

Blood Glucose Screening and Diabetes Mellitus in Some Borate Regions in Türkiye

B. İlhan,
Turkish Diabetes and Obesity Foundation, Istanbul

H. Ünek
Emet Bor İşletme Müdürlüğü, Emet, Kütahya

B. S. Şayh,
Ankara University Medical Faculty, Ankara (retired)
Balıkesir University Boron Research Center, Balıkesir

ABSTRACT: Because of the impression of high occurrence of diabetes mellitus Type 2 in some communities across borate centers in Türkiye, screening was made in İskele town, and in Yolbaşı village of Bigadiç County of the province Balıkesir, and in Emet County of the province Kütahya. Blood glucose levels were registered with the aid of Glucotrend® plus strips in 1232,241 and 1028, total 2501, individuals from, and known diabetics were % 2.9, 9.9 and 12.4 in respective places, suggesting random genetic drift rather than boron exposure has long been in operation.

ÖZET: Türkiye'deki bazı bor merkezleri çevresi yaşayanları arasında Tip 2 şeker hastalığının sık ve yaygın izlenimi aldığımız Balıkesir Bigadiç ilçesi İskele beldesi, Yolbaşı köyü ve Kütahya Emet ilçesinde kan glukozu taraması yapılmıştır. Tokluk kan şekeri tayini sırasıyla 1232, 241 ve 1028, toplam 2501, kişiden Glucotrend® plus stripleriyle gerçekleştirilmiş, bilinen diabetikler İskele,'de % 2.9, Yolbaşı'nda 9.9, Emet'te 12.4 çıkmıştır. Bulgular bor minerallerine temastan çok rastgele genetik akıntıyla açıklanır nitelikte görülmüştür

1. INTRODUCTION

In the course of study of health effects of boron exposure across borate centers of Türkiye, we had by story the impression of high occurrence of Type 2 diabetes mellitus in some communities thereabouts. In, for instance, Yolbaşı village of İskele town, Bigadiç county of province Balıkesir, many individuals have given a story that at least one family member was suffering from the disease. At the immediate vicinity of this village there were six underground colemanite ore pits active until their closure late 1990's; however, this was the case with other borate centers. Since there was no any previous approach and the prevalence figures were not available for the region, we decided to screen the population and try to reveal the etiology, if any. We here report preliminary findings on blood glucose levels, even though it is not a formal prevalence study.

2. EXPERIMENTAL WORK

Study areas have already been given in detail in previous articles dealing with fertility state of subpopulations exposed to borates continuously environmentally and/or occupationally (Şayh et al., 1998, 2003, Şayh, 1998, 2001, 2003). Here three areas will be considered. İskele, town of Bigadiç county, being a 'borate town' has been described by ourselves as a 'natural human boron laboratory'. It has a population 2045 and is situated on large colemanite and ulexite deposits with a nearby processing facility. Besides, boron contents of street fountains are the highest amongst: it is 8-10 ppm in one fountain and 26-30 in the other, both still in use; though drinking water with a less amount of boron is pumped out to houses recently.

Yolbaşı is a small village of İskele with 392 inhabitants. It is also a 'borate village' with 6 underground colemanite pits at its very proximity -

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all abandoned by the end of 1990's. And as expected, almost all villagers were once a borate worker.

Emet county of province Kütahya is too a belt of colemanite and ulexite »minerals. There is a processing facility plus-*a -recently-built boric acid plant. There live more than 20,000 individuals. Drinking waters contain 2.5-6.9 ppm boron. It served to some extent for comparison. Of these latter 145 men were active borate workers. It has to be added that almost all of these substantially-interrelated participants were natives of boron-rich soils without much movement lifespan.

2.2 Study subjects

From İskele 505 (41 %) males and 727 (59 %) females, 1232 in total, participated. This figure approximately corresponds to whole adult population. From Yolbaşı 145 (60.2 %) males and 96 (39.8 %) females, 241 in total, were included thus covering nearly whole village with the exception of youngsters. From Emet there were 794 (77.2 %) men and 234 (22.8 %) women, 1028 in total. Of these latter 145 men had an active borate job.

