

Comparison of Medical Data of Atomic-Bomb Survivors Resident in the U. S. and Hiroshima^{*1)}

Chikako ITO¹⁾, Hiroomi MATSUBARA²⁾, Michio YAMAKIDO³⁾
and Hiroaki YAMADA⁴⁾

1) *Hiroshima Atomic-Bomb Survivors Health Clinic, Hiroshima 730, Japan*

2) *Hiroshima Prefectural Medical Association, Hiroshima 733, Japan*

3) *2nd Department of Internal Medicine, Hiroshima, University School of Medicine, Hiroshima 734, Japan.*

4) *Radiation Effects Research Foundation, Hiroshima 730, Japan*

(Received January 8, 1982)

Key words: A-bomb survivors in US

ABSTRACT

The third medical examination of A-bomb survivors residing in the U. S. was performed in San Francisco, Los Angeles, Seattle and Honolulu during the period 6-28 May 1981. The test results were studied and the actual state of the survivors in the U. S., was reviewed as explained hereunder.

1) The number of survivors actually registered with the Committee of A-bomb Survivors in the U. S. is 491 (133 males and 358 females) of whom 57.2% are U. S. citizens. Those exposed in Hiroshima accounted for 91.8%. The mean age was 53.3 ± 8.9 , thus they were more than 3 years younger than their counterparts in Hiroshima. The present addresses of the survivors are distributed over 15 states, but those in California constitute 77.6% of the total, and when those residing in the states along the west coast and Hawaii are added the rate increases to 95.9%.

2) Those who underwent health examination numbered 166 (45 males and 121 females), and comparison of the U. S. survivors against the Hiroshima survivors showed there to be a difference in the following points. The prevalence of hypertension was lower among the U. S. survivors, but RBC counts and hemoglobin concentration were significantly higher. The same was observed for blood lipids with hypercholesterolemia and hypertriglyceridemia being found at a significantly higher rate in the U. S. survivors.

3) Those free of clinical abnormalities in this survey were 37.3%, and the rest required dietary guidance, follow-up observation, detailed examination or treatment. Those with diseases which are considered would make them eligible for health management allowance if in Japan, accounted for 18.7%.

INTRODUCTION

The health examination and health consultation program for A-bomb survivors resident in the U. S. began in 1977, and this last trip marked the third visit by medical teams. The areas visited for examination have increased each time. In addition to San Francisco and Los Angeles covered at the time of the previous visit, this time examinations were also performed in Seattle, and health consultation was provided in Honolulu.

As it had been the custom for 'nisei', Americans of Japanese ancestry, to receive education in Japan and thereafter return to the states, more than half of the A-bomb survivors (hereinafter referred to as survivors) currently residing in the U. S. had been in Japan receiving education when World War II broke out. Thus, they were unable to return to the U. S., and were subsequently exposed to the A-bombs in Japan. After the termination of the war, they returned to the states after being reinstated as U. S. citizens. This group of returnees are

*1) 伊藤千賀子, 松原博臣, 山木戸道郎, 山田廣明: 在米被爆者と広島在住の被爆者の検診成績の比較

referred to as 'kibei-nisei.' It appears not a few of them are spending days of anxiety out of concern over the development of A-bomb sequelae because of the high cost of medical care and their language difficulty.

The medical team left Japan on May 6, 1981 and was in San Francisco from the 6th to 13th, in Los Angeles from the 14th to 20th, and in Seattle from the 21st to 24th where examinations were conducted for the first time. From the 25th to 28th, health consultation was provided, also for the first time, in Honolulu.

The results of this last examination and the findings have been compared against the results obtained from survivors living in Hiroshima City. Further, as detailed analysis has been made of such information as the conditions at time of exposure, location at time of the bomb, nationality, age etc. obtained on the 491 persons currently registered with the Committee of Atomic Bomb Survivors in the U.S., this, too, will be reported.

METHOD

The examination consisted of doctor's physical examination (including gynecological examination), urinalysis, complete blood count (CBC), chest X-ray, EKG, blood chemistry and others. From those who had not received the A-bomb exposure status survey, detailed information on location at the time of the bomb etc. was sought by interview, and the exposure dose was estimated. The results of urinalysis, CBC and Pap smear test were obtained locally. The blood chemistry findings were obtained locally in San Francisco, but the Los Angeles and Seattle samples were frozen and shipped to Japan for tests at the Clinical Laboratory Center of the Hiroshima City Medical Association. The blood chemistry test items were slightly different between San Francisco and the other areas. That is, in San Francisco 28 items—total protein, albumin, A/G ratio, total bilirubin, GOT, GPT, alkaline phosphatase, LDH, γ -GTP, urea nitrogen, uric acid, creatinine, fasting plasma glucose, total cholesterol, triglycerides, total lipids, HDL-cholesterol, Na, K, Cl, P, Ca, Mg, Fe, CO₂, T₃RSU and T₄RIA were determined, while of the Los Angeles and Seattle samples CO₂ and T₃RSU were excluded because of sample volume and other problems, but the 6 items of CPK, cholesterol ester, T₃RIA, microsome test, TSH

and CEA were added to bring the total to 32 items. All tests presenting abnormal values were repeated. When indicated thyroid tests and LDH-isozyme tests were added.

RESULTS

(1) *Actual state of A-bomb survivors residing in the U.S.*

An actual state survey on survivors in the U.S. was initiated in 1974, and the results obtained by Yamada¹⁴⁾ 13 months later in 1975 indicated that there were 300 survivors. Subsequently, the number of survivors registered with the Committee of A-bomb Survivors in the U.S. has increased with each survey, and at present 491 consisting of 133 males and 358 females have been enumerated.

The exposure status of the 491 survivors is as shown in Table 1. There were 129 (26.3%) exposed at 0~1999 m, the closest having been exposed at 536 m, and 175 (35.6%) exposed beyond 2000 m. In addition, there were 11 (2.3%) exposed in-utero and 145 (29.5%) early entrants. Of the early entrants, the date of entry was known in 95, i.e. 57 (60.0%) had entered the city on the day of the bomb and 17 (17.9%) on the day after the bomb. Those entering the cities within 3 days after the bomb totalled 85 (89.5%).

Of the 491 survivors, 133 (27.1%) were males and 358 (72.9%) were females, thus females were approximately 2.7 times more numerous than males.

The 31 on whom the exposure status has not been ascertained are mostly survivors residing in

Table 1. Exposure status of Atomic Bomb Survivors in U.S.A.

