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DIABETES-RELATED DISEASES IN AMERICAN INDIAN PEOPLE  
INDIGENOUS TO THE SONORAN BIOME

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# DIABETES-RELATED DISEASES IN AMERICAN INDIAN PEOPLE INDIGENOUS TO THE SONORAN BIOME

## ABSTRACT

Certain groups of American Indian people residing in the Sonoran biome of Southwestern United States have prevalence rates of adult-onset diabetes which are among the higher currently known. The fact that the health services provided one of these groups is equipped with an automated health records system has facilitated analysis of morbidity experience to detect those corollary or related conditions which occur in higher level among symptomatic diabetic than among persons who have no overt symptoms of diabetes. The prevalence of diabetes in this population increases greatly after age 30, reaching its highest age-specific prevalence in the 65 to 69 year age group. In most age groups, far more females than males seek clinical attention for diabetes. Most symptomatic diabetics above age 15 have moderately severe stages of the disease; the most severe stages occur in the age groups above 30 years. Problem-specific analyses indicate that a wide variety of disease conditions occur at elevated levels among the identified diabetics, as compared to the non diabetic population. The correlated conditions include a number which have no obvious physio-pathological linkage to diabetes. The fact that a number of common conditions do not occur in any obviously greater incidence among diabetics as compared with non-diabetics indicates that the increments noted are real rather than artifacts of increased utilization. The data suggest that programmed care for diabetics should include preventive measures against a fairly wide spectrum of corollary conditions in addition to the well-known pathologically-linked problems.

## Diabetes-Related Diseases In American Indian People Indigenous To The Sonoran Biome

### DEMOGRAPHIC AND ENVIRONMENTAL DESCRIPTIONS

The Sells Service Unit of the Indian Health Service lies in south central Arizona. Three reservation areas exist in this region, one of them the second largest of the nation, having about 4,500 square miles of territory. All of the region lies in the Sonoran biome, one of the great desert areas of the world. The climate is hot and dry, producing only a few inches of rainfall a year. Most of the villagers live in small houses, generally made of adobe masonry or wood-framed adobe. Communities have had central, deep well water supply points for years. Pit privys are generally used for human waste disposal. Only recently have some modern housing projects been built, of masonry and frame construction, with internal plumbing and water and sewer service. Most of the communities are small, having a population of less than 100 people. The communities are themselves of low density and are spread diffusely over this relatively large geographic area. One main, east-west highway with a northern spur traverses the reservation. Most of the communities are served by gravel roads. Gradually, the routes serving communities are being paved, but the attainment of a complete network of paved roads with bridges and grading is still years from achievement. The people are basically industrious but lack job opportunity. Employment and average income are very low. Much of the population must subsist on welfare assistance; therefore, good nutrition is difficult to attain.

A substantial number of families are involved in cattle ranching, which is of very low productivity because of the climate. A small proportion have found employment in copper mining on or near the reservation. A substantial number work in government-supported activities. People living on the reservation edges often find laboring jobs in agriculture or industry. The reservation lacks an adequate economic base and young people in search of opportunity generally have to move off-reservation to find gainful employment.

The opportunities in urban areas are not great. Both faulty educational preparation and discrimination operate to hold the migrating Indian people in laboring or other menial work. Gradually, skills acquired in job training have assisted in placing some of the work force in the skilled labor class. A

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### DEMOGRAPHIC AND ENVIRONMENTAL DESCRIPTIONS (Continued)

few have obtained education sufficient to place them in professional work. Frequently, both man and wife will have to work to provide an adequate home for their family. Environmentally, the customary low earnings of urban Indian people and associated discrimination usually places them in less desirable regions of the city. But even these areas are usually better from the environmental sanitational aspects than most reservation housing. Not only will city housing usually have kitchens and bathrooms with running water and sewer services, but also electrical power for lighting, heating, cooling and food refrigeration. The latter is not only a convenience, but facilitates a better diet and hygienic food preservation.

### PREVIOUS STUDIES

The Piman people (Pima and Papago tribes) have one of the greater known prevalences of adult-onset diabetes. This has been described in detail by a number of clinical research workers, especially the staff of the Southwestern Field Station of the National Institute of Arthritis, Metabolic and Digestive Diseases, (1, 2, 3). The data derived from the health records system of the Sells Service Unit indicates equivalent prevalence of the disease among the Papago people, (4).

Four years ago we undertook a study evaluating the total disease experience of Papago persons with diabetes, as compared with an age-sex-geographically matched control population segment with no history of diabetes. The results showed the existence of an increment of corollary disease among the diabetics, ranging over a large spectrum of conditions. The study covered one year of outpatient services and 10 years of inpatient services, (5).

Now that six years of clinical services data have been retrieved, involving both inpatient and outpatient services, we feel it desirable that the study be repeated. In addition to the uniform period for counting of both inpatient and outpatient cases and workload, we now have population counts of greater precision than before, based on actual utilization (6). Consequently, rate computations can be carried out with greater confidence than at the time of the earlier study. We also have had more opportunity to evaluate the validity of using outputs from the automated records system to classify diabetes cases into grades of severity with regard to complications and have found the method to be reliable (7).

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### PREVIOUS STUDIES (Continued)

In the current study we use the entire population other than the verified diabetics as the comparison control. We believe that this control population contains about 600 or more non-symptomatic diabetics (Stage 1); for, according to the work of Bennett and others, the number of asymptomatic diabetics is liable to equal the total of the symptomatic diabetics (8). Nevertheless, they would comprise about 10% of the control population and, therefore, should have little effect on overall disease distribution patterns.

### DATA SOURCES

The data used in the study were the following outputs from the automated health records system of the Sells Service Unit (HIS).

