**Prevalence of Diabetes Mellitus in Selected Turkish Prisons and Exploration of Related Factors**

## Introduction

United Nations General Assembly, in 1957, adopted and approved universal declaration of human rights and standard minimum rules for the treatment of prisoners. It has been known that prisoners worldwide and in Europe have worse physical and mental health when compared to the general population. In this regard, both acute and chronic diseases show more severe courses; the rates of disability, smoking, alcohol and substance addiction, sexual disorders, self- destructive behavior, and committing suicide are higher; familial and social separations are more frequent, and average life expectancy is shorter in the prisoners .

Prisoners may be at increased risk of poor medical outcomes compared with the general population due to circumstances before and during incarceration. Inmates often come from disadvantaged backgrounds and have low levels of education; report high levels of smoking, drinking and illicit drug use prior to incarceration; have poor nutrition and limited physical activity in jail or prison; report mental health and neurological disorders such as schizophrenia, depression, and epilepsy that may complicate efforts to prevent or treat chronic health conditions; are exposed to infectious disease through risky drug injection or sex practices; have high levels of stress, anxiety, sleep deprivation, and depression, and have lower levels of self-efficacy as a result of the stigma and loss of social ties associated with being incarcerated .

Studies have documented worse health and increased risks of death, suggesting the prevalence of underlying chronic disease may be higher among inmates than the general population . As an important and widespread disease, diabetes mellitus (DM) is still one of the main reasons

of morbidity and mortality all over world. Beyond general population, the prevalence of DM and its related comorbidities and complications, will continue to increase both in young and aging prisoners . Recent studies on the prevalence of selected conditions in prisoners suggest higher prevalence of DM than the general population , but estimates do not adjust for possible confounders, including sex, race/ethnicity, education and other factors known to affect the prevalence of DM .

To the best of our knowledge, there is no study on the prevalence of DM in Turkish prisons, and very limited literature comes from other settings. In a study from the United States, it was found that prisoners had no increased odd for DM . This study aims to determine the prevalence of DM in the selected Turkish prisons. We additionally aim to explore sociodemographic characteristics of the prisoners diagnosed with DM, to discover undiagnosed DM patients and to determine comorbid diseases.

## Methods

### *Study Population*

In this cross-sectional study, 722 volunteer prisoners from a total of 4000 prisoners, who stayed in 4 of 8 prisons (L1 Closed, L2 Closed, Women, and Open Prisons) in Ankara Sincan Prison Campus between March and June 2013, were enrolled. Ethical approval for this study was obtained from Ankara Numune Training and Research Hospital (ANH; October 14, 2012, decree no: 2012-467) and official approval was obtained from the Department of Scientific Investigations within Turkish Ministry of Justice, General Directorate for Punishment and Custody Houses. ANH funded the study with 2000 test strips and 4 glucometers.

Self-reported height and weight were used to calculate body mass index (BMI) as weight in kilograms over height in meters, squared. BMI was categorized according to the World Health Organization standards; as underweight (BMI<18.5), normal weight (18.5< BMI<25.0),

overweight (25.0<BMI<30), and obese (BMI>30.0). The education status was coded as Illiterate, Primary school, Secondary school, High school and University graduate. Smoking use was categorized as: yes and no. Hypertension, family history for DM, Polydipsia, Polyuria, Weight loss, Xerostomia, Weight gain and Measurement of FBG in the previous year were self-reported and coded as Yes/No. Prisoners grouped into four quartiles according to age: Q1 (17 to 26), Q2 (27 to 32), Q3 (33 to 40) and Q4 (41 to 78). Duration in the prison was found in the prison record system (PRS). Study subjects were further grouped into five "duration in prison" categories: 1 to 6 months, 7 to 12 months, 13 to 24 months, 25 to 36 months and 37 and over months.

The prisoners who were diagnosed with DM previously and on treatment for DM were regarded as diabetics, and were not included in screening. All prisoners were informed about the diabetes screening, and the ones who accepted to participate in the study read the informed consent form, and provided their written informed consents. In addition, all participants filled a structured questionnaire regarding the sociodemographic data and DM symptoms of the participants. Our study was based on voluntariness in terms of attendance, thus attendance rate to our study was determined as 18.05 % and was completed with a total of 722 prisoners.

