Results of a Screening Program for Diabetes Mellitus

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Studies of diabetes mellitus in recent years have indicated that the incidence of undiagnosed cases of this disease is nearly as great as the incidence of known cases under treatment. Blotner's[1] study of selectees during World War II disclosed the presence of diabetes in 1.1 per cent of 69,088 young men undergoing physical examination at the Induction Station in Boston, Massachusetts. In another study, the U.S. Public Health Service made a survey of the town of Oxford, Massachusetts,[2] in which 3516 persons were interviewed and tested. It was found that 40 were known diabetics. The screening tests brought to light 30 "new cases" of diabetes and 25 cases of unclassified glycosuria and hyperglycemia. In another survey carried out by the U.S. Public Health Service in Jacksonville, Florida,[3] 736 blood relatives of a group of known diabetics were tested, and 4.1 per cent of these persons were found to have unsuspected diabetes. These and other studies have alerted the medical profession and public health agencies to the magnitude of the challenge which is presented by the estimated "million unknown diabetics" in the United States. This challenge has been met in part by the Diabetes Detection Drives sponsored each year by the American Diabetes Association assisted by State and County Medical Societies and other interested agencies.[4]

The success of these Detection Drives has demonstrated a remarkable public interest in diabetes, and a desire on the part of the public to avail itself of the simple tests which can disclose the presence of the disease. One of the problems facing agencies interested in finding new cases of diabetes has been to get large groups of persons together so that screening tests for diabetes can be done quickly and economically. In this connection the experience of the Diabetes Fair in Boston may prove to be a valuable guide to future detection drives.

Each year since 1950, the New England Diabetes Association has sponsored a Diabetes Fair.[5] As part of this free educational program, all who came were offered tests of the urine and blood for glycosuria and hyperglycemia. The methods used and the results obtained in the mass testing of the 1951 Diabetes Fair are here described in detail.

Each person wishing to be tested was first required to register. A volunteer helper recorded on a numbered card the subject's name, age, sex, home address, and his answers to three questions: Are you a diabetic? Have any relatives had diabetes? Have you ever had sugar in your urine? In answer to the first question, the subject could reply, "Yes," "No," or "Doubtful." The other two questions required a reply in the affirm-

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ative or negative. A urine specimen was then obtained and immediately tested for sugar by trained technicians. Females were tested by the Galatest method and males by the Clinitest method.* The subjects were then invited to proceed to the blood-testing booth, where a staff of technicians drew capillary blood for analysis of the blood sugar by the Wilkerson-Heftmann method,[7] in the Hewson Clinitron.[8] It should be pointed out that this method is simply a screening test which provides a positive or negative result above or below any desired level of blood sugar, and does not give the actual blood sugar content. At the Diabetes Fair the test was set to give a "positive" result above the level of 160 mg. per 100 cc. The Clinitron† is a machine which enables a small staff to process as many as 120 blood samples in one hour. At the Diabetes Fair blood testing was carried out continuously from noon to 8:00 p.m. without regard to time elapsed since the subject's most recent meal.

After the blood was drawn, each person was asked to wait for a report on the test. As soon as this was obtained, the subject was called by number, and was interviewed by a physician who told him the results of both the urine and the blood tests and gave him a cautious interpretation of them. Whenever a positive test was found, either glycosuria or hyperglycemia, the subject was urged to consult his own physician, and the importance of this was particularly stressed when it was thought that the tests and the interview suggested the presence of diabetes.

RESULTS OF TESTS

In the two days of the 1951 Diabetes Fair, a total of 2280 urine samples were tested for the presence of sugar, and 888 blood samples were tested to determine whether the true blood sugar value was above or below 160. The results are shown in Table 1 to 4. The large number of known diabetics tested, and the still larger number of subjects with a history of glycosuria and/or a family history of diabetes could be anticipated from the character of the Fair, which naturally attracted, in particular, persons who had some interest in the disease. As shown in Table 1, there were 323 known diabetics. A considerable number expressed themselves as being "doubtful" as to whether they had diabetes. In the subsequent interview it was found that many of these were actually under treatment for diabetes, and that many others had preferred that answer to a simple "No" because, after all, they had never before been tested. In tabulating the results, as many as possible of these were re-classified, leaving as "doubtfuls" only 139 persons in whom a reasonable doubt appeared to exist. 113 of these had a history of glycosuria. The total number of "nondiabetics" with a history of glycosuria was 275,

TABLE 1 Results of questionnaire

	Males	Females	Totals
Number registered	821	1459	2280
Known diabetics	152	171	323
"Doubtfuls"	65	74	139
History of glycosuria (Known diabetics excluded)	111	164	275
Positive family history	239	515	754