Exposure Status	Male		Female		Total	
	Cases	%	Cases	%	Cases	%
0—999m	3	2.3	8	2.2	11	2.3
1000—1499m	10	7.5	25	7.0	35	7.1
1500—1999m	31	23.3	52	14.5	83	16.9
2000—2499m	13	9.8	52	14.5	65	13.2
2500m over	25	18.8	85	23.8	110	22.4
In utero	4	3.0	7	2.0	11	2.3
Early Entrants	43	32.3	102	28.3	145	29.5
Unknown	4	3.0	27	7.5	31	6.3
Total	133	100.0	358	100.0	491	100.0

Hawaii. The A-bomb Survivors Association of Hawaii is yet rather new, having been established in September 1980. As the above survivors had merely mailed in their questionnaires, details of their conditions at the time of exposure have not been ascertained.

As to classification of the survivors by city of exposure, of the 462 whose city of exposure is known, 424 (91.8%) had been exposed in Hiroshima, while only 38 (8.2%) had been exposed in Nagasaki. Classification by sex showed that of the 130 males, 126 (96.9%) had been exposed in Hiroshima, while 4 (3.1%) in Nagasaki; and of the 332 females, 298 (89.8%) had been exposed in Hiroshima, and 34 (10.2%) in Nagasaki.

Concerning the nationality of the 491 survivors, of the 133 males, 86 (64.6%) were American citizens, while of the 358 females, 195 (54.4%) were U. S. citizens, totalling 281 (57.3%). This was followed by Japanese with rights for permanent residency accounting for 44 (33.1%) males and 155 (43.3%) females, totalling 199 (40.5%), and there were only 6 (1.2%) Japanese, all females. Other nationalities involved were Koreans, 2 males and 1 female.

Breakdown by age at the time of exposure is given in Table 2. The peak for both males and females is those between 15~19 with males numbering 43.9% out of 132, and females 32.5% out of 358, totalling 35.4%; followed by those 10~14 accounting for 36 males (27.3%) and 56 females (15.6%), totalling 92 (18.8%).

The current age composition as of May 31, 1981 when the examinations were performed is as follows. Of the registered survivors, confirmed deaths number 12, 1 male and 11 females. The cause of death in more than half was ma-

lignant neoplasm. Thus, it may readily be assumed that there were a number of deaths attributable to similar causes prior to 1975 when this program was initiated. The review on age was based on the 478 living survivors. The present age peak is those between 50~59, numbering 73 (55.7%) out of the 131 males and 188 (54.2%) out of the 347 females, totalling 261 (54.6%) out of 478. This is followed by those between 40~49. The mean age \pm standard deviation (S. D.) is 52.0 ± 8.1 for males and 53.8 ± 9.2 for females, while for the whole group it is 53.3 ± 8.9 .

Review of the registered survivors by present address shows that they live in 15 different states. The largest number reside in California with 381 (77.6%), followed by Hawaii with 64 (13.0%), Washington 21 (4.3%), Oregon 5 (1.0%), Colorado 4 (0.8%), Utah and Illinois 3 each (0.6%), Florida and Missouri 2 each (0.4%) and Arkansas, Maine, Michigan, New York, Pennsylvania and Texas 1 each. The survivors cluster along the west coast totalling 407 (82.9%).

Of the total survivors, 95.9% live on the west coast and Hawaii. As to the breakdown by city, the largest number living in California make their homes in Los Angeles with 61 (17.3%), followed by San Francisco with 36 (9.4%), Monterey Park and Sacramento with 20 each (5.2%), Gardena 17 (4.5%), San Jose 11 (2.9%), Culver City 10 (2.6%) and 98 other towns.

(2) Results of health examination

1) Number receiving health examination and health consultation

Health examination and health consultation were provided at all four locations. The number of participants by age composition is shown in Table 3: San Francisco 71 (24 males, 47 females), Los Angeles 73 (15 males, 58 females), Seattle 22 (6 males, 16 females) and Honolulu 37 (7 males, 30 females). The grand total was 203 (52 males and 151 females) of whom females accounted for 74.4%. The survivors were seen on two nights in Honolulu, but only health consultation was provided. Thus, those who actually received health examination in the three other cities totalled 166. There were 45 males who had all been exposed in Hiroshima and more than 70% were in their fifties. Of the females, 103 (85.1%) had been exposed in Hiroshima, and 18 (14.9%) in Nagasaki. The

Table 2. Age at time of Bomb

Age at ATB (yrs)	Male		Female		Total	
	Cases	%	Cases	%	Cases	%
— 4	11	8.3	33	9.2	44	9.0
5— 9	11	8.3	37	10.3	48	9.8
10—14	36	27.3	56	15.6	92	18.8
15—19	58	43.9	116	32.5	174	35.4
20—24	5	3.8	59	16.5	64	13.1
25—29	3	2.3	17	4.7	20	4.1
30—	8	6.1	40	11.2	48	9.8
Total	132	100.0	358	100.0	490	100.0

Table 3. Number of participants by city

Place of Exam.		Present Age (yrs)					Total
		39	40-49	50-59	60-69	70-	
San Francisco	Male	1	4	18	0	1	24
	Female	4	18	17	5	3	47
	Total	5	22	35	5	4	71
Los Angeles	Male	2	2	9	2	0	15
	Female	4	11	33	7	3	58
	Total	6	13	42	9	3	73
Seattle	Male	0	0	6	0	0	6
	Female	1	1	9	2	3	16
	Total	1	1	15	2	3	22
Honolulu*	Male	0	3	4	0	0	7
	Female	1	8	17	2	2	30
	Total	1	11	21	2	2	37
Total	Male	3	9	37	2	1	52
	Female	10	38	76	16	11	151
	Total	13	47	113	18	12	203

* Health Consultation

age peak in the females was also those in their fifties, followed by those in their forties, and those between 40~59 constituted more than 70% of the total.

The examinees when classified by exposure status are as follows, with 4 (2.4%) who had been directly exposed between 0~999 m, 13 (7.8%) exposed at 1000~1499, 30 (18.8%) exposed at 1500~1999 m, 26 (15.7%) exposed at 2000~2499 m, and 57 (34.3%) exposed beyond 2500 m, while there were 36 (21.7%) early entrants. These examination rates when compared against the survivors registered with the Committee of A-bomb Survivors show that 4 (40%) of 10 who had been exposed at 0~999 m, 13 (38.2%) of 34 in the 1000~1499 m group, 30 (36.1%) of 83 in the 1500~1999 m group, 26 (42.6%) of 61 in the 2000~2499 m group, 57 (51.8%) of 110 in the 2500 m and over group and 36 (25.7%) of 140 in the early entrants group received the health examination. As can be seen the examination rate of the early entrants was significantly less than all of the other exposure groups. The survivors were classified into three groups, e.g. 0~1999 m group, over 2000 m group and early entrants, and review was

made of the examination results.