The fasting blood glucose (FBG) levels of the prisoners were determined in the morning, after an 8-hour fasting period. Since it was difficult to obtain venous blood samples from such a large population in the setting of a prison, FBG levels were determined from the fingertip blood samples of the subjects, using GlucoDr plus glucometer . The prisoners with a FBG ≥ 126 mg/dl were regarded as DM. The FBG levels could not be measured twice since it could have caused administrative problems due to security concerns. The prisoners with an "impaired glucose tolerance" as determined by a FBG level 100–125 mg/dl had an oral glucose tolerance test (OGTT) with 75 g glucose and their blood glucose levels were

measured on minute 120, as proposed by World Health Organization. The subjects were regarded as diabetics if this value was ≥ 200 mg/dl. Newly diagnosed DM patients and the ones with an impaired glucose tolerance on OGTT were referred to the hospital located in the Prison Campus for further examinations.

***Statistical analysis***

Among 4000 prisoners, 722 prisoners staying in 4 prisons of Ankara Sincan Prison Campus were included in the study. Before study, it was estimated that 98% confidence interval could be reached if 500 of 5000 prisoners could be included in the study; therefore we could reach a confidence interval of 98% in this study.

IBM SPSS Statistics 21.0 (IBM SPSS Statistics for Windows Version 21.0) was used for statistical analysis. Based on sample size, we had a power of 0.91 to detect 3.5% prevalence in DM with 95% confidence intervals and a two-sided 5% type 1 error rate. The normality of distribution of the variables [age, height, weight, BMI, and FBG] was analyzed with Shapiro-Wilks test. Numerical parameters showing a normal distribution were presented as mean±standard deviation, ones that did not show a normal distribution were presented as median [interquartile range (IQR)]. Categorical variables (diagnosis of DM, education level, presence of hypertension, etc.) were presented as number and percent (%). For the comparison between two groups' student T test or Mann Whitney U test; and for the comparison between more than two groups ANOVA test or Kruskall Wallis H test were used where appropriate. Categorical variables were compared using chi-square and Fisher's exact chi-square test. Correlation between the numerical parameters was done by Pearson and Spearman correlation analysis. The stepwise logistic regression model was performed to identify predictors affecting parameters of DM. The regression model included family history for DM, gender, smoking, education, age (Quartille), BMI (categorize), duration in prison,

FBG, Polydipsia, Polyuria, Weight loss, Xerostomia, Weight gain, Hypertension, Measurement of FBG in the previous year as parameters. Statistical significance was set at $p < 0.05$.

**Results**

Baseline demographic and clinical characteristics in prisoners with all populations, with DM and without DM are shown in Table 1. Mean age of prisoners was 35.2±11.3 years (min: 17 years, max: 78 years). Mean BMI was 25.4±3.9 kg/m$^2$ (min: 16.2 kg/m$^2$, max: 48.8 kg/m$^2$). Mean FBG level of whole study population was 101±28 mg/dL (min: 67.0 mg/dL, max: 376.0 mg/dL).

Sixty % (n: 22) of prisoners with known DM were over 42 years old and 88.6 % (n: 31) were male. The mean age of the prisoners with DM was significantly higher when compared to the non-diabetics (35.8±11.1 vs 46.6±12.0; p <0.001). Mean BMI was 25.4±3.9 in all population. BMI was significantly higher in patients with DM when compared to non-diabetics (25.3±3.8 vs 28.2±4.4; p<0.001).The overweight or obese ratio of the prisoners with DM was significantly higher when compared to the non-diabetics (46.1% vs 74.2%; p <0.001).Median duration in prison was 12.0 months (1.0 – 300.0) and the median of the prisoners with DM was significantly higher when compared to the non-diabetics (12 vs 6; p: 0.018).