- (a) Numerical tabulation of age, sex and geographic distribution of all persons who had utilized the service unit clinical facilities during the years 1971 through 1975.
- (b) A roster of all persons (identified only by system identification number) who had received services for diabetes at any time.
- (c) A punch-card deck of the data on the roster, including age, sex, tribe, residence information.
- (d) A concise record of all clinical encounters, including diagnoses, for each individual on the roster.
- (e) A problem-oriented medical summary for each individual whose complete encounter record was equivocal or fragmentary.
- (f) Numerical tabulations of age, sex and geographic distribution of confirmed diabetics, overall and by severity stage (staging described later).
- (g) A series of outputs giving the age, sex and geographic distribution of ambulatory (patients and visits) and hospital services (patients-hospital days) in the period of 1971-75 provided to the following population components:
  - \* The Utilizing Population (Described in A)
  - \* The Diabetic Population (All Stages)
  - \* The Diabetic Population (Stage 2)
  - \* The Diabetic Population (Stage 3)
  - \* The Diabetic Population (Stage 4)

Separate output series were obtained by all diagnoses and by primary diagnoses.

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### ANALYTIC WORKFLOW

The process of analysis is shown in the flow diagram (Figure 1). First the complete encounter records of all of the people on the initial diabetic roster were reviewed and each case was assigned a severity grade stage according to the scheme given in table 1. The criteria of this staging scheme were derived from the studies of Dr. Peter Bennett and his colleagues (8). To protect privacy, individual records were specified and followed only by internal identification number, which prevented documentation containing proper names. In this initial review, cases with an equivocal history, non-Papagos, persons who had died previous to 1971, those who had merely been involved in diabetic casefinding screening, or the few records which had been included in the roster due to coding error, were eliminated from the study. Thus, although, 1227 individuals had been picked up on the initial roster output, the review of encounter records reduced the number of confirmed diabetic cases to about 700. It is likely that the hard criteria for evidence which were applied to screening the records caused the elimination of borderline or asymptomatic (Stage 1) cases. Nevertheless, we thought it better to apply hard criteria than to risk the inclusion of non-diabetics in the diabetic roster. Whenever the complete encounter record was equivocal, a medical summary was obtained to determine whether the clinical problem entries would verify the presence of diabetes or assist in staging of the severity of the condition in the patient.

Subsequently the deck of cards corresponding to the roster was separated into the components of those cases which were rejected from the study and those cases continued as basis for the study. The latter were further subdivided into the severity stage groupings, which had been established according to the criteria given in Table 1. These cards then became the controls for calling out of our data base the utilization counts (caseloads and workload) for inpatient and outpatient services as well as the diabetic population distribution summaries.

### RESULTS AND INTERPRETATIONS

The distribution of diabetics within the population is an epidemiological issue of primary importance. In another paper (6) we have shown the relation between various population subsets and have indicated that the 5-year

## RESULTS AND INTERPRETATIONS (Continued)

utilizing population count is probably the better one to use for epidemiological analyses. This population base was used to compute the summary of facts given in Table 2.

One of the salient items of table 2 is the obvious lower prevalence of symptomatic diabetes, clinically documented, in the off-reservation population (2.4% vs. 6.7%). Of course, as cited elsewhere (6) the off-reservation population has a lower proportion of middle aged and older people than the on-reservation population. But when we restrict the prevalence rate computation to groups 20 years of age and older, the difference becomes greater, (4.8% vs. 12.5%). This difference is a matter of patho-ecological interest which we hope to pursue in future extensions of the work. Greater investigative effort than simply statistical evaluation of outputs from our data base would be required and we do not have enough economic, social and nutritional information to discuss the issues definitively at this time.

Figure 2 illustrates well the fact that the diabetic condition among these people is an adult-onset problem. Here we compare the age-specific distribution of the total 5-year-utilizing population with that of the symptomatic diabetic population. The increase in the number of diabetics that occurs between the ages of 15 and 39 is quite striking. The lowered distribution of diabetics in advanced age groups may be a function of the interaction of decreased age group size with decreased longevity among diabetics. The most striking feature of this graph is the dip in the distribution curve at the 50-54 year age group. This same bimodal trend was found in the distribution curve of diabetics in our 1972-based study (5). But now the notch occurs in the 50-54 year group rather than the one just under age 50. Apparently, the studies have detected the moving occurrence of a lower-prevalence age cohort. The question arises - what is different about the cohort born between 1922 and 1926 in comparison with the next higher and lower age groups? This may be a problem worthy of in-depth clinical research.

In Figure 3 we show the age and sex composition of the diabetic persons (excluding the asymptomatic). Among the persons 15 to 39 years of age, the rates for males and females are close and the male rate is at times slightly higher than that of females. But the age groups between 39 and 74 years show

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### RESULTS AND INTERPRETATIONS (Continued)

much higher rates for females. We must bear in mind that these data arise out of clinical services. Dr. Bennett, of the NIAMDD diabetes research program among the Pima people (8) has stated that the findings in his project are the same with regard to the difference in rates of males and females seeking medical relief. But in community screening, Dr. Bennett's group has found about equal prevalence of diabetes in males and females.

Figure 4 illustrates the age-specific composition of the symptomatic diabetic population according to severity stages. The graph shows the delayed onset and low levels of Stage 4, which is the stage of poorest prognosis. Indeed, a substantial number of the Stage 4 individuals died within the 5-year period of statistical surveillance.

An analysis of morbidity, comparing the symptomatic diabetics against the remainder of the population (as controls) was carried out in the following manner: A morbidity classification scheme was used which has been developed over the past several years as a result of analyzing the Sells Service Unit workload (9, 10). It is a reordering of the 4 digit ICDA\* system. This taxonomy has 23 general problem classes subtended by about 160 more specific and miscellaneous classes. The utilization outputs from the data base conformed to this taxonomy.