2) Obesity index, prevalence of hypertension and chest X-ray findings

Standard weight was calculated by $(\text{height} - 100) \times 0.9$, and the obesity index was sought by $\{(\text{present weight} - \text{standard weight}) / \text{standard weight}\} \times 100$. The prevalence of those with an obesity index in excess of 20% accounted for 23.3% of the 43 males and 25% of the 120 females, or 24.5% of the 163 examinees. Classification by exposure status showed that the index was higher in females in all categories except early entrants, in whom the males had a higher index. The mean indices of those over 20% were 24.7% for males and 32.6% for females in the 0~1999 m group, 28.8% for males and 37.2% for females in the over 2000 m group, and 24.7% for males and 35.8% for females in the early entrants group showing that the mean obesity indices were higher in females in all groups.

The prevalence of those with blood pressure readings in excess of the WHO standards²²⁾, e.g. systolic pressure greater than 160 mmHg or a diastolic pressure greater than 95 mmHg, or both, was 11.6% among males and 15.0% for females, and 14.1% when combined, thus indicating that prevalence was greater among females. There was no apparent pattern between exposure status in the males, but the rate was 22.9% in females exposed at 0~1999 m, followed by those exposed at over 2000 m with 13.1% and early entrants with 8.3%.

Chest X-ray examination were performed on 163 examinees. Those with no abnormalities findings numbered 141 (86.5%), while those with signs of old tuberculosis 9 (5.5%), old pleurisy 5 (3.1%), pulmonary fibrosis 1 (0.6%), chronic inflammatory changes 2 cases who were considered to require further detailed examination and cardiomegaly 4 (2.5%).

3) Electrocardiographic (EKG) findings

The EKG tracings were evaluated in accordance with the Minnesota Code¹⁹⁾

Those evaluated as having no reportable items numbered 116 (70.7%) out of 164. There was 1 (0.6%) with I-3-4, in whom a Q wave was noted in limb leads II, III and aV_F, but this case could not be considered having definite myocardial infarction. There were 4 (2.4%) with II-1 left axis deviation. Under III, high amplitude R wave, were 14 (8.5%) with III-1

Table 4. Mean values of complete blood counts

C. B. C.		Exposure Status	0-1999m	≥2000m	Early Entrants	Total
Male	Cases		11	21	13	45
	W. B. C.		6673±1511	6959±1652	5631± 931	6515±1555
	R. B. C. (10 ⁴)		490± 31	503± 36	496± 45	498± 38
	Hemoglobin (g/dl)		15.7± 0.8	15.9± 0.8	15.2± 1.2	15.6± 0.9
	Hematocrit (%)		47.0± 2.0	48.0± 2.5	46.5± 3.6	47.4± 2.8
Female	Cases		36	60	24	120
	W. B. C.		6353±2140	5975±1650	5909±1094	6077±1740
	R. B. C. (10 ⁴)		441± 32	438± 35	448± 36	441± 34
	Hemoglobin (g/dl)		13.7± 0.9	13.5± 1.1	14.0± 1.2	13.7± 1.1
	Hematocrit (%)		42.0± 2.5	41.6± 3.2	42.7± 3.3	41.9± 3.0
Total	Cases		47	81	37	165
	W. B. C.		6427±2015	6240±1708	5808±1047	6200±1702
	R. B. C. (10 ⁴)		452± 38	455± 45	465± 46	457± 44
	Hemoglobin (g/dl)		14.1± 1.2	14.1± 1.4	14.4± 1.3	14.2± 1.4
	Hematocrit (%)		43.1± 3.3	43.3± 4.0	44.0± 3.8	43.4± 3.8

(Mean±S. D.)

and 1 (0.6%) with III-3, totalling 15 (9.1%). The ST junction and segment of IV showed there were 5 (3.0%) with IV-2, 1 (1.6%) with IV-3 and 1 (0.6%) with IV-4, totalling 7 (4.3%). Those with V, T wave items were 5 (3.0%) with V-2 and 3 (1.8%) with V-3, totalling 8 (4.8%). Under VI A-V conduction block, there were 7 (4.3%) with grade 1 A-V block. Under VII, ventricular conduction block, there were 4 (2.4%) with VII-2, complete RBBB, and 2 (1.2%) with incomplete RBBB. Under arrhythmia (VIII) were 3 (1.8%) with tachycardia, 2 (1.2%) with bradycardia and 6 (3.7%) with other arrhythmia. As the prevalence of abnormality was small, a definite trend by exposure status could not be observed.

4) Urine and complete blood count (CBC) findings

Proteinuria was found in 5 (3.1%) out of 163, acetone body 5 (3.1%) in 162, sugar 1 (0.6%) and occult blood 8 (4.9%). The prevalence of a WBC count of less than 4000 or over 10,000 was 14 (8.5%) in 164, there were 2 (1.2%) with an RBC of less than 350×10^4 , 2 with a hemoglobin concentration of less than 11.0 g/dl and 1 over 17.0 g/dl for a total of 3 (1.8%) and 2 (1.2%) with hematocrit values less than 35%. The mean value±S. D. for RBC, hemoglobin concentration and hematocrit value are shown

in Table 4. There was hardly any difference by exposure status observed, but females had lower RBC, hemoglobin concentration and hematocrit value than males, being approximately 500,000, 2 g/dl and 5% less respectively. In males, the RBC count was mean±S. D. or $498 \pm 38 \times 10^4$, hemoglobin concentration was 15.6 ± 0.9 g/dl and hematocrit value was $47.4 \pm 2.8\%$, while in females the values were $441 \pm 34 \times 10^4$, 13.7 ± 1.1 g/dl and $41.9 \pm 3.0\%$ respectively.

5) Biochemistry test findings

There were 11 with total protein values in excess of 8.1 g/dl, but the highest value registered was 8.6 g/dl which could not be considered pathologic. Decrease in A/G ratio was noted in 2 whose values were 0.8 and 0.9.

Those with elevated total bilirubin numbered 15 (9.3%) of whom 5 had values in excess of 1.5 mg/dl with 2.8 mg/dl being the highest, but all of these were increases in direct bilirubin.

GOT and GPT increases were noted in 9 (5.5%) and 6 (3.7%) respectively, but those with GPT values in excess of 100 units numbered 2.