Fasting blood glucose was significantly higher in diabetic patients compared to non-diabetics (96±14 vs 185±66; p <0.001). Fasting blood glucose level was < 100 mg/dL in 470 (65.1%) prisoners, 100 – 125 mg/dL in 203 (28.1%) prisoners and > 126 mg/dL in 49 (6.8%) prisoners. According to FBG, diagnosis of DM was made in 4 prisoners (%0.6). Despite the presence of 252 (FBG ≥100 mg/dL) prisoners with impaired FBG, we could perform OGTT with 75 gr glucose only in 12 prisoners. Three of them were diagnosed with impaired glucose

tolerance, and one was diagnosed with overt diabetes. HbA1C average was also higher in diabetic patients (5.5±0.7 (37±5.3 mmol/mol) vs 12.0±1.4 (108±13 mmol/mol); p:0.028).

Ratio of prisoners, who are diagnosed with diabetics, with excessive desire to drink water was detected higher than non-diabetics (36% vs 68.6%; p<0.001). Proportion of prisoners with frequent urination was higher among diabetics than non-diabetics (44.8% vs 68.6%; p: 0.008).

Hypertension was higher in diabetic prisoners compared to non-diabetic ones (9.8% vs 25.7%; p: 0.007). Other symptoms have not demonstrated significant difference in diabetic or non-diabetic group.

Baseline demographic and clinical characteristics according to the duration in prison are shown in Table 2. Prisoners with duration of 37 months or more in prison showed lower smoking rates compared to other durations of detention (p <0.001). Excessive water consumption was higher in the group of prisoners with duration of 37 months or more in prison than the other groups (p <0.001). A significant difference has not been detected in other symptoms. FBG average has not demonstrated a significant difference according to the duration of detention (p: 0.346). According to analyzed OGTT findings, 2 prisoners with duration of 1-6 months and 1 prisoner with duration of 37 months and more showed higher OGTT findings than other groups, however, due to insufficient number of prisoners who have been tested OGTT, OGTT findings could not been compared according to duration of prisonment. There were 5 prisoners in the group of less than 1 year prisonment and OGTT average was 135.0±51.5, there were 7 prisoners in more than 1 year group and OGTT average was 115.1±27.2. According to less or more than 1 year of prisonment, median OGTT have not showed a significant difference (p: 0.403). Diabetic patients among prisoners was higher in the group of 1-6 months of prisonment group compare to other duration groups (p: 0.044). Two of the prisoners (0.8 %) in 1-6 months group have just been diagnosed DM.

Presence of diabetes and a positive family history did not show any significant correlation (3.4% (n: 13) vs 6.5% (n: 22); p: 0.073). However, there was a significant correlation between diabetes and hypertension (p: 0.023). DM was present in 10.5% (n: 8) of the hypertensive prisoners, and in 4.2% (n: 27) of the normotensive ones. Presence of diabetes was significantly different in relation with polyuria and polydipsia (8.9% (n: 11) vs 8.9% (n: 24); p <0.001, 3.1% (n: 12) vs 6.9% (n: 23); p: 0.023; respectively). Even though diabetes ratios have not demonstrated significant difference in other symptoms, distribution is as following; prisoners with weight loss and without (5.1% (n: 29) vs 4.0% (n: 6); p: 0.675), prisoners with cotton mouth and without (3.3% (n: 12) vs 6.4% (n: 23); p: 0.058), prisoners with weight gain and without (4.8% (n: 29) vs 5.2% (n: 6); p: 0.815).

Diabetes was present in 14.7% (n: 14) of the cases that had FBG measurement in the previous year, and in 3.3% (n: 21) who did not have FBG measurement in the previous year (p <0.001).

**Discussion**

In this study, we analyzed the prevalence of DM in selected Turkish prisons and explored socio-demographic and clinical status of the prisoners therein. We found the prevalence of DM as 3.8%. Previously diagnosed patients constituted 3.4% while newly diagnosed patients constituted 0.4%. Therefore, in one of the biggest prisons of Turkey inhabiting 4000 prisoners, we included 722 prisoners into our study, and found similar rates with the aforementioned studies. Although our sample size was not sufficient to generalize our results to all prisoners in Turkey, the prevalence determined in our study sheds light to the general condition. In order to find out the actual prevalence, a study must be performed all over Turkey with a sufficient sample size, and better yet, the health records of all prisoners must be analyzed. Based on the prevalence found in our study, it may be estimated that there must be

4990 (3.8%) diabetic patients including 525 (0.4%) newly diagnosed ones among 131,317 prisoners in all Turkish prisons. Smoking rate was found as 77.28% in males and 52.58% in females in our study, and both rates were far above the mean smoking rates in the country (50% in males, and 18% in females >15 years of age) . There was no difference between the mean age of prison population (33 years) and Turkish population at the age of 33 years according to TURDEP-1 results .

