

THE GROWTH AND DEVELOPMENT OF CHILDREN EXPOSED IN UTERO
TO THE ATOMIC BOMBS IN HIROSHIMA AND NAGASAKI

広 島 お よ び 長 崎 に お け る 胎 内 被 爆 者 の
成 長 お よ び 発 育

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THE GROWTH AND DEVELOPMENT OF CHILDREN EXPOSED IN UTERO TO THE ATOMIC BOMBS IN HIROSHIMA AND NAGASAKI

広島および長崎における胎内被爆者の 成長および発育

INTRODUCTION

Many effects of fetal irradiation have been demonstrated in experimental animals¹ and reported in children born after maternal pelvic irradiation.²⁻⁴ Effects of whole body irradiation on the growth of children have also been reported,⁵⁻⁷ but little has been written about the growth of children who have received irradiation while in utero.

Both exposed and suitable control subjects who were in utero at the time of the atomic bombs (ATB) in Hiroshima and Nagasaki have been studied at ABCC since 1950. The purpose of the present study is to evaluate growth attainment at the 17-year level for the 1259 examined subjects in this group. Since that age there has been a dispersion of the sample; many have left Hiroshima and Nagasaki for universities or employment elsewhere. Age 17 is near the time of maturation and the most information that may ever be available concerning effects of in utero exposure to the atomic bombs on growth is probably that which was obtained at this age.

Previous reports on subsamples of 200-300 of these children have indicated decreased head size⁸⁻¹² and body size^{9,11} associated with proximal exposure to the atomic bombs.

METHOD

The study sample of 1613 Hiroshima and Nagasaki children is comprised of three major comparison groups, based on the distance of the mothers from the hypocenter ATB, and defined as 0-1999 m group, 3000-4999 m group, and not-in-city group. Included are children who were at all stages of gestation ATB. The two distal groups were matched for gestational age and sex to the 0-1999 m group. Radiation dose estimates (T57 D)¹³ based on air dose curves and shielding information have been completed for most of the mothers of children in the 0-1999 m group.

緒言

動物実験¹ および骨盤部に放射線照射を受けた母親に生まれた子供の調査²⁻⁴ では、胎児の放射線照射によって多くの影響が発現すると報告されている。子供の成長に及ぼす全身放射線照射の影響について報告されているが⁵⁻⁷ 胎内で放射線を受けた子供の成長に関する報告はほとんどない。

ABCCでは、広島および長崎の原爆胎内被爆者およびその適当な対照者について、1950年以来調査を行なっている。今回の研究の目的は、この調査対象群における被検者1259人の17歳時における成長を評価することである。この年齢を過ぎると、調査標本は分散して、大学進学あるいは就職のため広島および長崎を去った者が多い。17歳では、成長はほとんど完成し、胎内被爆の成長に及ぼす影響について入手しうる資料の大部分は、この年齢において求められていると思われる。

これらの子供の副標本200 - 300人に関する以前の報告では、近距離被爆者に頭の大きさが小さいこと⁸⁻¹² およびからだの大きさが小さいこと^{9,11} が認められている。

方法

調査標本は、広島および長崎の子供1613人から成り、原爆時における母親の爆心地からの距離に基づいて次の3つのおもな比較群に分類されている：すなわち、0-1999 m群、3000-4999 m群および市内にいなかった群である。原爆時に妊娠の各段階にあったものを対象児に含めてある。2つの遠距離群は、0-1999 m群と、妊娠月数および性別構成が一致するようにした。空中線量曲線および遮蔽資料を基として計算した放射線量推定値 (T57 D)¹³ は、0-1999 m群における子供の母親のほとんど全員について求められている。

Subjects are examined annually at ABCC near each birthday. A history is taken and a physical examination, leukocyte count, differential cell count, hematocrit, urinalysis, stool examination, chest and left wrist X-rays, and any other tests clinically indicated are done. Various anthropometric measurements, and at some examinations, vital capacity, visual acuity, and psychometrics are recorded. All data are collected and processed without the staff knowing the exposure status of the subjects.

The sample distribution and the percentage of subjects who were examined at age 17, and are included in this analysis of anthropometric data, are shown in Table 1. About 80% of the total sample were examined at that age. The not-examined subjects appear to be randomly distributed throughout the different exposure groups. Means for all measurements were calculated separately for each sex and distance group within each city. The group within 2000 m was further classified by distance of the mother from the hypocenter, estimated rad dose, trimester of gestation ATB, and the presence or absence of acute radiation syndrome to produce three 'high dose' and 'low dose' contrasts as follows:

対象者は、その誕生日の前後において毎年ABCCで診察を受けている。病歴聴取を行ない、身体検査、白血球算定、白血球分類像検査、ヘマトクリット値測定、検尿、検便、胸部と左手首のレントゲン検査およびその他臨床的に必要と認められる検査などを行なっている。各種の人体計測値のほかに、ある診察時には肺活量、視力および知能測定値も記録されたことがある。すべての資料の収集と処理は、職員に対象者の被爆状態がわからないようにして行なった。

17歳の時に診察を受け、今回の人体計測資料の解析に含めた対象者の標本分布および百分率は表1に示す。全標本の約80%はこの年齢で診察を受けた。診察を受けなかった対象者は、各被爆群に任意に分布しているようにみえる。すべての測定項目に対する平均値は、各都市について性別に、また、各被爆距離群別に計算した。2000 m未満の群は、母親の爆心地からの距離、推定線量(rad)および急性放射線症候群の有無によって、さらにこまかく分類し、次のように3つの「高線量」および「低線量」群別比較を行なった。

| | 'High Dose' 高線量群 | 'Low Dose' 低線量群 |
|-----------------------------|---------------------|--------------------|
| 1 Distance 距離 | <1500 m | 1500-1999 m |
| 2 Dose 線量 | 50 + rad | <50 rad |
| 3 Radiation syndrome 放射線症候群 | Positive 有 | Negative 無 |

TABLE 1 IN UTERO SAMPLE, NUMBER AND PERCENT EXAMINED AT AGE 17 YEARS

表1 胎内被爆児標本の総数、17歳で診察を受けた者の数および百分率

| Sex 性 | <2000 m | | | 3000-4999 m | | | Not-in-City 市内不在 | | |
|---------------------|------------|------------------|------|-------------|------------------|------|------------------|------------------|------|
| | Total 計 | Examined 受診者数 | % | Total 計 | Examined 受診者数 | % | Total 計 | Examined 受診者数 | % |
| Hiroshima 広島 | | | | | | | | | |
| Male 男 | 224 | 168 | 75.0 | 221 | 177 | 80.1 | 201 | 164 | 81.6 |
| Female 女 | 211 | 160 | 75.8 | 211 | 176 | 83.4 | 197 | 142 | 72.1 |
| Nagasaki 長崎 | | | | | | | | | |
| Male 男 | 54 | 43 | 79.6 | 71 | 56 | 78.9 | 60 | 45 | 75.0 |
| Female 女 | 48 | 36 | 75.0 | 61 | 48 | 78.7 | 54 | 44 | 81.5 |

RESULTS

Comparison of Mean Measurements - Age 17 Except for Nagasaki females, mean head circumferences were smaller for those within 2000 m as compared to the more distal groups. The greatest differences were observed between high dose and low dose subgroups and in every

結果

17歳における各測定の前平均値の比較 長崎における女性を除けば、2000 m未満群の平均頭囲は、遠距離被爆群と比較して小さい。高線量群と低線量群を比較した場合の頭囲の差は最大であり、いずれの比較でも高線量群の平

comparison the high dose subgroups had the smaller mean head circumferences (Table 2). Except for Nagasaki males, comparisons by distance, 0-1499 m versus 1500-1999 m, were statistically significant ($P \leq .01$). The least significance was found in comparisons by presence or absence of the acute radiation syndrome in the mother. However, few mothers gave a history of acute radiation symptoms.