Alkaline phosphatase was increased in 6 (3.7%), but all had only slightly exceeded the upper limits of normal and were not considered to pose any clinical problems.

In 12 cases (7.4%), LDH was increased, and

4 had values over 50 units in excess of the upper limit of normal. Two of the 4 cases underwent further tests on LDH isozyme, but no special abnormalities could be found.

The γ -GTP showed abnormal values in 10 (6.1%), but only 1 case had a value in excess of 100 units.

There were 9 cases (9.5%) with abnormal CPK values, but only 1 case had a value greater than 150 units.

In 10 cases (6.1%), the urea nitrogen value was abnormal, but in all the degree of elevation was slight, being within 5 mg/dl of the upper limits of normal, and in none was renal dysfunction suspected. The creatinine value checked at the same time failed to demonstrate a single case with abnormal values.

There were 11 cases (6.7%) with abnormal uric acid values. Two had values in excess of 9 mg/dl, but there were none with complaints of gout.

Abnormal serum iron values were noted in 12 (7.5%), and 3 had values below 50 γ /dl with the lowest being 27 γ /dl. There were also 2 with values in excess of 250 γ /dl.

The abnormal electrolyte values noted were as follows. Na value was low in 1 out of 164 and the value was 129 mEq/l. Elevated K values were not observed at all, while decreased values were noted in 4 out of 159, the values being 3.2 mEq/l, 3.3 mEq/l and two with 3.4 mEq/l, but there were no diseased states considered to be attributable to these values. Decreased Cl values were observed in 2 out of 160 cases, the values being 94 mEq/l and 89 mEq/l. Both decreases in value were slight and no special diseased state was observed.

6) Papanicolaou's smear test

Pap smear test was performed on 91 cases, and all were evaluated as Class I or II. There were no cases with findings suggestive of cancer, but there was 1 case with trichomonas vaginalis.

Table 5. Serum lipids

Exposure Status		0—1999m		≥ 2000 m		Early Entrants		Total	
		Cases	%	Cases	%	Cases	%	Cases	%
Total cholesterol (mg/dl)	—249	23	48.9	44	54.3	24	66.7	91	55.5
	250—299	18	38.3	26	32.1	9	25.0	53	32.3
	300—	6	12.8	11	13.6	3	8.3	20	12.2
	Total	47	100.0	81	100.0	36	100.0	164	100.0
	mean \pm S.D.	253.2 \pm 42.6		246.6 \pm 42.1		238.8 \pm 37.8		246.8 \pm 41.7	
Triglycerides (mg/dl)	—179	32	68.1	66	81.5	27	75.0	126	76.9
	180—199	1	2.1	2	2.5	1	2.8	3	1.8
	200—249	2	4.3	7	8.6	3	8.3	12	.3
	250—	12	25.5	6	7.4	5	13.9	23	14.0
	Total	47	100.0	81	100.0	36	100.0	164	100.0
Mean \pm S. D.	170.6 \pm 111.8		133.2 \pm 66.2		150.5 \pm 78.6		147.8 \pm 85.9		
Total lipids (mg/dl)	—800	35	74.6	70	84.3	35	97.2	140	84.3
	801—999	6	12.7	12	14.5	1	2.8	19	11.5
	1000—	6	12.7	1	1.2	0	0	7	4.2
	Total	47	100.0	83	100.0	36	100.0	166	100.0
	Mean \pm S. D.	728.9 \pm 193.1		671.7 \pm 135.6		650.8 \pm 98.1		683.4 \pm 150.8	
HDL- cholesterol (mg/dl)	— 40	3	6.4	4	4.8	2	5.6	9	5.4
	41—	44	93.6	79	95.2	34	94.4	157	94.6
	Total	47	100.0	83	100.0	36	100.0	166	100.0
	Mean \pm S. D.	64.0 \pm 16.2		63.4 \pm 16.4		66.8 \pm 18.4		64.4 \pm 16.9	

In the U. S., examinations for uterine cancer are carried out on an annual basis, which is considered to be the reason there were hardly any abnormal findings.

7) Blood lipid findings

The prevalences of high total serum cholesterol, triglycerides total lipid and low HDL-cholesterol values together with their respective mean values \pm S. D. are shown in Table 5.

Those with total serum cholesterol values between 250~299 mg/dl were 32.3% of the 164 cases, and those whose values exceeded 300 mg/dl were 12.2%. The values of the 0~1999 m group were higher than the early entrants, but this is considered to be because there were more obese persons in the former.

There were 12 (7.3%) with triglyceride values in excess of 200~249 mg/dl and 23 (14.0%) out of 164 whose values exceeded 250 mg/dl. Those in the 0~1999 m group tended to show higher values than the early entrants, but this, too, is due to the fact that there were more obese persons in the former.

Of the 164, there were 7 (4.2%) with total lipids values in excess of 1000 mg/dl, who by exposure status showed those in the 0~1999 m group had high values.

Those with HDL-cholesterol values less than 40 mg/dl numbered 9 (5.4%) out of 164 and the lowest value registered was 27 mg/dl. No difference by exposure status could be observed.

The mean value \pm S. D. of blood lipids value was 246.8 ± 41.7 mg/dl, and there was no variation by exposure status. The triglycerides value was 147.8 ± 85.9 mg/dl, and there was great variation among the exposure groups, but when reviewed on the basis of mean value, there was no difference by exposure status. The total lipids value was 683.4 ± 150.8 mg/dl, and the 0~1999 m group tended to show a high value. The HDL-cholesterol value was 64.4 ± 16.9 mg/dl, and there was no difference by exposure status.

8) Fasting plasma glucose levels

Those with fasting plasma glucose levels of less than 109 mg/dl numbered 143 (87.3%), those between 110~119 mg/dl was 11 (6.7%), 120~129 mg/dl 5 (3.0%), 130~139 mg/dl 1 (0.6%), and those in excess of 140 mg/dl, the diabetes mellitus standards established by the NIH⁽¹⁸⁾ and WHO⁽²³⁾, numbered 4 (2.4%). There was no difference by exposure status.

Those whose values had exceeded 140 mg/dl showed levels of 217, 170, 147 and 145 mg/dl respectively.