2.3 Methods

Probands were informed before testing and they were announced to gather in a municipal building. No infants were asked to bring out; but some parents did not pay care. Testing was started at 10 A.M. Although not questioned individually, they all most probably had some breakfast. In addition they were asked to report if he (she) himself (herself)

and/or anyone else in the family has diabetes mellitus and taken antidiabetics.

Glucotrend® plus strips (Roche Diagnostics GmbH) were used to register 'glucose in fresh capillary blood. The concentration was read over Glucotrend® monitor within 30 seconds. Results were then-analyzed in different ways. No standard laboratory examination was attempted at all in field but the testers were informed for the outcome. Statistical evaluation was carried out by means of *X* test.

2.4 Controls

While three subgroups under consideration served controls each other, findings involving some 120,000 individuals tested by the Turkish Diabetes and Obesity Association throughout the country were used for comparison.

3. RESULTS

Table 1 gives findings from all three centers. Of İskele participants 1079 (87.6 %) persons, 449 male and 630 females, had normal glucose levels. Of the remaining, 93 (7.5 %), 40 males and 53 females, were registered with values at upper limits, hence 'critical', whereas 36 (2.9 %) subjects, 7 men and 29 women, were known diabetics. On the other hand, 24 (1.9 %), 9 men and 15 women were considered recent cases of diabetes because of high glucose levels. As it can be seen females were in excess among known patients as well as recent cases - statistically significant (Table 1).

Table 1. Blood glucose test results*.

Community	Blood glucose registers															
	Normal				Critical				Known case				Recent case			
	Male		Female		Male		Female		Male		Female		Male	Female		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
iskele	449	88.9	630	88.6	40	7.9	53	7.3	7	1.4	29	3.9	9	1.7	15	2.1
Yolbaşı	111	76.6	80	83.3	17	11.7	4	4.1	13	8.9	11	11.4	4	2.7	1	1.0
Emet	661	83.2	172	73.5	41	5.2	10	4.3	76	9.6	52	22.2	16	2.0	-	-
Totals	1221		882		98		67		96		92		29		16	

* Percentage refers to gender distribution.

in Yolbaşı 111 males and 80 females, 191 in total, were showed normal glucose values (79.2 %). Results were interpreted at upper limits for 17 men and 4 women, 21 in total (8.7 %). While 13 men and 11 women, 24 in total, were known diabetics (9.9 %) 4 men and 1 woman, 5 in total (2.1 %) presented high levels of glucose registry so as to be regarded recent patients. Sex difference also persisted.

Findings of Emet subgroup were as follows: 661 male and 172 female subjects, totalling 833 (81 %), were found with normal glucose levels; 41 male and 10 female participants, totalling 51 (4.9 %) with upper registers. On the other hand, 76 men and 52 women, 128 in total (12.4 %), were known diabetic

patients whereas the remaining 16 (1.5 %) were considered recent examples of the disease. Among 1028 participants a high incidence of diabetic women appeared an ascertainment bias.

Findings were summarized in Table 2 for the sake of simplicity, both sexes combined, old patients stood at 2.9 % in iskele, 9.9 % in Yolbaşı and 12.4 % in Emet, the total being 7.5 % among 2501 treated. While the first of these would reflect the 'usual' prevalence rate in the general population, two others are apparently higher than this. It then appears clear that one should test more people from Emet-Hisarçik belt to reach a decision.

Table 2. Blood glucose screening results (both sexes combined).

Community	Test register									
	Normal		Critical		Known case		Recent case		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%
iskele	1079	87.6	93	7.5	36	2.9	24	1.9	1232	49.2
Yolbaşı	191	79.2	21	7.9	24	9.9	5	2.9	241	9.6
Emet	833	81.0	51	4.9	128	12.4	16	1.5	1028	41.1
Totals	2103	76.6	165	6.0	188	7.5	45	1.6	2501	100.0

Other parameters are the following. Table 3 shows age range of respective subpopulations. Even though limits were too wide, changing from the first year of life to 90, the number from both extremities did not exceed 10 % so as to alter the outcome significantly. People having normal glucose values were composed of a relatively young group of subjects, differing between 31.5 and 38.4 years of age so far as the first two areas were concerned.. It

was from 48.5 to 55.6 years in those revealing upper levels of register, and 55.1 to 56.0 years for known -old- diabetics as was the case with recent discoveries. Known diabetics from Yolbaşı constituted so far the oldest subgroup. Observing teen-aged persons with abnormal registers suggested the operation of genetic determinants rather than exposure to borates in pathogenesis of diabetes mellitus.

