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Original Article

Prevalence and Risk Factors for Diabetes: A Ten Year Follow- up Study of the Yaeyama District of Okinawa

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Abstract To clarify the prevalence and incidence of diabetes and to evaluate which risk factors are predictive of future diabetes in the general population of Okinawa, 1,690 residents were screened in 1989 and 758 were prospectively followed-up in 1999. Of the 1,690 residents surveyed in 1989 and 1, 163 in1999, diabetes was found in 91 (5.4%) in1989 and 52 (4.5%) in 1999. Residents with diabetes were significantly older, more likely to have significantly higher levels of HbA1c, fasting glucose, serum triglyceride, ALT, BMI, systolic blood pressure, and a history of hypertension than non diabetic residents, both in 1989 and 1999. 717 residents who did not have diabetes at the 1989 screening were re-examined in 1999. Among them, 17 (incidence rate 2.4%) had developed diabetes over the ten years. Multivariate logistic regression analysis showed HbA1c, BMI, and systolic blood pressure to be independent risk factors for newly developed diabetes ($p < 0.0001$, odds ratio ; 28.1, $p = 0.020$, odds ratio ; 1.21, $p = 0.039$, odds ratio ; 1.04, respectively) after adjusting for age, sex, BMI, blood pressure, hystory of hypertension, HbA1c, fasting glucose, serum triglyceride, ALT, and γ GTP. Our results showed that the prevalence and incidence of diabetes are low in the general population of the Yaeyama district of Okinawa and that elevated HbA1c level, even in the normal range, is one of the best predictors of diabetes. Following BMI and systolic blood pressure is important.

Key words : prevalence, incidence, diabetes, HbA1c, BMI, blood pressure

Introduction

Diabetes mellitus is related to a substantial increase in the risk of vascular disease, such as ischemic heart disease and cerebrovascular disease[1)]. It has been estimated that 135 million people had diabetes worldwide in 1989 and that the number will increase to 300 million by 2025[2)]. The greatest increases in the prevalence of diabetes are expected to occur in Asia and Africa, where the number of people with this disease may triple by the end of the decade[3)]. Indeed, a recent survey of the Japanese Ministry of Health and Welfare showed that 7.4 million Japanese (approximately 9.8% of the population) had glycosylated hemoglobin (HbA1c) of 6.9 % or greater, suggesting that the Japanese trend in the prevalence of diabetes closely matches the worldwide trend[4)]. The lifestyle and diet of the Japanese people have changed dramatically since the end of World War II[5)]. However, in Okinawa, despite rapid changes in lifestyle and regional politics, Okinawa's people have maintained their culture of respect for their ancestors and the elderly[6)]. Okinawa is known for having the highest longetivity in Japan and a low rate of death due to cardiovascular disease[7)8)]. We previously reported that the intima-media thickness of Okinawa residents was significantly

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lower than that of K town residents in a town of Fukuoka prefecture[9]. We thought, therefore, the prevalence and incidence of diabetes mellitus in Okinawa would be lower than the national average of Japan.

The present study aims to address questions as to whether or not the prevalence has changed during the past decade and what factors contribute to the development of diabetes in the Yaeyama district of Okinawa. A further aim was to estimate the incidence rate of diabetes over the ten years.

Methods

2.1 Study area and subjects

The present study was done as a cohort investigation between 1989 and 1999 in the general population of the Yaeyama District of Okinawa Prefecture, Japan. Okinawa is located in the subtropical zone about 1,000 km south of the main islands of Japan. The Yaeyama District is in the southwestern part of Okinawa near Taiwan and consists of Ishigaki, Hateruma, Iriomote, Kohama, Taketomi, Kuroshima, and Yonaguni Islands. The yearly average temperature and humidity are 25.4 ℃ and 76 %, respectively. After the Second World War, Okinawa was occupied and governed by the United States until it was returned to Japan in 1972. Traditional Okinawan food is composed of rice, sweet potatoes, soybeans, vegetables, seaweed, pork and fish. A large-population, long term study of residents of the Yaeyama District of Okinawa for hepatitis B virus (HBV) markers has been carried out by our laboratory since 1968[10]. Free health examinations, provided to all residents, were announced by distributing written notices to all households. Written informed consent was obtained from each participant before testing. The protocol of our study was reviewed and approved by the Ethic Committee of Kyushu University Hospital.