9) Prevalence of thyroid hormone and CEA level abnormalities

T₄RIA, T₃RIA, T₃RSU and TSH levels were determined to ascertain the state of thyroid function. T₃RIA, as a rule, tended to be slightly low, but there were 2 cases with values of 70 ng/dl. There were 9 among the 164 cases with T₄RIA levels in excess of 13 μ g/dl, but there were none considered to have hyperthyroidism. The T₃RSU level was below 23% in 3 (4.2%). TSH test was performed only on the Los Angeles and Seattle cases, but there were 4 (4.2%) with values in excess of 10 μ U/ml, e.g. 87, 16, 25 and 16 μ U/ml respectively. Three of these cases were in the 0~1999 m group, 1 in whom the TSH was 87 μ U/ml and CEA was 6.0 ng/ml. This individual had received thyroidectomy, but on this examination was found to have a single isolated tumor the size of the thumb tip.

As thyroid cancer was strongly suspected, it is felt the individual should undergo detailed examination at an early date.

10) Microsome test findings

The antibody titer against microsome, an autoantibody present in the epithelial cells of the thyroid gland, was determined. Those with microsome test positive findings in the 0~1999 m group was markedly high constituting 37.0%, but in the over 2000 m group it was 13.2%, and 17.4% in the early entrants. Thus, the rate was significantly higher in the 0~1999 m group than the over 2000 m group ($p < 0.05$). However, 40% of the positive cases in the 0~1999 m group were in the lowest antibody titer class of 10².

11) Clinical diagnosis

From the overall point of view, those in whom no obvious abnormalities were detected through the examinations and tests numbered 13 (27.7%) among 47 in the 0~1999 m group, 36 (43.4%) among 83 in the over 2000 m group and 13 (36.1%) among 36 in the early entrants. Thus, as a whole, there were 62 (37.3%) such individuals among the 166 cases. Those who were found, as a result of this program, to require follow-up observation, treatment or further detailed study are as shown in Table 6. The abnormal finding of highest prevalence was hyperlipidemia followed by those with total cho-

Table 6. Diseases diagnosed and abnormal findings for which treatment or further examinations were recommended

Exposure Status Diagnosis and Findings	0-1999m		≥2000m		Early Entrants		Total	
	Cases	%	Cases	%	Cases	%	Cases	%
Lung disease	5	10.6	0	0	0	0	5	3.0
Hypertension	10	21.3	12	14.5	4	11.1	26	15.7
Ischemic heart disease	4	8.5	6	7.2	4	11.1	14	8.4
Liver disease	3	6.4	2	2.4	2	5.6	7	4.2
Diabetes mellitus	0	0	3	3.6	1	2.8	4	2.4
Dermatosis	3	6.4	0	0	1	2.8	3	1.8
Hypothyroidism	3	6.4	0	0	1	2.8	4	2.4
Hyperlipidemia	17	36.2	25	30.1	12	33.3	54	32.5
Obesity (obesity index ≥25%)	13	17.7	12	14.5	5	13.9	30	18.1
Urinary tract infection	1	2.1	0	0	1	2.8	2	1.2
Nephritis possible	0	0	2	2.4	1	2.8	3	1.8
Hyperuricemia	0	0	0	0	2	5.6	2	1.2
Hyperglycemia	1	2.1	1	1.2	4	11.1	6	3.6
Other findings	2*	4.2	2**	2.4	1***	2.8	5	3.0
Total examinees	47	100.0	83	100.0	36	100.0	166	100.0

* Trichomonas vaginalis, rheumatoid arthritis

** Breast tumor, iron deficiency anemia

*** High γ -Globulinemia

lesterol levels in excess of 300 mg/dl or triglyceride levels of 200 mg/dl, each with 54 cases (32.5%). These individuals were personally provided dietary guidance. Those with an obesity index of 25% or more numbered 30 (18.1%). These individuals were provided guidance on how to prevent cardiovascular disturbance, and to those in whom such signs were noted a dietary guide was enclosed with the report on the results of the examination. Those with hypertension (including those on hypotensive drugs) numbered 26 (15.7%). There were 14 (8.4%) with ischemic heart disease. In 4, the EKG findings had either aggravated as compared to the previous examinations or abnormal tracings were noted for the first time. The report of findings was accompanied by copies of the latest and previous tracings when indicated. There were 7 (4.2%) in whom liver disorder was either noted or there was strong suspicion of such and further studies were necessary. Diabetes mellitus was found in 4 (2.4%), but those with high fasting plasma glucose values who were felt to require glucose tolerance test numbered 6 (3.6%). Hypothyroidism was noted in 4 (2.4%). Those with lung disease numbered 5 (1.8%). There were 2 in whom malig-

nant tumors were suspected, 1 of the thyroid and the other of the breast.

DISCUSSION

The number of A-bomb survivors residing in the U. S. registered with the Committee of A-bomb Survivors as of the end of May 1981 is 491, but the true total number is estimated to be over 1,000, thus the actual state has not yet been fully ascertained. The reason for the great discrepancy between the estimated true number and those actually registered is considered to be because being an A-bomb survivor in the American society which is completely different from that in Japan, the individual is often confronted with the fear of being subjected to social and financial losses, and also there appears at present practically no hope for the introduction of relief measures.

The registered total is 491, 133 males and 358 females, but 26.3% of the total were exposed at 0-1999 m from the hypocenter, 35.6% at over 2000 m, 29.5% were early entrants and 2.3% were exposed in utero. Those exposed in Hiroshima constituted 91.8% of the total. This is considered to be because many immigrated to foreign countries from Hiroshima Prefecture,

Table 7. Present age of survivors in Hiroshima as of March 31, 1981

Age (yrs)	Male		Female		Total	
	Cases	%	Cases	%	Cases	%
—39	7265	16.6	7149	10.9	14414	13.2
40—49	10817	24.7	11114	16.9	21931	20.0
50—59	10429	23.8	19059	28.9	29488	26.9
60—69	6861	15.7	14249	21.6	21110	19.3
70—	8391	19.2	14278	21.7	22669	20.7
Total	43763	100.0	65849	100.0	109612	100.0

Mean age Male 54.8 yrs
 Female 57.9 yrs
 Total 56.6 yrs

and it was customary for the second generation 'nisei' or Americans of Japanese ancestry to go to Japan to receive higher education and later return to the U. S.

Breakdown by nationality showed more than half (57.3%) were U. S. citizens, and Japanese granted permanent residency made up 40.8%. The mean age \pm S. D. as of May 31, 1981 was 52.0 ± 8.1 for males and 53.8 ± 9.2 for females, or 53.3 ± 8.9 for both sexes combined. The age composition of survivors residing in Hiroshima is as shown in Table 7¹⁾, e. g. the mean age for males as of March 31, 1981 is 54.8 and that for females is 57.9, while for both sexes combined it is 56.6. Comparison of mean ages shows that the survivors residing in the U. S. are younger than their counterparts in Hiroshima, e. g. 2.8 for males, 4.1 for females and 3.3 for both sexes combined. Further, breakdown by age composition shows that those in their fifties in the U. S. group constituted 50%, whereas although the peak was in the fifties also in the Hiroshima group, it made up only 1/4 of the total. Review by sex shows that the number of females in the U. S. group was 2.7-fold that of males, whereas in Hiroshima females were only 1.5-fold more numerous, indicating that the proportion of female survivors in the U. S. is greater than that of Hiroshima.