均頭圍は小さい(表2)。距離別の比較では、長崎における男性を除いて、0-1499 m群と1500-1999 m群の間に統計的に有意な差を認めた($P \leq .01$)。母親における急性放射線症候群の有無による比較では、有意性は最小であった。しかしながら、急性放射線症状の病歴を有する母親は少数である。

TABLE 2 MEAN MEASUREMENTS, HIGH DOSE AND LOW DOSE SUBGROUPS WITHIN 2000 m

表2 2000 m未満の群における高線量および低線量群の測定の平均値

| Measurement 測定値 | City 都市 | Sex 性 | Distance 距離 (m) | | T 57 D (rad) | | Radiation Syndrome† 放射線症候群 | | | | |
|-------------------------------|-----------------|----------|--------------------|-----------|--------------|-------|-------------------------------|-------|-------|-------|-------|
| | | | <1500 | 1500-1999 | 50+ | <50 | Yes 有 | No 無 | | | |
| Head circumference (cm) 頭圍 | Hiroshima 広島 | Male 男 | 53.9 | *** | 55.1 | 54.0 | *** | 55.1 | 54.3 | NS | 54.6 |
| | | Female 女 | 53.1 | ** | 54.0 | 53.3 | * | 53.9 | 52.7 | NS | 53.7 |
| | Nagasaki 長崎 | Male 男 | 53.8 | NS | 54.9 | 54.4 | NS | 54.6 | 52.9 | ** | 55.0 |
| | | Female 女 | 53.7 | ** | 54.8 | 53.7 | ** | 55.0 | 53.7 | Sugg. | 54.5 |
| Standing height (cm) 身長 | Hiroshima 広島 | Male 男 | 163.4 | * | 165.4 | 163.7 | Sugg. | 165.5 | 165.1 | NS | 164.6 |
| | | Female 女 | 151.3 | ** | 153.9 | 151.8 | * | 154.1 | 149.2 | * | 153.3 |
| | Nagasaki 長崎 | Male 男 | 161.0 | NS | 162.3 | 161.9 | NS | 161.2 | 159.1 | NS | 162.5 |
| | | Female 女 | 161.5 | * | 155.1 | 152.4 | NS | 153.9 | 151.0 | NS | 154.1 |
| Body Weight (kg) 体重 | Hiroshima 広島 | Male 男 | 51.25 | ** | 54.20 | 51.95 | * | 54.59 | 54.04 | NS | 52.99 |
| | | Female 女 | 46.06 | * | 48.41 | 46.87 | NS | 47.75 | 44.04 | * | 47.87 |
| | Nagasaki 長崎 | Male 男 | 50.48 | NS | 52.77 | 51.81 | NS | 51.77 | 47.93 | Sugg. | 53.03 |
| | | Female 女 | 45.58 | ** | 50.75 | 44.79 | ** | 50.04 | 44.74 | NS | 49.33 |

NS $P \geq .10$; Sugg. $.10 \geq P \geq .05$; * $.05 \geq P \geq .01$; ** $.01 \geq P \geq .001$; *** $P < .001$

† Acute radiation symptoms in mother 母親の急性放射線症状

Mean standing height and weight were less for Hiroshima males and females and Nagasaki males who were within 2000 m as compared to the more distal groups. For each sex in both cities the means were smallest for the subgroups within 1500 m (Table 2) and, except for Nagasaki males, the differences were statistically significant ($P \leq .05$). The least significant comparisons were by symptoms of the mother.

Nagasaki females within 2000 m had smaller mean intercrystic diameters than the distal subjects but analysis by high dose and low dose subgroups revealed no consistent patterns in either city. Mean chest circumferences were smaller for subjects within 2000 m as compared to distal subjects and for the high dose as compared to the low dose subgroups, but few of the differences were statistically significant. No consistent patterns by exposure groups and few significant differences were observed for arm span, vital capacity, maximal and minimal chest circumferences, sitting height, systolic and diastolic blood pressures, and pulse count.

広島における男女ならびに長崎における男性では、2000 m未満群の平均身長および体重は、遠距離被爆群に比べて小であった。両市における男女ともに、1500 m未満群の平均値は最小で(表2)、長崎における男性を除いては、統計的に有意な差を認めた($P \leq .05$)。母親の急性放射線症状による比較では、有意性は最小であった。

長崎では2000 m未満の女性の平均胸間径は、遠距離被爆群に比べて小であったが、高線量群と低線量群の解析では、両市とも一貫した傾向を示さなかった。平均胸圍は、2000 m未満群が遠距離群と比較して小さく、また高線量群が低線量群より小であったが、これらの差の中で統計的に有意なものは少なかった。翼幅、肺活量、最大-最小胸圍、坐高、収縮期-拡張期血圧、および脈搏には、被爆群間に一貫した傾向はなく、また有意差を示すものは少ない。

For each sex within each city the mean measurements were compared for the within 1500 m and 1500-1999 m subgroups and the 3000-4999 m and not-in-city groups (Table 3). The consistency of smaller means for the most proximal subjects is striking, however, to some extent this reflects the multiple positively correlated measurements on the same individuals. Generally, the means were similar for all groups beyond 1500 m.

Height and weight means for individuals at 17 years of age in Hiroshima and Nagasaki Prefectures, as published by the Ministry of Welfare, are shown with those for the present study in Table 4. The Ministry's data are for children who were born at about the same time as those in this study sample. In every case their means are larger than those of the subgroups within 1500 m and similar to those beyond 1500 m.

Mean Measurements by Trimester of Gestation - Age 17

For the group within 2000 m, mean measurements by trimester of gestation were compared and no consistent patterns of effect were evident. Similarly, for the subgroups within 1500 m no pattern of effect by trimester of gestation was detected. The corresponding trimesters for the within 1500 m and 1500-1999 m subgroups were compared and proximal subjects had the smaller means, with the exception of third trimester Hiroshima females and Nagasaki males. Within 1500 m there was only one third trimester subject in Nagasaki.

Cumulative Measurement Frequencies - Age 17

The foregoing data demonstrate that there are significant differences between mean growth attainment for children who were exposed in utero within 1500 m as compared with the more distally or not exposed children. In an effort to describe more precisely the nature of these differences, cumulative percentage frequencies have been plotted on normal probability paper for all measurements at age 17 years.

When measurements are normally distributed and the number of subjects is large, cumulative frequency curves approximate straight lines. When the number of subjects is small, deviations from a straight line at the tails of the curves may be due to a difference of two or three subjects from the expected.

For most of the measurements the subgroups within 1500 m tend to have the lower values throughout the entire range. However, there is considerable variation and, as with mean comparisons, the differences are not impressive except for head circumference, height, and weight. Even for these measurements there are some

両市における男性および女性の各測定の平均値について、1500 m未満および、1500-1999 mの細区分群と、3000-4999 m群および市内にいなかった群との比較を行なった(表3)。最も爆心地に近い対象者の平均値が一貫して小さいことが目立つが、これは、同一対象者における各測定の中で互いに正の相関関係を示すものが多いということはある程度反映している。全般的に、1500 m以上のすべての群における平均値は類似していた。

厚生省が発表した広島県および長崎県における17歳の者の平均身長および体重、ならびに本研究における結果を表4に示す。厚生省の資料は、本研究の調査標本における子供とほぼ同じ時に生まれた者を対象にしている。厚生省資料の平均値は、1500 m未満群の平均値に比べて大きく、1500 m以上の群と同程度である。

17歳における測定の平均値の妊娠3か月期別比較 2000 m未満群について、妊娠3か月期別に測定の平均値を比較したが、一貫した影響は認めなかった。同様に、1500 m未満の細区分群にも、妊娠3か月期の影響は認めなかった。1500 m未満群と1500-1999 m群について対応する妊娠3か月期を比較したところ、第3妊娠3か月期にあった広島の女性および長崎の男性を除いては、平均値は近距離群の方が小さい。長崎の1500 m未満群には第3妊娠3か月期のものが1例あったにすぎない。

17歳における測定の累積度数 前述の資料は、1500 m未満の胎内被爆者の平均成長を遠距離被爆群または非被爆群と比べた場合、有意な差があることを示している。これらの差の性質をもっと正確に調べるために、17歳における各測定の百分率累積度数分布を正規確率紙に描いてみた。

測定値が正規分布をして、対象者の数が多い場合は、累積度数曲線はほぼ直線を示す。対象者の数が多い場合は、累積度数曲線はほぼ直線を示す。対象者の数が少ない場合は、曲線の両端は直線から偏位するが、これは対象者の数が期待値とは2、3違うためであるかもしれない。

大部分の測定においては、1500 m未満群が、全体を通じて低値を示す傾向がある。しかしながら、かなりの変動があり、平均値の比較でも認められたように、頭囲、身長および体重を除いては、差は顕著ではない。著しい差を示したものについても、長崎の資料では、特に女性よ