Computations of age-specific rates of cases, outpatient visits and hospital days were made according to the general health problem areas and selected specific health problems, comparing the experience of the symptomatic diabetics with the remainder of the population (control). We do not have space to present highly detailed age-sex morbidity figures within each problem category. We will look at computations of morbidity rates for the ages 20 and over, since diabetes in the subject population is of very low incidence before that age.

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\* INTERNATIONAL CLASSIFICATION OF DISEASES, ADAPTED FOR USE WITHIN THE U.S.A.

## RESULTS AND INTERPRETATIONS (Continued)

Table 3 compares outpatient and inpatient workload by the general problem categories of our taxonomy. The workloads are given in rates per thousand to enable comparison. Each column is provided with a comparison ratio to show more concisely the increment or the deficit of the diabetic service load in relation to the population not having symptomatic diabetes. If we empirically classify the outpatient caseload according to the comparison ratio, the association of diseases with diabetes might be defined in the following manner, (See Table 4). "No Obvious Positive Association," (ratio of 1 to 1.5), Venereal Disease, Mental-Behavioral Problems, Maternal-Infant Continuum problems, Injuries and Supplementary Care; "Positive Association With Moderate Increment," Diarrheal Disease, Other Bacterial Infections, Viral Disease, Neoplasms, Eye Diseases, Ear Diseases, Respiratory Diseases, Digestive Tract Disease, Genital Tract Disease, Skin Diseases, and Musculoskeletal Disease; "Positive Association With Large Increment", (ratio of 2.5-4.0), Tuberculosis, Neurological Disease, Cardiovascular Disease, Urinary Tract Disease and Ill-Defined Conditions. With only two exceptions, the disease classes fall into the same classes in Inpatient comparison if the cut-off points of ratios are set at 1.6, 4.5 and over 4.5.

The ratio scale of visits does not necessarily follow that of cases (patients) (Table 3). Note the higher increments of workload (visits) in the case of Tuberculosis, Metabolic-Nutritional-Blood Disorders, Cardiovascular Disease, Urinary Tract Disease, Skin Diseases, and Ill-Defined problems. This infers a second level of workload increment - the first level is caused by a positive association of a condition with increment of cases, the second level is an increment of visits in relation to caseload. This is especially marked, of course, in the class containing Diabetes.

A comparison of case rates of the diabetic and control population with regard to more specific problem areas is summarized in Table 5. We find that some of the more specific entities fall into lower or higher gradations than those assigned the parent problem areas in the preceding analysis. Because of the range of the comparison ratios, four groupings can be made reasonably; namely, the problems with no obvious positive association, those positively associated with moderate increment in workload, those associated

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### RESULTS AND INTERPRETATIONS (Continued)

with major increment. Except for active respiratory tuberculosis and the arthritis items, all of the associated specific conditions with larger or major increment over the control, are items used in staging diabetic cases according to severity. Only one of the items of moderate increment, "Neurological Symptoms," is possibly related to the staging scheme given in Table 1.

Table 6, based upon outpatient utilization data compares the case rates of selected specific problems and problem areas, among the 3 severity stages of symptomatic diabetes. The range of problems includes items such as diarrheal disease, active respiratory tuberculosis, acute upper respiratory disease and the arthritides, which are not necessarily linked to diabetes. Some of the problems, such as hypertension, neuritis, ischemic heart disease, varicose veins, and chronic nephritis were criteria for staging, therefore it is not surprising to find them clustering in one stage. But it is surprising to find common infections such as diarrheal disease, and acute respiratory disease rising greatly in prevalence as one proceeds from stage 2 to stage 4. Diseases such as arthritis and rheumatism also increase directly with the stage of diabetes (from 2 to 4). These may be affected by the fact that stage 4 is generally, an older group than in the other stage cohorts.

The overall, 5 year, inpatient and outpatient caseload and workload relationships are given in Table 7. Roughly, per unit of population, the diabetic population causes twice the caseload and three times the workload (visits and hospital days) than in the remainder of the population. The caseload-workload impact of diabetes can be summarized in another way; namely that the symptomatic diabetics represent 5.5% of the population, yet they cause 8.7% of the outpatient caseload, 14.4% of the visits, 13.1% of the hospital cases and 17.5% of the hospital days. This indicates that services to diabetics should be planned to make each encounter more effective and that diabetics need to be educated in self-care and in intelligent, economical use of health care, in order that the system may not be subjected to redundant utilization.

### DISCUSSION AND CONCLUSION

The medical textbooks dealing with diabetes point out many of the other conditions of ill health which appear in association with diabetes. As diabetes is subjected to clinical study on large scale, the importance of characterizing

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### DISCUSSION AND CONCLUSION (Continued)

the linked and corollary conditions in evaluating the diabetic case has become evident (11). Some of the correlated problems subject of recent studies are the microvascular complications (12), nephropathy (13), congenital anomalies (14), heart disease (general) (15), parotid enlargement (16), pulmonary tuberculosis (17), Huntingdons Chorea (18), pernicious anemia (19), and hepatic cirrhosis (21, 22, 23, 24). A recent epidemiological study done by this office disputes positive association of diabetes and cirrhosis. The study relative to parotid enlargement concluded that age was the common associate of both, but the messages of the other papers just cited point to positive association.