In 1989, a screening survey for the present study was performed. A total of 1,712 residents in 1989 and 1,235 residents in 1999 ≥ 30 years of age (67.1%, and 58.9% of the total population of this age group, respectively) participated in the examination. A physical examination, which included measurement of height, weight, and blood pressure, was given, and a routine blood biochemistry was tested that included plasma glucose, HbA1c, serum lipids, ALT (alanine aminotransferase) and γ GTP(γ glutamyltransferase). Questionnaires covering personal and family history of cardiovascular and other diseases, as well as smoking and drinking habits, were administered to 1,690 persons (793 males and 897 females, age range 30–87 years, mean age 56.1 years) in 1989 and 1,163 persons (473 males and 690 females, age range 30–89 years, mean age 61.0 years) in 1999. Blood pressure was measured twice in the right arm with a mercury sphygmomanometer, with the subject in a sitting position after taking a short rest. The second measurement was used for the analysis. Body mass index (BMI) was calculated as weight (kg) divided by height in meters squared. Participants were defined as hypertensive if diastolic blood pressure was ≥ 90 mmHg, systolic blood pressure ≥ 140 mmHg, or if they were taking antihypertensive medication. The participants were classified as smokers if they smoked at least one cigarette per day. Regular alcohol consumption was defined as the consumption of at least 30g of alcohol per week for one year or more.

2.2 Biochemical measurements

Plasma glucose was measured by the glucose oxidase method, and HbA1c levels were measured by high-pressure liquid chromatography (MBC Laboratories, Inc., Tokyo, Japan). The value for HbA1c (%) is etstimated as an NGSP (National Glycohemoglobin Standaridization Program) equivalent value (%) calculated by the formula HbA1c(%) = HbA1c (JDS)(%) + 0.4%[11]. Both serum ALT and γ GTP concentrations were determined by a kinetic ultraviolet ray method based on the rate of reduced nicotinamide

adenine dinucleotide oxidation. Serum total cholesterol and triglyceride were measured enzymatically.

2.3 Definition of diabetes

Of the 1,690 residents tested in 1989 and 1,163 tested in 1999, 376 (23.6%) and 334 (29.5%), respectively, were hyperglycemic, with fasting plasma glucose (FPG) of ≥ 110 mg/dL (6.1 mmol/L) and < 126mg/dL (7.0 mmol/L), respectively. All hyperglycemic participants were asked to receive a 75g oral glucose tolerance test (OGTT), after fasting for 12-14 hours and refraining from smoking, exercise, or other unusual activity before the testing. 264 in 1989 and 273 in 1999 revisited a community center where they were given OGTT. All OGTT were carried out in the morning, using 75 g of glucose, Trelan-G (Shimizu Pharmaceutical, Shimizu, Japan) administered over 4 to 5 minutes under supervision. Plasma glucose samples were taken at baseline and 2 hours after the glucose load. The following definitions of glucose tolerance, recommended by JDS, were used in the present study[12] : diabetic type : FPG 126 mg/dL (7.0 mmol/L) or above or a 2-hour plasma glucose value 200 mg/dL (11.1 mmol/L) or above; borderline type : FPG between 110 and 125 mg/dL (6.1 and 6.9 mmol/L) or a 2-hour plasma glucose value between 140 and 199 mg/dL (7.8 and 11.0 mmol/L) ; and normal type : not fitting the criteria for the diabetic or borderline types. After the testing, a diagonsis of diabetes was based on the following: 1) fasting plasma glucose ≥ 126mg/dL (7.0 mmol/L), 2) HbA1c ≥ 6.9%, 3) medication for diabetes, and 4) diabetic type after 75g oral glucose tolerance test (OGTT).

2.4 Incidence of diabetes

Of the1,690 residents were screened in 1989, 932 residents were excluded because of missing data or dropout, leaving 758 residents (296 men and 462 women ; 55.0 ± 12.5 years) who were enrolled and followed up over the ten years. Of these 758 residents, 41 continuously had diabetes, leaving 717 residents for the calculation of the incidence of diabetes.

2.5 Statistical analysis

Skewed variables were log-transformed before analyses. Rates were compared by using chi-squared test with continuity correction or by Fisher's exact test when appropriate. Continuous data were expressed as mean values ± standard deviation (SD). Unpaired t-test or Mann-Whitney U-test was used to compare the means of samples between two groups. Multiple logistic regression analysis was used to determine the independent risk factors for the development of diabetes mellitus. A p value < 0.05 was considered to indicate statistical significance; all tests were two-tailed. All statistical analyses were performed on a personal computer with the statistical package SPSS for Windows (IBM PASW 18, Tokyo).