TABLE 3 MEAN MEASUREMENTS BY DISTANCE FROM HYPOCENTER

表3 爆心地からの距離別平均測定値

| Measurement 測定値 | City 都市 | Sex 性 | <1500 m | | 1500-1999 m | | 3000-4999 m | | Not-in-City 市内不在 | |
|-----------------------------------|-----------------|----------|------------|-------------|-------------|------------|-------------|------------|------------------|------------|
| | | | Mean 平均 | Rank† 順位 | Mean 平均 | Rank 順位 | Mean 平均 | Rank 順位 | Mean 平均 | Rank 順位 |
| Head circumference (cm) 頭囲 | Hiroshima 広島 | Male 男 | 53.9 | 1 | 55.1 | 3 | 55.0 | 2 | 55.1 | 4 |
| | | Female 女 | 53.1 | 1 | 54.0 | 2 | 54.1 | 3 | 54.2 | 4 |
| | Nagasaki 長崎 | Male 男 | 53.8 | 1 | 54.9 | 3 | 54.9 | 2 | 55.4 | 4 |
| | | Female 女 | 53.7 | 1 | 54.8 | 4 | 54.3 | 2 | 54.5 | 3 |
| Standing height (cm) 身長 | Hiroshima 広島 | Male 男 | 163.4 | 1 | 165.4 | 3 | 165.3 | 2 | 165.5 | 4 |
| | | Female 女 | 151.3 | 1 | 153.9 | 3.5 | 153.9 | 3.5 | 153.8 | 2 |
| | Nagasaki 長崎 | Male 男 | 161.0 | 1 | 162.3 | 2 | 163.0 | 3 | 166.7 | 4 |
| | | Female 女 | 151.5 | 1 | 155.1 | 4 | 153.5 | 3 | 152.9 | 2 |
| Body weight (kg) 体重 | Hiroshima 広島 | Male 男 | 51.25 | 1 | 54.20 | 4 | 53.93 | 2 | 54.19 | 3 |
| | | Female 女 | 46.06 | 1 | 48.41 | 2 | 48.61 | 3 | 48.95 | 4 |
| | Nagasaki 長崎 | Male 男 | 50.48 | 1 | 52.77 | 3 | 52.42 | 2 | 54.94 | 4 |
| | | Female 女 | 45.58 | 1 | 50.75 | 4 | 48.46 | 3 | 48.29 | 2 |
| Chest circumference (cm) 胸囲 | Hiroshima 広島 | Male 男 | 77.2 | 1 | 78.3 | 4 | 78.1 | 3 | 78.0 | 2 |
| | | Female 女 | 71.9 | 1 | 73.4 | 4 | 73.2 | 3 | 73.1 | 2 |
| | Nagasaki 長崎 | Male 男 | 78.7 | 1 | 81.0 | 3 | 80.8 | 2 | 82.0 | 4 |
| | | Female 女 | 77.6 | 1 | 79.9 | 4 | 79.7 | 2 | 79.7 | 3 |
| Intercristic diameter (cm) 楯間径 | Hiroshima 広島 | Female 女 | 26.8 | 1 | 26.9 | 4 | 26.8 | 2 | 26.9 | 3 |
| | Nagasaki 長崎 | Female 女 | 26.0 | 1 | 27.3 | 4 | 27.0 | 3 | 26.8 | 2 |

† Rank of mean measurements prior to rounding, smallest to largest (1-4)
丸める前の測定の前平均値の順位小から大 (1→4)

TABLE 4 MEAN MEASUREMENTS, ABCC SUBJECTS AND SCHOOL HEALTH SURVEY

表4 ABCC対象者および学校衛生統計における測定の平均値

| Measurement 測定値 | City 都市 | Sex 性 | ABCC Subjects 対象者 | | School Health Survey * 衛生統計 |
|----------------------------|-----------------|----------|-------------------|---------|-----------------------------------|
| | | | <1500 m | 1500+ m | |
| Standing height (cm) 身長 | Hiroshima 広島 | Male 男 | 163.4 | 165.4 | 165.7 |
| | | Female 女 | 151.3 | 153.9 | 154.0 |
| | Nagasaki 長崎 | Male 男 | 161.0 | 164.1 | 165.6 |
| | | Female 女 | 151.5 | 153.5 | 153.8 |
| Body weight (kg) 体重 | Hiroshima 広島 | Male 男 | 51.2 | 54.1 | 56.4 |
| | | Female 女 | 46.1 | 48.7 | 51.0 |
| | Nagasaki 長崎 | Male 男 | 50.5 | 53.4 | 56.3 |
| | | Female 女 | 45.6 | 48.8 | 50.2 |

* Statistical yearbooks, Hiroshima and Nagasaki Prefectures, 1963 (Data for Prefecture)
1963年広島県および長崎県統計年鑑(県の資料)

erratic variations in the Nagasaki data, more for males than females, but this is most likely the result of the small number of subjects in the subgroups within 1500 m in Nagasaki (13 males, 17 females). The Nagasaki cumulative frequencies for head circumference, height, and weight do, in a general way, parallel the curves for Hiroshima.

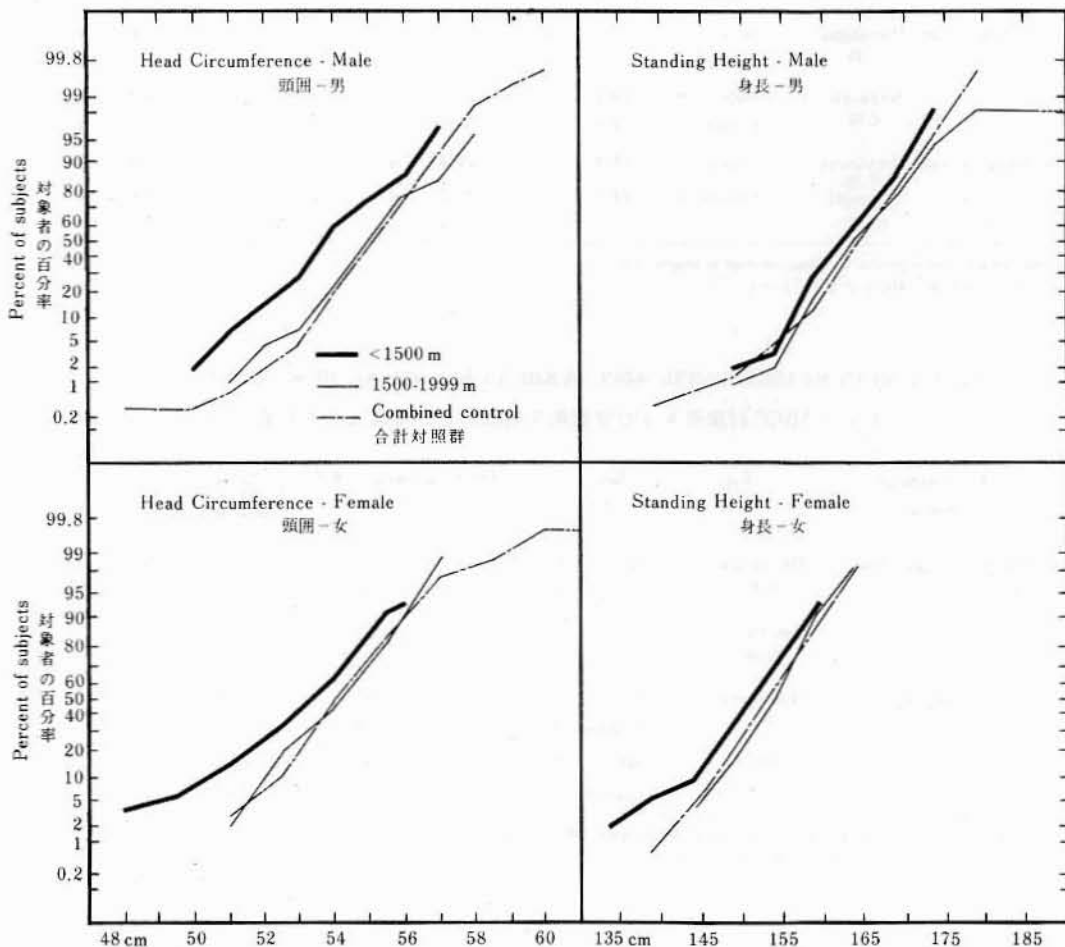
Head circumference data for Hiroshima males and females produce cumulative frequency curves indicating a slightly smaller head size (4-14 mm) for the subgroups within 1500 m as compared to the more distal subjects. Standing height for Hiroshima subjects shows a general trend for shorter stature; about 1 cm for males and 1-2 cm for females (Figure 1). The trends for weight are the same as for stature, and they are lighter than their more distally located contemporaries by 1-3 kg.

りは男性の場合に、不規則な変動がみられるが、これは長崎の1500 m未満群における対象者の数が少ない(男性13人、女性17人)ためであるという公算が大である。長崎における頭囲、身長および体重の累積度数は、概して、広島におけるものに平行している。

広島における男性および女性の頭囲資料から作った累積度数曲線によると、1500 m未満群の頭の大きさは、遠距離被爆に比較して少し小さい(4-14 mm)ことを示す。広島における対象者の身長は一般に小さい傾向を示している。すなわち、男性は約1 cm、女性は1-2 cm小さい(図1)。体重の傾向は、身長における傾向と同様である。すなわち、近距離被爆群の体重は遠距離被爆群よりも1-3 kg小である。

FIGURE 1 CUMULATIVE PERCENTAGE FREQUENCIES, HEAD CIRCUMFERENCE AND STANDING HEIGHT HIROSHIMA

図1 広島における頭囲および身長の累積百分率頻度



DISCUSSION

The present study indicates that exposure of the human fetus to the radiation of the atomic bombs has resulted in limitation of head and body size. The agreement with previous observations⁸⁻¹² and the much larger sample size permit little doubt regarding the validity of the findings. The evaluation having been made at age 17 years, when most meaningful growth had been completed, adds strength to the conclusions and suggests that the effects are likely to persist throughout life.

The major effects on growth attainment are those of decreased head circumference, height, and weight with several other measurements showing suggestive differences. Most detectable effects on growth of children who were in utero ATB occur within 1500 m from the hypocenter. This is demonstrated by the mean comparisons (Tables 2-4), and the cumulative frequency distributions (Figure 1) which indicate that the observed differences are not caused simply by a reduction in size of a limited number of subjects but rather by a general reduction in growth attainment for all subjects within 1500 m. Thus, even for those who would be considered within 'normal limits' there has been a failure to achieve optimal growth when compared to distal or nonexposed subjects. Additional assurance that the inferences are applicable to the entire sample was established by comparing the means of subjects not examined at age 17 years with those of the examined group at other ages.