The ultimate cause of the high prevalence of diabetes among the people of the Piman group, whose residence from antiquity has been the lower Sonoran Life Zone, is quite obscure. It is one of a number of knotty problems confronting diabetologists. A number of theories of causation have been proposed. The one of more recent origin is that of viral infection (25, 26, 27). This can be applied easily to the sudden onset of diabetes in persons who have been afflicted with pancreatitis, or to the origin of juvenile diabetes. It is difficult, however, to rationalize viral infection as the etiology of diabetes which has onset in adult life - sometimes quite late in adulthood. Diabetologists have long studied the implications of genetically determined predisposition to diabetes and with greater success in juvenile diabetes, although familial trends are evident also in the adult-onset variety. Some investigators propose a combination genetic-viral theory in which the genetic predisposition is susceptibility to viral infection affecting the pancreatic  $\beta$  cells, which in turn causes the metabolic abnormality. Persons with anthropological and ecological leanings tend to interpret the massive presence of diabetes in the Pimans as a result of earlier physiological adaptation to a rigorous life in the desert environment - possibly the development of types of carbohydrate storage and mobilization control mechanisms which now work to the disadvantage of a people whose life-style and nutrition have undergone great change in the last few generations (28). This authors leanings are toward the latter theory, since other studies have shown that abnormally high levels of two other (unassociated) diseases with metabolic implications are present in

## Diabetes-Related Diseases In American Indian People Indigenous To The Sonoran Biome

### DISCUSSION AND CONCLUSION (Continued)

these people; namely, Laennec cirrhosis and biliary disease, particularly cholelithiasis (29, 30, 31, 32). While, ultimately, some profound clinical and physiological research is needed to fully define the origins of these problems, we hope that surveillance of the prevalence and distribution of diabetes and related diseases will not only contribute to the planning of effective health services for prolongation of useful life, but also contribute to the studies which must ultimately be pursued to elucidate the natural history, pathogenesis, and effective clinical management.

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TABLE 1

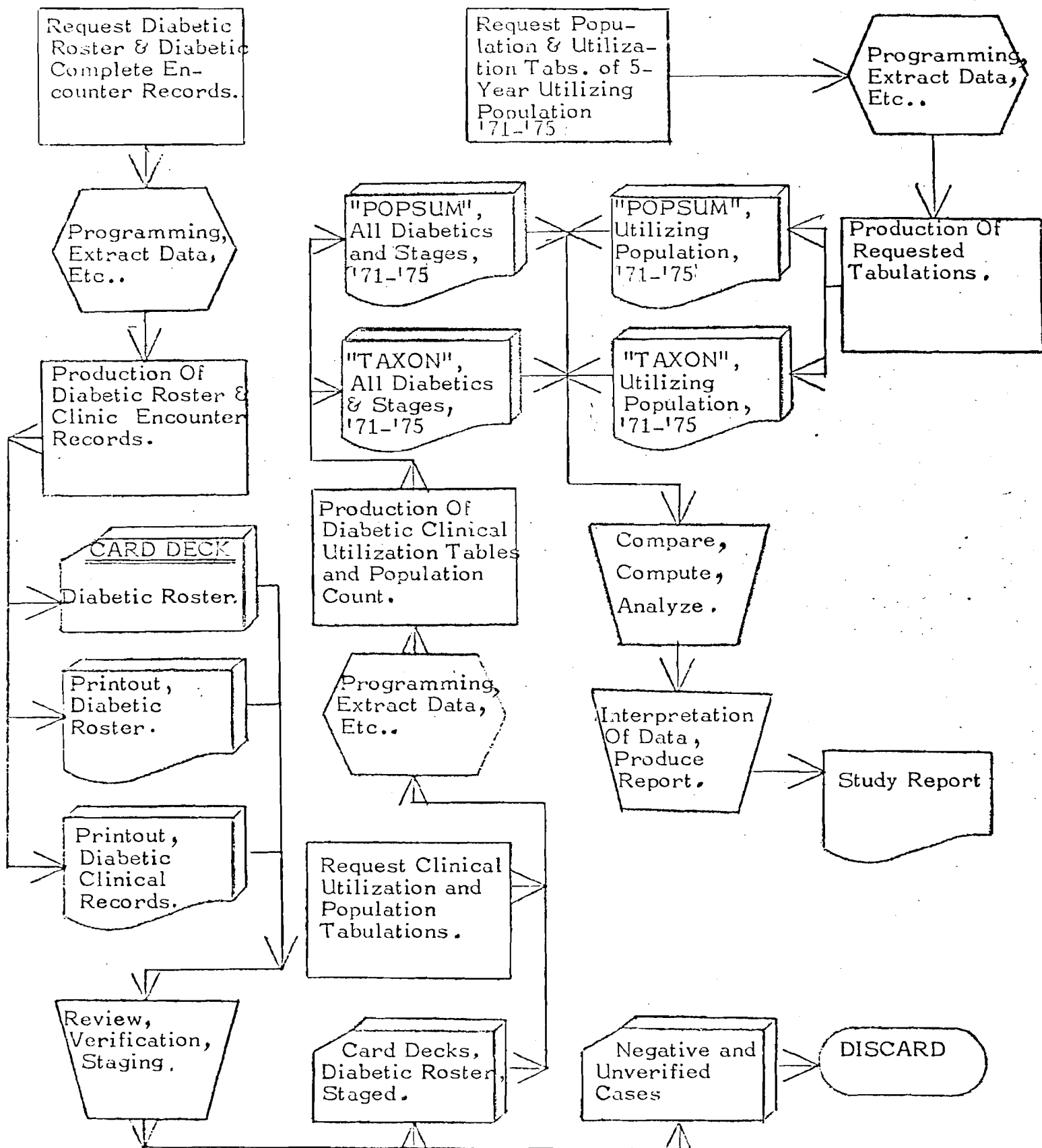
CRITERIA FOR CLASSIFICATION OF DIABETES CASES INTO SEVERITY STAGES\*

- GRADE 1    Elevated blood sugar level. (Preferably this should be quantified by a glucose tolerance test).  
            No other symptomatology.
- GRADE 1a   Patient is pregnant - Other Criteria as in 1 (above).
- GRADE 2    Elevated blood sugar level. (Preferably, according to glucose tolerance test).  
            "Classic" symptoms, such as polydipsia, polyuria, glucosuria, weight loss and itching.
- GRADE 3    Criteria given in Grade 2, plus such symptoms and changes as persistent hypertension, peripheral  
            vascular disease, peripheral neuropathy, retinopathy, arteriosclerotic changes including cerebro-  
            vascular disease, and proteinuria and other signs of developing nephropathy.
- GRADE 4    Symptoms and changes as in Grade 3, plus arteriosclerotic heart disease and/or established renal  
            disease with elevated serum creatinine.