TABLE 2 Results of blood and urine tests (known diabetics excluded)

	Males	Females	Totals
Number tested	669	1288	1959
Negative urine only	484	748	1332
Negative urine, negative blood	112	297	409
Positive urine only	8	20	28
Positive urine, negative blood	33	162	195
Negative urine, positive blood	9	12	21
Positive urine, positive blood	23	49	72

TABLE 3 Analysis of questionnaire and positive tests (known diabetics excluded)

	Number Tested	Positive Urine	Per cent	Positive Blood	Per cent
Negative questionnaire	1113	148	13.4	37	3.3
Positive family history only	543	63	11.2	16	2.9
"Doubtfuls"*	139	48	34.5	29	20.8
History of glycosuria only**	162	35	21.6	11	6.7
Total	1957	294	15.0	93	4.7

*Of the "doubtfuls" 113 had a history of glycosuria, and 59 had a family history of diabetes.
*57 of this group had a family history of diabetes.

TABLE 4 Results of tests in 323 known diabetics

	Urines Tested	Positive Urine Test	Per cent	Bloods Tested	Positive Blood Test	Per cent
Males	152	50	32%	84	32	37%
Females	171	86	50%	111	62	57%
Totals	323	136	42%	195	94	48%

TABLE 5 Analysis of replies to follow-up questionnaire

	Pos. Urine Pos. Blood	Neg. Urine* Pos. Blood	Urine* Pos.	Total
Number of positive tests	72	21	223	316
Number of replies	64	17	174	255
Consulted a physician	54	13	112	179
Physician diagnosed diabetes	31	3	16	50
Physician denied presence of diabetes	9	8	80	97
Physician made no definite statement	11	2	13	26
Physician prescribed diet	44	5	48	97
Physician prescribed insulin	17	1	4	22
Subject had previously diagnosed diabetes	5	—	4	9

*10% of this group had the urine test only; 90% had also a "negative" blood sugar test.

* Reagents for these tests were supplied by the Denver Chemical Mfg. Co. and the Ames Company, Inc., respectively.

† The Clinitron was loaned by the U.S. Public Health Service.

and the number of "nondiabetics" with a family history of diabetes was 649.

Table 2 lists the results of the laboratory tests in the nondiabetics. 72 persons, or 3.6 per cent of the group had both glycosuria and hyperglycemia, and approximately half of these had definite symptoms of diabetes, 21 persons had hyperglcemia without glycosuria, 195 persons had glycosuria without hyperglycemia; but the marked disproportion of females to males in this group strongly suggests that many of the urine tests done on women (The Galatest was the method used) were erroneously called positive.

A further analysis of these figures (Table 3) attempts to correlate the laboratory data with the information given by the subjects. Here it appears that in the group of nondiabetics the incidence of glycosuria was 15 per cent and that of hyperglycemia was 4.7 per cent. That those persons with a history of glycosuria showed an incidence of positive urine and blood tests well above the average is perhaps not surprising. The very high percentage of positive tests among the "doubtfuls" suggests that this group harbored a considerable number of known diabetics who were merely reluctant to admit the fact, or who chose to doubt the accuracy of the previous diagnosis. It is thus impossible to estimate the actual number of "new cases" discovered. Further information obtained through a follow-up study suggests that the number of new cases was close to 100. It is realized, of course, that a lower blood sugar screening level—130 for example—would have disclosed a larger number of hyperglycemics, and that the opportunity to question these subjects in more detail, and to re-test them by more precise methods would have made possible many more accurate diagnoses. [8, 9] This task had to be left to the private physician. The purpose of the screening tests at the Diabetes Fair was primarily an educational one, to show that such tests are available, and can be of great diagnostic significance. The detection of new cases was only a secondary aim.

As shown in Table 4, 323 admitted diabetics were tested. It was interesting to find that 42 per cent of this group had glycosuria and 48 per cent of those who submitted to a blood test had hyperglycemia. This is perhaps not so surprising as the fact that the women diabetics showed a much higher incidence of hyperglycemia than did the men. The interviews with these subjects indicated that the majority were under active treatment. However, it was found that a considerable number had allowed treatment to lapse, and some had not consulted a physician for as long as 10 years.

DISCUSSION

The experience of the New England Diabetes Association in Boston indicates that mass testing of a large group of people attracted by an interest in diabetes can be expected to disclose a considerable number of new cases of the disease. A comparison of the results with those of the other surveys mentioned as references above suggests that a Diabetes Fair may be one of the best ways of finding new cases. The value of a Fair cannot, of course, be measured entirely by the number of newly discovered cases. The stimulation of interest in the disease, the educational features providing accurate information for the uninitiated and a "refresher course" for the diabetic, and the general good will created—all these have to be counted as being of even greater value, and without these features, it is unlikely that such a large group could have been reached.