Results

The prevalence of diabetes by age and sex in both 1989 and 1999 are shown in Table 1. In 1989, 793 subjects were men and 987 were women (mean age 53.9 years for men, 55.0 years for women). Of the 1,690 residents surveyed in 1989, diabetes was found in 91 (5.4%), 61 (7.7%) men and 30 (3.3%) women. The prevalence was significantly higher for men than for women ($p<0.05$). No diabetes was found in any of the participants under 30 years in 1989 . For residents 50-69 years-of-age, the prevalence of diabetes was significantly higher for men than for women (50-59: 12.7% for men and 5.7% for women) (60-69: 11.0% for men and 2.4% for women) ($p<0.05$).

In 1999, 473 subjects were men and 690 were women (mean age 60.0 years for men, 60.8 years for women). Of the 1,163 residents surveyed in 1999, diabetes was found in 52 (4.5%), 24 (5.1%) men and 28 (4.1%) women, with no measurable difference between men and women. As in 1989, no diabetes was found in any of the participant

Table 1 The prevalence of diabetes of Yaeyama district subjects in 1989 and in 1999 by age and sex

	Age (years)	1989		1999	
		n	diabetes ; n (%)	n	diabetes ; n (%)
Men					
	<30	49	0	11	0
	30–39	155	4 (2.6)	40	1 (2.5)
	40–49	98	4 (4.1)[a]	100	0
	50–59	166	21 (12.7)[b]	52	3 (5.8)
	60–69	173	19 (11.0)[b]	108	6 (5.6)
	70–79	122	13 (10.7)	118	11 (9.3)[b]
	≥80	30	0	44	3 (2.4)
	total	793	61 (7.7)[b]	473	24 (5.1)
Women					
	<30	47	0	20	0
	30–39	164	1 (0.6)	74	1 (1.4)
	40–49	89	4 (4.5)	108	3 (2.8)
	50–59	211	12 (5.7)	69	4 (5.8)
	60–69	211	5 (2.4)	177	11(6.2)
	70–79	139	8 (5.6)	176	5 (2.8)
	≥80	36	0	66	4 (6.1)
	total	897	30 (3.3)	690	28 (4.1)
Total		1690	91 (5.4)	1163	52 (4.5)

[a] $P<0.05$ vs. 1999
[b] $P<0.05$ vs. women of each year

under 30 years. Only in residents 70–79 years-of-age was the prevalence of diabetes significantly higher for men than for women (9.3% for men and 2.8% for women, $p<0.05$). There was no statistically significant difference in the change in the prevalence of diabetes over the ten years for either men or women in any age group.

The characteristics of the 1,690 residents tested in 1989 and of the 1,163 in 1999, with or without diabetes, are shown in Table 2. In 1989, 184 of 1, 599 subjects in the non diabetes group were given 75g OGTT, and 52 (28.3%) were diagnosed as borderline type and 132 (71.7%) as normal type (data not shown). In 1989, residents with diabetes were significantly older ($p<0.001$), more likely to be men ($p<0.01$), to drink alcohol ($p<0.05$), and to have significantly higher values of BMI ($p<0.001$) and blood pressure (systolic, $p<0.001$; diastolic, $p<0.01$) than residents without diabetes. Also, residents with diabetes were more likely to have a history of hypertension ($p<0.01$) and to have significantly higher values of HbA1c ($p<0.001$), fasting plasma glucose ($p<0.001$), total cholesterol ($p<0.001$), serum triglyceride ($p<0.001$), and ALT (alanine aminotransferase) ($p<0.01$). The prevalence of smoking and γ GTP values were not significantly different between the diabetes and non-diabetes groups.

In 1999, 244 subjects in the non diabetes group were given 75g OGTT, and 73 (29.9%) were diagnosed as borderline type and 171(70.1%) as normal type (data not shown). In 1999, residents with diabetes were significantly older ($p<0.01$) and had significantly higher BMI ($p<0.01$) and systolic blood pressure ($p<0.01$) than residents without diabetes. Also, residents with diabetes were more likely to have a history of hypertension ($p<0.05$) and higher HbA1c ($p<0.001$), and higher levels of fasting plasma glucose ($p<0.001$), serum triglyceride ($p<0.05$), ALT ($p<0.01$) and γ GTP ($p<0.001$). However, smoking and alcohol use, diastolic blood pressure, and total cholesterol were not