Previous reports from Japan and the Marshall Islands have shown that exposure of young children to ionizing radiation has a limiting effect on growth.⁵⁻⁷ It is reasonable to expect that similar effects would occur in subjects irradiated while in utero and that the fetus may be susceptible throughout the gestational period, thus making the identification of quantitative differences by gestational age difficult. The search for a trimester-specific effect is further complicated by the additional subdivision of the sample and the resulting small numbers in each age group. In this study growth limitation was detectable in all trimesters. Those who were within 1500 m had smaller mean measurements than the more distal subjects for any trimester, indicating that proximity to the hypocenter is operative regardless of trimester. A gestational time of maximal or minimal risk in terms of ultimate growth achievement was not detected. This contrasts with observations on mental retardation where prevalence was increased within 1500 m and those between 6-15 weeks of gestational age ATB were particularly susceptible.¹⁴

考 察

本研究は、胎児の被爆により、頭やからだの大きさが制限されたことを示している。これらの所見は以前の観測結果⁸⁻¹²と一致しており、今回の標本の大きさが、はるかに大きいので、その信頼性についてはほとんど疑う余地はない。成長がほとんど完了している17歳時の評価を行なったので、その結論はいっそう確実となり、この影響が一生を通じて持続する可能性があることを示唆している。

成長に対するおもな影響は、頭囲、身長ならびに体重の減少で、その他、示唆的な差を示す測定が若干ある。原爆時胎内にあった子供の中で成長に最も多くの影響が現われたのは、爆心地から1500 m未満にあった者である。これは、平均値の比較(表2-4)および累積度数分布(図1)にもみられるが、この差が認められた理由は、唯単に対象者中の限られた一部の者の大きさが小さいためではなく、むしろ1500 m未満群における全例の成長の全般的遅滞によるものであると思われる。かくして、「正常範囲」内であると考えられる者でも、遠距離被爆群または非被爆群に比べた場合は、最善の成長を達成していないことになる。17歳で診察を受けなかった者と診察を受けた者のその他の年齢における測定の平均値を比較した結果、この推論が標本全体に当てはまるという確信は高められた。

日本およびマーシャル群島では、年少時に電離放射線に曝された子供に成長の制限が認められたと報告されている。⁵⁻⁷ 胎内被爆者にも同様の影響があるであろうということ、および胎児は妊娠全期間を通じて放射線感受性があるかもしれないので、妊娠月齢による量的差異の確認は困難であろうということを考えるのは合理的である。妊娠3か月期別に影響の有無を探究するためには、標本をさらに細分類することになり、その結果、各年齢群における対象者数が減少することによって、ますます複雑になる。本研究においては、妊娠の各3か月期にあった者に成長の制限が認められた。いずれの妊娠3か月期においても、1500 m未満の群の測定の平均値は、遠距離群よりは小であったが、このことは、爆心地に近いことが妊娠のすべての時期において影響を及ぼしているということを示している。最終的成長の観点からみて、危険が最大または最小である妊娠の時期を確認することはできなかった。これは、知能遅滞に関する観察結果と対照的である。すなわち、知能遅滞が1500 m未満の群に多く発生しており、また、被爆時に妊娠6-15週であった知能遅滞に特になりやすいと認められている。¹⁴

Childhood exposure to whole-body irradiation has been shown to result in more growth limitation in boys than girls.^{5,6} No sex-specific response on growth attainment for the proximal exposed in utero subjects was found, but a dose response (those within 1500 m affected) was demonstrated. The radiation dose dropped precipitously at 1500 m while the effects of blast, fire, trauma, and disease subsequent to the bombs, extended considerably beyond that limit.^{13,15} It is impossible to separate all these various factors, but growth limitation observed within 1500 m suggests irradiation as the major cause. Supporting this is the Marshall Islands experience where the source of irradiation was fallout without blast effects, and retardation of growth of exposed children occurred thus suggesting irradiation of the fetus rather than secondary maternal influences as the cause.

SUMMARY

Subjects who were exposed in utero to the atomic bombs in Hiroshima and Nagasaki, along with suitable controls, are examined annually at ABCC. At age 17 years, 1259 of the 1613 subjects in the study sample were examined and a tendency was observed for the proximal exposed to be least advanced in growth. The major effects are found most frequently in those who had been within 1500 m from the hypocenter of the bomb and include decreased head circumference, height, and weight. The levels of these effects do not vary by trimester of gestation.

幼児期の全身照射による成長制限の影響は、女性よりも男性に強いと報告されている。^{5,6} 近距離胎内被爆群においては、その成長に及ぼす影響には性別の差は認めなかったが、線量による影響(1500 m未満の被爆群に影響がある)が証明された。放射線量は1500 mで急激に減少するが、爆風、火災、外傷および被爆後の疾患による影響はもっと遠方まで及んだ。^{13,15} これら各種の要素をすべて分離することは不可能であるが、1500 m未満で成長制限が観察されたことは、放射線照射がそのおもな原因であるということを示唆している。マーシャル群島の経験はこれを支持している。すなわち、そこでは線源は、爆風効果を伴わない降下物であり、被爆児の成長の遅滞の原因は、母体の第2次的影響というよりは、むしろ胎児の照射であることを示唆している。

総括

広島および長崎における胎内被爆者ならびにその適当な対照者の診察をABCCにおいて毎年実施している。調査対象者1613人中1259人が17歳時診察を受け、近距離被爆群の成長が最も遅れている傾向が認められた。主要な影響は、爆心地から1500 m未満にあった者に最も多く、頭囲、身長および体重の減少が認められた。これらの影響の程度は、妊娠月数によって変わらない。

TABLE 5 SUBJECTS MEASURED, STANDING HEIGHT (cm)

表5 身長を測定した対象者数

| Group 群 | Male 男 | | | Female 女 | | |
|------------------------|------------------|------------|-------|------------------|------------|------|
| | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Hiroshima 広島 | | | | | | |
| Total 計 | 509 | 165.2 | 6.08 | 474 | 153.6 | 5.27 |
| <2000 m | 168 | 164.7 | 6.42 | 160 | 153.0 | 5.56 |
| <1500 m | 63 | 163.4 | 5.83 | 58 | 151.3 | 5.96 |
| 1500-1999 m | 105 | 165.4 | 6.66 | 102 | 153.9 | 5.11 |
| 50+ rad | 72 | 163.7 | 5.65 | 68 | 151.8 | 5.61 |
| <50 rad | 73 | 165.5 | 6.63 | 69 | 154.1 | 5.21 |
| Symptoms 症状あり | 17 | 165.1 | 7.30 | 13 | 149.2 | 7.15 |
| No symptoms 症状なし | 151 | 164.6 | 6.34 | 147 | 153.3 | 5.29 |
| 1st trimester 第1妊娠3か月期 | 51 | 166.1 | 6.84 | 46 | 152.0 | 5.06 |
| 2nd trimester 第2妊娠3か月期 | 69 | 164.4 | 6.41 | 63 | 153.1 | 6.20 |
| 3rd trimester 第3妊娠3か月期 | 48 | 163.5 | 5.83 | 51 | 153.7 | 5.10 |
| 3000-4999 m | 177 | 165.3 | 6.06 | 173 | 153.9 | 5.10 |
| Not-in-city 市内不在 | 164 | 165.5 | 5.75 | 141 | 153.8 | 5.16 |
| Nagasaki 長崎 | | | | | | |
| Total 計 | 143 | 163.8 | 6.98 | 128 | 153.3 | 5.17 |
| <2000 m | 43 | 161.9 | 7.87 | 36 | 153.4 | 5.45 |
| <1500 m | 13 | 161.0 | 7.70 | 17 | 151.5 | 6.05 |
| 1500-1999 m | 30 | 162.3 | 8.04 | 19 | 155.1 | 4.34 |
| 50+ rad | 13 | 161.9 | 7.42 | 15 | 152.4 | 5.90 |
| <50 rad | 24 | 161.2 | 8.55 | 14 | 153.9 | 4.07 |
| Symptoms 症状あり | 8 | 159.1 | 5.96 | 8 | 151.0 | 7.91 |
| No symptoms 症状なし | 35 | 162.5 | 8.18 | 28 | 154.1 | 4.48 |
| 1st trimester 第1妊娠3か月期 | 19 | 162.2 | 6.36 | 9 | 156.2 | 2.64 |
| 2nd trimester 第2妊娠3か月期 | 14 | 164.5 | 5.88 | 12 | 154.7 | 4.38 |
| 3rd trimester 第3妊娠3か月期 | 10 | 157.7 | 11.30 | 15 | 150.7 | 6.42 |
| 3000-4999 m | 55 | 163.0 | 7.05 | 48 | 153.5 | 5.05 |
| Not-in-city 市内不在 | 45 | 166.7 | 4.92 | 44 | 152.9 | 5.16 |

Source: Tabulations 01516, 01549, 01558, 01580, and 01663
資料

TABLE 6 SUBJECTS MEASURED, BODY WEIGHT (kg)

