

Hyperglycemia in Washoe and Northern Paiute Indians

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SUMMARY

The prevalence of hyperglycemia in two American Indian tribes, the Washoe and Northern Paiute, was evaluated by determining the number of individuals aged fifteen years and older with a history of concurrently treated diabetes or with a plasma glucose level of at least 160 mg./100 ml. (AutoAnalyzer) two hours after a 75-gm. glucose equivalent load. One hundred and twelve Washoe Indians, representing 74.2 per cent of the Washoe study population, and 131 Paiute Indians, 60.6 per cent of the Paiute study population, were examined. The prevalence of hyperglycemia was 10.7 per cent for the Washoe and 11.5 per cent for the Paiute group. These rates, when adjusted for age and sex, did not differ significantly from each other or from that reported for the Cocopah Indians. The adjusted rates for these three tribes were significantly lower than the adjusted rate for the Pima. In both the Washoe and Paiute populations, the prevalence of hyperglycemia increased with age, but was not related to parity. *DIABETES* 22:58-62, January, 1973.

In 1968, Miller and co-workers¹ reported that 23.5 per cent of 1,881 Pima Indians from the Gila River Reservation over five years of age (32.0 per cent of those aged fifteen and older) either had plasma glucose levels of at least 160 mg./100 ml. two hours following a 75-gm. glucose equivalent load or were receiving hypoglycemic medication. Using identical methods and criteria, Henry and co-workers² found the prevalence

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of diabetes in the Cocopah tribe for those over five years of age to be 17.0 per cent (for those aged fifteen and older, 24.4 per cent). The difference in prevalence between the two linguistically distinct tribes* was found to be statistically significant. The same methods have been extended to two other tribes, the Washoe and Northern Paiute, and the results are presented in this report.

The Washoe and Northern Paiute formed part of the Desert Culture, which began 9,000 to 15,000 years ago in the Great Basin area of the United States. The Washoe occupied the eastern slopes of the Sierra Nevada in the region of Lake Tahoe, while the Paiute ranged over a wide area including western Nevada and southern Oregon.³ Despite geographic proximity, they are linguistically different: The Washoe constitute a branch of the Hokan family of languages, while the Paiute, like the Pima, are part of the Uto-Aztecan family. Today each tribe lives in small, predominantly homogeneous colonies and reservations in western and central Nevada and eastern California. There is no census of this area currently available that enumerates Indians by tribe, but an unofficial estimate of its total Indian population in 1970 was 7,700, of which 60 per cent were probably Paiute.⁴ The estimated number of Washoe was 600. Occupations are chiefly farming and ranching, although employment in service and manufacturing industries is increasing. The diets of neither of the tribes have been closely studied, but the impression has been that they contain much carbohydrate.

METHODS

The Washoe population selected for study included all individuals aged fifteen years and older, putatively one-half or more Washoe, and residing (in the summer of 1970) in the communities of Dresslerville, Nevada, and Woodfords, California. Those persons aged fifteen

*The Pima derive from the Uto-Aztecan linguistic family, while the Cocopah belong to the Yuman family.

years and older and one-half or more Paiute residing on the Fort McDermitt Indian Reservation (Nevada) comprised the Paiute study population. These particular communities were chosen because of the homogeneity of tribal composition and the relatively large number of available subjects. One hundred and twelve individuals, or 74.2 per cent of the Washoe group, and 131, or 60.6 per cent of the Paiute group, were evaluated either by determination of the plasma glucose level two hours (\pm thirty minutes) after a 75-gm. glucose equivalent load,* or by eliciting a history of concurrently treated diabetes. The glucose load was administered irrespective of time of day or time of last meal. Twenty-nine per cent of the tests were performed in the morning, 38 per cent in the afternoon, and 33 per cent in the evening after 5 p.m. A blood sample was also collected for serum creatinine determination, and a urine specimen was obtained, tested for protein with Labstix,[†] and saved for quantitative determinations if a trace or more of protein was registered. For each subject examined, information on age, weight, height, and parity was recorded.

The serum, plasma, and urine samples were frozen and shipped in dry ice to the laboratory of the Southwestern Field Studies Section, National Institute of Arthritis, Metabolism, and Digestive Diseases in Phoenix, Arizona, where the analyses were performed. The plasma glucose concentration was measured with the AutoAnalyzer by the modified Hoffman method.⁵ The serum and urine creatinine and the urine albumin concentration were measured, and the urine albumin/creatinine ratio[‡] were calculated.

RESULTS

In the Washoe group, twelve individuals, or 10.7 per cent, were hyperglycemic by the criterion of either a two-hour post-load plasma glucose level of at least 160 mg./100 ml. or by a history of concurrently treated diabetes. Seven of these hyperglycemic individuals were previously known to have diabetes. In the Paiute group, fifteen individuals, or 11.5 per cent, were hyperglycemic, and eleven of these were previously known.