Table 3. Age range of testers from three subgroups (in years).

Community	Blood glucose registers							
	Normal		Critical		Known case		Recent case	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Iskele	31.5	1-90	48.5	4-90	55.1	33-76	51.2	28-80
Yolbaşı	38.4	1-80	55.6	17-77	56	19-86	48.6	19-86
Emet	-	2-84	-	10-74	-	29-83	-	38-60

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Known diabetics were further subdivided with respect to the familial occurrence of condition. Two-hundred-eight out of 1473 interviewers with reliable information stated there was at least one family member suffering from diabetes, making an overall frequency 14.1% in İskele and Yolbaşı communities. This was 9.4 % for subjects with normal values of glucose, 1.5 % for subjects with critical values, 2.2 % for known patients, and 0.3% for recent ones. In Yolbaşı village, depending on stories given by probands, there were 6 kindreds with three diabetics, 2 kindreds with four diabetics, and another 2 with seven diabetics in addition to male proband himself having diabetes, and only one kindred in which 3 members were suffering from the disease in addition to proposita with the condition - typical familial aggregation. However no information was available for further discussion.

In the first days of this work we were not able to predict some of the issues of relevance, thus leaving several questions unanswered. However, the data presented here confirm a high incidence of diabetes mellitus, implying presence of a familial factor running perhaps over generations in a community with no much movement but with a consanguinity rate around 25 % rather than continuous exposure to an environmental agent, borates in this case, in the pathogenesis of the disease. It seemed to be random genetic drift, established for centuries and so in operation.

4. DISCUSSION

According to test results performed with more than 120,000 individuals by The Turkish Diabetes and Obesity Foundation throughout the Country for years the prevalence of diabetes mellitus Type 2 is 7.2 percent and the incidence 2.5 percent. Authorities believe these figures are 'genuine' and further consider 6.1 percent of people suffer from 'impaired glucose tolerance'. Meanwhile they state these figures are 'high enough' (Anonyme, 1995; Bağnaçık et al., 2003). So far no data of that size are available for the general population. On the other hand prevalence figures related to other countries differ considerably between around 1 % in Japan and 34 % among Nauru Micronesians (Powers, 2001). Yet most authors maintain the

approximately 2 percent for white populations (Crawford and Cotran 1999).

The purpose of this work was not to perform a formal prevalence study across the country but to reveal some facts regarding observations of our own in boron areas. This work was accomplished with technical assistance of experienced people of the Foundation and with the same method.

The treatment covers at least 80 of inhabitants from İskele town and Yolbaşı village, if not over 90 percent. In the first area the rate rises to 7.3 %, if one adds one third of borderline and 'recent' cases. It is elevated to 14.9 % in Yolbaşı and 15.8 in Emet if the same reasoning applies to both (Bağnaçık et al., 2003). Findings related to last two areas are statistically significant. It can however be argued that participants with known diabetes are in excess just because 'to be tested their blood glucose level as doctors come!'. Therefore Emet County should be retested.

One of the important observations is the observation of young people aged 4, 10 and 17 among testers. They were found with a borderline register and as recent cases as well. Even though the number is small indeed, one should suspect they were under a continuous stress that most probably genetic in nature. In the pathogenesis of Type 2 diabetes mellitus the weight of hereditary factors would not be less heavy than environmental ones, but here the presence and so operation of boron exposure seems unlikely; since data do not support this latter. AH three are boron towns and there live borate families so that, excepting Yolbaşı village, no diabetics among borate workers are concentrated. Instead the facts that we are dealing with a subpopulation in a relatively small community without much movement and with a high frequency of consanguineous marriages make it most plausible that random genetic drift is the main variable, one or more 'essential' gene determinants being mutated and introduced into the community - leading to a high prevalence of diabetes mellitus.

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