Epidemiological Study of Diabetes Mellitus in the Hiroshima Area-Prevalence of Diabetes Mellitus and Follow-Up Studies Using the Glucose Tolerance Test 5-19 Years after Initial Testing

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ITO, C. *Epidemiological Study of Diabetes Mellitus in the Hiroshima Area-Prevalence of Diabetes Mellitus and Follow-Up Studies Using the Glucose Tolerance Test 5-19 Years after Initial Testing.* Tohoku J. exp. Med., 1983, 141, Suppl., 115-118 — Tests for diabetes mellitus have been performed annually since 1963 on about 100,000 A-bomb survivors living in Hiroshima. We report here on the trends over the 19 years leading up to 1981 for the glycosuria positive rate, the 75 g GTT results of positive cases and the findings of the 5-19 year follow-up. 1) The glycosuria positive rate was 3-4 times higher in males. During the period of 1963-1979, the positive rate increased annually in both sexes, reaching 2.6 and 3.0 times the male-female values for 1963, but subsequently levelling off. 2) When Body Mass Index (BMI) < 25, 24.9% of the sample was diabetic (including those under treatment), 26.0% had Impaired Glucose Tolerance (IGT) and 49.1% were normal, whereas when BMI ≥ 25, the rates were significantly higher being 45.0%, 27.4% and 27.6% respectively ($p < 0.001$). Frequency increased with BMI, reaching 75.0% at BMI 33.3) Results of the 5-19 year follow-up showed the annual diabetes onset rate by the person year method in those with BMI < 25 at initial GTT to be 1.72% among 848 normals, while it was a significantly higher 4.82% in those suffering from IGT. For those with BMI ≥ 25, the rates were 3.77% among 161 normals and 7.93% among 132 IGT cases. ——— diabetes mellitus in Hiroshima; follow-up studies of GTT

An epidemiological study of diabetes mellitus was carried out based on annual post prandial urine sugar tests performed in our clinic since 1963 on about 100,000 A-bomb survivors living in Hiroshima City, we report the 19 years trend up to 1981 on the prevalence rate of glycosuria. The results of 75 g GTT (glucose tolerance test) of glycosurics and the diabetes onset rate in cases followed for 5-19 years are reported.

MATERIALS AND METHODS

A total of 1797 subjects (1019 males, 706 females) received 75 g GTT and 1853 (1367 males, 486 females) underwent 5-19 year follow-up. Their ages ranged from 21 to 84 with a mean age of 57.2 in males and 59 in females. Those who had received gastrectomy or had liver dysfunction were excluded. Venous plasma glucose levels were determined by the glucose oxidase method, and the evaluation of GTT results was based on WHO criteria which use the 75 g method¹⁾, but for those who had undergone GTT the 50 g method was used, and the WHO criteria for the 75 g method were adjusted for the 50 g method^{2,3)}.

RESULTS

Prevalence of glycosuria

The prevalence rates of glycosuria from 1963 to 1981 are shown in Fig. 1. Throughout this whole period, the rate in males was 3-4 times higher than in females. In 1963, the rate was 5.7% in males and 1.5% in females, and these rates continued to increase in both sexes until 1979, when they reached 14.6% and 4.5% respectively, 2.6 and 3.0 times higher than the initial rates of 1963, but both subsequently levelled off. The rates for 1981 were 14.2% in males and 4.2% in females.

Results of 75 g GTT

The results of 75 g GTT in glycosuria cases detected between June 1980 and December 1981 were compared based on Body Mass Index (BMI) < 25 and BMI $\geq$ 25. Those evaluated as normal with BMI < 25 accounted for 51.1% of 886 males and 38.1% of 501 females, while those with BMI $\geq$ 25 comprised 32.7% of 205 males and 22.9% of 205 females, and those evaluated as having Impaired Glucose Tolerance (IGT) classified by BMI groups comprised 27.9% and 24.4% ; 34.1% and 18.0%, respectively. Diabetic cases (including those under treatment) with

Fig. 1. Prevalence of Glycosuria

BMI < 25 constituted 21.0% of males and 37.5% of females, while those with BMI $\geq$ 25 comprised 33.2% and 59.1%, respectively. The rate of diabetes mellitus was 1.78 times higher in females than in males in both BMI groups ($p < 0.001$). Also the rates were 1.58 times higher in subjects with BMI $\geq$ 25 than in subjects with BMI < 25 in both sexes ($p < 0.001$).