Table 2 Characteristics of 1,690 subjects in 1989 and 1,163 subjects in 1999 with or without diabetes

Variables	diabetes			p-value		
	diabetes n= 91	non diabetes n= 1,599	p-value	diabetes n= 52	non diabetes n= 1,111	p-value
Age (years)	60.3 ± 9.8	54.3 ± 15.9	<0.001	66.7 ± 12.3	60.3 ± 16.1	<0.01
Men (N(%))	61 (67.0)	732 (45.8)	<0.01	24 (46.2)	449 (40.4)	0.412
HbA1c (%)	6.0 ± 1.3	4.9 ± 0.5	<0.001	7.5 ± 1.5	5.4 ± 0.4	<0.001
fasting plasma glucose (mg/dl)	155.1 ± 53.3	93.9 ± 22.5	<0.001	159.3 ± 39.5	95.4 ± 10.1	<0.001
BMI (kg/m^2)	24.6 ± 12.4	23.0 ± 10.3	<0.001	25.2 ± 16.4	23.5 ± 12.4	<0.01
Blood pressure (mmHg)						
Systolic	131.8 ± 15.7	125.6 ± 15.8	<0.001	137.0 ± 13.9	130.3 ± 17.3	<0.01
Diastolic	75.2 ± 8.4	72.3 ± 8.4	<0.01	78.5 ± 8.1	78.1 ± 10.4	0.788
Clinical history						
Hypertension (N(%))	26 (28.6)	266 (16.9)	<0.01	23 (44.2)	312 (28.1)	<0.05
Smoking (N(%))	27 (29.6)	398 (24.9)	0.34	12(23.1)	230 (20.7)	0.18
Alcohol (N(%))	44 (48.4)	501 (35.1)	<0.05	21 (40.5)	411 (37.0)	0.564
Total cholesterol (mg/dl)	208.2 ± 37.5	193.5 ± 36.5	<0.001	205.6 ± 40.0	200.1 ± 35.9	0.283
Serum triglycerides (mg/dl)	243.6 ± 171.4	149.8 ± 107.3	<0.001	171.9 ± 133.1	140.1 ± 110.6	<0.05
ALT (IU/L)	18.0 ± 9.9	14.7 ± 10.3	<0.01	28.9 ± 25.4	21.8 ± 16.8	<0.01
γ GTP (IU/L)	24.2 ± 18.1	19.9 ± 3.2	0.226	85.5 ± 188.8	45.0 ± 67.6	<0.001

Data represents the mean value ± S.D. or number (%) of subjects.
HbA1c ; hemoglobin A1c is estimated as an NGSPequivalent value (%) calculated by the formula HbA1c (%) = HBA1c (JDS) (%) + 0.4%.
BMI ; body mass index, ALT ; alanine aminotransferase, γ GTP ; γ glutamyltransferase.

Table 3 Comparison of 1989 data between newly diagnosed diabetes group and no diabetes group over the ten years

Variables	Newly developed diabetes n=17	without diabetes n=700	*p*-value
Age	59.7 ± 13.3	54.9 ± 12.5	0.113
Men (N(%))	8 (47.1)	268 (38.3)	0.629
HbA1c (%)	5.4 ± 0.5	4.9 ± 0.5	<0.001
fasting plasma glucose (mg/dl)	104.9 ± 32.2	94.0 ± 20.8	<0.05
BMI (kg/m^2)	25.2 ± 4.5	23.3 ± 3.1	<0.01
Blood pressure (mmHg)			
Systolic	134.7 ± 17.7	124.3 ± 14.4	<0.01
Diastolic	75.6 ± 11.6	71.8 ± 7.7	<0.05
Clinical history			
Hypertension (N(%))	5 (29.4)	103 (14.9)	0.194
Total cholesterol (mg/dl)	189.1 ± 37.3	194.8 ± 36.2	0.156
Serum triglycerides (mg/dl)	127.2 ± 39.1	151.4 ± 97.4	0.307
ALT (IU/L)	16.2 ± 7.0	14.6 ± 9.2	0.454
γ GTP (IU/L)	22.3 ± 20.0	18.8 ± 25.9	0.583

Data represents the mean value ± S.D. or number (%) of subjects.
HbA1c (hemoglobin A1c) is estimated as an NGSP equivalent value (%) calculated by the formula HbA1c(%) = HBA1c (JDS) (%)+ 0.4%.
BMI ; body mass index, ALT ; alanine aminotransferase, γ GTP ; γ glutamyltransferase.