\* Obtained from Dr. Peter Bennet (8)

N.B. Suggested standards for diagnosis and management of diabetes recently promulgated within the Indian Health Service use additional criteria based on prognosis, in addition to co-pathology. These were not used here because they have not been introduced into the programming of our automated health records system.

Fig 1



"POPSUM" = Tabulation of Age-Sex-Geographic Distribution of population.

"TAXON" = Tabulation of Age-Sex-Geographic Distribution of patients and utilization units, by health problem category.

TABLE 2  
DEMOGRAPHIC SUMMARY

	ALL AGES	AGE 20 & OLDER
5-YEAR UTILIZING POPULATION		
TOTAL	11,828	6,215
ON-RESERVATION	8,517	4,560
OFF-RESERVATION	3,311	1,656
DIABETIC POPULATION		
TOTAL	651	645
ON-RESERVATION	571	566
OFF-RESERVATION	80	79
DIABETIC RATE		
TOTAL	5.5%	10.4%
ON-RESERVATION	6.7%	12.4%
OFF-RESERVATION	2.4%	4.8%

FIGURE 2: Age Distribution of Diabetics Compared With 5-Year Utilizing Population

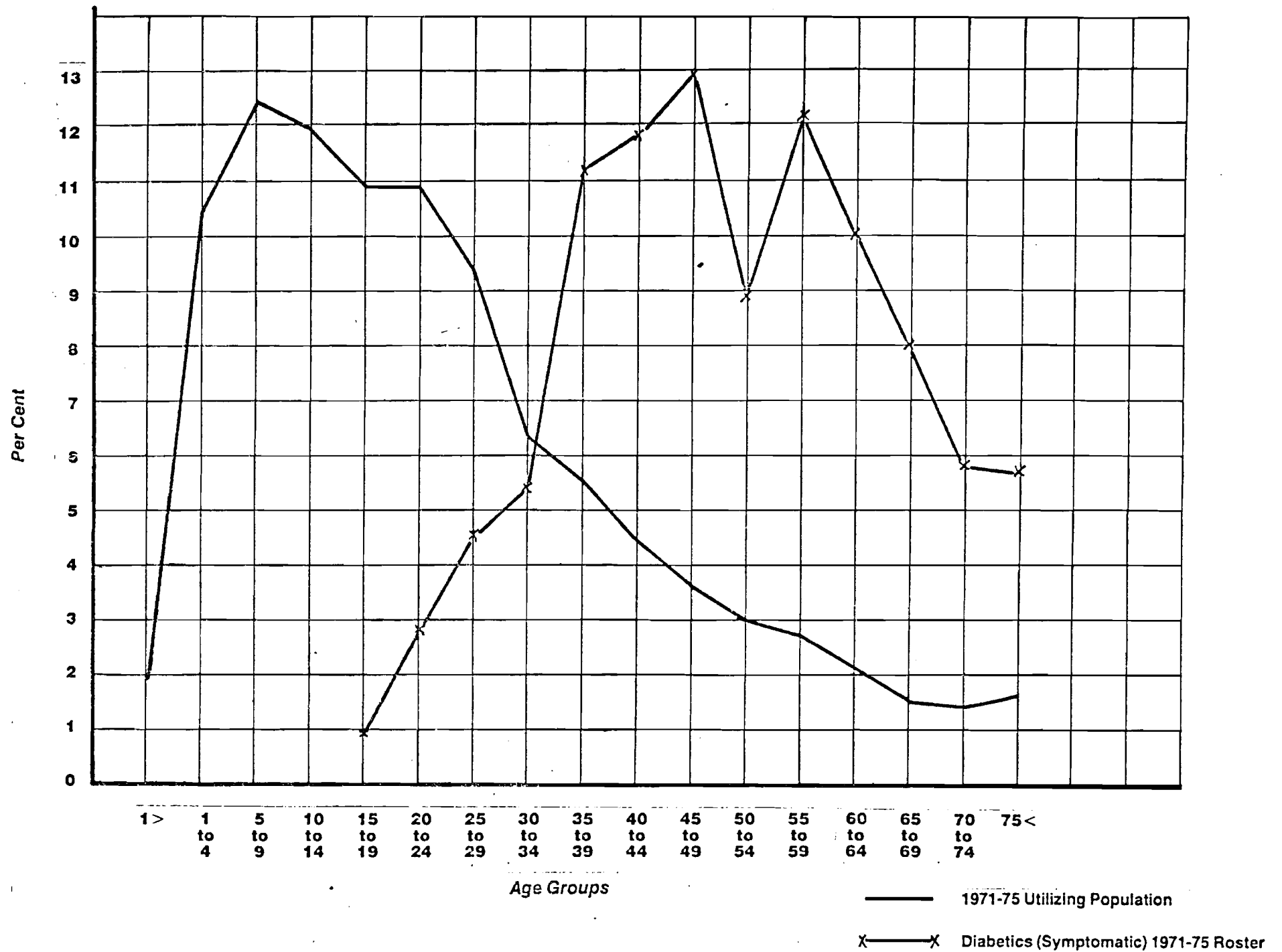


FIGURE 3: Age/Sex Distribution of Diabetics

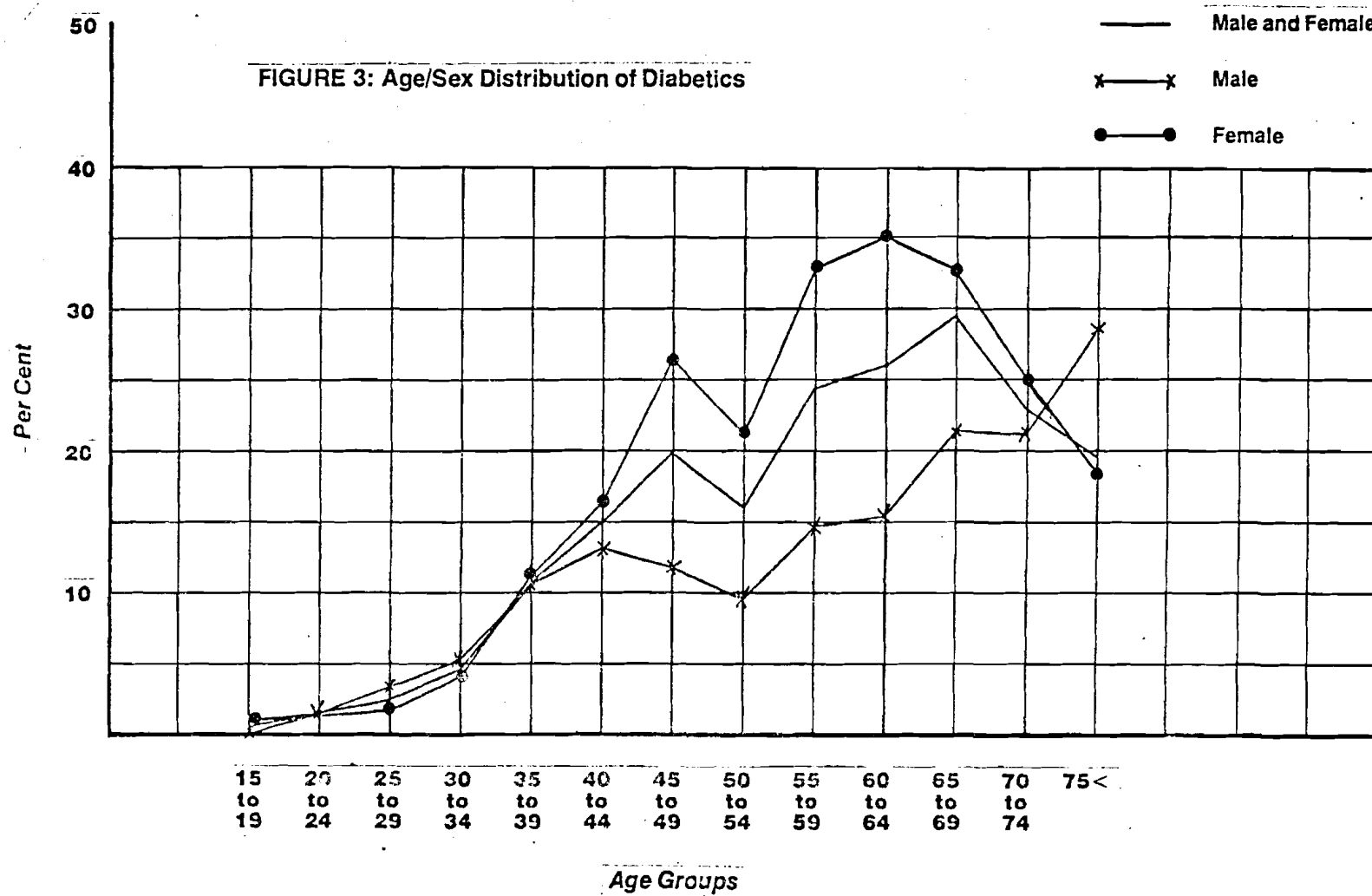


FIGURE 4: Cumulative Distribution of Severity Stages By Age.

