ORIGINAL CONTRIBUTION

Risk Factors for Low Birth Weight Infants in Japan

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Prevalence of low birth weight infants in Japan has been increasing, although infant mortality is the lowest in the world. We conducted a population based case-control study to clarify risk factors for low birth weight infants in Japan. Information was obtained by questionnaire. The response rate was 78.9% from 402 cases and 804 controls.

The majority of low birth weight infants belongs to full-term case group. This is considered to be an important factor for low infant mortality in Japan. We examined potential risk factors by a multiple logistic regression model. Lower maternal academic career and toxemia were identified as significant risk factors for pre-term low birth weight infants, while maternal shorter height, lower pre-pregnancy weight, maternal smoking and employment during pregnancy and hypertension were identified as significant risk factors for full-term low birth weight infants. The Japanese small physique and prevalent hypertension are considered to be causes for the high prevalence of low birth weight infants. J Epidemiol, 1994; 4: 91-98.

case-control study, japan, logistic regression model, low birth weight infant

Infant mortality in Japan has remarkably improved since the end of the Second World War1,2). However, the prevalence of low birth weight infants (hereinafter “LBW infants”) has continued to increase since 1976, although it had decreased until 1975. The prevalence of low birth weight infants in Japan is not low among developed counties (Table 1), although the infant mortality is lowest in the world3). This is notable because low birth weight is an important factor for both post-neonatal mortality and morbidity during infancy and early childhood4-9). There are few studies to introduce risk factors for LBW infants in Japan to other countries. Therefore, it is very important to identify risk factors for LBW infants and to clarify causes of the increasing prevalence of LBW infants in Japan.

There are many factors related to a higher prevalence of LBW infants10). Epidemiological studies have demonstrated a close relationship between low birth weight and socio-economic conditions11-14). Multivariate analyses have been employed to estimate the magnitude of the effect of risk factors associated with LBW infants15-21).

Although LBW infants are caused by two different etiologies, premature birth and intrauterine growth retardation10), the previous research findings have often been conflicting because of a failure to distinguish premature from intrauterine growth retardation22). It is very difficult to independently assess the magnitude of risk factors for prematurity and intrauterine growth retardation because many premature infants are complicated with intrauterine growth retardation22).

Live born infants delivered before 37 weeks from the first day of the last menstrual period are termed “pre-term infants” and those weighing less than 2,500 g at birth are termed “low birth weight infants” by the World Health Organization. As the gestational age is younger, mortality and morbidity become higher because of the prematurity of organs23,24). Although pre-term LBW infants are caused by premature birth or both premature birth and intrauterine growth retardation, full-term LBW infants are caused only by intrauterine growth retardation. Therefore, pre-term LBW infants and full-term LBW infants are different with regard to prognosis as well as etiology. Thus, it is
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Table 1. International comparison of infant mortality and low birth weight infants in 1990.

|                | Infant Mortality Per 100 Live Births | Low Birth Weight Infants Per 100 Live Births |
|----------------|--------------------------------------|-----------------------------------------------|
| Australia      | 0.82                                 | 5.50*                                         |
| Austria        | 0.78                                 | 5.60                                          |
| Belgium        | 0.79                                 | 6.06                                          |
| Canada         | 0.68                                 | 5.40                                          |
| Denmark        | 0.75                                 | 5.20                                          |
| Finland        | 0.56                                 | 4.00                                          |
| France         | 0.72                                 | 5.26                                          |
| Germany        | 0.71                                 | 5.92*                                         |
| Greece         | 0.97                                 | 5.96                                          |
| Iceland        | 0.89                                 | 2.99                                          |
| Ireland        | 0.82                                 | 4.71*                                         |
| Italy          | 0.82                                 | 5.61*                                         |
| Japan          | 0.46                                 | 6.33                                          |
| Luxembourg     | 0.74                                 | —                                             |
| Netherlands    | 0.71                                 | —                                             |
| New Zealand    | 0.83                                 | 5.80*                                         |
| Norway         | 0.70                                 | 4.62                                          |
| Portugal       | 1.10                                 | 5.40*                                         |
| Spain          | 0.78*                                | 4.90*                                         |
| Sweden         | 0.60                                 | 4.50                                          |
| Switzerland    | 0.68                                 | 5.78                                          |
| Turkey         | 5.93                                 | —                                             |
| United Kingdom | 0.79                                 | 6.40                                          |
| United States  | 0.91                                 | 7.05*                                         |

* : 1988, * : 1989
Source: OECD, OECD HEALTH SYSTEMS; Fact and Trend 1960-1991. Paris, 1993.

