.0051	.0910	.1620	.3352	.1977	.2850	.1359
$r^*_{F+M\cdot O}$	.2422	.2094	.1295	.2569	.1201	.1209	.4482	.1654	.1983
W^*	16.59	15.37	7.95	15.17	7.59	7.75	30.70	9.03	12.39
W^{**}	16.59	15.37	7.96	15.18	7.59	7.75	30.70	9.03	12.39
$\bar{W}^*$	16.59	15.37	7.96	15.18	7.59	7.75	30.70	9.03	12.39
Boys Aged 14 Years									
No. of offspring	2105	338	79	65	38	47	28	29	286
Mean Dose ($\bar{D}$)	0.00	0.00	4.99	14.66	27.18	61.60	141.04	400.62	72.87
Variance (V_O)	51.35	58.27	53.76	45.77	53.90	53.83	30.70	59.59	49.88
Variance (V_{F+M})	74.63	81.67	90.07	68.28	80.43	62.00	116.45	56.62	77.73
Covariance ($W_{F+M\cdot O}$)	16.38	17.66	24.75	18.23	17.78	24.99	−12.01	33.95	19.22
Correlation coefficient ($r_{F+M\cdot O}$)	.2645	.2560	.3556	.3260	.2701	.4326	−.2008	.5846	.3086
Correlation coefficient (r_{FM})	.2201	.2361	.2197	.0751	.2858	.1237	.6401	.2081	.2260
$r^*_{F+M\cdot O}$	.2168	.2071	.2915	.3032	.2101	.3850	−.1224	.4839	.2517
W^*	13.42	14.29	20.29	16.95	13.83	22.24	−7.32	28.11	15.67
W^{**}	13.43	14.29	20.29	16.96	13.83	22.24	−7.32	28.10	15.36
$\bar{W}^*$	13.42	14.29	20.29	16.95	13.83	22.24	−7.32	28.10	15.51

→

Mean dose ($\bar{D}$: unit=rad)
Mean (M_O = Mean stature of offspring in cm)
Variance (V_O = Variance in stature of offspring in cm^2)
Covariance ($W_{F+M\cdot O}$ = covariance of statures between "father+mother" and "offspring" in cm^2)
Correlation ($r_{F+M\cdot O}$ = correlation coefficient of statures between "father+mother" and "offspring")

TABLE 2 Continued 表2続き

Item	Radiation Dose in rad								
	Nonexposed	<1	1-9	10-19	20-39	40-99	100-199	200+	1+
Girls Aged 12 Years									
No. of offspring	1700	248	65	37	21	43	19	20	205
Mean Dose ($\bar{D}$)	0.00	0.00	4.85	13.92	29.81	64.42	135.53	486.95	80.68
Variance (V_O)	37.33	40.47	31.52	39.86	81.07	31.97	33.31	29.62	37.43
Variance (V_{F+M})	68.93	68.67	55.56	88.08	69.03	69.63	166.89	73.25	77.63
Covariance ($W_{F+M\cdot O}$)	15.92	18.07	16.56	13.10	18.60	18.77	40.21	3.30	17.06
Correlation coefficient ($r_{F+M\cdot O}$)	.3138	.3428	.3956	.2210	.2486	.3978	.5393	.0709	.3164
Correlation coefficient (r_{FM})	.2116	.1886	.0530	.2795	−.1071	.2663	.5599	.0673	.1928
$r^*_{F+M\cdot O}$	.2590	.2884	.3757	.1727	.2784	.3141	.3457	.0664	.2653
W^*	13.14	15.20	15.72	10.23	20.83	14.82	25.77	3.09	14.30
W^{**}	13.14	15.20	15.73	10.24	20.83	14.82	25.78	3.09	14.30
$\bar{W}^*$	13.14	15.20	15.72	10.24	20.83	14.82	25.78	3.09	14.30
Girls Aged 13 Years									
No. of offspring	1949	296	88	53	31	41	19	26	258
Mean Dose ($\bar{D}$)	0.00	0.00	5.02	14.11	28.19	64.05	135.58	467.31	75.26
Variance (V_O)	30.78	33.16	33.38	45.71	32.71	39.06	40.08	28.00	36.36
Variance (V_{F+M})	65.60	68.75	77.68	46.83	77.14	73.16	43.87	82.62	68.98
Covariance ($W_{F+M\cdot O}$)	17.63	21.81	20.68	14.54	27.30	25.79	17.48	34.13	21.55
Correlation coefficient ($r_{F+M\cdot O}$)	.3923	.4568	.4061	.3143	.5435	.4825	.4169	.7096	.4304
Correlation coefficient (r_{FM})	.1989	.1095	.2676	.1550	.0419	.3257	−.0265	.5051	.2372
$r^*_{F+M\cdot O}$	.3272	.4117	.3204	.2721	.5216	.3640	.4282	.4715	.3479
W^*	14.70	19.66	16.31	12.59	26.20	19.46	17.96	22.68	17.42
W^{**}	14.71	19.66	16.31	12.59	26.20	19.46	17.96	22.68	17.42
$\bar{W}^*$	14.70	19.66	16.31	12.59	26.20	19.46	17.96	22.68	17.42
Girls Aged 14 Years									
No. of offspring	2336	380	90	60	39	61	33	38	321
Mean Dose ($\bar{D}$)	0.00	0.00	5.38	15.02	29.69	63.10	139.12	489.21	92.13
Variance (V_O)	26.41	28.21	27.01	22.63	17.61	35.49	25.84	39.51	27.90
Variance (V_{F+M})	65.96	78.45	66.11	72.62	81.06	83.59	66.75	86.16	74.68
Covariance ($W_{F+M\cdot O}$)	19.19	21.03	23.84	19.82	11.93	22.56	24.35	33.83	22.64
Correlation coefficient ($r_{F+M\cdot O}$)	.4599	.4470	.5641	4889	.3156	.4142	.5863	.5798	.4960
Correlation coefficient (r_{FM})	.2019	.2425	.2005	.2439	.1701	.2791	.1893	.0510	.1919
$r^*_{F+M\cdot O}$	.3826	.3598	.4699	.3930	.2697	.3238	4930	.5517	.4161
W^*	15.97	16.93	19.85	15.93	10.19	17.64	20.48	32.19	18.99
W^{**}	15.97	16.93	19.85	15.93	10.20	17.64	20.47	32.19	18.99
$\bar{W}^*$	15.97	16.93	19.85	15.93	10.19	17.64	20.48	32.19	18.99

$$r^*_{F+M\cdot O} = \frac{r_{F+M\cdot O}}{(1 + r_{FM})},\quad W^* = r^*_{F+M\cdot O}\cdot\sqrt{V_O}\cdot\sqrt{V_{F+M}},\quad W^{**} = \frac{W_{F+M\cdot O}}{(1 + r_{FM})},\text{ and }\quad \bar{W}^* = (W^* + W^{**})/2$$

TABLE 3 RELATION OF NONEXPOSED VS <1 RAD AND NONEXPOSED VS 1+ RAD
表 3 「非被爆群」と「1 rad 未満群」の比較及び「非被爆群」と「1 rad 以上群」の比較