表6 体重を測定した対象者数

| Group 群 | Male 男 | | | Female 女 | | |
|------------------------|------------------|------------|-------|------------------|------------|------|
| | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Hiroshima 広島 | | | | | | |
| Total 計 | 509 | 53.7 | 6.62 | 474 | 48.4 | 5.78 |
| <2000 m | 168 | 53.1 | 6.83 | 160 | 47.6 | 5.87 |
| <1500 m | 63 | 51.2 | 6.34 | 58 | 46.1 | 6.15 |
| 1500-1999 m | 105 | 54.2 | 6.91 | 102 | 48.4 | 5.55 |
| 50+ rad | 72 | 52.0 | 6.52 | 68 | 46.9 | 6.09 |
| <50 rad | 73 | 54.6 | 6.86 | 69 | 47.8 | 6.07 |
| Symptoms 症状あり | 17 | 54.0 | 6.98 | 13 | 44.0 | 6.02 |
| No symptoms 症状なし | 151 | 53.0 | 6.83 | 147 | 47.9 | 5.77 |
| 1st trimester 第1妊娠3か月期 | 51 | 55.0 | 7.15 | 46 | 47.9 | 5.47 |
| 2nd trimester 第2妊娠3か月期 | 69 | 52.2 | 6.77 | 63 | 48.1 | 6.69 |
| 3rd trimester 第3妊娠3か月期 | 48 | 52.3 | 6.28 | 51 | 46.5 | 5.05 |
| 3000-4999 m | 177 | 53.9 | 6.91 | 173 | 48.6 | 5.45 |
| Not-in-city 市内不在 | 164 | 54.2 | 6.03 | 141 | 49.0 | 6.00 |
| Nagasaki 長崎 | | | | | | |
| Total 計 | 143 | 53.1 | 6.97 | 128 | 48.4 | 5.63 |
| <2000 m | 43 | 52.1 | 8.90 | 36 | 48.3 | 6.12 |
| <1500 m | 13 | 50.5 | 9.58 | 17 | 45.6 | 5.84 |
| 1500-1999 m | 30 | 52.8 | 8.67 | 19 | 50.8 | 5.40 |
| 50+ rad | 13 | 51.8 | 10.33 | 15 | 44.8 | 4.60 |
| <50 rad | 24 | 51.8 | 8.40 | 14 | 50.0 | 5.19 |
| Symptoms 症状あり | 8 | 47.9 | 7.11 | 8 | 44.7 | 7.48 |
| No symptoms 症状なし | 35 | 53.0 | 9.08 | 28 | 49.3 | 5.40 |
| 1st trimester 第1妊娠3か月期 | 19 | 51.5 | 7.99 | 9 | 51.0 | 6.64 |
| 2nd trimester 第2妊娠3か月期 | 14 | 56.2 | 9.30 | 12 | 45.8 | 4.81 |
| 3rd trimester 第3妊娠3か月期 | 10 | 47.4 | 8.10 | 15 | 48.7 | 6.34 |
| 3000-4999 m | 55 | 52.4 | 6.31 | 48 | 48.5 | 4.83 |
| Not-in-city 市内不在 | 45 | 54.9 | 5.22 | 44 | 48.3 | 6.14 |

Source: Tabulations 01516, 01549, 01558, 01580, and 01663
資料

TABLE 7 SUBJECTS MEASURED, HEAD CIRCUMFERENCE (cm)

表7 頭囲を測定した対象者数

| Group 群 | Male 男 | | | Female 女 | | |
|------------------------|------------------|------------|------|------------------|------------|------|
| | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Hiroshima 広島 | | | | | | |
| Total 計 | 509 | 54.9 | 1.53 | 466 | 54.0 | 1.75 |
| <2000 m | 168 | 54.6 | 1.74 | 159 | 53.6 | 1.84 |
| <1500 m | 63 | 26.5 | 1.44 | 58 | 26.8 | 1.45 |
| 1500-1999 m | 105 | 26.9 | 1.37 | 101 | 26.9 | 1.43 |
| 50+ rad | 72 | 26.7 | 1.46 | 68 | 26.8 | 1.47 |
| <50 rad | 73 | 26.9 | 1.27 | 68 | 26.7 | 1.41 |
| Symptoms 症状あり | 17 | 27.0 | 1.64 | 13 | 26.3 | 1.36 |
| No symptoms 症状なし | 151 | 26.7 | 1.38 | 146 | 26.9 | 1.43 |
| 1st trimester 第1妊娠3か月期 | 51 | 27.0 | 1.38 | 46 | 26.7 | 1.41 |
| 2nd trimester 第2妊娠3か月期 | 69 | 26.5 | 1.44 | 63 | 26.8 | 1.58 |
| 3rd trimester 第3妊娠3か月期 | 48 | 26.7 | 1.36 | 50 | 27.1 | 1.25 |
| 3000-4999 m | 177 | 55.0 | 1.40 | 169 | 54.1 | 1.36 |
| Not-in-city 市内不在 | 164 | 55.1 | 1.41 | 138 | 54.2 | 1.99 |
| Nagasaki 長崎 | | | | | | |
| Total 計 | 143 | 54.9 | 1.64 | 128 | 54.4 | 1.37 |
| <2000 m | 43 | 54.6 | 2.08 | 36 | 54.3 | 1.22 |
| <1500 m | 13 | 26.4 | 1.83 | 17 | 26.0 | 0.97 |
| 1500-1999 m | 30 | 26.2 | 1.62 | 19 | 27.3 | 1.36 |
| 50+ rad | 13 | 26.6 | 1.86 | 15 | 26.2 | 1.31 |
| <50 rad | 24 | 25.9 | 1.59 | 14 | 27.0 | 1.37 |
| Symptoms 症状あり | 8 | 25.2 | 1.24 | 8 | 25.9 | 1.33 |
| No symptoms 症状なし | 35 | 26.5 | 1.67 | 28 | 26.9 | 1.27 |
| 1st trimester 第1妊娠3か月期 | 19 | 26.0 | 1.88 | 9 | 27.1 | 1.13 |
| 2nd trimester 第2妊娠3か月期 | 14 | 26.8 | 1.04 | 12 | 26.5 | 1.00 |
| 3rd trimester 第3妊娠3か月期 | 10 | 26.0 | 1.90 | 15 | 26.5 | 1.67 |
| 3000-4999 m | 55 | 54.9 | 1.54 | 48 | 54.3 | 1.48 |
| Not-in-city 市内不在 | 45 | 55.4 | 1.16 | 44 | 54.5 | 1.37 |

Source: Tabulations 01516, 01549, 01558, 01580, and 01663

資料

TABLE 8 SUBJECTS MEASURED, INTERCRISTIC DIAMETER (cm)

表8 櫛間径を測定した対象者数

| Group 群 | Male 男 | | | Female 女 | | |
|------------------------|------------------|------------|------|------------------|------------|------|
| | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Hiroshima 広島 | | | | | | |
| Total 計 | 509 | 26.8 | 1.39 | 466 | 26.9 | 1.35 |
| <2000 m | 168 | 26.7 | 1.41 | 159 | 26.8 | 1.43 |
| <1500 m | 63 | 26.5 | 1.44 | 58 | 26.8 | 1.45 |
| 1500-1999 m | 105 | 26.9 | 1.37 | 101 | 26.9 | 1.43 |
| 50+ rad | 72 | 26.7 | 1.46 | 68 | 26.8 | 1.47 |
| <50 rad | 73 | 26.9 | 1.27 | 68 | 26.7 | 1.41 |
| Symptoms 症状あり | 17 | 27.0 | 1.64 | 13 | 26.3 | 1.36 |
| No symptoms 症状なし | 151 | 26.7 | 1.38 | 146 | 26.9 | 1.43 |
| 1st trimester 第1妊娠3か月期 | 51 | 27.0 | 1.38 | 46 | 26.7 | 1.41 |
| 2nd trimester 第2妊娠3か月期 | 69 | 26.5 | 1.44 | 63 | 26.8 | 1.58 |
| 3rd trimester 第3妊娠3か月期 | 48 | 26.7 | 1.36 | 50 | 27.1 | 1.25 |
| 3000-4999 m | 177 | 26.8 | 1.43 | 169 | 26.8 | 1.28 |
| Not-in-city 市内不在 | 164 | 26.9 | 1.32 | 138 | 26.9 | 1.34 |
| Nagasaki 長崎 | | | | | | |
| Total 計 | 143 | 26.5 | 1.39 | 128 | 26.8 | 1.39 |
| <2000 m | 43 | 26.3 | 1.66 | 36 | 26.7 | 1.34 |
| <1500 m | 13 | 26.4 | 1.83 | 17 | 26.0 | 0.97 |
| 1500-1999 m | 30 | 26.2 | 1.62 | 19 | 27.3 | 1.36 |
| 50+ rad | 13 | 26.6 | 1.86 | 15 | 26.2 | 1.31 |
| <50 rad | 24 | 25.9 | 1.59 | 14 | 27.0 | 1.37 |
| Symptoms 症状あり | 8 | 25.2 | 1.24 | 8 | 25.9 | 1.33 |
| No symptoms 症状なし | 35 | 26.5 | 1.67 | 28 | 26.9 | 1.27 |
| 1st trimester 第1妊娠3か月期 | 19 | 26.0 | 1.88 | 9 | 27.1 | 1.13 |
| 2nd trimester 第2妊娠3か月期 | 14 | 26.8 | 1.04 | 12 | 26.5 | 1.00 |
| 3rd trimester 第3妊娠3か月期 | 10 | 26.0 | 1.90 | 15 | 26.5 | 1.67 |
| 3000-4999 m | 55 | 26.5 | 1.19 | 48 | 27.0 | 1.48 |
| Not-in-city 市内不在 | 45 | 26.8 | 1.32 | 44 | 26.8 | 1.33 |