Table 2. Distribution of responding subjects (responding rates).

|                | T district | N district | Total |
|----------------|------------|------------|-------|
|                | Male       | Female     | Total | Male       | Female     | Total |       |
| Case           | 104        | 112        | 216   | 37         | 55         | 92    | 308    |
|               | (73.8 %)   | (75.7 %)   | (74.7 %) | (77.1 %) | (84.6 %)   | (81.4 %) | (76.6 %) |
| Control        | 228        | 235        | 463   | 78         | 103        | 181   | 644    |
|               | (80.9 %)   | (79.4 %)   | (80.1 %) | (81.3 %) | (79.2 %)   | (80.1 %) | (80.1 %) |
| Total          | 332        | 347        | 679   | 115        | 158        | 273   | 952    |
|               | (78.5 %)   | (78.2 %)   | (78.3 %) | (79.9 %) | (81.0 %)   | (80.5 %) | (78.9 %) |

important to differentiate risk factors between the two.

In Japan, we identify risk factors for pre-term and full-term LBW infants, respectively, in order to clarify causes of the increasing prevalence of low birth infants in Japan, although the infant mortality rate is the lowest in the world.

**MATERIALS AND METHODS**

The studied area was the T district and the N district of Kobe city in Japan. From birth certificates, we determined that cases were all single live LBW infants born in the area from January 1, 1986 to December 31, 1987. The number of cases was 402. Controls were selected from single live infants whose birth weight ranged from 3,100 g to 3,400 g, which represents Japanese typical birth weights. For each case, we selected two controls whose birth district and gender were the same, and whose birthdays were closest to one another. We compiled a questionnaire concerning factors related to birth weight. With reference to other research10-21, potential risk factors were selected as follows:

1. parental physiological characteristics: paternal age, height and weight, maternal age, height and pre-pregnancy weight;
2. familial characteristics: home ownership, number of family members, paternal and maternal academic careers;
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Table 3. Distribution of birth weights of LBW infants.

| Birth Weight (g) | Pre-term Case N = 116 (37.8%) | Full-term Case N = 191 (62.2%) | Total N = 307 (100.0%) |
|------------------|-------------------------------|--------------------------------|-----------------------|
| < 999            | 7 (6.0%)                      | 0 (0.0%)                       | 7 (2.3%)              |
| 1,000-1,499      | 11 (9.5%)                     | 0 (0.0%)                       | 11 (3.6%)             |
| 1,500-1,999      | 22 (19.0%)                    | 8 (4.2%)                       | 30 (9.8%)             |
| 2,000-2,499      | 76 (65.5%)                    | 183 (95.8%)                    | 259 (84.4%)           |

Table 4. Distribution of continuous variables.

|                         | Pre-term Case (N = 116) | Full-term Case (N = 191) | Control (N = 643) |
|-------------------------|-------------------------|--------------------------|-------------------|
| Paternal Age            | mean (s.d.)             | mean (s.d.)              | mean (s.d.)       |
|                         | 32.9 (8.3)              | 31.5 (8.4)               | 31.5 (6.5)        |
| Maternal Age            | 29.2 (5.1)              | 27.7 (3.8)               | 28.3 (4.2)        |
| Paternal Height (cm)    | 168.5 (5.5)             | 169.3 (5.1)              | 170.4 (5.5)       |
| Maternal Height (cm)    | 156.0 (4.7)             | 155.3 (5.1)              | 157.0 (4.6)       |
| Paternal Weight (kg)    | 64.2 (9.5)              | 62.7 (8.6)               | 65.4 (9.4)        |
| Maternal Pregnancy Weight (kg) | 50.4 (8.1) | 47.7 (5.7)               | 50.5 (6.0)        |
| Number of Family Members | 3.9 (1.1)              | 3.9 (1.1)                | 4.0 (1.1)         |
| Maternal Sleeping Hours | 7.6 (1.3)              | 7.7 (1.1)                | 7.8 (1.1)         |

3. maternal life conditions during pregnancy: maternal smoking, paternal smoking, alcohol consumption, sleeping hours, stress factors (factors having persistently bothered a mother during pregnancy), emesis, employment, standing work, lifting work (> 5 kg), VDT (Visual Display Terminal) work, night work;

4. maternal pregnancy history: number of pregnancies, previous abortions, previous premature births;

5. maternal complicating diseases during pregnancy: toxemia, hypertension, nephritis, anemia, diabetes mellitus, heart disease, collagen disease and thyroid disease.