Item	Nonexposed vs <1 rad				Nonexposed vs 1+ rad			
	Nonexposed	<1 rad	Test	P	Nonexposed	1+ rad	Test	P
			Boys Aged 12 Years					
Mean	146.00	145.72	.48	NS	146.00	144.41	2.67	P<.01
Variance	56.39	70.57	1.25	NS	56.39	59.24	1.05	NS
Covariance	18.18	22.84	-	-	18.18	20.50	-	-
Z-value	.295	.281	.20	NS	.295	.319	.31	NS
$W^*_{F+M\cdot O}$	15.34	17.05	-	-	15.34	17.46	-	-
$Z^*_{F+M\cdot O}$	.247	.207	.56	NS	.247	.269	.28	NS
			Boys Aged 13 Years					
Mean	152.90	153.44	1.03	NS	152.90	152.56	.61	NS
Variance	64.96	65.82	1.01	NS	64.96	62.24	1.04	NS
Covariance	19.77	19.73	-	-	19.77	14.07	-	-
Z-value	.297	.276	.32	NS	.297	.229	.95	NS
$W^*_{F+M\cdot O}$	16.59	15.37	-	-	16.59	12.39	-	-
$Z^*_{F+M\cdot O}$	.247	.212	.54	NS	.247	.201	.65	NS
			Boys Aged 14 Years					
Mean	159.18	159.47	.65	NS	159.18	159.07	.25	NS
Variance	51.35	58.27	1.14	NS	51.35	49.88	1.03	NS
Covariance	16.38	17.66	-	-	16.38	19.22	-	-
Z-value	.271	.262	.15	NS	.271	.319	.76	NS
$W^*_{F+M\cdot O}$	13.42	14.29	-	-	13.42	15.67	-	-
$Z^*_{F+M\cdot O}$	.220	.210	.17	NS	.220	.257	.58	NS
			Girls Aged 12 Years					
Mean	147.53	147.01	1.21	NS	147.53	147.65	.27	NS
Variance	37.33	40.47	1.08	NS	37.33	37.43	1.00	NS
Covariance	15.92	18.07	-	-	15.92	17.06	-	-
Z-value	.325	.357	.47	NS	.325	.328	.04	NS
$W^*_{F+M\cdot O}$	13.14	15.20	-	-	13.14	14.30	-	-
$Z^*_{F+M\cdot O}$	.265	.297	.47	NS	.265	.272	.09	NS
			Girls Aged 13 Years					
Mean	151.25	150.70	1.54	NS	151.25	151.30	.13	NS
Variance	30.78	33.16	1.08	NS	30.78	36.36	.85	NS
Covariance	17.63	21.81	-	-	17.63	21.55	-	-
Z-value	.415	.493	1.25	NS	.415	.460	.68	NS
$W^*_{F+M\cdot O}$	14.70	19.66	-	-	14.70	17.42	-	-
$Z^*_{F+M\cdot O}$	.340	.438	1.56	NS	.340	.363	.35	NS
			Girls Aged 14 Years					
Mean	153.45	153.31	.48	NS	153.45	153.50	.16	NS
Variance	26.41	28.21	1.07	NS	26.41	27.90	1.06	NS
Covariance	19.19	21.03	-	-	19.19	22.64	-	-
Z-value	.497	.481	.29	NS	.497	.544	.79	NS
$W^*_{F+M\cdot O}$	15.97	16.93	-	-	15.97	18.99	-	-
$Z^*_{F+M\cdot O}$	.403	.377	.47	NS	.403	.443	.67	NS

NS: Not significant Sug: .05<P≤.10

TABLE 4 REGRESSION COEFFICIENT OF MEAN, VARIANCE, COVARIANCE, & Z-VALUE OF CORRELATION COEFFICIENT

表 4　平均，分散，共分散，及び相関係数のZ値への回帰係数

Item	Regression for Nonexposed & Exposed Data				Regression for Exposed Data			
	Constant	Slope	t-value	(df=5)	Constant	Slope	t-value	(df=4)
Boys Aged 12 Years								
Mean (M_O)	145.9	−.00485	1.150	NS	144.4	−.00169	.458	NS
Variance (V_O)	56.4	.01318	.453	-	56.8	.01244	.381	-
Covariance ($W_{F+M\cdot O}$)	18.4	−.00038	.027	-	20.5	−.00486	.322	-
Z-value ($Z_{F+M\cdot O}$)	.310	−.00009	.305	NS	.379	−.00023	.803	NS
$W^*_{F+M\cdot O}$	15.7	−.00541	.388	-	19.0	−.01231	.857	-
$Z^*_{F+M\cdot O}$	.260	−.00014	.490	NS	.344	−.00031	1.179	NS
Boys Aged 13 Years								
Mean (M_O)	152.8	.00295	.715	NS	152.2	.00530	1.207	NS
Variance (V_O)	64.8	−.02919	1.273	-	63.3	−.02320	.895	-
Covariance ($W_{F+M\cdot O}$)	19.1	−.01182	.366	-	12.0	.01658	.576	-
Z-value ($Z_{F+M\cdot O}$)	.298	−.00001	.025	NS	.201	.00038	.675	NS
$W^*_{F+M\cdot O}$	16.1	−.01199	.465	-	10.9	.00878	.362	-
$Z^*_{F+M\cdot O}$	.246	−.00008	.182	NS	.180	.00019	.451	NS
Boys Aged 14 Years								
Mean (M_O)	159.2	.00021	.093	NS	159.1	.00072	.281	NS
Variance (V_O)	51.2	.00420	.182	-	49.5	.01055	.402	-
Covariance ($W_{F+M\cdot O}$)	16.6	.02195	.633	-	18.7	.01379	.348	-
Z-value ($Z_{F+M\cdot O}$)	.280	.00092	1.415	NS	.315	.00079	1.043	NS
$W^*_{F+M\cdot O}$	13.7	.02125	.776	-	16.3	.01135	.370	-
$Z^*_{F+M\cdot O}$	.228	.00065	1.293	NS	.274	.00047	.827	NS
Girls Aged 12 Years								
Mean (M_O)	147.5	.00191	1.772	NS	147.5	.00200	1.622	NS
Variance (V_O)	37.6	−.01455	.385	-	40.0	−.02207	.517	-
Covariance ($W_{F+M\cdot O}$)	16.2	−.01064	.490	-	19.1	−.01974	.839	-
Z-value ($Z_{F+M\cdot O}$)	.342	−.00028	.675	NS	.416	−.00051	1.185	NS
$W^*_{F+M\cdot O}$	13.4	−.01153	.800	-	16.5	−.02105	1.472	-
$Z^*_{F+M\cdot O}$	.278	−.00031	1.052	NS	.350	−.00054	2.002	NS
Girls Aged 13 Years								
Mean (M_O)	151.3	.00172	1.324	NS	151.2	.00184	1.249	NS
Variance (V_O)	31.5	.00207	.098	-	38.1	−.01859	1.231	-
Covariance ($W_{F+M\cdot O}$)	17.8	.03610	2.928	-	19.9	.02961	2.340	-
Z-value ($Z_{F+M\cdot O}$)	.439	.00199	6.554	P<.01	.429	.00202	5.891	P<.01
$W^*_{F+M\cdot O}$	14.9	.01971	1.740	-	17.0	.01319	1.159	-
$Z^*_{F+M\cdot O}$	.355	.00052	1.794	NS	.377	.00045	1.396	NS
Girls Aged 14 Years								
Mean (M_O)	153.4	.00218	1.723	NS	153.2	.00302	2.447	Sug
Variance (V_O)	26.3	.02648	2.182	-	25.3	.02943	2.137	-
Covariance ($W_{F+M\cdot O}$)	19.3	.02999	3.389	-	20.1	.02758	2.757	-
Z-value ($Z_{F+M\cdot O}$)	.550	.00054	1.470	NS	.596	.00040	.974	NS
$W^*_{F+M\cdot O}$	16.0	.03225	4.460	-	16.1	.03187	3.826	-
$Z^*_{F+M\cdot O}$	.428	.00059	2.346	Sug	.438	.00056	1.918	NS