The rates of diabetes mellitus by BMI were ; 17.2% in those with BMI 16-18, 21.1% with BMI 19-20, 21.8% with BMI 21-22, 31.2% with BMI 23-24, 37.9% with BMI 25-26, 47.2% with BMI 27-28, 51.2% with BMI 29-30, 66.7% with BMI 31-32 and 75.0% with BMI 33-36, the rates increasing with BMI. When BMI is expressed as X, and the rate of diabetes mellitus is given as log Y, $\log Y = 0.595 + 0.0379X$; r, the correlation coefficient is 0.988, indicating a significantly high correlation ($p < 0.001$).

Results of GTT follow-up studies during the 5-19 year period

The author compared the results of the initial and final GTTs in 1826 glycosuric cases during a 5 to 19 year follow-up. Of the 1009 subjects with normal initial GTT, 57.2% remained unchanged over time, 24.2% showed IGT, and 18.6% developed diabetes mellitus. Of the 510 with IGT on initial GTT, 28.2% remained unchanged, 23.5% became normal and 48.2% developed diabetes mellitus, while of the 307 evaluated as diabetes mellitus on initial GTT, 83.1% remained unchanged, 8.5% became normal and 8.5% displayed IGT.

The annual diabetes onset rates by initial GTT results using the person year method for the 1519 normal and IGT cases were as follows. In subjects with BMI < 25, the rate was 1.72% when the initial GTT results had been normal significantly lower than the rate of 4.82% in those who had IGT. For those with BMI $\geq$ 25, the rates were 3.77% and 7.93% respectively. Further, in those whose initial GTT results were either normal or IGT, the diabetes onset rate was higher in those with BMI $\geq$ 25 than in those with BMI < 25.

DISCUSSION

The positive rate of glycosuria is considered to reflect the prevalence of diabetes mellitus, but the fact that this positive rate reached a plateau in 1979, and that the national nutrition intake volume is declining⁴⁾ lead us to feel that we will never again see such a marked increase in diabetes mellitus as was observed between 1963 and 1979 (an 8-fold increase in 16 years)^{5,6)}.

The 75 g GTT results for glycosuria-positive cases show that the prevalence rates of diabetes mellitus were 1.78 times higher in females than males in both BMI < 25 and BMI $\geq$ 25 groups, but in contrast to this, the glycosuria-positive rates were 3-4 times higher in males. These findings indicate that the prevalence rates of diabetes mellitus in this population are higher in males than in females, and in those with BMI $\geq$ 25, it is 1.58 times higher than those with BMI < 25, for both sexes. Further, the diabetes rate increased with BMI, indicating that

obesity is a very important diabetes inducing factor as has been advocated in the past.

The results of the 5-19 year follow-up showed the annual diabetes onset rate to be 1.72% in those with BMI < 25 and normal initial test findings, which was significantly lower than the rate of 4.82% in those with IGT. In those who had BMI $\geq$ 25 and normal initial results, the onset rate was 3.77%, lower than the 7.93% for those with IGT. The onset rate in IGT has been reported to be 1-5%^{7,8)}, but our results were slightly higher which was probably due to the fact that our population was composed entirely of older glycosurics.

References

- 1) WHO Expert Committee on Diabetes Mellitus (1980) *WHO Tech. Rep. Ser.*, 646, 8-12.
 - 2) Hara, H. & Ito, C. (1982) Comparison of plasma glucose levels between 50 g and 75 g GTT. *J. Jap. Diab. Soc.*, **25**, 31-33.
 - 3) Hakura, R. (1982) Comparison of plasma glucose levels between 75 g and 100 g GTT. *J. Jap. Diab. Soc.*, **25**, 28-30.
 - 4) Ministry of Health and Welfare (1982) Summary of National Nutrition Survey-1980. *Clin. Nutr.*, **60**, 195-199.
 - 5) Ministry of Health and Welfare (1976) *National Health Survey. Welfare Index*, **23**(16), 64-65.
 - 6) Ministry of Health and Welfare (1981) *Trends in National Health. Welfare Index*, **28**(9), 489.
 - 7) Birmingham Diabetes Survey Working Party (1976) Ten year follow-up report on Birmingham Diabetes Survey of 1961. *Brit. med. J.*, **2**, 35-37.
 - 8) Jarrett, R.J., Keen, H., Fuller, J.H. & McCartney, M. (1979) Worsening to diabetes in men with impaired glucose tolerance. *Diabetologia*, **16**, 25-30.
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