Table 4 Odds ratio of incidence of diabetes over the ten years by multiple logistic regression analysis

Variable (unit)	Adjusted odds ratio*	95% CI	*p-value*
HbA1c(%)	28.1	6.740-116.9	<0.0001
BMI(kg/m^2)	1.21	1.031-1.424	0.020
Systolic blood pressure(mmHg)	1.04	1.012-1.066	0.039

*Multivariate adjustment was made for age, sex, body mass index, blood pressure,hystory of hypertension, HbA1c, fasting glucose, triglyceride,alanine aminotransferase, and γ glutamyltransferase.

significantly different between the diabetes and non diabetes groups.

Among 717 subjects who did not have diabetes at the 1989 screening, 17 (8 men and 9 women) had developed diabetes over the ten years. Table 3 shows a comparison of 1989 baseline data between newly developed diabetes (n = 17) and non diabetes group (n = 700). The incidence of new diabetes was 2.4%. Of the 17 cases of newly developed dibetes, all of whom were given 75g OGTT in1989, 5 (29.4%) were borderline type and 12 (70.6%) were normal type in 1989. Of the 700 in the non diabetes group, 147 were given 75gOGTT in 1989, with 33 (22.4%) borderline type and 114 (77.6%) normal type by blood test or 75g OGTT (data not shown). The newly developed diabetes group had significantly higher values of HbA1c (p<0.001), fasting plasma glucose (p<0.01), BMI (p<0.01) and blood pressure (systolic, p<0.01 ; diastolic, p<0.05) than the non diabetes group.

Multivariate logistic regression analysis showed HbA1c, BMI, and systolic blood pressure to be independent risk factors for newly developed diabetes after adjusting for age, sex, BMI, blood pressure, hystory of hypertension, serum triglyceride, ALT, and γ GTP (Table 4).

Discussion

The prevalence and incidence of diabetes in theYaeyama district of Okinawa prefecture during the last decade was investigated to determine the relationship between the development of diabetes and lifestyle. Our study showed that the prevalence of diabetes was 5.4% in 1989 (7.7% for men, 3.2% for women) and 4.5% in 1999 (5.1% for men, 4.1% for women) of all individuals who underwent health screening. These rates were lower than the national average in Japan, which was estimated on the basis of HbA1c values[4] The incidence of new diabetes in this district, 2.4% over the ten years, was also lower than that of other parts of Japan[13]. This may be because Okinawan people have maintained their traditional culture and lifestyle, so that the prevalence and incidence of diabetes were low, as in our previous report that the intima-media thickness of Okinawa residents was significantly lower than that of K town residents of Fukuoka prefecture[9]. Men had a significantly higher prevalence of diabetes than women in1989, especially those in their fifties and sixties. In Japan, there is no solid data to suggest that the prevalence of diabetes differs by gender. However, some Japanese studies have shown that the frequency of diabetes is higher for men than women, as did our study[4)14)15)]. In contrast, the third National Health and Nutrition Examination Survey in the US showed that adult men and women of all races had a similar prevalence of diabetes. Genetic factors, lifestyle factors, and/or the level of physical activity might explain these differences.

In this study, residents with diabetes were more likely to have significantly higher values of BMI, blood pressure, serum triglyceride, ALT, and γ GTP than non diabetic residents, both in 1989 and 1999. Higher BMI, hypertension, and dyslipidemia are the main components of metabolic syndrome[16]. It has also been reported that non-alcoholic steatohepatitis (NASH) is a hepatic expression of this syndrome[17]. It is generally accepted that insulin resistance is the central pathogenic mechanism of metabolic syndrome

and that it plays a major role in the development of type 2 diabetes[18]. Indeed, prospective studies have revealed that insulin resistance predates the onset of type 2 diabetes by 10 to 20 years, and it has been reported to be the best clinical predictor of the subsequent development of type 2 diabetes[19)20)]. Therefore, it is reasonable to assume that screening for diabetes would be essential for persons with metabolic syndrome.