TABLE 5 MEAN & VARIANCE OF OFFSPRING STATURE BY PARENTAL EXPOSURE STATUS

表 5　親の被爆状態別，子の身長の平均と分散

Exposure Status		No. of Offspring	Mean Dose	Stature of Offspring	
Father	Mother			Mean	Variance
		Boys Aged 12 Years			
Nonexposed	Nonexposed	1501	0.00	146.00	56.39
Nonexposed	<1 rad	140	0.00	144.75	61.27
Nonexposed	1-9	22	4.77	144.06	56.96
Nonexposed	10-19	42	14.60	146.11	45.08
Nonexposed	20-99	32	51.19	145.05	63.05
Nonexposed	100+	20	504.90	143.25	36.24
Nonexposed	1+	116	107.36	144.94	50.60
<1 rad	Nonexposed	58	0.00	147.05	84.27
1-9	Nonexposed	6	4.17	139.27	21.87
10-19	Nonexposed	3	12.33	142.70	7.39
20-99	Nonexposed	6	41.50	145.42	104.79
100+	Nonexposed	8	264.50	144.14	97.34
1+	Nonexposed	23	105.52	143.01	66.31
Nonexposed 1+	1+ Nonexposed	139	107.06	144.62	53.26
		Boys Aged 13 Years			
Nonexposed	Nonexposed	1761	0.00	152.90	64.96
Nonexposed	<1 rad	194	0.00	154.04	61.40
Nonexposed	1-9	44	4.55	153.85	64.71
Nonexposed	10-19	28	14.46	151.20	48.95
Nonexposed	20-99	34	46.32	153.82	60.14
Nonexposed	100+	20	240.25	155.44	56.00
Nonexposed	1+	126	55.44	153.50	59.09
<1 rad	Nonexposed	41	0.00	150.41	86.13
1-9	Nonexposed	15	5.33	148.01	88.56
10-19	Nonexposed	5	15.20	154.88	61.07
20-99	Nonexposed	5	33.20	155.68	30.28
100+	Nonexposed	13	252.62	154.62	73.87
1+	Nonexposed	38	94.89	152.18	79.13
Nonexposed 1+	1+ Nonexposed	164	64.58	153.19	63.59
		Boys Aged 14 Years			
Nonexposed	Nonexposed	2105	0.00	159.18	51.35
Nonexposed	<1 rad	225	0.00	160.19	61.91
Nonexposed	1-9	47	4.55	159.47	43.84
Nonexposed	10-19	36	14.83	157.53	32.57
Nonexposed	20-99	43	44.86	159.37	56.11
Nonexposed	100+	32	307.28	158.26	49.36
Nonexposed	1+	158	79.18	158.75	45.51
<1 rad	Nonexposed	62	0.00	158.13	45.90
1-9	Nonexposed	8	6.38	163.36	30.05
10-19	Nonexposed	9	14.22	157.00	25.03
20-99	Nonexposed	12	60.33	160.58	79.94
100+	Nonexposed	11	277.27	160.27	45.69
1+	Nonexposed	40	98.82	160.25	49.25
Nonexposed 1+	1+ Nonexposed	198	83.15	159.05	46.38

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TABLE 5 Continued 表 5 続き

Exposure Status		No. of Offspring	Mean Dose	Stature of Offspring	
Father	Mother			Mean	Variance
		Girls Aged 12 Years			
Nonexposed	Nonexposed	1700	0.00	147.53	37.33
Nonexposed	<1 rad	158	0.00	147.08	40.12
Nonexposed	1-9	41	4.49	147.46	31.54
Nonexposed	10-19	19	13.79	147.60	36.02
Nonexposed	20-99	39	53.51	146.55	61.18
Nonexposed	100+	18	304.33	147.61	35.98
Nonexposed	1+	117	68.47	147.20	42.00
<1 rad	Nonexposed	49	0.00	146.63	46.06
1-9	Nonexposed	10	4.70	146.98	33.08
10-19	Nonexposed	8	13.25	149.45	35.59
20-99	Nonexposed	12	49.50	148.01	40.85
100+	Nonexposed	7	563.14	149.49	12.28
1+	Nonexposed	37	126.73	148.32	30.80
Nonexposed 1+	1+ Nonexposed	154	82.47	147.47	39.32
		Girls Aged 13 Years			
Nonexposed	Nonexposed	1949	0.00	151.25	30.78
Nonexposed	<1 rad	194	0.00	150.54	33.24
Nonexposed	1-9	58	4.88	152.08	24.15
Nonexposed	10-19	32	14.19	149.69	32.66
Nonexposed	20-99	43	48.05	150.49	37.53
Nonexposed	100+	22	229.18	152.79	43.92
Nonexposed	1+	155	50.61	151.25	33.00
<1 rad	Nonexposed	53	0.00	150.25	40.86
1-9	Nonexposed	15	4.93	149.46	55.06
10-19	Nonexposed	8	13.75	151.59	72.09
20-99	Nonexposed	9	51.00	153.69	20.46
100+	Nonexposed	9	646.22	153.23	12.16
1+	Nonexposed	41	157.54	151.63	41.71
Nonexposed 1+	1+ Nonexposed	196	72.98	151.33	34.64
		Girls Aged 14 Years			
Nonexposed	Nonexposed	2336	0.00	153.45	26.41
Nonexposed	<1 rad	240	0.00	153.40	27.70
Nonexposed	1-9	46	5.04	154.01	29.70
Nonexposed	10-19	37	15.24	152.66	24.25
Nonexposed	20-99	60	48.62	151.84	23.08
Nonexposed	100+	36	373.06	154.01	29.24
Nonexposed	1+	179	95.77	153.01	26.76
<1 rad	Nonexposed	66	0.00	154.09	26.75
1-9	Nonexposed	22	5.18	152.53	23.56
10-19	Nonexposed	9	14.44	156.62	13.42
20-99	Nonexposed	12	46.75	153.96	27.66
100+	Nonexposed	10	191.90	152.25	32.10
1+	Nonexposed	53	51.40	153.49	25.42
Nonexposed 1+	1+ Nonexposed	232	85.63	153.12	26.38