The questionnaire was sent to the mothers of 402 cases and 804 controls. It was answered by 308 (76.6%) cases and 644 (80.1%) controls (Table 2). One case and one control were excluded from the analysis because their birth weights proved to be unsatisfactory with the criteria by the data re-examination. As a result, 307 cases and 643 controls were analyzed. Although we asked the mothers to answer regarding pregnancy history including the recent pregnancy, many mothers answered excluded the recent pregnancy. Because of the confusion, we excluded pregnancy history from our analysis.

The cases were divided into pre-term and full-term case groups. In order to clarify the characteristics of the two case groups and the control group, we calculated their means and standard deviations for continuous variables, while we described distribution for categorical variables.

We could not directly compare the distributions of risk factors among the groups because we sampled controls matched by district and gender. Therefore, we separately employed a simple logistic regression model of each variable for detecting potential risk factor for each case group, using the same control group. The two matching factors, district and gender, were included in the model only for controlling their effects. Then, we did not interpret the regression coefficients of the matching factors because we did not have any knowledge of the sampling fraction of the control group from the mother population. However, the regression coefficients of potential risk factors are guaranteed as their log odds ratios because of the independence between the matching factors and the potential risk factors. Variables of which the total number of people having risk factors less than five were excluded from further analysis because of small sample size. These were prenatal care, maternal complicating disease of cardiac disease, collagen disease and thyroid disease.

Finally, we applied a multiple logistic regression model of all variables which were statistically significant (p < 0.05) by the primary analysis, in addition to district and gender. Cases and controls who did not answer all significant risk factors were excluded from the analysis. As significant risk factors were different between pre-term and full-term case groups by the primary analysis, the numbers of controls were not exactly the same between two analyses; for pre-term cases versus controls and for full-term cases and controls. Thus, 106 pre-term cases and 621 controls were analyzed for the former, while 182 full-term cases and 623 controls were analyzed for the latter.
RESULTS

The proportion of the pre-term case group was 37.8%, while that of the full-term case group was 62.2%. LBW infants whose birth weights were less than 1,500 g were only 5.9% among LBW infants and all of them were pre-term cases (Table 3). Among 643 controls, only 2 babies were pre-term.

Means and standard deviations of continuous variables are shown in Table 4, while distributions of categorical variables are shown in Table 5. Odds ratios, adjusted by district and gender, for pre-term and full-term LBW infants are shown in Table 6. Parental ages of pre-term LBW infants were older than control group. Parental heights of pre-term and full-term LBW infants were shorter than control group. Parental weights of full-term were lower than control group. Parental academic careers of pre-term LBW infants were lower than control group. For maternal life conditions and complicating diseases during pregnancy, mothers of pre-term case group more frequently had risk factors of stress, weight lifting work, night work, toxemia than those of control group. On the other hand, mothers of full-term case group more frequently had risk factors of smoking, stress, employment, hypertension and diabetes mellitus than those of control groups. Thus, ten risk factors for pre-term LBW infants and nine risk factors for full-term LBW were selected by the primary analysis.

By the multiple logistic regression model, maternal lower academic career and maternal complicating disease of...
Toxemia were identified as significant risk factors for preterm LBW infants, while maternal shorter height, maternal lower pre-pregnancy weight, maternal smoking and employment during pregnancy and maternal complicating disease of hypertension were identified as significant risk factors for full-term LBW infants (Table 7).

**DISCUSSION**

In the study, the response rates ranged from 73.8% to 84.6% among the groups. They were high for a population-based study and there were not many differences among the groups. Although it is likely that mothers whose babies had died responded differently from mothers whose babies were alive, this would not change the results because the infant mortality rate is lower than 0.5 (per hundred births).