Although the present address of survivors covers 15 states, 77.6% live in California, and when Oregon and Washington on the west coast are added this figure is increased to 82.9%, and further when those in Hawaii are considered the total reaches 95.9%. In California, those residing in Los Angeles are most numerous consti-

tuting 17.3%, followed by San Francisco with 9.4%.

Those who underwent the health examinations performed in San Francisco, Los Angeles and Seattle numbered 166, 45 males and 121 females, and 85.1% had been exposed in Hiroshima. Classification by exposure status showed 47 were exposed between 0~1999 m, 83 over 2000 m and 36 were early entrants.

Comparison was made on the prevalence of those with an obesity index in excess of 20% between survivors residing in the U. S. and their counterparts living in Hiroshima City matched by sex and age, totalling 112 males and 309 females. Males in the U. S. showed a rate of 23.3% whereas those in Hiroshima had a low 11.6%. Among females, it was 25.0% versus 30.1%, thus failing to demonstrate a difference.

The prevalence of hypertension in males was 11.6% whereas it was a high 15% in females. The rates reported in 13,533 males and 21,500 females in Hiroshima in 1977 was 20.7~22.4% in the former and 15.9~18.4% in the later³⁾, both being higher than those in the U. S.. The mean age \pm S. D. of survivors in 1977 was 55.5 ± 14.2 for males and 56.0 ± 12.5 for females. Important factors affecting hypertension are age and obesity index, but social status and smoking are also said to have correlation with blood pressure level¹⁵⁾. Also the interaction of these with environmental factors must be seriously regarded. Salt intake, obesity, glucose tolerance, drinking habits, psychological stress, cold temperature are also considered to be involved in causing elevation of blood pressure^{16,20)}. Comparison of the difference in prevalence of hypertension between the survivors living in Japan and those living in the U. S. on the basis of the 1977 Hiroshima survey shows that the U. S. survivors have values which are equivalent to those 3 years younger than their counterparts in Japan, which is considered to be due to the lower salt intake and the favorable small variation in atmospheric temperature the year-around. The higher prevalence in the U. S. females in the 0~1999 m group, is probably due to the fact that many in this group were obese.

The EKG findings showed 9.1% with III, 4.2% with IV, 4.8% with V, 4.3% with VI, 3.6% with VII and 6.7% with VIII. These findings were compared against the same for the Hiroshima survivors¹⁷⁾. Considering the mean

age of the U. S. survivors, comparison was based on the 286 aged 50~59. There were 10.8% with III, 12.9% with IV, 12.6% with V, 1.7% with VI and 1.0% with VII. The Hiroshima survivors showed higher rate tendencies in IV and V. In another report⁴⁾ based on non-diabetics in the age range of 40~59, there were 3.4% with IV and 1.1% with V, while in the over 60 group, 7.2% had IV and 6.0% had V. Although the number of cases was limited, at least there was no evidence that ST, T abnormalities were increased in the U. S. survivors, but many with conduction block were noted.

Urinalysis showed that 3.1% had proteinuria and 0.6% had glycosuria, while 2~3% of those in their sixth decade in Hiroshima had positive urine protein³⁾ indicating that the findings were almost the same as those of the survivors in the U. S. The glycosuria rate in Hiroshima was 13.4% for males and 3.3% for females⁵⁾ indicating a marked sex difference of 3~4: 1, and there was also a great difference between the U. S. survivors. It is felt Hiroshima positive rates are high because practically all urinalysis are performed after meals. If urine sugar tests are to be performed for the purpose of screening for diabetes mellitus, the optimum sample would be that collected 2 hours after meals. There are problems associated with conducting urine sugar tests using fasting urine samples.

Complete blood count results of Hiroshima survivors show that WBC count abnormalities are noted at a frequency of 7.5~9.7%³⁾ which resembled the findings of the U. S. survivors.

The prevalences of those with RBC counts less than 350×10^4 were 1.3~3.0% for males and 3.1~8.5% for females in Hiroshima³⁾, which were markedly higher than those of their counterparts in the U. S.. The hemoglobin values were also higher in the Hiroshima survivors as in the case of RBC counts, with the frequency of those whose values were less than 11 g/dl in males being 0.9~3.0% and in females 5.2~15.3%.

Comparison of blood counts for survivors in the U. S. and those in Hiroshima are shown in Table 8. Further, as the RBC counts and hemoglobin concentrations decreased linearly with age, review of these values was made on those aged 50~59. The CBC were obtained by using the Coulter Counter Model S, and as the same control blood was used for quality control in

Table 8. Comparison of complete blood counts between U. S. A. and Hiroshima

Complete Blood Counts		U. S. A.	Hiroshima	Significant
Male	Cases	45	2234	—
	W. B. C.	6515 ± 1555	6478 ± 1593	n. s.
	R. B. C. (10^4)	498 ± 38	433 ± 34	$P < 0.001$
	Hemoglobin (mg/dl)	15.6 ± 0.9	14.0 ± 1.3	$P < 0.001$
Female	Cases	120	6374	—
	W. B. C.	6077 ± 1740	5906 ± 1427	n. s.
	R. B. C. (10^4)	441 ± 34	402 ± 32	$P < 0.001$
	Hemoglobin (mg/dl)	13.7 ± 1.1	12.4 ± 1.1	$P < 0.001$

(Mean \pm S. D.)

both Japan and the U. S., it is considered there is no difference by the methods of determination. There are no differences in WBC counts for either sex. The RBC count for males in Hiroshima is $433 \pm 34.4 \times 10^4$ which is 65×10^4 less than the count of $498 \pm 38 \times 10^4$ for males in the U. S. ($p < 0.001$), while for females in Hiroshima it is $402 \pm 32 \times 10^4$ which is 39×10^4 less than the count of $441 \pm 34 \times 10^4$ for their counterparts in the U. S. ($p < 0.001$).