TABLE 6 COVARIANCE & CORRELATION COEFFICIENT MODIFIED BY CORRELATION BETWEEN PARENTS

表 6　両親の相関で補正した共分散及び相関係数

Exposure Status		Correlation Coefficient	Relation of Father (F) and Offspring (O)				Relation of Mother (M) and Offspring (O)			
Father	Mother	No. of cases	r_{FM}	W_{FO}	r_{FO}	W^*_{FO}	r^*_{FO}	W_{MO}	r_{MO}	W^*_{MO}	r^*_{MO}
Boys Aged 12 Years											
Nonexposed	Nonexposed	1501	.185	9.978	.222	8.420	.187	8.204	.222	6.925	.187
Nonexposed	<1 rad	140	.382	13.512	.267	9.784	.193	9.721	.220	7.036	.159
Nonexposed	1-9	22	.081	12.089	.258	11.180	.239	4.257	.113	3.945	.105
Nonexposed	10-19	42	.274	13.576	.314	10.651	.246	9.924	.322	7.797	.253
Nonexposed	20-99	32	.051	10.947	.210	10.441	.200	6.982	.188	6.637	.179
Nonexposed	100+	20	.398	3.933	.106	2.819	.076	−1.038	−.036	−.730	−.025
Nonexposed	1+	116	.199	10.941	.242	9.129	.202	5.822	.174	4.860	.145
<1 rad	Nonexposed	58	.148	12.969	.201	11.272	.175	10.725	.239	9.334	.208
1-9	Nonexposed	6	−.428	23.393	.736	16.396	.516	.200	.010	.146	.007
10-19	Nonexposed	3	−.985	34.350	.998	17.314	.503	−7.150	−.994	−3.603	−.501
20-99	Nonexposed	6	.571	15.533	.251	9.918	.160	−28.613	−.533	−18.188	−.339
100+	Nonexposed	8	.836	65.192	.735	35.505	.400	47.234	.813	25.745	.443
1+	Nonexposed	23	.298	35.686	.559	27.510	.431	8.639	.216	6.647	.166
Nonexposed	1+	139	.222	14.589	.303	11.935	.248	5.708	.164	4.670	.134
1+	Nonexposed										
Boys Aged 13 Years											
Nonexposed	Nonexposed	1761	.192	10.096	.207	8.452	.173	9.674	.245	8.102	.205
Nonexposed	<1 rad	194	.228	2.615	.061	2.133	.050	10.632	.266	8.674	.217
Nonexposed	1-9	44	−.003	−2.805	−.064	2.782	−.063	6.970	.215	6.937	.214
Nonexposed	10-19	28	−.017	3.191	.099	3.130	.097	4.564	.136	4.505	.134
Nonexposed	20-99	34	.093	8.268	.194	7.584	.178	7.754	.178	7.100	.163
Nonexposed	100+	20	.191	8.175	.213	6.859	.179	10.111	.359	8.485	.301
Nonexposed	1+	126	.058	3.398	.085	3.199	.080	7.869	.219	7.439	.207
<1 rad	Nonexposed	41	.546	31.535	.442	20.409	.286	20.481	.349	13.266	.226
1-9	Nonexposed	15	−.056	−9.343	−.175	−8.845	−.166	24.660	.440	23.333	.416
10-19	Nonexposed	5	−.008	31.310	.684	31.075	.679	15.470	.592	15.351	.587
20-99	Nonexposed	5	.698	−11.860	−.253	−6.995	−.149	−2.425	−.074	−1.443	−.044
100+	Nonexposed	13	.193	41.831	.671	35.046	.562	16.064	.359	13.478	.301
1+	Nonexposed	38	.173	14.799	.246	12.643	.210	16.938	.364	14.443	.310
Nonexposed	1+	164	.106	5.695	.128	5.146	.115	9.388	.242	8.485	.218
1+	Nonexposed										
Boys Aged 14 Years											
Nonexposed	Nonexposed	2105	.220	8.575	.200	7.027	.164	7.801	.215	6.414	.177
Nonexposed	<1 rad	225	.296	5.747	.118	4.424	.091	9.374	.232	3.720	.092
Nonexposed	1-9	47	.232	12.432	.295	10.109	.240	3.618	.118	2.934	.096
Nonexposed	10-19	36	.128	10.810	.323	9.587	.286	6.397	.201	5.686	.179
Nonexposed	20-99	43	.320	7.312	.171	5.529	.129	7.034	.209	5.328	.158
Nonexposed	100+	32	.600	15.122	.373	9.453	.233	3.299	.099	2.060	.062
Nonexposed	1+	158	.291	11.125	.277	8.636	.215	5.372	.165	4.171	.128
<1 rad	Nonexposed	62	.123	13.036	.290	11.604	.258	9.281	.241	8.282	.215
1-9	Nonexposed	8	.168	19.204	.454	16.469	.389	−6.609	−.188	−5.670	−.161
10-19	Nonexposed	9	−.663	−18.023	−.645	10.835	−.388	8.938	.401	5.367	.241
20-99	Nonexposed	12	−.203	6.325	.112	5.247	.093	27.791	.656	23.090	.545
100+	Nonexposed	11	.468	−12.509	−.281	−8.516	−.191	5.541	.119	3.766	.081
1+	Nonexposed	40	.023	−1.210	−.026	−1.168	−.025	11.850	.302	11.582	.295
Nonexposed	1+	198	.231	8.068	.192	6.552	.156	6.450	.190	5.238	.154
1+	Nonexposed										

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TABLE 6 Continued 表6続き

Exposure Status		Correlation Coefficient		Relation of Father (F) and Offspring (O)				Relation of Mother (M) and Offspring (O)			
Father	Mother	No. of cases	r_{FM}	W_{FO}	r_{FO}	W^*_{FO}	r^*_{FO}	W_{MO}	r_{MO}	W^*_{MO}	r^*_{MO}
Girls Aged 12 Years											
Nonexposed	Nonexposed	1700	.212	7.634	.223	6.313	.184	8.286	.269	6.840	.222
Nonexposed	<1 rad	158	.144	7.636	.209	6.676	.183	12.273	.390	10.734	.341
Nonexposed	1-9	41	−.135	11.042	.341	9.747	.301	2.553	.098	2.260	.087
Nonexposed	10-19	19	.256	6.614	.154	5.268	.123	8.797	.330	7.013	.263
Nonexposed	20-99	39	.131	10.071	.280	8.901	.247	21.195	.550	18.744	.486
Nonexposed	100+	18	.206	3.811	.101	3.163	.084	10.278	.452	8.528	.375
Nonexposed	1+	117	.072	8.732	.236	8.149	.220	10.687	.363	9.979	.339
<1 rad	Nonexposed	49	.160	6.235	.173	5.372	.149	2.590	.087	2.230	.075
1-9	Nonexposed	10	.418	14.268	.532	10.066	.375	14.074	.487	9.936	.344
10-19	Nonexposed	8	.192	−12.707	−.304	−10.646	−.255	17.114	.537	14.363	.451
20-99	Nonexposed	12	−.146	−23.192	−.508	−20.263	−.444	11.999	.320	10.486	.280
100+	Nonexposed	7	.167	−1.808	−.066	−1.540	−.056	.844	.029	.730	.025
1+	Nonexposed	37	.076	−6.001	−.165	−5.581	−.153	9.577	.291	8.919	.271
Nonexposed 1+	1+ Nonexposed	154	.074	5.270	.142	4.271	.132	10.448	.340	9.729	.317
Girls Aged 13 Years											
Nonexposed	Nonexposed	1949	.199	9.500	.301	7.923	.251	8.125	.309	6.788	.258
Nonexposed	<1 rad	194	.094	11.655	.331	10.650	.302	10.395	.379	9.497	.346
Nonexposed	1-9	58	.159	10.199	.330	8.806	.285	8.959	.387	7.737	.334
Nonexposed	10-19	32	.089	.340	.013	.317	.012	3.071	.114	2.825	.105
Nonexposed	20-99	43	.159	25.046	.635	21.609	.548	−.691	−.023	−.604	−.020
Nonexposed	100+	22	−.183	20.818	.716	17.610	.606	2.341	.073	1.995	.062
Nonexposed	1+	155	.126	13.743	.413	12.211	.367	4.349	.158	3.857	.140
<1 rad	Nonexposed	53	.079	14.694	.389	13.622	.361	12.069	.380	11.176	.352
1-9	Nonexposed	15	.411	3.747	.105	2.667	.075	7.973	.177	5.630	.125
10-19	Nonexposed	8	.035	27.627	.758	26.704	.733	2.329	.073	2.246	.070
20-99	Nonexposed	9	−.197	−.386	−.027	−.318	−.022	2.583	.152	2.159	.127
100+	Nonexposed	9	.432	10.513	.670	7.345	.468	2.238	.112	1.557	.078
1+	Nonexposed	41	.277	11.256	.383	8.826	.300	4.108	.125	3.211	.098
Nonexposed 1+	1+ Nonexposed	196	.151	13.165	.403	11.436	.350	4.237	.149	3.681	.129
Girls Aged 14 Years											
Nonexposed	Nonexposed	2336	.202	9.843	.345	8.196	.287	9.351	.371	7.790	.309
Nonexposed	<1 rad	240	.224	9.909	.308	8.111	.252	10.687	.394	8.717	.321
Nonexposed	1-9	46	.345	9.793	.339	7.276	.252	16.253	.612	12.088	.455
Nonexposed	10-19	37	.410	18.189	.626	12.909	.444	7.117	.305	5.038	.216
Nonexposed	20-99	60	.248	9.478	.373	7.602	.299	10.736	.429	8.608	.344
Nonexposed	100+	36	.125	7.824	.220	6.947	.195	14.760	.491	13.130	.437
Nonexposed	1+	179	.271	11.377	.385	8.954	.303	12.189	.465	9.600	.366
<1 rad	Nonexposed	66	.329	9.390	.306	7.063	.230	7.186	.304	5.413	.229
1-9	Nonexposed	22	.003	10.735	.381	10.711	.380	8.942	.388	8.909	.386
10-19	Nonexposed	9	−.263	2.019	.074	1.589	.058	−1.899	−.199	−1.507	−.158
20-99	Nonexposed	12	−.236	10.298	.295	8.316	.238	2.263	.087	1.840	.071
100+	Nonexposed	10	.190	15.623	.442	13.120	.371	17.039	.597	14.302	.501
1+	Nonexposed	53	−.038	10.953	.346	10.542	.333	7.134	.316	6.864	.304
Nonexposed 1+	1+ Nonexposed	232	.210	11.096	.368	9.168	.304	10.909	.429	9.014	.354