The percentage of the full-term LBW group, whose prognosis is much better than that of the pre-term LBW group, was 62.2% among LBW infants. It was not so different from 68.9% in total Japanese population. In the United States, only about one third of LBW infants have a gestational age of 37 weeks or more. It is considered to be a substantial factor of low infant mortality in Japan that the majority of LBW infants belongs to full-term case group. In addition, our health care system has contributed to it, which was verified by the fact that only one person among 950 mothers in this study had not had prenatal care.

Lower maternal academic career and maternal complicating disease of toxemia were significant factors for pre-term LBW infants by the multivariate logistic regression model. As academic career is an indicator for socioeconomic status, our study is consistent with the study showing that socioeconomic status is related to pre-term birth. Toxemia has been established as a cause of pre-term birth. Although ten risk factors for pre-term LBW infants were detected by the simple logistic regression model, only two factors were significant by the multivariate logistic regression model. It suggests that most risk factors...
Table 7. Results of multiple logistic regression analysis.

| Variables                                | Pre-term LBW OR (95%CI) | Full-term LBW OR (95%CI) |
|------------------------------------------|-------------------------|--------------------------|
| Parental Physiological Characteristics   |                         |                          |
| Paternal Old Age (per 10 years)          | 1.10 (0.74-1.64)        | —                        |
| Maternal Old Age (per 10 years)          | 1.38 (0.77-2.49)        | —                        |
| Paternal Short Height (per 10 cm)        | 0.99 (0.97-1.01)        | 1.02 (0.99-1.05)         |
| Maternal Short Height (per 10 cm)        | 1.45 (0.90-2.33)        | 1.57 (1.03-2.38)*        |
| Paternal Low Weight (per 10 kg)          | —                      | 0.99 (0.97-1.01)         |
| Maternal Low Weight (per 10 kg)          | —                      | 2.26 (1.56-3.27)**       |
| Familial Characteristics                 |                         |                          |
| Paternal Low Academic Career             | 1.15 (0.72-1.83)        | —                        |
| Maternal Low Academoc Career             | 1.67 (1.05-2.66)*       | —                        |
| Maternal Life Conditions During Pregnancy|                         |                          |
| Maternal Smoking                         | —                      | 1.89 (1.03-3.47)*        |
| Stress Factors                           | 1.44 (0.93-2.23)        | 1.39 (0.97-1.98)         |
| Employment                               | —                      | 1.58 (1.08-2.30)*        |
| Lifting Work                             | 2.36 (0.83-6.67)        | —                        |
| Night work                               | 2.68 (0.83-8.63)        | —                        |
| Maternal Complicating Diseases During Pregnancy|                   |                          |
| Toxaemia                                  | 3.19 (1.58-6.44)**      | —                        |
| Hypertension                              | —                      | 2.87 (1.11-7.42)*        |
| Diabetes Mellitus                         | —                      | 2.88 (0.65-13.2)         |

*: p<0.05, **: p<0.01, —: not in the equation

identified were confounded by other factors or that they had not enough power to be detected by the multivariate analysis.

Maternal shorter height and lower pre-pregnancy weight, maternal smoking and employment during pregnancy and maternal complicating disease of hypertension were risk factors for full-term LBW infants. Although there are studies to demonstrate the relationship between birth weight and parental stature, these studies did not differentiate pre-term LBW infants from full-term LBW infants. In our study, maternal height and pre-pregnancy weight were risk factors only for full-term LBW infants. It is understandable that maternal physique reflects the physical environment of the fetus as well as a genetic component. As the physique of Japanese women is smaller than that of western women, it is a substantial cause for a higher prevalence of full-term LBW infants. Both maternal smoking and maternal employment have been reported to have adverse effects on birth weight. This is very important because the number of both smoking women and of working women have been increasing in Japan. These factors could play some parts in the increasing prevalence of LBW infants in Japan. Although maternal smoking is considered to be a direct factor, maternal employment is not considered to be. Therefore, it is important to consider the reason why maternal employment is related to a higher incidence of full-term LBW infants. It is possible that the dietary conditions of working women are less nutritional than those of housewives because the former spend less time on meals than the latter, and the former skip breakfast more frequently than the latter. Further investigation is important to make clear why maternal employment has an effect on birth weight, especially as the number of working women is increasing. As hypertension was reported to have negative effects on birth weight by impairing placental blood circulation, it is understandable that hypertension is a risk factor for full-term LBW infants. Japan has been reported to have a higher prevalence of hypertension because of its high salt diet. It would influence the prevalence of full-term LBW infants in Japan.