Similarly, the hemoglobin of males in Hiroshima was 14.0 ± 1.3 g/dl which is 1.6 g/dl less than the 15.6 ± 0.9 g/dl for those in the U. S. ($p < 0.001$), and for females the Hiroshima values of 12.4 ± 1.1 g/dl are 1.3 g/dl less than the U. S. values of 13.7 ± 1.1 g/dl ($p < 0.001$). The Complete Blood Count varies by dietary habit, living environments and amount of work, but according to Tsukamoto²¹⁾, the blood counts and hematocrit values can be increased by administration of iron preparations. According to reports on Dietary Studies⁹⁻¹⁰⁾ of American of Japanese Ancestry Living in the U. S. conducted by the Second Department of Medicine, Hiroshima University, different from indigenous Japanese, their intake of total energy, animal fat and proteins were large. Thus, the difference between the two groups of survivors is considered to be most likely due to the type of food intake.

A high uric acid value was noted in 6.7% of the survivors in the U. S., but as it is said high protein diet and obesity cause hyperuricemia, it is considered obesity and contents of food intake are responsible for this finding.

A group of 328 Hiroshima survivors was matched by sex, age and exposure status to the

Table 9. Comparison of serum lipids between U. S. A. and Hiroshima

Serum lipids	U. S. A.		Hiroshima		Significant	
	Cases	%	Cases	%		
Total cholesterol (mg/dl)	—249	91	55.5	273	82.2	p < 0.001
	250—299	53	32.3	47	14.2	p < 0.001
	300—	20	12.2	12	3.6	p < 0.001
	Total	164	100.0	332	100.0	—
	Mean ± S. D.	246.8 ± 41.7		214.6 ± 42.3		p < 0.001
Triglycerides (mg/dl)	—179	126	76.8	263	79.3	n. s.
	180—199	3	1.8	19	5.7	p < 0.05
	200—249	12	7.3	25	7.5	n. s.
	250—	23	14.0	25	7.5	p < 0.05
	Total	164	100.0	332	100.0	—
Mean ± S. D.	147.8 ± 85.9		143.4 ± 88.8		N. S.	

U. S. survivors and check was made of serum total cholesterol and triglyceride values. Comparison of these values for survivors in the U. S. and those in Hiroshima are shown in Table 9. Those with total cholesterol values of 250~299 mg/dl was 32.3% among the U. S. survivors whereas it was 14.2% for the Hiroshima group. Those with values in excess of 300 mg/dl were 12.2% and 3.6% respectively. In both instances, the U. S. survivors had significantly higher values ($p < 0.001$).

Those with triglyceride values of 200~249 mg/dl accounted for 7.3% in the U. S. survivors while it was 7.5% in the Hiroshima group, thus exhibiting no difference. However, for those with values in excess of 250 mg/dl, the values were 14.0% versus 7.5% respectively, indicating the values of the U. S. survivors to be significantly higher ($p < 0.05$). Many survivors in the U. S. were, thus, found to have markedly high triglyceride values as compared to their counterparts in Hiroshima. Comparison of the mean values of these lipids show that the serum total cholesterol value of the U. S. survivors is 246.8 ± 41.7 mg/dl, while that of the Hiroshima survivors is significantly lower with a value of 214.6 ± 42.3 mg/dl ($p < 0.001$). On the other hand, the triglyceride values were 147.8 ± 85.9 mg/dl and 143.4 ± 88.8 mg/dl, thus the mean values do not show a significant difference. The rates of those with hypercholesteremia and hypertriglyceridemia were higher among the U. S. survivors, and there are reports

of similar findings obtained from studies on indigenous Japanese and Americans of Japanese ancestry^{7,10}. The serum lipid values are affected by sex, age, genetic factors and obesity, and it is reported that these two conditions are induced particularly, by dietary habits, that is, excess ingestion of animal fat, sugar and fructose¹⁰. The fact that such hyperlipidemia causes increase in the death rate of ischemic heart disease is evident from the findings on Americans of Japanese ancestry in the Island of Hawaii¹¹. Thus, it is considered important that those with hyperlipidemia be provided adequate dietary guidance. As described, there are disease tendencies in some which are different from those observed in the Hiroshima survivors, and thus it is considered this is a serious problem which will require attention in the future health examinations.

The conduct of study on diabetes based only on fasting plasma glucose is felt will result in the overlooking of many cases. The 2,748 Hiroshima survivors who underwent the survey for diabetes mellitus were classified into groups depending upon their fasting blood glucose levels, and the prevalence of diabetes mellitus was determined on the basis of the NIH criteria¹³. The results are as shown in Table 10, that is, diabetes was noted in 9.5% even when the fasting plasma glucose was 100~109 mg/dl, and the prevalence increased with the glucose level. There were 46.6% among those with values of 120~129 mg/dl, and 72.3% in those with val-

Table 10. Prevalence of Diabetes Mellitus in terms of fasting plasma glucose

Fasting Plasma Glucose (mg/dl)	Subjects	Diabetes Mellitus	
		Cases	%
100—109	1351	128	9.5
110—119	670	172	25.7
120—129	369	172	46.6
130—139	213	154	72.3
140—149	145	112	77.2
Total	2748	738	26.9

ues of 130~139 mg/dl. It has been reported previously that the prevalence of diabetes is high among the Americans of Japanese ancestry residing in Hawaii and Los Angeles^{8,12,13}. The prevalence of the two communities were 13.9% and 11.0% respectively whereas it was 5.8% in Hiroshima. It is considered these differences are due to dietary habits and living environments. The diabetes prevalence rate for the U. S. survivors in the last examination, however, was markedly low being 2.4%. Further, as there has been no difference observed by exposure status⁵, it is assumed that it is possible a considerable number of patients were missed this time, and in view of this, it is felt it is absolutely necessary to include glucose tolerance test in the examination program.

Positive microsome test results were registered by 5.3% of the male and 11.0% of the female survivors of Hiroshima⁶, but the values of the survivors in the U. S. tended to be somewhat higher. It had said there was no difference by exposure status, but our findings showed the values to be higher in the 0~1999 m group. We were unable to determine the reason, but as the number of cases involved is small, it is felt that it is necessary to study autoantibodies such as this in more detail in the future. As there were 3 cases in this group with thyroid diseases, which is a high rate, it is felt they may have had a role in increasing the positive rate.

There were only 37.3% of the total who were found to be free of clinical abnormalities in this survey. All of the rest required dietary guidance, follow-up observation, further detailed examination or treatment. The difference in disease trend between the Hiroshima survivors is

considered due to the variation in dietary habits and living environments. Therefore, as the survivors in the U. S. advance in age, it is felt possible that in addition to the disease trend observed among the survivors of Hiroshima, they will also have a higher prevalence rate of hyperlipidemia, ischemic heart disease and diabetes mellitus. Further, as there is a paucity of mass screening results on thyroid diseases, it is not possible to make any definitive statement, but the fact that the prevalence rate is high in the 0~1999 m group requires attention.