TABLE 7 COMPARISON OF ESTIMATED VALUES BETWEEN OFFSPRING & AN EXPOSED FATHER & NONEXPOSED MOTHER - BOYS

表 7　父被爆・母非被爆と子(男)の間の推定値の比較

Item (Father .... Nonexposed, Mother.... Nonexposed)	(1)	<1 rad Nonexposed (2)	Test (1):(2)	P	1+ rad Nonexposed (3)	Test (1):(3)	P
Boys Aged 12 Years							
Mean	146.00	147.05	.86	NS	143.01	1.75	Sug
Variance	56.39	84.27	1.49	P<.01	66.31	1.18	Sug
Covariance (W_{FO})	9.98	12.97	-		35.69	-	
Covariance (W_{MO})	8.20	10.72	-		8.64	-	
Z-value (Z_{FO})	.225	.204	.15	NS	.632	1.81	Sug
Z-value (Z_{MO})	.225	.244	.14	NS	.219	.03	NS
Z^*_{FO}	.189	.177	.09	NS	.461	1.21	NS
Z^*_{MO}	.189	.211	.16	NS	.168	.13	NS
Boys Aged 13 Years							
Mean	152.90	150.41	1.70	Sug	152.18	.50	NS
Variance	64.96	86.13	1.33	P<.01	79.13	1.22	P<.05
Covariance (W_{FO})	10.10	31.53	-		14.80	-	
Covariance (W_{MO})	9.67	20.48	-		16.94	-	
Z-value (Z_{FO})	.210	.475	1.62	NS	.251	.24	NS
Z-value (Z_{MO})	.250	.579	2.01	P<.05	.381	.77	NS
Z^*_{FO}	.175	.294	.73	NS	.213	.22	NS
Z^*_{MO}	.208	.230	.13	NS	.320	.66	NS
Boys Aged 14 Years							
Mean	159.18	158.13	1.20	NS	160.25	.96	NS
Variance	51.35	45.90	1.12	NS	49.25	1.07	NS
Covariance (W_{FO})	8.58	13.04	-		−1.21	-	
Covariance (W_{MO})	7.80	9.28	-		11.85	-	
Z-value (Z_{FO})	.203	.298	.72	NS	−.026	1.38	NS
Z-value (Z_{MO})	.219	.246	.21	NS	.312	.56	NS
Z^*_{FO}	.166	.264	.74	NS	−.025	1.15	NS
Z^*_{MO}	.178	.218	.30	NS	.304	.76	NS

TABLE 8 COMPARISON OF ESTIMATED VALUES BETWEEN OFFSPRING & A NONEXPOSED FATHER & EXPOSED MOTHER - BOYS

表 8　父非被爆・母被爆と子(男)の間の推定値の比較

Item (Father .... Nonexposed, Mother.... Nonexposed)	(1)	Nonexposed <1 rad (2)	Test (1):(2)	P	Nonexposed 1+ rad (3)	Test (1):(3)	P
Boys Aged 12 Years							
Mean	146.00	144.75	1.81	Sug	144.94	.51	NS
Variance	56.39	61.27	1.09	NS	50.60	1.11	NS
Covariance (W_{FO})	9.98	13.51	-		10.94	-	
Covariance (W_{MO})	8.20	9.72	-		5.82	-	
Z-value (Z_{FO})	.225	.273	.54	NS	.247	.23	NS
Z-value (Z_{MO})	.225	.223	.02	NS	.176	.50	NS
Z^*_{FO}	.189	.195	.07	NS	.205	.16	NS
Z^*_{MO}	.189	.160	.33	NS	.146	.44	NS

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TABLE 8 Continued 表8続き

		Boys Aged 13 Years					
Mean	152.90	154.04	1.92	Sug	153.50	.84	NS
Variance	64.96	61.40	1.06	NS	59.09	1.10	NS
Covariance (W_{FO})	10.10	2.61	-		3.40	-	
Covariance (W_{MO})	9.67	10.63	-		7.87	-	
Z-value (Z_{FO})	.210	.061	1.96	P<.05	.085	1.34	NS
Z-value (Z_{MO})	.250	.273	.30	NS	.223	.29	NS
Z^*_{FO}	.175	.050	1.64	NS	.081	1.01	NS
Z^*_{MO}	.208	.220	.16	NS	.210	.02	NS
		Boys Aged 14 Years					
Mean	159.18	160.19	1.85	Sug	158.75	.77	NS
Variance	51.35	61.91	1.21	Sug	45.51	1.13	NS
Covariance (W_{FO})	8.58	5.75	-		11.13	-	
Covariance (W_{MO})	7.80	9.37	-		5.37	-	
Z-value (Z_{FO})	.203	.119	1.19	NS	.284	.97	NS
Z-value (Z_{MO})	.219	.236	.24	NS	.166	.64	NS
Z^*_{FO}	.166	.092	1.05	NS	.218	.63	NS
Z^*_{MO}	.178	.092	1.22	NS	.218	.48	NS