However, there are several limitations in this study. First, this study was a questionnaire survey. Information bias is not avoidable. Second, we excluded pregnancy history from our analysis. Although we cannot deny the possibility that it was a confounding factor, the risk factors which we identified were consistent with other studies. Third, some factors were considered not being significant because the number of mothers having risk factors was too small. However, it means that they are not so important in the population. Finally, this study was conducted only in one of big cities in Japan, although Japan has a homogeneous population racially and socio-economically.

The majority of LBW infants belongs to the full-term case group in Japan. This is considered to be an important reason why Japan has the lowest infant mortality rate,
although LBW infants are still prevalent. The small physique and prevalent hypertension of Japanese pregnant mothers might explain the high prevalence of LBW infants. Also increasing maternal smoking and increasing number of working women should be considered as influencing the increasing low birth weight infants in Japan.

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REFERENCES

1. Ministry of Health and Welfare. Health and Welfare Statistics in Japan. Health And Welfare Statistics Association, Tokyo, 1993.
2. Kousei No Shihyou. Kokumin Eisei No Doko. Health and Welfare Statistics Association, Tokyo, 1993.
3. OECD. OECD Health Systems ; Facts and Trends 1960-1961, Paris, 1993.
4. Berg BJ, Yereshalmy J, et al. The relationship of the Rate of Intrauterine Growth of Infants of Low Birth Weight to Mortality, Morbidity and Congenital Anomalies. J Pediatr, 1966; 69: 531-545.
5. Lubchencho LO, Delivoria-Papadopoulos M, Butterfield LJ, et al. Long-term Follow-up Studies of Prematurely Born Infants. J Pediatr, 1972; 80: 501-508.
6. Goldenberg RL, Nelson KG, Hale CD, et al. Survival of Infants with Low Birth Weight and Early Gestational Age, 1979 to 1981. Am J Obstet Gynecol, 1984; 149: 508-511.
7. McCormick MC. The Contribution of Low Birth Weight to Infant Mortality and Childhood Morbidity. N Engl J Med, 1985; 312: 82-90.
8. Goldenberg RL, Humphrey JL, Hale CB, Body BW, Wayne JB. Neonatal Deaths in Alabama, 1970-1980: An Analysis of Birth Weight and Race Specific Neonatal Mortality Rates. Am J Obstet Gynecol, 1983; 145: 545-552.
9. Commy JOO, Fitzhardinge PM. Handicap in the Preterm Small for Gestational Age Infant. J Pediatr, 1979; 94: 779-786.
10. Beharman RE, Vaughan VC. Nelson Textbook of Pediatrics, 12th Edition. W.B. Saunders Company, Philadelphia, 1983; 342-353.
11. Dowding VM. New Assessment of the Effects of Birth Order and Socioeconomic Status to Birth Weight. Br Med J, 1981; 282: 683-687.
12. Baird D, F.R.C.O.G. The Epidemiology of Prenatal Maternal Mortality. J Pediatr, 1972; 65: 909-924.
13. Kodera R. A Study on the Factors related to Birth Weight in "Buraku". Okayama Igakkai Zassi, 1986; 98: 515-524.
14. Gruenwald, P. Influence of Environmental Factors on Fetal Growth in Man. Lancet, 1976; 1: 1026-1029.
15. Einsner V, Brazie JV, Pratt MW, Hexter AB. The Risk of Low Birth Weight. Am J Public Health, 1979; 69: 887-893.
16. Makino T. An Epidemiologic Study on Pregnancy and Childbirth [II], Influence of Physical and Social Factors to Stillbirth. Jap J Public Health, 1973; 20: 433-447.
17. Rantakallio P. Groups at Risk in Low Birth Weight and Prenatal Mortality. University of Oulu, Finland, 1969.