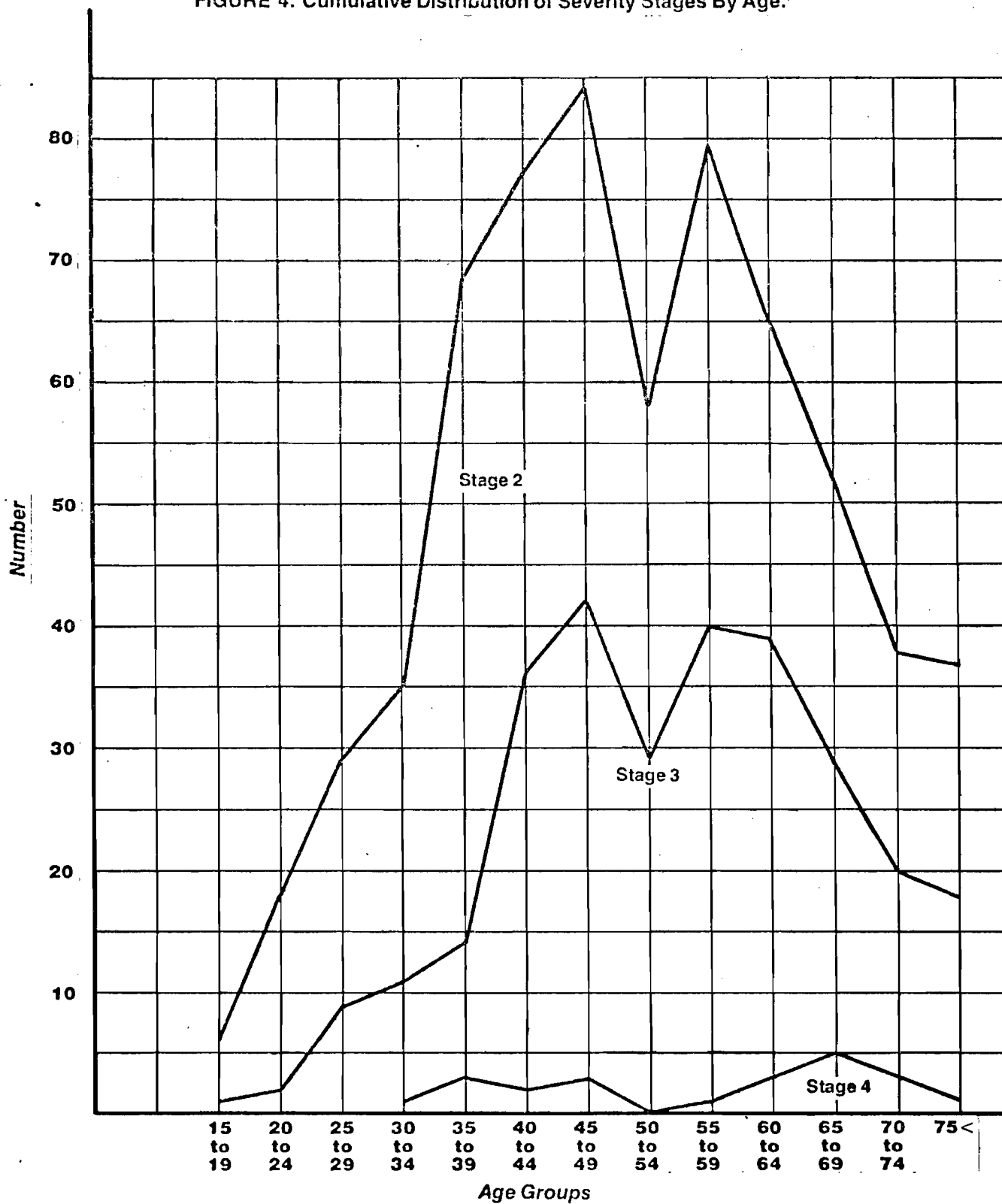


TABLE 3  
COMPARISONS OF DIABETIC AND CONTROL POPULATION CASELOADS AND WORKLOADS

PROBLEM CLASS	OUTPATIENT						HOSPITALIZATION					
	PATIENT			VISITS			PATIENTS			HOSP. DAYS		
	Contr	Diab	Ratio	Contr	Diab	Ratio	Contr	Diab	Ratio	Contr	Diab	Ratio
	*	*	**	*	*	**	*	*	**	*	*	**
1. Enteric-Diarrheal Disease	154	324	2.1	254	602	2.3	13	54	4.2	122	424	3.5
2. Tuberculosis-General	138	400	2.9	454	2578	5.7	25	94	3.8	358	2038	5.7
3. Venereal Disease-General	55	56	1.0	100	98	1.0	4	18	4.5	39	184	4.7
4. Other Bacterial & Parasitic Disease	294	487	1.7	553	1040	1.9	9	37	4.1	90	349	3.9
5. Viral Diseases	149	240	1.6	225	359	1.6	5	14	2.8	29	115	4.0
6. Neoplasms	41	82	2.0	109	325	2.1	6	17	2.8	111	243	2.2
7. Metabolic-Nutritional Blood Disorders	174	1082	6.2	478	18485	38.6	37	459	12.4	531	9628	18.1
8. Mental-Behavioral Disorders	147	198	1.3	471	648	1.4	46	74	1.6	660	1414	2.1
9. Neurological Disorders	75	200	2.7	263	613	2.3	6	33	5.5	155	261	1.7
10. Diseases of the Eye	271	594	2.2	661	1971	3.0	12	43	3.5	125	682	5.4
11. Diseases of the Ear	155	267	1.7	336	662	2.0	5	14	2.8	79	140	1.9
12. Cardiovascular Diseases	233	679	2.9	1370	8381	6.1	46	230	5.0	1033	4977	4.8
13. Respiratory Diseases	476	728	1.5	1745	3623	2.1	38	101	2.7	584	1377	2.4
14. Diseases of the Digestive Tract	382	680	1.8	1390	2953	2.1	42	101	2.4	703	1307	1.9
15. Diseases of the Urinary Tract	155	581	3.7	485	3028	6.2	29	197	6.8	611	3896	6.4
16. Diseases of the Genital Tract	161	299	1.9	438	941	2.1	13	50	3.8	111	602	5.4
17. Maternal-Infant Continuum Dis.	137	79	0.6	1315	439	0.3	87	28	0.3	707	305	0.4
18. Skin Diseases	292	645	2.2	898	3651	4.1	24	109	4.5	255	2108	8.3
19. Musculoskeletal Disorders	242	541	2.2	962	2966	3.1	15	67	4.5	335	1460	4.4
20. Ill-Defined Problems	382	1015	2.7	745	3591	4.8	24	87	3.6	345	1864	5.4
21. Injuries	458	637	1.4	1610	2948	1.6	83	135	1.6	1576	2553	1.6
22. Supplementary Care	597	871	1.5	2273	3988	1.8	43	133	3.1	368	1819	4.9

\* Numbers given are rates per 1,000 population (age 20 and over)

\*\* This is a comparison ratio obtained by dividing the Diabetic Rate by the Control Rate