TABLE 9 COMPARISON OF ESTIMATED VALUES BETWEEN OFFSPRING & AN EXPOSED FATHER & NONEXPOSED MOTHER - GIRLS

表9 父被爆・母非被爆と子(女)の間の推定値の比較

Father.... Nonexposed Mother.... Nonexposed Item	(1)	<1 rad Nonexposed (2)	Test (1):(2)	P	1+ rad Nonexposed (3)	Test (1):(3)	P
		Girls Aged 12 Years					
Mean	147.53	146.63	.92	NS	148.32	.86	NS
Variance	37.33	46.06	1.23	P<.05	30.80	1.21	Sug
Covariance (W_{FO})	7.63	6.24	-		−6.00	-	
Covariance (W_{MO})	8.29	2.59	-		9.58	-	
Z-value (Z_{FO})	.226	.175	.34	NS	−.166	2.26	P<.05
Z-value (Z_{MO})	.276	.087	1.27	NS	.300	.14	NS
Z^*_{FO}	.186	.150	.24	NS	−.154	1.96	P<.05
Z^*_{MO}	.226	.075	1.01	NS	.277	.29	NS
		Girls Aged 13 Years					
Mean	151.25	150.25	1.13	NS	151.63	.37	NS
Variance	30.78	40.86	1.33	P<.01	41.71	1.36	P<.01
Covariance (W_{FO})	9.50	14.69	-		11.26	-	
Covariance (W_{MO})	8.13	12.07	-		4.11	-	
Z-value (Z_{FO})	.311	.411	.70	NS	.403	.56	NS
Z-value (Z_{MO})	.319	.400	.57	NS	.126	1.18	NS
Z^*_{FO}	.257	.378	.85	NS	.309	.32	NS
Z^*_{MO}	.264	.368	.73	NS	.099	1.01	NS
		Girls Aged 14 Years					
Mean	153.45	154.09	.99	NS	153.49	.06	NS
Variance	26.41	26.75	1.01	NS	25.42	1.04	NS
Covariance (W_{FO})	9.84	9.39	-		10.95	-	
Covariance (W_{MO})	9.35	7.19	-		7.13	-	
Z-value (Z_{FO})	.359	.316	.34	NS	.361	.01	NS
Z-value (Z_{MO})	.390	.314	.60	NS	.327	.44	NS
Z^*_{FO}	.295	.234	.47	NS	.347	.36	NS
Z^*_{MO}	.319	.233	.67	NS	.314	.04	NS

TABLE 10 COMPARISON OF ESTIMATED VALUES BETWEEN OFFSPRING & A NONEXPOSED FATHER & EXPOSED MOTHER - GIRLS

表10 父非被爆・母被爆と子(女)の間の推定値の比較

Item (Father .... Nonexposed, Mother.... Nonexposed)	(1)	Nonexposed <1 rad (2)	Test (1):(2) P		Nonexposed 1+ rad (3)	Test (1):(3) P	
Girls Aged 12 Years							
Mean	147.53	147.08	.86	NS	147.20	.54	NS
Variance	37.33	40.12	1.08	NS	42.00	1.13	NS
Covariance (W_{FO})	7.63	7.64	-	-	8.73	-	-
Covariance (W_{MO})	8.29	12.27	-	-	10.69	-	-
Z-value (Z_{FO})	.226	.212	.17	NS	.240	.15	NS
Z-value (Z_{MO})	.276	.412	1.62	NS	.381	1.09	NS
Z^*_{FO}	.186	.185	.01	NS	.224	.39	NS
Z^*_{MO}	.226	.355	1.54	NS	.353	1.31	NS
Girls Aged 13 Years							
Mean	151.25	150.54	1.64	NS	151.25	.00	NS
Variance	30.78	33.24	1.08	NS	33.00	1.07	NS
Covariance (W_{FO})	9.50	11.66	-	-	13.74	-	-
Covariance (W_{MO})	8.13	10.40	-	-	4.35	-	-
Z-value (Z_{FO})	.311	.343	.42	NS	.439	1.52	NS
Z-value (Z_{MO})	.319	.399	1.06	NS	.159	1.90	Sug
Z^*_{FO}	.257	.312	.73	NS	.385	1.52	NS
Z^*_{MO}	.264	.361	1.28	NS	.141	1.46	NS
Girls Aged 14 Years							
Mean	153.45	153.40	.14	NS	153.01	1.10	NS
Variance	26.41	27.70	1.05	NS	26.76	1.01	NS
Covariance (W_{FO})	9.84	9.91	-	-	11.38	-	-
Covariance (W_{MO})	9.35	10.69	-	-	12.19	-	-
Z-value (Z_{FO})	.359	.318	.60	NS	.406	.60	NS
Z-value (Z_{MO})	.390	.416	.38	NS	.503	1.45	NS
Z^*_{FO}	.295	.257	.56	NS	.313	.23	NS
Z^*_{MO}	.319	.333	.21	NS	.383	.82	NS

TABLE 11 REGRESSION COEFFICIENT FOR THE RELATION BETWEEN EXPOSED FATHER & NONEXPOSED MOTHER

表11 父被爆群と母非被爆群間の関連した回帰係数

Item	Nonexposed & Exposed Father & Nonexposed Mother				Exposed Father & Nonexposed Mother			
	Constant	Slope	t-value (df=3)		Constant	Slope	t-value (df=2)	
Boys Aged 12 Years								
Mean	145.89	−.01059	.41	NS	141.44	.01219	1.05	NS
Variance	56.30	.16869	1.59	NS	44.99	.21679	1.57	NS
Covariance (W_{FO})	10.06	.20901	6.40	-	19.49	.16890	5.29	-
Covariance (W_{MO})	8.00	.12821	1.76	-	−16.39	.23195	3.88	-
Z-value (Z_{FO})	.232	.00561	2.54	P<.05	1.015	.00239	.99	NS
Z-value (Z_{MO})	.227	.00340	2.15	P<.05	−.442	.00615	4.35	P<.01
Z^*_{FO}	.192	.00097	1.46	NS	.423	.00002	.03	NS
Z^*_{MO}	.160	.00041	.29	NS	−.443	.00187	2.96	P<.01

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TABLE 11 Continued 表11続き

Boys Aged 13 Years								
Mean	152.89	.00790	.72	NS	152.02	.01186	.86	NS
Variance	65.05	.02961	.45	NS	72.47	−.00238	.03	NS
Covariance (W_{FO})	9.92	.12103	2.08	-	−3.99	.18099	3.07	-
Covariance (W_{MO})	9.78	.02419	.67	-	18.02	−.01134	.31	-
Z-value (Z_{FO})	.210	.00360	2.71	P<.01	−.065	.00475	3.12	P<.01
Z-value (Z_{MO})	.256	.00056	.70	NS	.488	−.00041	.54	NS
Z^*_{FO}	.175	.00225	1.86	Sug	−.032	.00312	2.14	P<.01
Z^*_{MO}	.221	.00028	.15	NS	.438	−.00098	.53	NS
Boys Aged 14 Years								
Mean	159.19	.00421	.45	NS	159.86	.00131	.12	NS
Variance	51.30	−.00090	.01	NS	45.92	.02293	.23	NS
Covariance (W_{FO})	8.52	−.07694	1.74	-	3.76	−.05582	.99	-
Covariance (W_{MO})	7.84	.00768	.18	-	11.32	−.00774	.14	-
Z-value (Z_{FO})	.202	−.00192	1.03	NS	−.119	−.00050	.22	NS
Z-value (Z_{MO})	.224	.00035	.21	NS	.550	−.00109	.54	NS
Z^*_{FO}	.166	−.00136	1.41	NS	.043	−.00081	.66	NS
Z^*_{MO}	.182	.00000	.00	NS	.234	−.00021	.14	NS