Of those found to have diseases, 31 (18.7% of all examinees) would probably be eligible for a health management allowance under Japanese law. Breakdown by exposure status shows 11 (23.4%) out of 47 were in the 0~1999 m group, followed by 13 (15.7%) of 83 in the over 2000 m group and 7 (19.4%) of 36 the early entrants. The diseases involved were hypertensive cardiovascular disease 7, arteriosclerotic heart disease 9, liver disorder 4, diabetes mellitus 4, hypothyroidism 4, anemia 2 and pulmonary function disorder 1. Those who would be eligible for special allowance and health management allowance are quite less than the 47.2% for Hiroshima², but as the number of test items performed were limited, it is assumed that there actually are many more who would qualify.

As explained above, although the survivors in the U. S. are somewhat younger than their counterparts in Hiroshima, it is expected that as they advance in age, plus the difference in their living environments, the prevalence rate will increase. It is felt that they must be spending days of anxiety living the U. S. where medical expenses are so high and not having the benefit of undergoing periodic health examinations 2 to 4 times a year as in Japan.

REFERENCES

1. **A-bomb Casualty Department, Health Bureau, Hiroshima City Office.** 1981. Medical Treatment and A-bomb Survivors Countermeasures under the A-bomb Survivors Medical Treatment Law—Brief Description of A-bomb Survivors Countermeasures, -1981 Edition, p 32-55. A-bomb Casualty Department, Health Bureau, Hiroshima City Office.
2. **A-bomb Casualty Department, Health Bureau, Hiroshima City Office.** 1981. Relief Measures of A-bomb Survivors under the A-bomb Special Measures Law—Brief Description of A-

- bomb Survivors Countermeasures, -1981 Edition, p. 56-67, A-bomb Casualty Department, Health Bureau, Hiroshima City Office
3. **Ito, C., Tsubota, N. and Kumasawa, T.** 1980. Results of medical survey in atomic bomb survivors. *J. Hiroshima Med. Ass.* **33** : 320-326
 4. **Ito, C.** 1969. Follow up study of oral glucose tolerance test. *Med. J. Hiroshima Univ.* **17** : 973-998.
 5. **Ito, C., Tsubota, M. and Kawate, R.** 1978. 15 years epidemiological studies of diabetes mellites in atomic bomb survivors. *Nagasaki Igk. Z.* **53** : 59-64.
 6. **Ito, C. and Naito, Y.** 1978. Anti-thyroid Antibody of A-bomb Survivors. *J. Hiroshima Med. Ass.* **31** : 476-479.
 7. **Kato, H., Tillotson, J., Nichaman, M. Z., Rhoads, G. G. and Hamilton, H. B.** 1973. Epidemiologic studies of coronary heart disease and stroke in Japanese men living in Japan, Hawaii and California *Am. J. Epid.* **97** : 372-385
 8. **Kawate, R., Miyanishi, M., Yamakido, M., Ishibashi, F., Nakano, K., Ebitani, E., Nishimoto, Y., ITO, C., Naito, Y. and Murakami, F.** 1977. Diabetes Mellitus. *Rinsho Seijin-byo* **7** : 1071-1080.
 9. **Kawate, R., Miyanishi, M., Yamakido, M., Ishibashi, F., Nakano, K., Hara, H., Sakai, M., Murakami, F., Ebitani, Y. and Nishimoto, Y.** 1977. Changes in Dietary Habits and Disease Structure. *Rinsho Eiyo* **51** : 679-686.
 10. **Kawate, R., Ishibashi, F., Ebitani, Y., Nishimoto, Y., Miyanishi, M., Yamakido, M., Nakano, K. and Murakami, F.** 1977. Environment and hyperlipidemia. *Med. Clin. Jpn.* **3** : 1278-1281.
 11. **Kawate R., Miyanishi, M. and Nishimoto, Y.** 1975. Prevalence and mortality of diabetes mellitus in Japanese in Hawaii and Japan. *Excerpta Medica, Amsterdam.* p 82-90.
 12. **Kawate, R.** 1979. Diabetes mellitus and its vascular complication in Japanese migrants on the island of Hawaii. *Diabetes Care* : 161-170.
 13. **Kawate, R.** 1980. Geographical Distribution of Diabetes Mellitus. *Nippon Ronen Igakukai Zasshi (Japanese J. of Geriatrics)* **17** : 153-157.
 14. **Kerr, G. D., Yamada, H. and Sidney, M.** 1976. A survey of radiation doses received by Atomic Bomb survivors residing in the United States. *Health Physics Program Press* **31** : 305-313.
 15. **Kesteloot, H., and Houte O. V.** 1974. An epidemiologic survey of arterial blood pressure in a large male population group. *Am. J. Epid.* **99** : 14-29
 16. **Keys, A., Kimura, N., Kuskawa, A., Stewart, B., Larsen, N. and Keys, M. H.** 1958. Lessons from serum cholesterol studies in Japan, Hawaii and Los Angeles. *Ann. Int. Med.* **48** : 83-94.
 17. **Miyanishi, M., Yoshida, M., Furonaka, H., Ito, M., Ueda, K., Suzukawa, M., Matsushita, H., Kiyosada, K., Sasaki, H. and Kumazawa, T.** 1971. Cardiovascular changes in atomic bomb exposed survivors in terms of aging with special reference to electrocardiographic findings. *J. Hiroshima Med. Ass.* **24** : 1183-1195
 18. **National Diabetes Data Group, National Institutes of Health.** 1979. Classification and diagnosis of diabetes mellitus and other categories of glucose tolerance. *Diabetes* **28** : 1039-1057.
 19. **Rose, G. A. and Blackburn, H.** 1968. Cardiovascular survey methods, *World Health Organization Monograph Series No. 56.* 137-142.
 20. **Sano, T.** 1978. Hypertension *Junkanki-byogaku (Circulatory Diseases)*, Bunko-do, Tokyo, 1025-1075
 21. **Tsukamoto, H.** 1958. Blood Picture of the Normal Japanese. *Acta Haematologica Japonica* **21** : 854-873.
 22. **W. H. O.** 1958. Arterial hypertension and ischemic heart disease, prevention aspects. *Tech. Rep. Ser. No. 231*
 23. **W. H. O.** 1980. WHO Expert Committee on Diabetes. Technical report series 646, Geneva.