FOLLOW-UP STUDY

The value of this method of diabetes detection could be checked further by ascertaining what action was taken by those persons whose tests were found to be abnormal. Did they seek medical advice, as they had been advised to do? If so, did the physician confirm the diagnosis of diabetes? And did he prescribe diet and insulin? The New England Diabetes Association undertook a follow-up study designed to settle these points.* Three months after the Diabetes Fair each of the 316 persons with positive tests was sent a questionnaire, and replies were returned by 255 persons in the next 2 months. The results, recorded in Table 5, show 179 persons, or 70 per cent of those replying had consulted a physician. The diagnosis of diabetes was confirmed in 50 cases. There were 97 cases in which the physician said that diabetes was not present. In 26 instances the replies indicated that the doctor had made no definite statement regarding the diagnosis. A diet was prescribed in 97 cases, or more than one-half of those who consulted a physician; 22 persons received treatment with insulin. The replies of 9 persons gave information which showed that the diagnosis of diabetes had been made prior to the Diabetes Fair.

In each of the 50 cases in which the diagnosis was confirmed, the patient was given a diet prescription; in 22 cases insulin was also advised. An additional 47 persons were given diet prescriptions by their physicians. The replies to the questionnaires indicated that many of these were treated for simple obesity; but since most of those whose physicians made no definite

diagnosis were, nevertheless, placed on a diet, it seemed that some physicians found it easier to treat diabetes than to diagnose it. And finally, there was a small group of persons who though they had failed to consult a physician had imposed on themselves diet restrictions which in most instances had resulted in freedom from glycosuria.

Table 5 has listed the subjects in 3 categories according to results of their laboratory tests. Those with both glycosuria and hyperglycemia showed the highest percentages of positive answers: That is, a larger proportion of this group consulted a physician, were diagnosed as diabetics, and were given diets and insulin. Several factors appeared to contribute to this. Many of these persons had come to the Fair because they suspected the presence of diabetes either on account of previous positive tests, or the presence of symptoms. The unequivocal nature of positive tests in both urine and blood, and the emphasis placed on this at the interview undoubtedly served to impress both the patient and the physician he subsequently consulted. In the group of 223 persons with glycosuria only (and most of these also had a blood sugar test reported as under 160) the percentage of positive answers to the questionnaire was smallest. Nevertheless, the family doctor made a diagnosis of diabetes in 16 of the 112 who sought medical care and prescribed a diet to 48 of these.

The questionnaire from which the above replies were tabulated allowed space for the subject to volunteer additional information if he so desired. Perhaps one-third of those who returned the form furnished an account of their subsequent medical experience which throws considerable light on the reaction of doctor and patient to the suspicion of diabetes. It was apparent that among the doctors consulted there was a wide range of skill, knowledge and interest shown in attacking the problem of diagnosis. Some physicians gave glucose tolerance test; others studied the post-prandial or the fasting blood sugar. Several doctors were content merely to test the urine for sugar, and finding it negative, had told the patient that he did not have diabetes. A few instances were reported where the doctor had made no tests at all.

There were 76 persons who answered the questionnaire even though they had not consulted a physician. Many of these furnished excuses for this neglect, particularly lack of money and doubt as to what doctor to consult. Several were still "planning to see a doctor" (five months after the Diabetes Fair); others were "too busy," or "took sick" or "afraid of the needle."

It is evident from these accounts that much remains to be done to render diabetics detection drives more effective. In particular, there is a need of more accurate knowledge of the criteria for the diagnosis of diabetes, and a greater appreciation on the part of the medical profession that early and continuous treatment of "mild" diabetes can prevent or delay many serious complications. Much of the resistance of the patient will disappear as the physician devotes more of his time and energy to the diagnosis and treatment of diabetes.

SUMMARY

The screening tests at the 1951 Diabetes Fair in Boston are described: 2280 persons were tested for glycosuria, and 888 persons were tested for hyperglycemia in the course of 2 days. Excluding 323 admitted diabetics there were 93 cases of hyperglycemia and 223 cases of glycosuria. It is estimated that approximately 100 "new cases" of diabetes were found.

A follow-up study of this group with abnormal screening tests showed that the physicians whom these subjects consulted made a diagnosis of diabetes in 50 cases, prescribed insulin for 22, and a diet for 97 persons.

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