TABLE 12 REGRESSION COEFFICIENT FOR THE RELATION BETWEEN NONEXPOSED FATHER & EXPOSED MOTHER

表12 父非被爆群と母被爆群間の関連した回帰係数

Item	Nonexposed Father & Nonexposed & Exposed Mother				Nonexposed Father & Exposed Mother			
	Constant	Slope	t-value	(df=3)	Constant	Slope	t-value	(df=2)
Boys Aged 12 Years								
Mean	145.97	−.00551	3.20	P<.01	145.48	−.00441	2.51	P<.02
Variance	56.28	−.03815	2.02	P<.05	54.37	−.03357	1.59	NS
Covariance (W_{FO})	10.13	−.01135	1.89	-	12.82	−.01779	7.70	-
Covariance (W_{MO})	8.20	−.01822	3.69	-	8.07	−.01792	3.16	-
Z-value (Z_{FO})	.232	−.00024	1.40	NS	.292	−.00038	3.11	P<.01
Z-value (Z_{MO})	.230	−.00052	2.35	P<05	.259	−.00058	2.40	P<01
Z^*_{FO}	.194	−.00022	1.81	Sug	.246	−.00034	7.76	P<.01
Z^*_{MO}	.191	−.00081	6.45	P<.01	.155	−.00066	4.23	P<.01
Boys Aged 13 Years								
Mean	152.89	.01055	1.91	Sug	152.77	.01126	1.71	Sug
Variance	64.70	−.04485	1.20	NS	59.42	−.01500	.42	NS
Covariance (W_{FO})	9.68	−.01184	.29	-	1.28	.03574	1.52	-
Covariance (W_{MO})	9.51	−.00195	.13	-	6.22	.01668	2.59	-
Z-value (Z_{FO})	.205	−.00003	.04	NS	.036	.00094	1.63	NS
Z-value (Z_{MO})	.251	.00042	1.02	NS	.171	.00088	3.57	P<.01
Z^*_{FO}	.170	−.00000	.01	NS	.033	.00079	1.43	NS
Z^*_{MO}	.211	.00042	4.63	P<01	.199	.00047	4.10	P<.01
Boys Aged 14 Years								
Mean	159.15	−.00310	.89	NS	158.73	−.00140	.38	NS
Variance	50.99	−.00564	.16	NS	43.93	.02270	.65	NS
Covariance (W_{FO})	8.65	.02023	2.24	-	10.06	.01455	1.53	-
Covariance (W_{MO})	7.69	−.01478	1.80	-	5.63	−.00649	1.03	-
Z-value (Z_{FO})	.208	.00066	2.01	P<.05	.272	.00040	1.26	NS
Z-value (Z_{MO})	.219	−.00040	1.64	NS	.155	−.00014	.80	NS
Z^*_{FO}	.169	.00023	.80	NS	.228	−.00000	.01	NS
Z^*_{MO}	.180	−.00042	3.71	P<.01	.160	−.00033	2.40	P<05

TABLE 13 REGRESSION COEFFICIENT FOR THE RELATION BETWEEN EXPOSED FATHER & NONEXPOSED MOTHER

表13 父被爆群と母非被爆群間の関連した回帰係数

Item	Nonexposed & Exposed Father & Nonexposed Mother			Exposed Father & Nonexposed Mother		
	Constant	Slope	t-value (df=3)	Constant	Slope	t-value (df=2)
Girls Aged 12 Years						
Mean	147.54	.00352	3.12 Sug	147.96	.00273	1.95 NS
Variance	37.34	−.04313	5.44 -	37.79	−.04406	4.81 -
Covariance (W_{FO})	7.39	−.02499	.63 NS	7.53	.00609	.18 NS
Covariance (W_{MO})	8.39	−.01173	1.02 NS	14.71	−.02490	6.80 P<.05
Z-value (Z_{FO})	.23	−.00082	.62 NS	−.10	−.00012	.09 NS
Z-value (Z_{MO})	.29	−.00040	.72 NS	.54	−.00095	3.14 Sug
Z^*_{FO}	.18	−.00068	.66 NS	−.13	.00001	.01 NS
Z^*_{MO}	.24	−.00051	.78 NS	.41	−.00129	4.13 Sug
Girls Aged 13 Years						
Mean	151.26	.00321	1.99 NS	151.87	.00221	1.00 NS
Variance	31.09	−.02873	.73 -	51.34	−.06330	2.02 -
Covariance (W_{FO})	9.49	.00079	.05 NS	8.63	.00226	.12 NS
Covariance (W_{MO})	8.08	−.00982	1.73 NS	5.20	−.00490	1.07 NS
Z-value (Z_{FO})	.32	.00125	.72 NS	.64	.00071	.36 NS
Z-value (Z_{MO})	.33	−.00036	1.35 NS	.15	−.00006	.82 NS
Z^*_{FO}	.26	.00045	.43 NS	.40	.00022	.19 NS
Z^*_{MO}	.26	−.00107	1.48 NS	.12	−.00014	.91 NS
Girls Aged 14 Years						
Mean	153.47	−.00291	.23 NS	154.29	−.00911	.65 NS
Variance	26.34	.02470	.73 -	21.35	.05894	1.96 -
Covariance (W_{FO})	9.82	.02646	1.32 NS	8.12	.03810	1.68 NS
Covariance (W_{MO})	9.27	.02387	.65 NS	4.05	.05975	1.78 NS
Z-value (Z_{FO})	.38	.00050	.64 NS	.32	.00087	.95 NS
Z-value (Z_{MO})	.41	.00143	.76 NS	.20	.00292	1.53 NS
Z^*_{FO}	.30	.00039	.50 NS	.31	.00033	.34 NS
Z^*_{MO}	.32	.00059	.69 NS	.10	.00132	1.71 NS

TABLE 14 REGRESSION COEFFICIENT FOR THE RELATION BETWEEN NONEXPOSED FATHER & EXPOSED MOTHER

表14 父非被爆群と母被爆群間の関連した回帰係数

Item	Nonexposed Father & Nonexposed & Exposed Mother			Nonexposed Father & Exposed Mother		
	Constant	Slope	t-value (df=3)	Constant	Slope	t-value (df=2)
Girls Aged 12 Years						
Mean	147.52	−.00039	.22 NS	147.27	.00063	.34 NS
Variance	37.59	.02180	.38 -	43.00	−.00250	.04 -
Covariance (W_{FO})	7.75	−.00923	.85 NS	10.30	−.02068	2.75 NS
Covariance (W_{MO})	8.37	.02034	.64 NS	10.11	.01250	.34 NS
Z-value (Z_{FO})	.23	−.00032	.75 NS	.32	−.00072	2.10 NS
Z-value (Z_{MO})	.28	.00130	1.24 NS	.35	.00102	.83 NS
Z^*_{FO}	.19	−.00023	.58 NS	.28	−.00063	1.97 NS
Z^*_{MO}	.23	.00045	.93 NS	.33	.00022	.44 NS