Hornung and Gadre in the United States and Remartínez and Fernández in Spain found prevalences of DM as 4.8% and 5.3% based on the data obtained in 1998 and 2014 respectively . D'Souza et al. found the same prevalence as 3.5% in 1996, and as 3.2% in 2002, without any significant difference in between . In our study, the most important handicap for determining DM prevalence in prisons is the tendency of the prisoners to hide their disease. By this way, they expect to be referred to bigger hospitals where they suppose to find better living conditions. They do not use their medications, consume sugars excessively, and impair their health for this purpose. This attitude in prisoners was reported first by MacFarlene in United Kingdom and Wales . After their report, this attitude was reported by a number of studies, and included in the reports concerning diabetes management in prisons . We also noticed similar problems in our study. We realized that, among 8 patients with newly diagnosed DM, 4 were diagnosed with DM previously, and hided their disease from the Prison Management and Medical Team. One of those patients ate excessive sugar hoping to fall into a diabetic coma. In addition, one of the newly diagnosed diabetics refused both further investigations and treatment.

Undoubtedly, the security measures taken by the Prison Management may cause discomfort for prisoners. The methods found to solve this problem may be different among the countries; however their basic characteristics are the same. The main method is regular follow up of the prisoners by a well-educated health care team, and education of the prison personnel. There

are diabetes teams in the United Kingdom, and an integrated health care system is used in Texas founded by the collaboration of university and Ministry of Justice . Taking those into consideration, there is a need for educating both diabetic prisoners and the prison personnel for DM, and for well-educated health teams to follow up diabetic prisoners. An individual building inhabiting a health center may be built for the diabetic prisoners to lessen security issues in prison campuses while a separate ward may be used in small prisons close to the infirmary. In Turkey, prisoners have been included into the practice of the family practitioners, and the wage paid for a prisoner was identified as three-fold for the wage paid for a civil adult . However, follow up of the prisoners cannot be done properly both due to difficulties of in-service training of the family practitioners, and due to excess number of people registered to each family physician. A well-trained diabetes nurse working in prison in conjunction with family physicians and hospital may be a good alternative for a better follow up. Before all of those, a “Diabetes Follow up Guide for Prisons” must be prepared and issued as a circular by the Ministry of Justice.

Diabetes mellitus is an important health care problem not only in general population but also in prisoners. Although this study presented the prevalence of DM, and socio-demographic and clinical status of prisoners, difficulty of study population originated from social problems could restrict the findings of this study. This special population should be followed more closely in terms of chronic diseases such as DM.

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**Table 1. Baseline demographic and clinical characteristics according to the duration in prison**