Source: Tabulations 01516, 01549, 01558, 01580, and 01663
資料

TABLE 9 SUBJECTS MEASURED, SELECTED MEASUREMENTS

特定の計測値を測定した対象者数

| City 都市 | Group 群 | Male 男 | | | Female 女 | | |
|---|------------------|------------------|------------|-------|------------------|------------|-------|
| | | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Sitting Height (cm) 坐高 | | | | | | | |
| Hiroshima 広島 | Total 計 | 509 | 89.7 | 3.03 | 466 | 85.2 | 2.79 |
| | <2000 m | 168 | 89.6 | 2.75 | 159 | 85.2 | 3.03 |
| | 3000-4999 m | 177 | 89.6 | 3.35 | 169 | 85.3 | 2.51 |
| | Not-in-city 市内不在 | 164 | 89.9 | 2.94 | 138 | 85.0 | 2.84 |
| Nagasaki 長崎 | Total 計 | 143 | 89.1 | 4.24 | 128 | 85.2 | 2.69 |
| | <2000 m | 43 | 87.8 | 4.95 | 36 | 85.7 | 2.94 |
| | 3000-4999 m | 55 | 88.7 | 4.36 | 48 | 85.0 | 2.32 |
| | Not-in-city 市内不在 | 45 | 90.7 | 2.59 | 44 | 85.1 | 2.87 |
| Span (cm) 翼幅 | | | | | | | |
| Hiroshima 広島 | Total 計 | 508 | 165.1 | 6.69 | 466 | 152.2 | 6.26 |
| | <2000 m | 168 | 164.4 | 7.07 | 159 | 151.5 | 6.88 |
| | 3000-4999 m | 176 | 165.5 | 6.39 | 169 | 152.6 | 5.81 |
| | Not-in-city 市内不在 | 164 | 165.6 | 6.58 | 138 | 152.4 | 6.01 |
| Nagasaki 長崎 | Total 計 | 143 | 164.2 | 7.51 | 128 | 152.2 | 5.64 |
| | <2000 m | 43 | 163.0 | 7.73 | 36 | 152.0 | 5.24 |
| | 3000-4999 m | 55 | 162.9 | 7.97 | 48 | 152.6 | 5.96 |
| | Not-in-city 市内不在 | 45 | 167.0 | 5.96 | 44 | 151.9 | 5.71 |
| Chest Circumference (cm) 胸囲 | | | | | | | |
| Hiroshima 広島 | Total 計 | 509 | 78.0 | 4.37 | 466 | 73.0 | 4.64 |
| | <2000 m | 168 | 77.9 | 4.59 | 159 | 72.8 | 4.47 |
| | 3000-4999 m | 177 | 78.1 | 4.38 | 169 | 73.2 | 4.70 |
| | Not-in-city 市内不在 | 164 | 78.0 | 4.13 | 138 | 73.1 | 4.79 |
| Nagasaki 長崎 | Total 計 | 143 | 81.0 | 4.35 | 128 | 79.4 | 4.79 |
| | <2000 m | 43 | 80.3 | 5.27 | 36 | 78.8 | 5.04 |
| | 3000-4999 m | 55 | 80.8 | 3.87 | 48 | 79.7 | 4.12 |
| | Not-in-city 市内不在 | 45 | 82.0 | 3.83 | 44 | 79.7 | 5.31 |
| Vital Capacity (dl) 肺活量 | | | | | | | |
| Hiroshima 広島 | Total 計 | 508 | 36.7 | 5.27 | 463 | 26.0 | 3.77 |
| | <2000 m | 168 | 36.2 | 5.57 | 156 | 25.7 | 4.16 |
| | 3000-4999 m | 177 | 36.6 | 5.36 | 169 | 26.0 | 3.67 |
| | Not-in-city 市内不在 | 163 | 37.3 | 4.82 | 138 | 26.3 | 3.41 |
| Nagasaki 長崎 | Total 計 | 142 | 35.4 | 6.73 | 126 | 24.7 | 3.66 |
| | <2000 m | 42 | 32.7 | 7.58 | 35 | 24.5 | 3.75 |
| | 3000-4999 m | 55 | 35.6 | 5.97 | 47 | 25.1 | 3.64 |
| | Not-in-city 市内不在 | 45 | 37.6 | 6.00 | 44 | 24.4 | 3.65 |
| Blood Pressure-Systolic (mmHg) 収縮期血圧 | | | | | | | |
| Hiroshima 広島 | Total 計 | 509 | 111.7 | 11.67 | 466 | 106.0 | 10.58 |
| | <2000 m | 168 | 111.6 | 11.78 | 158 | 105.8 | 10.45 |
| | 3000-4999 m | 177 | 111.5 | 12.16 | 168 | 105.8 | 10.47 |
| | Not-in-city 市内不在 | 164 | 112.1 | 11.08 | 140 | 106.5 | 10.93 |
| Nagasaki 長崎 | Total 計 | 144 | 110.9 | 11.82 | 128 | 105.2 | 9.79 |
| | <2000 m | 43 | 110.3 | 13.03 | 36 | 105.6 | 9.68 |
| | 3000-4999 m | 56 | 110.4 | 12.01 | 48 | 106.3 | 8.71 |
| | Not-in-city 市内不在 | 45 | 112.0 | 10.49 | 44 | 103.8 | 10.95 |

TABLE 表 9

| City 都市 | Group 群 | Male 男 | | | Female 女 | | |
|--|------------------|------------------|------------|-------|------------------|------------|------|
| | | Subjects 対象者数 | Mean 平均 | SD | Subjects 対象者数 | Mean 平均 | SD |
| Blood Pressure - Diastolic (mmHg) 拡張期血圧 | | | | | | | |
| Hiroshima 広島 | Total 計 | 509 | 64.1 | 10.65 | 466 | 63.0 | 8.91 |
| | <2000 m | 168 | 63.2 | 10.09 | 158 | 63.4 | 8.50 |
| | 3000-4999 m | 177 | 65.2 | 10.70 | 168 | 62.8 | 8.97 |
| | Not-in-city 市内不在 | 164 | 63.8 | 11.11 | 140 | 62.7 | 9.32 |
| Nagasaki 長崎 | Total 計 | 144 | 66.5 | 9.28 | 128 | 65.4 | 7.75 |
| | <2000 m | 43 | 65.6 | 11.19 | 36 | 64.3 | 6.77 |
| | 3000-4999 m | 56 | 66.8 | 9.20 | 48 | 66.4 | 7.23 |
| | Not-in-city 市内不在 | 45 | 67.1 | 7.31 | 44 | 65.1 | 8.99 |

Source Tabulations 01516, 01549, 01580, and 01663

資料

TABLE 10 CUMULATIVE PERCENTAGE FREQUENCIES, STANDING HEIGHT

表10 身長の累積百分率分布

| Measurement (cm) 測定値 | Male 男 | | | | | Female 女 | | | | |
|----------------------------|---------|-----------|-----------|---------------------|--|----------|-----------|-----------|---------------------|--|
| | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 |
| Hiroshima 広島 | | | | | | | | | | |
| Subjects 対象者数 63 | 105 | 177 | 164 | 341 | 58 | 102 | 173 | 141 | 314 | |
| 129 | | | | | 0 | | | | | |
| 134 | | | 0 | 0 | 1.7 | | 0 | 0 | 0 | |
| 139 | | | 0 | 0.6 | 0.3 | 5.2 | 0 | 0.6 | 0.7 | 0.6 |
| 144 | 0 | 0 | 0.6 | 0.6 | 0.6 | 8.6 | 3.9 | 3.5 | 4.3 | 3.8 |
| 149 | 1.6 | 1.0 | 1.7 | 0.6 | 1.2 | 34.5 | 16.7 | 19.1 | 19.9 | 19.4 |
| 154 | 3.2 | 1.9 | 5.1 | 2.4 | 3.8 | 67.2 | 52.0 | 52.0 | 53.9 | 52.9 |
| 159 | 28.6 | 15.2 | 11.9 | 14.6 | 13.2 | 93.1 | 89.2 | 87.9 | 87.9 | 87.9 |
| 164 | 55.6 | 48.6 | 46.9 | 42.7 | 44.9 | 100.0 | 98.0 | 97.7 | 98.6 | 98.1 |
| 169 | 84.1 | 76.2 | 76.3 | 79.3 | 77.7 | | 100.0 | 100.0 | 100.0 | 100.0 |
| 174 | 98.4 | 94.3 | 94.4 | 95.7 | 95.0 | | | | | |
| 179 | 100.0 | 98.1 | 100.0 | 99.4 | 99.7 | | | | | |
| 184 | | 98.1 | | 100.0 | 100.0 | | | | | |
| 189 | | 98.1 | | | | | | | | |
| 194 | | 100.0 | | | | | | | | |
| Nagasaki 長崎 | | | | | | | | | | |
| Subjects 対象者数 13 | 30 | 55 | 45 | 100 | 17 | 19 | 48 | 44 | 92 | |
| 129 | | 0 | | | | | | | | |
| 134 | | 3.3 | 0 | | 0 | | | | | |
| 139 | | 3.3 | 1.8 | | 1.0 | 5.9 | | 0 | 0 | 0 |
| 144 | 0 | 3.3 | 1.8 | | 1.0 | 11.8 | 0 | 2.1 | 6.8 | 4.4 |
| 149 | 7.7 | 6.7 | 1.8 | 0 | 1.0 | 35.3 | 10.5 | 18.8 | 29.6 | 23.9 |
| 154 | 30.8 | 6.7 | 14.6 | 2.2 | 9.0 | 70.6 | 42.1 | 56.2 | 50.0 | 53.3 |
| 159 | 46.2 | 30.0 | 23.6 | 6.7 | 16.0 | 94.1 | 84.2 | 87.5 | 95.4 | 91.3 |
| 164 | 53.8 | 53.3 | 54.5 | 40.0 | 48.0 | 100.0 | 100.0 | 97.9 | 100.0 | 98.9 |
| 169 | 84.6 | 83.3 | 87.2 | 68.9 | 79.0 | | | 100.0 | | 100.0 |
| 174 | 100.0 | 100.0 | 96.3 | 97.8 | 97.0 | | | | | |
| 179 | | | 100.0 | 100.0 | 100.0 | | | | | |