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TABLE 14 Continued 表14続き

Girls Aged 13 Years								
Mean	151.24	.00426	.62	NS	151.13	.00503	.64	NS
Variance	30.66	.06341	2.41	-	28.55	.07653	2.63	-
Covariance (W_{FO})	9.57	.06708	1.48	NS	10.77	.05958	1.11	NS
Covariance (W_{MO})	7.97	−.03821	1.56	NS	5.18	−.02087	.85	NS
Z-value (Z_{FO})	.32	.00560	3.61	P<.05	.34	.00548	2.95	Sug
Z-value (Z_{MO})	.33	−.00167	1.57	NS	.25	−.00119	1.00	NS
Z^*_{FO}	.26	.00312	2.56	Sug	.29	.00295	2.03	NS
Z^*_{MO}	.27	−.00036	1.38	NS	.22	−.00027	.93	NS
Girls Aged 14 Years								
Mean	153.41	.00037	.11	NS	152.62	.00311	.95	NS
Variance	26.36	.00556	.65	-	25.43	.00864	.88	-
Covariance (W_{FO})	9.96	−.00494	.44	NS	12.22	−.01244	1.06	NS
Covariance (W_{MO})	9.46	.01457	1.35	NS	11.45	.00794	.69	NS
Z-value (Z_{FO})	.38	−.00033	.44	NS	.56	−.00091	1.22	NS
Z-value (Z_{MO})	.42	.00053	.72	NS	.59	−.00003	.04	NS
Z^*_{FO}	.31	−.00025	.84	NS	.36	−.00044	1.36	NS
Z^*_{MO}	.33	.00095	1.08	NS	.44	.00018	.21	NS

The following two tables included in this report were inadvertently omitted from the previous report.[1]

次の2表は前回の報告[1]の際，不注意により省略されたので，今回の報告に加える．

REGRESSION COEFFICIENT FOR THE RELATION BETWEEN NONEXPOSED FATHER & EXPOSED MOTHER

父非被爆群と母被爆群間の関連した回帰係数

Item	Nonexposed Father & Nonexposed & Exposed Mother				Nonexposed Father & Exposed Mother			
	Constant	Slope	t-value	(df=3)	Constant	Slope	t-value	(df=2)
Girls Aged 15 Years								
Mean	154.47	−.00344	1.38	NS	154.57	−.00407	1.48	NS
Variance	24.39	−.02565	1.40	NS	21.82	−.00703	.51	NS
Covariance (W_{FO})	9.61	.00924	1.44	NS	9.06	.01299	1.93	NS
Covariance (W_{MO})	8.80	.00676	1.59	NS	8.88	.00632	1.26	NS
Z-value (Z_{FO})	.35	.00079	6.00	P<.01	.35	.00078	5.10	P<.05
Z-value (Z_{MO})	.38	.00099	1.91	NS	.42	.00080	1.36	NS
Z^*_{FO}	.30	.00013	.69	NS	.28	.00026	1.43	NS
Z^*_{MO}	.33	.00022	.75	NS	.33	.00026	.75	NS
Girls Aged 16 Years								
Mean	154.89	.00611	3.31	P<.05	155.00	.00573	2.46	NS
Variance	23.80	.03519	.70	NS	22.55	.01169	.30	NS
Covariance (W_{FO})	10.49	.01515	.58	NS	10.55	.01465	.47	NS
Covariance (W_{MO})	8.58	.02106	3.20	P<.05	8.74	.01948	2.61	NS
Z-value (Z_{FO})	.40	.00151	2.57	P<.10	.44	.00127	1.98	NS
Z-value (Z_{MO})	.41	.00059	1.51	NS	.42	.00051	1.13	NS
Z^*_{FO}	.33	.00071	1.67	NS	.37	.00047	1.08	NS
Z^*_{MO}	.33	.00018	.47	NS	.36	.00005	.12	NS

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Girls Aged 17 Years							
Mean	154.93	.00446	.90	NS	154.66	.00686	1.30 NS
Variance	24.79	−.03622	.73	NS	22.05	−.00613	.12 NS
Covariance (W_{FO})	9.81	−.00645	.15	NS	12.90	−.03996	1.06 NS
Covariance (W_{MO})	8.50	−.02462	.54	NS	8.80	−.02810	.50 NS
Z-value (Z_{FO})	.36	.00010	.07	NS	.53	−.00116	1.10 NS
Z-value (Z_{MO})	.38	.00017	.11	NS	.47	−.00052	.32 NS
Z^*_{FO}	.32	−.00025	.30	NS	.43	−.00114	2.53 NS
Z^*_{MO}	.34	−.00045	.40	NS	.39	−.00089	.74 NS

REGRESSION COEFFICIENT FOR THE RELATION BETWEEN EXPOSED FATHER & NONEXPOSED MOTHER

父被爆群と母非被爆群間の関連した回帰係数

Item	Exposed Father & Nonexposed & Exposed Mother			Exposed Father & Nonexposed Mother		
	Constant	Slope	t-value (df=3)	Constant	Slope	t-value (df=2)
Girls Aged 15 Years						
Mean	154.25	−.00412	.84 NS	154.33	−.00457	.82 NS
Variance	24.39	−.02690	1.51 NS	22.66	−.01498	1.25 NS
Covariance (W_{FO})	9.61	−.00174	.04 NS	19.57	−.05092	11.11 P<.01
Covariance (W_{MO})	8.80	.01605	1.73 NS	8.62	.01703	1.59 NS
Z-value (Z_{FO})	.35	.00043	.23 NS	.72	−.00162	8.41 P<.02
Z-value (Z_{MO})	.39	.00236	7.61 P<.01	.34	.00265	12.93 P<.01
Z^*_{FO}	.31	.00051	.31 NS	.60	−.00116	1.97 NS
Z^*_{MO}	.33	.00222	6.54 P<.01	.29	.00247	8.40 P<.02
Girls Aged 16 Years						
Mean	154.90	−.00451	.49 NS	155.29	−.00690	.68 NS
Variance	23.81	.02195	.27 NS	13.85	.08642	2.17 NS
Covariance (W_{FO})	10.49	−.09223	2.75 Sug	5.13	−.06454	2.50 NS
Covariance (W_{MO})	8.58	−.00460	.16 NS	7.36	.00171	.05 NS
Z-value (Z_{FO})	.39	−.00311	2.64 P<.10	.45	−.00341	2.44 NS
Z-value (Z_{MO})	.40	.00009	.04 NS	.39	.00019	.07 NS
Z^*_{FO}	.33	−.00230	2.70 P<.10	.33	−.00233	2.27 NS
Z^*_{MO}	.33	−.00057	.29 NS	.30	−.00038	.16 NS
Girls Aged 17 Years						
Mean	154.96	.00652	1.31 NS	155.89	.00145	6.11 NS
Variance	24.79	.12962	2.30 NS	28.61	.08738	2.25 NS
Covariance (W_{FO})	9.80	.13636	12.24 P<.01	9.60	.13788	11.22 P<.01
Covariance (W_{MO})	8.50	.03051	1.92 NS	7.82	.03392	1.98 NS
Z-value (Z_{FO})	.35	.00384	8.37 P<.01	.27	.00422	11.65 P<.01
Z-value (Z_{MO})	.37	.00144	2.50 P<.01	.34	.00162	2.58 NS
Z^*_{FO}	.31	.00117	3.01 P<.10	.25	.00146	4.33 P<.05
Z^*_{MO}	.33	.00043	.86 NS	.28	.00068	1.33 NS

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