TABLE 4  
CLASSIFICATION OF LEVELS OF ASSOCIATION OF COROLLARY DISEASES WITH DIABETES

Little or no Association; No Substantial increment of rates over occurrence in controls. <u>(Ratios of 1 to 1.5)</u>	Positive Association; moderate increment of rates over occurrence in controls <u>(Ratios over 1.5 to 2.5)</u>	Positive Association; Large increment of rates over occurrence in control <u>Ratios over 2.5)</u>
<ul style="list-style-type: none"> <li>* Venereal Disease</li> <li>* Mental-Behavioral Disorders</li> <li>* Maternal-Infant Continuum Disorders</li> <li>* Injuries</li> <li>* Supplementary Care</li> </ul>	<ul style="list-style-type: none"> <li>* Enteric-Diarrheal Disease</li> <li>* Other Bacterial Infections</li> <li>* Viral Diseases</li> <li>* Neoplasms</li> <li>* Diseases of Ear</li> <li>* Diseases of Eye</li> <li>* Respiratory Diseases</li> <li>* Diseases of the Genital Tract</li> <li>* Diseases of the Digestive Tract</li> <li>* Skin Diseases</li> <li>* Musculoskeletal Disorders</li> </ul>	<ul style="list-style-type: none"> <li>* Neurological Diseases</li> <li>* Cardiovascular Diseases</li> <li>* Urinary Diseases</li> <li>* Ill-Defined</li> <li>* Tuberculosis (General)</li> </ul>

TABLE 5

## CLASSIFICATION OF LEVEL OF ASSOCIATION OF SPECIFIC DISEASE PROBLEMS WITH DIABETES

No obvious + association or increment over normal. (Comparison Ratio to 1.5)	Positive Association, moderate rate increment, (Comparison Ratio to 2.5)	Positive Association, Large rate increment, (Comparison ratio to 4.5)	Positive Association, Major rate increment, (Comparison ratio > 4.5)
<ul style="list-style-type: none"> <li>* Streptococcal infections</li> <li>* Benign neoplasia</li> <li>* Anemia</li> <li>* Alcoholism &amp; Alcoholic Psychosis</li> <li>* Neuroses</li> <li>* Hepatic Inflammation and Cirrhosis</li> <li>* Disorders of Menstruation</li> <li>* Toxemia of pregnancy</li> <li>* General Medical Exam.</li> <li>* Other Supplementary Care</li> </ul>	<ul style="list-style-type: none"> <li>* Dermal Fungal Infections</li> <li>* Neoplasms, unspecified</li> <li>* Conjunctivitis-Blepharitis</li> <li>* Eye Refraction Errors</li> <li>* Otitis Externa</li> <li>* Otitis Media</li> <li>* Rheumatic Fever</li> <li>* Chronic Rheumatic Heart Disease</li> <li>* Acute Upper Respiratory Disease</li> <li>* Acute Lower Respiratory Disease</li> <li>* Chronic Respiratory Dis.</li> <li>* Biliary Tract Disease</li> <li>* Cystitis</li> <li>* Vaginitis-Vulvitis</li> <li>* Seborrhea-Eczema</li> <li>* Osteomyelitis</li> <li>* Other Musculoskeletal Disease</li> </ul>	<ul style="list-style-type: none"> <li>* Central Neurological Disorders</li> <li>* Essential Benign Hypertension</li> <li>* Phlebitis-Varicosities</li> <li>* Other Cardiovascular Disease</li> <li>* Other Urinary Diseases</li> <li>* Cellulitis</li> <li>* Rheumatoid Arthritis</li> <li>* Other Arthritis and Rheumatism</li> </ul>	<ul style="list-style-type: none"> <li>* Tuberculosis, Active, Respiratory</li> <li>* Neuralgia &amp; Neuritis</li> <li>* Corneal Opacities</li> <li>* Ischemic Heart Disease</li> <li>* Nephritis, Subacute and chronic</li> <li>* Cutaneous Inflammation and lymphadenitis</li> </ul>

TABLE 6  
COMPARISON OF RATES OF OCCURRENCE OF SELECTED DISEASES  
WITHIN SEVERITY STAGES OF DIABETES

	Stage 2	Stage 3	Stage 4
Enteric and Diarrheal Disease (All)	233	375	772
Tuberculosis, Active, Respiratory	88	121	136
Central Neurological Disorders	14	22	136
Neuralgia and Neuritis	57	154	227
Essential Benign Hypertension	236	694	1,364
Ischemic Heart Disease	26	55	545
Phlebitis-Varicose Veins	71	235	318
Other Cardiovascular Disease and Symptoms	114	309	818
Acute Upper Respiratory Disease	561	662	1,272
Hepatic Inflammation and Cirrhosis	14	15	45
Nephritis, Subacute and Chronic	0	29	591
Other Urinary Disease and Symptoms	239	335	1,273
Cellulitis	168	313	409
Other Cutaneous Inflammations and Lymphadenitis	228	551	864
Rheumatoid Arthritis	83	77	91
Other Arthritis and Rheumatism	197	309	636
Supplemental Care (All)	177	915	1,500

Note: Numbers given are rates/1,000 population.

TABLE 7  
OVERALL UTILIZATION COMPARISONS--FIVE YEAR PERIOD

		Population Over 20 yrs.	Total OP Cases	* Cases/ 1,000	Total OP Visits	* Visits/ 1,000
OUTPATIENT	Diabetic	645	5638	8741	28185	43697
(20 Yrs. of Age & Over)	Control	5570	25285	4539	77490	13912
		Population Over 20 yrs.	Total IP Cases	* Cases/ 1,000	Total Hosp. Days	* Hosp. Days/ 1,000
HOSPITALIZATION	Diabetic	645	603	934	8619	13362
(20 Yrs. of Age & Over)	Control	5570	2104	377	22746	4083

OTHER COMPARISONS

	All Ages	Diabetic	% Diabetic
TOTAL POPULATION	11828	645	5.5
TOTAL OP PATIENTS	64868	5638	8.7
TOTAL OP VISITS	194562	28185	14.4
TOTAL IP PATIENTS	4596	603	13.1
TOTAL IP HOSP. DAYS	49226	8619	17.5

NOTES: \* Rates given are per 1,000 population