Tables 1 and 2 present the data on the prevalence of hyperglycemia in both populations by age and sex. Al-

though the prevalence was higher in the females of both tribes, in neither group was there a statistically significant difference in rates between the sexes ($p > 0.2$). Comparison of the prevalence in the fifteen through thirty-four-year age group with that in persons thirty-five years of age and older revealed a significant increase in the older category in both tribes ($p < 0.05$).

No statistically significant relationship was found between parity and the frequency of hyperglycemia in the females of either population ($p > 0.2$). An accurate assessment of the association between hyperglycemia and obesity could not be made, as values for height and weight had to be estimated in a large number of cases, but approximately 20 per cent of the respondents of each tribe were obese.*

Finally, the number of abnormalities detected in serum creatinine and urine albumin/creatinine ratio was too small to permit definite conclusions: Two Washoe and four Paiute subjects[†] with significant proteinuria (A/C ratio ≥ 1) and an additional two Washoe and one Paiute subjects with elevated serum creatinine levels.[‡] Three of these nine individuals with abnormal kidney function were hyperglycemic.

Direct comparisons of the observations made on the Washoe and Paiute groups with those on the Pima and Cocopah Indians were possible because variations in method were minimized.[§] To correct for age and sex differences, prevalence rates were adjusted to a standard population, the sum of the individuals in the four populations. Ninety-five per cent confidence limits were calculated for the adjusted rates, and the criterion for a significant difference between values was taken to be no overlap of the confidence limits. Under these terms, the prevalence rate of hyperglycemia for those of both sexes aged fifteen years and older, was significantly higher in the Pima (31.9 per cent) than in the Cocopah (21.7 per cent), Washoe (10.6 per cent), and Paiute (15.3 per cent) groups. There were no statistically significant differences in the rates for the latter three populations (see table 3).

*Obesity is defined as ≥ 150 per cent of desirable weight.⁶

[†]Two Paiutes with proteinuria also had elevated creatinine levels.

[‡] > 1.5 mg. per cent for males; > 1.3 mg. per cent for females.

[§]The Pima study¹ also included half- to full-blooded Pima Indians, whereas the Cocopah study included one-quarter to full-blooded Cocopah Indians (about 70 per cent were full blood). In the present study, approximately 80 per cent of those examined were putatively full-blooded Indians of their respective tribes.

*Dexcola, Custom Laboratories, Baltimore.

[†]Ames Company, Elkhart, Ind.

[‡]The albumin/creatinine (A/C) ratio is thought to give an estimate of the twenty-four-hour protein excretion.¹ A value equal to or greater than one was interpreted in this study to indicate significant proteinuria.

TABLE 1
Prevalence of hyperglycemia in Washoe Indians by age and sex

Age group (yr.) by sex	Number evaluated	With previously diagnosed diabetes		Plasma glu- cose level ≥160 mg./ 100 ml.*		Plasma glu- cose level ≥200 mg./ 100 ml.*†		Total hyper- glycemia*‡	
		No.	%	No.	%	No.	%	No.	%
Males									
15-34	16	—	—	—	—	—	—	—	—
35-64	22	1	4.5	—	—	—	—	1	4.5
65+	12	2	16.7	—	—	—	—	2	16.7
Total male	50	3	6.0	—	—	—	—	3	6.0
Females									
15-34	30	1	3.3	—	—	—	—	1	3.3
35-64	25	2	8.0	1	4.0	1	4.0	3	12.0
65+	7	1	14.3	4	57.1	1	14.3	5	71.4
Total female	62	4	6.5	5	8.1	2	3.2	9	14.5
Total male + female									
15-34	112	7	6.3	5	4.5	2	1.8	12	10.7
35-64	46	1	2.2	—	—	—	—	1	2.2
65+	47	3	6.4	1	2.1	1	2.1	4	8.5
65+	19	3	15.8	4	21.1	1	5.3	7	36.8

* Not including previously diagnosed diabetics.

† This information included for comparison with other studies.

‡ Previously diagnosed diabetes or two-hour post-load plasma glucose level ≥ 160 mg./100 ml.

DISCUSSION

Over the past ten to fifteen years a number of papers have appeared on the subject of diabetes mellitus in American Indian populations.⁷⁻⁹ A major stimulus for this work has been the question of whether the prevalence and pattern of the disease vary among tribes and whether there are general differences in its presenta-

tion in Indian and non-Indian groups. Unfortunately, the problem remains unsolved chiefly because of the wide variation in both the criteria used to define diabetes and hyperglycemia and in the methods employed to identify the condition. O'Sullivan and Williams¹⁰ have shown that such differences alone, when applied to a survey population in Sudbury, Massachusetts, could yield