| Variables | All population (n:722) | Diabetes Mellitus | | p |
|---|---|---|---|---|
| | | No (n:687) | Yes (n:35) | |
| Age (years) | 35.2±11.3 | 35.8±11.1 | 46.6±12.0 | <0.001* |
| 21-36 | 179(24.8) | 178(25.9) | 1(2.9) | |
| 27-33 | 198(27.4) | 190(27.7) | 7(22.9) | <0.001* |
| 34-41 | 166(23) | 161(23.4) | 5(14.3) | |
| 42+ | 179(24.8) | 158(23.0) | 22(60.0) | |
| Sex | | | | |
| Male | 625(86.6) | 594(86.5) | 31(88.6) | 0.721 |
| Female | 97(13.4) | 93(13.5) | 4(11.4) | |
| Education | | | | |
| Illiterate | 20(2.8) | 16(2.3) | 4(11.4) | |
| Primary school | 241(33.4) | 224(32.6) | 17(48.6) | |
| Secondary school | 197(27.3) | 194(28.2) | 3(8.6) | 0.002* |
| High school | 177(24.5) | 170(24.7) | 7(20) | |
| University | 87(12) | 83(12.1) | 4(11.4) | |
| Smoking | 534(74) | 513(74.7) | 21(60) | 0.083 |
| Family history for DM | 385(53.3) | 373(54.3) | 12(34.3) | 0.024* |
| BMI (kg/m2) | 25.4±3.9 | 25.3±3.8 | 28.2±4.4 | <0.001* |
| Underweight | 10(1.4) | 10(1.5) | 0(0) | |
| Normal weight | 369(51.1) | 360(52.4) | 9(25.7) | <0.001* |
| Overweight | 262(36.3) | 249(36.2) | 13(37.1) | |
| Obese | 81(11.2) | 68(9.9) | 13(37.1) | |
| Duration in prison (months) | 12.0 (1-300) | 12(1-300) | 6(1-132) | 0.018* |
| 1-6 | 240(33.2) | 223(32.5) | 17(48.6) | |
| 7-12 | 173(24) | 164(23.9) | 9(25.7) | |
| 13-24 | 129(17.9) | 126(18.3) | 3(8.6) | 0.044* |
| 25-36 | 66(9.1) | 64(9.3) | 2(5.7) | |
| 37+ | 114(15.8) | 110(16) | 4(11.4) | |
| Polydipsia | 271(37.5) | 247(36) | 24(68.6) | <0.001* |
| Polyuria | 332(46) | 308(44.8) | 24(68.6) | 0.008* |
| Weight loss | 150(20.8) | 145(21.1) | 5(14.3) | 0.399 |
| Xerostomia | 359(49.7) | 336(48.9) | 23(65.7) | 0.058 |
| Weight gain | 116(16.1) | 110(16) | 6(17.1) | 0.815 |
| Hypertension | 76(10.5) | 67(9.8) | 9(25.7) | 0.007* |
| Measurement of FBG in the previous year | 95(13.2) | 81(11.8) | 14(40) | <0.001* |
| FBG (mg/dL) | 101±28 | 96±14 | 185±66 | <0.001* |
| <100 | 470(65.1) | 469(68.3) | 1(2.99 | |
| 100-125 | 203(28.1) | 199(29.0) | 4(11.4) | <0.001* |
| >125 | 49(6.8) | 19(2.8) | 30(85.7) | |
| OGTT 2nd hour | n:12<br>123.8±38.0 | n:8<br>115.4±24.1 | n:4<br>221.2±38.4 | <0.001* |
| PBG | 133.1±10.2 | 133.1±10.2 | - | - |
| HBA1C(% and mmol/mol) | 8.8±3.8 (73±18) | 5.5±0.7(37±5.3) | 12.0±1.4(108±13) | 0.028* |
| Diabetes mellitus | | | | |
| Old diagnosis | 31(4.3) | 0(0) | 31(88.6) | - |
| New diagnosis | 4(0.6) | 0(0) | 4(11.4) | |

*p<0.05 statistical significance was accepted.