18. Dougherty CRS, Johnes AD. Determinants of Birth Weight. Am J Obstet Gynecol, 1982; 144: 190-200.
19. Bante H. A Multiple Regression Analysis of Variables Influencing Birth Weight. Trop Geogr Med, 1986; 38: 123-130.
20. Gauguly M, Elwood JH, MacKenzie G. Factors Associated “Low” and “High” Birth Weight. Am J Epidemiol, 1972; 96: 161-167.
21. Matsuda S. Analysis of Factors Associated with Birth Weight. Jap J Hygiene, 1990; 45: 752-761.
22. Kramer MS. Intrauterine Growth and Gestational Duration Determinants. Pediatrics, 1987; 80: 502-511.
23. Goldenberg RL, Nelson KG, Koski JF, et al. Low Birth Weight, Intrauterine Growth Retardation, and Preterm Delivery. Am J Obstet Gynecol, 1985; 152: 80-984.
24. Philip AGS, Little GA, Polivy DR, Lucey JF. Neonatal Mortality Risk for the Eighties: The Importance of Birth Weight/Gestational Age Groups. Pediatrics, 1981; 68: 122-129.
25. Ministry of Health and Welfare. Vital Statistics 1987 Japan. Volume 2, Tokyo, 1989.
26. Fedrick J, Anderson ABM. Factors Associated with Spontaneous Preterm Birth. Br J Obstet Gynaecol, 1976; 83: 342-350.
27. Hendericks CH, et al. Toxemia of Pregnancy. Am J Obstet Gynecol, 1966; 94: 1120-1132.
28. Hendricks CH, Brenner WE. Toxemia of Pregnancy, Relationship between Fetal Weight, Fetal Survival and the Maternal State. Am J Obstet Gynecol, 1971; 109: 225-233.
29. Winikoff V, Debrowner CH. Anthropometric Determinants of Birth Weight. Obstet Gynecol, 1981; 58: 678-684.
30. Pritchard CW, Sutherland HW, Carr-Hill RA. Birthweight and Paternal Height. Br J Obstet Gynaecol, 1983; 90: 156-161.
31. Niswander K, Jackson EC. Physical Characteristics of the Gravidia and Their Association with Birth Weight and Perinatal Death. Am J Obstet Gynecol, 1974; 119: 306-313.
32. Terris MT, Gold EM. An Epidemiologic Study of Prematurity. Am J Obstet Gynecol, 1969; 103: 358-379.
33. Abernathy JR, Greenberg BG, Wells HB, Frazier TM. Smoking as an Independent Variable in a Multiple Regression Analysis upon Birth Weight and Gestation. Am J Public Health, 1966; 56: 626-633.
34. Sexton M, Hebel R. A Clinical Trial of Change in Maternal Smoking and Its Effect on Birth Weight. JAMA, 1984; 251: 911-915.
35. Butler NR, Goldstein H, Ross EM. Cigarette Smoking in Pregnancy; Its Influence on Birth Weight and Perinatal Mortality. Br Med J, 1972; 2: 127-131.
36. Prager K, et al. Smoking and Drinking Behavior Before and During Pregnancy of Married Mothers of Live-Born Infants and Stillborn Infants. Public Health Report, 1984; 99: 117-121.
37. Takamura, T. Smoking and health for women. JAMA, 1987; 98: 1075-1078.
38. Year Book of Labour Statistics. Policy Planning and Research Department, Minister's Secretariat. Ministry of Labor, Tokyo, 1990.
39. The Survey on Time Use and Leisure Activities 1986—Major Result and Analysis. Statistics Bureau Management and Coordination Agency. Tokyo, 1986.
40. Ministry of Health and Welfare. The Nutritional Condition of the People. Daiichi Syuppansya, Tokyo, 1986.
41. Soffronoff EC, Kaufmann BM, Connaughton JF. Intravas-
cicular Volume Determination and Fetal Outcome in Hypertensive Disease of Pregnancy. Am J Obstet Gynecol, 1977; 127: 4-9.

42. Intersalt Cooperative Research Group. Intersalt: An International Study of Electrolytes Excretion and Blood Pressure. Results for 24 hour Urinary Sodium and Potassium Excretion. BMJ, 1988; 297: 319-328.

43. Dahl LK, LK. Possible Role of Chronic Excess Salt Consumption in the Pathogenesis of Essential Hypertension. Am J Cardiol, 1961; 8: 571.