TABLE 11 CUMULATIVE PERCENTAGE FREQUENCIES, BODY WEIGHT

表11 体重の累積百分率分布

| Measurement (kg) 測定値 | Male 男 | | | | | Female 女 | | | | |
|----------------------------|-------------------------|------------|------------|---------------------|--|-----------|------------|------------|---------------------|--|
| | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 |
| Hiroshima 広島 | Subjects 対象者数 63 | 105 | 177 | 164 | 341 | 58 | 102 | 173 | 141 | 314 |
| 27.9 | | | | | | | 0 | | | |
| 29.9 | | | | | | 0 | 1.0 | | | |
| 31.9 | | 0 | | 0 | 0 | 1.7 | 1.0 | | | |
| 33.9 | | 1.0 | | 0.6 | 0.3 | 3.4 | 1.0 | | 0 | 0 |
| 35.9 | | 1.0 | 0 | 0.6 | 0.3 | 5.2 | 1.0 | 0 | 1.4 | 0.6 |
| 37.9 | 0 | 1.0 | 1.1 | 0.6 | 0.9 | 6.9 | 2.9 | 2.9 | 4.3 | 3.5 |
| 39.9 | 1.6 | 1.9 | 1.7 | 0.6 | 1.2 | 10.3 | 9.8 | 3.5 | 6.4 | 4.8 |
| 41.9 | 4.8 | 1.9 | 2.3 | 1.2 | 1.8 | 20.7 | 9.8 | 8.7 | 10.6 | 9.6 |
| 43.9 | 9.5 | 4.8 | 5.1 | 2.4 | 3.8 | 39.7 | 17.6 | 22.0 | 18.4 | 20.4 |
| 45.9 | 19.0 | 5.7 | 9.6 | 5.5 | 7.6 | 56.9 | 34.3 | 32.4 | 27.0 | 29.9 |
| 47.9 | 28.6 | 16.2 | 17.5 | 11.6 | 14.7 | 67.2 | 43.1 | 45.1 | 46.1 | 45.5 |
| 49.9 | 47.6 | 31.4 | 23.7 | 25.0 | 24.3 | 72.4 | 58.8 | 61.8 | 60.3 | 61.2 |
| 51.9 | 60.3 | 41.0 | 39.6 | 34.8 | 37.2 | 81.0 | 71.6 | 74.6 | 67.4 | 71.3 |
| 53.9 | 69.8 | 48.6 | 55.9 | 51.2 | 53.7 | 86.2 | 82.4 | 84.4 | 80.1 | 82.5 |
| 55.9 | 81.0 | 60.0 | 67.2 | 66.5 | 66.9 | 93.1 | 94.1 | 91.3 | 87.9 | 89.8 |
| 57.9 | 84.1 | 69.5 | 75.1 | 75.6 | 75.4 | 94.8 | 97.1 | 93.6 | 95.7 | 94.6 |
| 59.9 | 88.9 | 81.0 | 84.2 | 82.9 | 83.6 | 98.3 | 98.0 | 97.1 | 97.9 | 97.4 |
| 61.9 | 92.1 | 84.8 | 89.3 | 90.8 | 90.0 | 100.0 | 100.0 | 98.3 | 97.9 | 98.1 |
| 63.9 | 95.2 | 90.5 | 92.7 | 93.9 | 93.3 | | | 99.4 | 97.9 | 98.7 |
| 65.9 | 96.8 | 96.2 | 96.0 | 96.3 | 96.2 | | | 100.0 | 98.6 | 99.4 |
| 67.9 | 100.0 | 97.1 | 97.7 | 97.0 | 97.4 | | | | 99.3 | 99.7 |
| 69.9 | | 98.1 | 97.7 | 97.6 | 97.6 | | | | 100.0 | 100.0 |
| 71.9 | | 99.1 | 97.7 | 99.4 | 98.5 | | | | | |
| 73.9 | | 100.0 | 97.7 | 100.0 | 98.8 | | | | | |
| 75.9 | | | 98.9 | | 99.4 | | | | | |
| 77.9 | | | 98.9 | | 99.4 | | | | | |
| 79.9 | | | 99.4 | | 99.7 | | | | | |
| 81.9 | | | 100.0 | | 100.0 | | | | | |
| Nagasaki 長崎 | Subjects 対象者数 13 | 30 | 55 | 45 | 100 | 17 | 19 | 48 | 44 | 92 |
| 31.9 | | 0 | | | | | | | | |
| 33.9 | 0 | 3.3 | | | | | | | 0 | 0 |
| 35.9 | | 3.3 | 0 | | 0 | 0 | | 0 | 2.3 | 1.1 |
| 37.9 | 7.7 | 6.7 | 3.6 | | 2.0 | 5.9 | 0 | 2.1 | 2.3 | 2.2 |
| 39.9 | 15.4 | 10.0 | 3.6 | | 2.0 | 11.8 | 5.3 | 4.2 | 11.4 | 7.6 |
| 41.9 | 23.1 | 10.0 | 3.6 | | 2.0 | 29.4 | 5.3 | 6.2 | 13.6 | 9.8 |
| 43.9 | 30.8 | 10.0 | 9.1 | 0 | 5.0 | 35.3 | 10.5 | 16.7 | 25.0 | 20.6 |
| 45.9 | 30.8 | 13.3 | 14.6 | 2.2 | 9.0 | 64.7 | 15.8 | 31.2 | 38.6 | 34.8 |
| 47.9 | 46.2 | 23.3 | 23.6 | 4.4 | 15.0 | 70.6 | 26.3 | 47.9 | 50.0 | 48.9 |
| 49.9 | 53.8 | 30.0 | 32.7 | 15.6 | 25.0 | 88.2 | 42.1 | 56.2 | 59.1 | 57.6 |
| 51.9 | 61.5 | 50.0 | 43.6 | 31.1 | 38.0 | 88.2 | 52.6 | 81.2 | 70.4 | 76.1 |
| 53.9 | 61.5 | 63.3 | 61.8 | 44.4 | 54.0 | 88.2 | 79.0 | 89.6 | 77.3 | 83.7 |
| 55.9 | 69.2 | 70.0 | 65.4 | 57.8 | 62.0 | 94.1 | 89.5 | 93.8 | 90.9 | 92.4 |
| 57.9 | 69.2 | 76.7 | 80.0 | 75.6 | 78.0 | 94.1 | 89.5 | 95.8 | 95.5 | 95.6 |
| 59.9 | 92.3 | 83.3 | 90.9 | 80.0 | 86.0 | 94.1 | 94.7 | 95.8 | 95.4 | 95.6 |
| 61.9 | 92.3 | 83.3 | 94.6 | 86.7 | 91.0 | 100.0 | 94.7 | 100.0 | 100.0 | 100.0 |
| 63.9 | 92.3 | 86.7 | 96.4 | 91.1 | 94.0 | | 100.0 | | | |
| 65.9 | 92.3 | 90.0 | 98.2 | 97.8 | 98.0 | | | | | |
| 67.9 | 92.3 | 96.7 | 100.0 | 100.0 | 100.0 | | | | | |
| 69.9 | 92.3 | 96.7 | | | | | | | | |
| 71.9 | 100.0 | 100.0 | | | | | | | | |