Participants with newly developed diabetes had significantly higher values of HbA1c than non-diabetes subjects, and HbA1c was the strongest independent risk factor for incident diabetes in this study. Previous studies showed that HbA1c was a predictor of diabetes, but only for high-risk populations[21)22)]. In contrast, Pradhan et al. have revealed an increased diabetes risk even with HbA1c levels between 5.0% and 5.5%, values within the normal range among healthy middle-aged subjects[23)]. Our study also showed that the mean HbA1c level of newly developed diabetes subjects was 5.4 ± 0.5%, which is within the normal range. These results suggest that we should pay careful attention to people whose HbA1c level is in the normal range, which is not generally considered indicative of high risk in routine clinical practice.

Our data showed that subjects with newly developed diabetes in the ten year follow-up had significantly higher BMI values than non-diabetes subjects and that BMI was an independent risk factor for incident diabetes. Cross-sectional studies of the BMI of Japanese and other Asians[24)] have reported dose-response relationships between BMI and the prevalence of diabetes over a wide range of BMI. Nagaya et al.[25)] found that an increase in BMI of 1kg/m^2 raised the risk for incident diabetes by 26% for Japanese men and by 24% for Japanese women. It is known that Japanese are susceptible to diabetes, even when they are not obese (BMI<25)[26)]. Body-weight control is simple and, from a medical cost standpoint, would obviously be one of the most effective strategies for preventing diabetes.

It has been reported that type 2 diabetes mellitus is almost 2.5 times as likely to develop in subjects with hypertension as in subjects with normal blood pressure[27)]. In addition to hypertension , high normal blood pressure (no history of hypertension and a blood pressure of 130-139/85-89mmHg) and prehypertension (a blood pressure 120-139/80-89mmHg) were associated with an increased risk of developing type 2 diabetes[28)29)]. A Japanese epidemiological study revealed that 62% of diabetic patients have hypertension compared to 32% of normal glucose tolerance subjects who have hypertension[30)] In our study, systolic blood pressure was one of the independent risk factors for newly developed diabetes identified after adjusiting for variables. Our results suggest that the prognostic significance of elevated blood pressure may warrant a emphasis in primary prevention in Japanese residents.

There are several limitations in this study. First, the participants were voluntary attendants for a health check-up, thus they may have been more conscious of health and had a more healthy lifestyle than the residents who did not participate. Second, we could not perform OGTT for all the subjects with fasting hyperglycemia between 110 and 125mg/dl. Subjects with lower fasting glucose than 110mg/dl might have 200mg/dl or above with the 2-hr plasma glucose in OGTT. Therefore, our data may underestimate the true prevalence and incidence of diabetes. Third, the effects of medication on the incidence of diabetes were not examined. Finally, other possible confounding factors, such as socioeconomic condition, education, and physical activity were not examined in this study.

In conclusion, our results showed that the prevalence and the incidence of diabetes are low in the general population of the Yaeyama district of Okinawa and that elevated HbA1c level, even in the normal range, is the best predictor of diabetes, Following BMI and systemic blood pressure is important.

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（和文抄録）

10 年間の追跡調査による沖縄県八重山地区における糖尿病有病率と罹患率及びその危険因子についての検討

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【目的】沖縄県八重山地区の一般住民において，糖尿病の有病率及び 10 年後の糖尿病の新規発症率とその危険因子について検討した．

【方法】1989 年に 1,693 名，1999 年に 1,163 名に対し住民検診を施行した．糖尿病の診断は，①空腹時血糖値が 126mg/dl 以上② HbA1c 6.9％（国際標準値）以上③糖尿病治療中④ 75 g 糖負荷試験結果が糖尿病型のいずれかで診断した．

【結果】1989 年に検診を受けた住民 1,693 名のうち計 91 名（5.4％）が糖尿病と診断され，1999 年は 1,163 名のうち計 52 名（4.5％）が糖尿病と診断されたが，有意な経年的変化は認めなかった．糖尿病と診断された住民は，非糖尿病住民と比べて，年齢，BMI，収縮期血圧，高血圧の病歴，血清中性脂肪値，ALT 値が有意に高値であった．追跡調査可能で 1989 年時に非糖尿病であった 717 名の住民のうち，17 名が 10 年後に新規に糖尿病に罹患していた（罹患率 2.4％）．糖尿病発症の独立した危険因子として，HbA1c，BMI，収縮期血圧が抽出された（p<0.0001，odds ratio；28.1，p=0.020，odds ratio；1.21，p=0.039，odds ratio；1.04，respectively）．

【結論】沖縄県八重山地区の一般住民は，他地域と比べ糖尿病の有病率及び罹患率が低く，HbA1c，BMI，収縮期血圧が正常範囲内であっても危険因子になりうることが示唆された．