**Table 2. Baseline demographic and clinical characteristics according to the duration in prison**

| Variables | Duration in prison (month) | | | | | p |
|---|---|---|---|---|---|---|
| | 1-6 (n:240) | 7-12 (n:173) | 13-24 (n:129) | 25-36 (n:66) | 37+ (n:1149 | |
| Age (years) | 34±11 | 36±11 | 34±12 | 36±11 | 37±12 | 0.152 |
| 21-36 | 71(29.6) | 38(22) | 36(27.9) | 15(22.7) | 19(16.7) | |
| 27-33 | 60(25) | 54(31.2) | 36(27.9) | 17(25.8) | 31(27.2) | 0.154 |
| 34-41 | 51(21.3) | 37(21.4) | 25(19.4) | 14(21.2) | 39(34.2) | |
| 42+ | 58(24.2) | 44(25.4) | 32(24.8) | 20(30.3) | 25(21.9) | |
| Sex | | | | | | |
| Male | 219(91.3) | 153(88.4) | 113(87.6) | 55(83.3) | 85(74.6) | 0.001* |
| Female | 21(8.8) | 20(11.6) | 16(12.4) | 11(16.7) | 29(25.4) | |
| Education | | | | | | |
| Illiterate | 8(3.3) | 4(2.3) | 4(3.1) | 0(0) | 4(3.5) | |
| Primary school | 90(37.5) | 55(31.8) | 52(40.3) | 20(30.3) | 24(21.1) | |
| Secondary school | 74(30.8) | 47(27.2) | 34(26.4) | 16(24.2) | 26(22.8) | <0.001* |
| High school | 52(21.7) | 40(23.1) | 31(24) | 19(28.8) | 35(30.7) | |
| University | 16(6.7) | 27(15.6) | 8(6.2) | 11(16.7) | 25(21.9) | |
| Smoking | 177(73.8) | 130(75.1) | 107(82.9) | 53(80.3) | 67(58.8) | <0.001* |
| Family history for DM | 123(51.3) | 95(54.9) | 68(52.7) | 35(53) | 64(56.1) | 0.914 |
| BMI (kg/m2) | 25.4±4.3 | 25.6±3.7 | 24.7±3.5 | 26.1±4.1 | 25.6±3.5 | 0.172 |
| Underweight | 5(2.1) | 3(1.7) | - | - | 2(1.8) | |
| Normal weight | 127(52.9) | 78(45.1) | 83(64.3) | 31(47) | 50(43.9) | 0.442 |
| Overweight | 77(32.1) | 74(42.8) | 36(27.9) | 26(39.4) | 49(43) | |
| Obese | 31(12.9) | 18(10.4) | 10(7.8) | 9(13.6) | 13(11.4) | |
| Polydipsia | 89(37.1) | 68(39.3) | 44(34.1) | 16(24.2) | 54(47.4) | 0.032* |
| Polyuria | 113(47.1) | 68(39.3) | 61(47.3) | 26(39.4) | 64(56.1) | 0.056 |
| Weight loss | 51(21.3) | 39(22.5) | 28(21.7) | 12(18.2) | 20(17.5) | 0.853 |
| Xerostomia | 115(47.9) | 76(43.9) | 68(52.7) | 38(57.6) | 62(54.4) | 0.221 |
| Weight gain | 37(15.4) | 21(12.1) | 24(18.6) | 14(21.2) | 20(17.5) | 0.342 |
| Hypertension | 30(12.5) | 18(10.4) | 10(7.8) | 10(15.2) | 8(7) | 0.283 |
| Measurement of FBG in the previous year | 23(9.6) | 23(13.3) | 14(10.9) | 13(19.7) | 22(19.3) | 0.007* |
| FBG (mg/dL) | 100.1±26.8 | 103.8±32.6 | 100.7±30.5 | 101.6±24.2 | 96.5±23.7 | 0.346 |
| <100 | 161(67.1) | 99(57.2) | 82(63.6) | 40(60.6) | 88(77.2) | |
| 100-125 | 62(25.8) | 60(34.7) | 39(30.2) | 21(31.8) | 21(18.4) | 0.081 |
| >125 | 17(7.1) | 14(8.1) | 8(6.2) | 5(7.6) | 5(4.4) | |
| OGTT 2nd hour | n:2 | n:3 | n:3 | n:3 | n:1 | |
| | 159.0±87.7 | 119.0±22.6 | 100.0±7.5 | 111.0±11.0 | 173 | |
| PBG | 133.3±10.1 | 118.5±20.9 | 134.6±9.4 | 138.0±17.5 | 127.0±3.9 | 0.377 |
| HBA1C (% and mmol/mol) | 8.5±1.9 (69±5.7) | 6.9±2.1 (52±6.3) | 7.8±2.2 (62±6.6) | 7.1±2.3 (54±6.9) | 10.7±3.2 (93±11) | 0.088 |
| Diabetes mellitus | | | | | | |
| No | 222(92.5) | 165(95.4) | 126(97.7) | 64(97) | 110(96.5) | 0.044* |
| Yes | 18(7.5) | 8(4.6) | 3(2.3) | 2(3.0) | 4(3.5) | |
| Old diagnosis | 16(6.7) | 7(4.0) | 2(1.6) | 2(3.0) | 4(3.5) | |
| New diagnosis | 2(0.8) | 1(0.6) | 1(0.8) | - | - | |

*p<0.05 statistical significance was accepted.