TABLE 12 CUMULATIVE PERCENTAGE FREQUENCIES, HEAD CIRCUMFERENCE

表12 頭圍の累積百分率分布

| Measurement (cm) 測定値 | Male 男 | | | | | Female 女 | | | | |
|----------------------------|---------|-----------|-----------|---------------------|--|----------|-----------|-----------|---------------------|--|
| | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 | <1500 m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 |
| Hiroshima 広島 | | | | | | | | | | |
| Subjects 対象者数 63 | 105 | 177 | 164 | 341 | 58 | 101 | 169 | 138 | 307 | |
| 46.9 | | | 0 | 0 | 0 | | | | | |
| 47.9 | | | 0.6 | 0.3 | 3.4 | | | | | |
| 48.9 | 0 | | 0.6 | 0.3 | 5.2 | | | | | |
| 49.9 | 1.6 | 0 | 0.6 | 0.3 | 12.1 | 0 | 0 | 0 | 0 | |
| 50.9 | 6.4 | 1.0 | 1.2 | 0.6 | 13.8 | 2.0 | 1.2 | 3.6 | 2.3 | |
| 51.9 | 12.7 | 3.8 | 1.7 | 1.2 | 1.5 | 25.9 | 10.9 | 3.6 | 7.2 | 5.2 |
| 52.9 | 27.0 | 6.7 | 6.2 | 2.4 | 4.4 | 43.1 | 26.7 | 20.7 | 23.9 | 22.2 |
| 53.9 | 57.1 | 23.8 | 21.5 | 16.5 | 19.1 | 60.3 | 44.6 | 47.9 | 44.2 | 46.2 |
| 54.9 | 71.4 | 47.6 | 50.8 | 41.5 | 46.3 | 82.8 | 68.3 | 72.8 | 68.8 | 71.0 |
| 55.9 | 84.1 | 74.3 | 72.9 | 73.2 | 73.0 | 91.4 | 89.1 | 89.9 | 90.6 | 90.2 |
| 56.9 | 96.8 | 83.8 | 92.1 | 93.3 | 92.7 | 100.0 | 99.0 | 98.8 | 95.6 | 97.4 |
| 57.9 | 100.0 | 95.2 | 98.3 | 98.2 | 98.2 | | 100.0 | 99.4 | 97.8 | 98.7 |
| 58.9 | | 100.0 | 99.4 | 99.4 | 99.4 | | | 100.0 | 99.3 | 99.7 |
| 59.9 | | | 99.4 | 100.0 | 99.7 | | | | 99.3 | 99.7 |
| 60.9 | | | 100.0 | | 100.0 | | | | 99.3 | 99.7 |
| | | | | | | | | | 100.0 | 100.0 |
| Nagasaki 長崎 | | | | | | | | | | |
| Subjects 対象者数 13 | 30 | 55 | 45 | 100 | 17 | 19 | 48 | 44 | 92 | |
| 49.9 | | 0 | | 0 | | | 0 | | 0 | |
| 50.9 | 0 | 0 | 1.8 | 0 | 1.0 | | 2.1 | | 1.1 | |
| 51.9 | 38.5 | 6.7 | 1.8 | 0 | 1.0 | 0 | 4.2 | 0 | 2.2 | |
| 52.9 | 46.2 | 13.3 | 5.4 | 0 | 3.0 | 17.6 | 5.3 | 14.6 | 13.6 | 14.1 |
| 53.9 | 53.8 | 36.7 | 23.6 | 15.6 | 20.0 | 64.7 | 21.0 | 39.6 | 43.2 | 41.3 |
| 54.9 | 61.5 | 53.3 | 52.7 | 35.6 | 45.0 | 88.2 | 57.9 | 75.0 | 63.6 | 69.6 |
| 55.9 | 76.9 | 66.7 | 78.2 | 66.7 | 73.0 | 100.0 | 73.7 | 89.6 | 77.3 | 83.7 |
| 56.9 | 84.6 | 86.7 | 90.9 | 93.3 | 92.0 | | 100.0 | 95.8 | 100.0 | 97.8 |
| 57.9 | 92.3 | 96.7 | 96.4 | 97.8 | 97.0 | | | 97.9 | | 98.9 |
| 58.9 | 100.0 | 100.0 | 98.2 | 100.0 | 99.0 | | | 97.9 | | 98.9 |
| 59.9 | | | 100.0 | | 100.0 | | | 100.0 | | 100.0 |

TABLE 13 CUMULATIVE PERCENTAGE FREQUENCIES, INTERCRISTIC DIAMETER

表13 櫛間径の累積百分率分布

| Measurement (cm) 測定値 | Male 男 | | | | | Female 女 | | | | |
|----------------------------|--------|-----------|-----------|---------------------|--|----------|-----------|-----------|---------------------|--|
| | <1500m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 | <1500m | 1500-1999 | 3000-4999 | Not-in-city 市内不在 | 3000-4999 plus Not-in-city 市内不在 |
| Hiroshima 広島 | | | | | | | | | | |
| Subjects 対象者数 63 | 105 | 177 | 164 | 341 | 58 | 101 | 169 | 138 | 307 | |
| 69.9 | 1.0 | 0 | 0 | 0 | 15.5 | 4.0 | 3.6 | 8.0 | 5.5 | |
| 71.9 | 0 | 1.0 | 0.6 | 0.6 | 24.1 | 9.9 | 10.6 | 12.3 | 11.4 | |
| 73.9 | 1.6 | 1.0 | 1.1 | 0.6 | 39.7 | 24.8 | 22.5 | 25.4 | 23.8 | |
| 75.9 | 9.5 | 4.8 | 4.0 | 5.5 | 51.7 | 43.6 | 40.2 | 44.2 | 42.0 | |
| 77.9 | 25.4 | 17.1 | 13.0 | 8.5 | 10.8 | 65.5 | 55.4 | 59.2 | 65.9 | 62.2 |
| 79.9 | 38.1 | 24.8 | 26.6 | 22.0 | 24.3 | 84.5 | 80.2 | 78.7 | 80.4 | 79.5 |
| 81.9 | 49.2 | 43.8 | 39.6 | 42.1 | 40.8 | 93.1 | 88.1 | 90.5 | 88.4 | 89.6 |
| 83.9 | 68.2 | 61.0 | 54.2 | 66.5 | 60.1 | 98.3 | 96.0 | 97.0 | 94.2 | 95.8 |
| 85.9 | 79.4 | 75.2 | 79.1 | 76.8 | 78.0 | 100.0 | 99.0 | 97.0 | 96.4 | 96.7 |
| 87.9 | 90.5 | 81.0 | 87.6 | 89.6 | 88.6 | | 100.0 | 98.8 | 97.1 | 98.0 |
| 89.9 | 95.2 | 93.3 | 94.9 | 95.1 | 95.0 | | | 98.8 | 100.0 | 99.4 |
| 91.9 | 96.8 | 97.1 | 97.7 | 99.4 | 98.5 | | | 98.8 | | 99.4 |
| 93.9 | 100.0 | 99.0 | 98.3 | 99.4 | 98.8 | | | 99.4 | | 99.7 |
| 95.9 | | 99.0 | 99.4 | 99.4 | 99.4 | | | 100.0 | | 100.0 |
| 97.9 | | 99.0 | 100.0 | 100.0 | 100.0 | | | | | |
| 99.9 | | 100.0 | | | | | | | | |
| Nagasaki 長崎 | | | | | | | | | | |
| Subjects 対象者数 13 | 30 | 55 | 45 | 100 | 17 | 19 | 48 | 44 | 92 | |
| 69.9 | 0 | | | | | | 0 | 2.3 | 1.1 | |
| 71.9 | 3.3 | 0 | | 0 | 0 | 0 | 2.1 | 2.3 | 2.2 | |
| 73.9 | 0 | 3.3 | 3.6 | 2.0 | 5.9 | 5.3 | 2.1 | 2.3 | 2.2 | |
| 75.9 | 15.4 | 6.7 | 5.4 | 3.0 | 17.6 | 10.5 | 4.2 | 9.1 | 6.5 | |
| 77.9 | 23.1 | 10.0 | 7.3 | 4.0 | 29.4 | 15.8 | 16.7 | 25.0 | 20.6 | |
| 79.9 | 38.5 | 16.7 | 16.4 | 4.4 | 11.0 | 58.8 | 36.8 | 31.2 | 40.9 | 35.9 |
| 81.9 | 46.2 | 36.7 | 32.7 | 28.9 | 31.0 | 76.5 | 47.4 | 45.8 | 50.0 | 47.8 |
| 83.9 | 61.5 | 53.3 | 47.3 | 44.4 | 46.0 | 82.4 | 63.2 | 64.6 | 56.8 | 60.9 |
| 85.9 | 69.2 | 73.3 | 61.8 | 60.0 | 61.0 | 88.2 | 68.4 | 83.3 | 79.6 | 81.5 |
| 87.9 | 76.9 | 76.7 | 83.6 | 68.9 | 77.0 | 94.1 | 84.2 | 93.8 | 86.4 | 90.2 |
| 89.9 | 92.3 | 83.3 | 94.6 | 82.2 | 89.0 | 100.0 | 84.2 | 97.9 | 90.9 | 94.6 |
| 91.9 | 100.0 | 90.0 | 98.2 | 95.6 | 97.0 | | 94.7 | 97.9 | 93.2 | 95.6 |
| 93.9 | | 93.3 | 98.2 | 100.0 | 99.0 | | 100.0 | 100.0 | 97.7 | 98.9 |
| 95.9 | | 96.7 | 100.0 | | 100.0 | | | | 100.0 | 100.0 |
| 97.9 | | 100.0 | | | | | | | | |

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