TABLE 2
Prevalence of hyperglycemia in Northern Paiute Indians by age and sex

Age group (yr.) by sex	Number evaluated	With previously diagnosed diabetes		Plasma glu- cose level ≥160 mg./ 100 ml.*		Plasma glu- cose level ≥200 mg./ 100 ml.*†		Total hyper- glycemia‡	
		No.	%	No.	%	No.	%	No.	%
Males									
15-34	39	—	—	—	—	—	—	—	—
35-64	22	4	18.2	1	4.5	—	—	5	22.7
65+	5	—	—	—	—	—	—	—	—
Total male	66	4	6.1	1	1.5	—	—	5	7.6
Females									
15-34	38	1	2.6	—	—	—	—	1	2.6
35-64	24	6	25.0	3	12.5	2	8.3	9	37.5
65+	3	—	—	—	—	—	—	—	—
Total female	65	7	10.8	3	4.6	2	3.1	10	15.4
Total male + female									
15-34	131	11	8.4	4	3.1	2	1.5	15	11.5
35-64	77	1	1.3	—	—	—	—	1	1.3
65+	46	10	21.8	4	8.7	2	4.3	14	30.4
65+	8	—	—	—	—	—	—	—	—

* Not including previously diagnosed diabetics.

† This information included for comparison with other studies.

‡ Previously diagnosed diabetes or two-hour post-load plasma glucose level ≥ 160 mg./100 ml.

TABLE 3

Adjusted rates, with standard error* and 95 per cent confidence limits,†
for hyperglycemia‡ in four Indian populations

	Tribe			
	Pima	Cocopah	Washoe	Paiute
Hyperglycemia				
A. ≥ 140 mg./100 ml.§				
Adjusted prevalence rate (%)	—	25.0	14.5	18.1
Standard error of rate (%)	—	3.6	3.2	3.6
95% confidence limits of rate (%)	—	17.8-32.2	8.1-20.9	10.9-25.3
B. ≥ 160 mg./100 ml.				
Adjusted prevalence rate (%)	31.9	21.7	10.6	15.3
Standard error of rate (%)	1.1	3.4	2.7	3.4
95% confidence limits of rate (%)	29.7-34.1	14.9-28.5	5.2-16.0	8.5-22.0

* The adjusted prevalence rate for a group was calculated by applying age-, sex-specific rates from the original surveys to the corresponding subgroups in the standard population, the sum of individuals in the four study groups. The standard error (S.E.) of the adjusted prevalence is expressed as:

$$\sqrt{\frac{\sum Ni^2 V(Pi)}{\sum (Ni)^2}}$$

where N_i is the size of each subgroup in the standard population; $V(P_i)$ is the variance of the rate for a subgroup in a survey which in turn equals pq/n , where p is the rate, q is $1-p$, and n is the size of the sample from which the rate was calculated.

† 95 per cent confidence limits equal rate ± 2 S.E.

‡ Elevation of the two-hour post-load plasma glucose level or history of concurrently treated diabetes.

§ Rates by the 140 mg./100 ml. criterion not available for the Pima.

prevalence rates ranging from 0.8 per cent to 13.4 per cent. Thus, for example, the rate of 1.3 per cent reported for diabetes in the Eskimo,¹¹ and based on an elaborate series of screening tests, cannot be directly compared with the figure of 29.0 per cent described for the Cherokee,¹² based on the results of one blood sample following a glucose load. The need for standardization of methods and definitions is obvious.

The only data from a non-Indian United States population suitable for approximate comparison with the figures from the present study were those from a study of the prevalence of diabetes in Sudbury, Massachusetts.¹⁰ O'Sullivan and Williams reported that 13.4 per cent of a 5 per cent random sample of individuals aged fifteen and older in Sudbury had a plasma glucose level of at least 135 mg./100 ml. (AutoAnalyzer)* two hours following a 100-gm. glucose load. The 135 mg./100 ml. standard would yield a rate of hyperglycemia of 14.3 per cent for the Washoe and 17.6 per cent for the Paiute (including concurrently treated diabetics). If one considers the variations in method to be of minimal importance and assumes similar age distributions in the three populations, there is no significant difference among the prevalence rates.

In both the Paiute and Washoe groups, hyperglycemia was associated with increased age but was inde-

pendent of sex and parity insofar as could be ascertained with available sample sizes.

While the prevalence of obesity was not accurately determined among the Washoe and Paiute, the estimated frequency (20 per cent in each group) was less than that found in the Cocopah (37 per cent), but was roughly similar to that in the Pima Indians (24 per cent).² Since the prevalence of diabetes was much lower in the Washoe and Paiute Indians than in the Pima, and the prevalence of obesity appeared to be similar, it seems unlikely that the differences in the prevalence of diabetes can be explained by differences in the prevalence of obesity.

The higher prevalence of hyperglycemia in the Pima Indians than among the Washoe, Paiute, or Cocopah establishes that there are variations in prevalence in different tribal groups. In addition, the present study demonstrates that the rates and patterns of hyperglycemia are very similar in three linguistically distinct tribal groups and, in fact, for the two tribes currently studied, the prevalence rates show no statistically significant difference from those for the Sudbury, Massachusetts, population.¹⁰

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*The standard actually employed was a whole venous blood glucose value of 110 mg./100 ml. This value is approximately equivalent to a plasma glucose level of 135 mg./100 ml.¹³

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