Thrita. 2014 March; 3(1): e7065. DOI: 10.5812/thrita.7065

Published online 2014 February 1. **Research Article**

Diabetes Mellitus in Drivers: A Cross-Sectional Study in Yazd, Iran, 2006 - 2009

Shahnaz Tofangchiha [1]; Faezeh Dehghan [2,*]; Hamid reza Saberi [3]

[1]Department of Internal Medicine, Imam Reza Hospital, AJA University Of Medical Sciences ,Tehran, IR Iran
[2]Department of occupational medicine, Imam Reza Hospital, AJA University of Medical Sciences, Tehran, IR Iran
[3]Department of Occupational Health, Kashan University of Medical Sciences, Kashan, IR Iran

*Corresponding author: Faezeh Dehghan, Department of occupational medicine, Imam Reza Hospital, AJA University of Medical Sciences, Tehran, IR Iran. Tel: +98-9123068225, Fax: +98-2188076501, E-mail: drfdehghan@gmail.com

Received: July 10, 2012; **Revised:** May 5, 2013; **Accepted:** October 18, 2013

Background: Diabetes complications such as retinopathy and diabetic foot are more important in drivers compared to general population.
Objectives: This study was designed to determine the prevalence of diagnosed and undiagnosed patients with diabetes mellitus and glucose intolerant, as well as the effects of follow up in the commercial drivers in Yazd province, Iran.
Materials and Methods: During three consecutive years, levels of blood sugars were checked in 1137 registered drivers working on heavy motor vehicles such as trucks and buses. After 3 years, data was collected and analyzed by SPSS version 16. One sample K-S, Mauchly's test, and if appropriate, variance analysis test were performed to compare FBS levels differences between the three occasions.
Results: The mean age of participants was 47.7 ± 28.7 (19 - 56) years old, and they were working on heavy vehicles for 15.3 ± 9.3 (26 - 47) years. The prevalence of diagnosed diabetes was 3.3% (n = 38), but the prevalence of FBS > 127 was 6.3%, and that of impaired glucose test was 4.9%. There was a significant reduction in the blood glucose levels from the first to the third occasions in drivers with type 2 diabetes.
Conclusions: The prevalence of diabetes is considerable in drivers and is poorly controlled. Educations during the annual check-ups are helpful in reducing glucose levels and further complications.

Keywords: Diabetes Mellitus; Blood Glucose, Prevalence

1. Background

According to the reports of WHO, currently 346 million people have diabetes worldwide, and most of the deaths related to this disease happen in low and middle-income countries (1). The prevalence of diabetes is reported 9.3% in the Middle East, and 5.5 - 25.7% in Iran (2-6). In a study in Iran, 25.7% had overt diabetes and 17.5% had impaired glucose tolerance (IGT) (4). As undiagnosed diabetics increases, the number of affected people becomes more alarming. Moreover, there is no available estimation regarding the costs of diabetes in Iran as well as the prevalence of its micro and macrovascular complications, and consequences such as cardio-cerebral events, diabetic foot ulcers, and amputations.

While it seems that there is no relation between occupation and incidence of diabetes (3), this disease and especially its complications have significant impacts on certain types of occupations such as drivers, pilots, and other important careers. In drivers, who are the target group of this study, successive hours of driving and the resulting fatigue and obesity (7, 8), eating junk foods on the road, limited time for exercise, and possibly having low access to medical facilities for check-ups, are usually associated with poor control and management of the disease in drivers with diabetes. Furthermore, diabetes complications such as decrease of visual acuity (9, 10), drug-induced hypoglycemia and subsequent drowsiness (11), foot ulcers, and amputation due to vasculopathies or neuropathies (12) have significant consequences, such as early retirement, job loss and subsequent working absence (13), and dangerous and inevitable traffic road accidents.

Due to these factors, diabetes has a more prominent impact on drivers compared to other professions. Although diabetes is not assumed as a contraindication for driving specially in the early stages, road authorities in many countries ask diabetic drivers for periodic assessment of blood sugar levels and diabetes complications (14).

Implication for health policy/practice/research/medical education:
This study was conducted to help diabetes control programs in drivers and reduce the prevalence of diabetes among them.

2. Objectives

In this study, performed from September 2006 to 2009 in a driver examination center in Yazd, Iran, we analyzed the data of diabetic drivers of heavy vehicles referred for routine physical examinations and evaluation of blood sugar, to monitor the diabetes status.

3. Materials and Methods

In a 3-year cross-sectional study from September 2006 to 2009 in a driver examination center in Yazd, Iran, 1137 registered drivers were assessed regarding their blood sugar level once a year. These drivers referred to the center for getting or extending their health certificate, which must be renewed annually for drivers with diabetes based on the guidelines of the Iranian Health Ministry. The inclusion criterion was the history of driving heavy vehicles (trucks and buses) for at least one year as the main job. This study was designed to determine the prevalence of patients with diagnosed and undiagnosed diabetes mellitus and glucose intolerant and the effects of follow ups in the commercial drivers in Yazd province, Iran.

Demographic information, past medical and drug history, and fasting blood sugar (FBS) were documented for each case. FBS values were determined by auto-analyzer device using Pars Azmoon kits (Iran). After 3 years, data was collected and analyzed by SPSS version 16. One sample kolmogrove-smirnove (K-S) test was used to analyze the normality of data distribution, and the Mauchly's test was applied to assess data sphericity. Results of these two tests were required for the variance analysis test as a parametric test for comparing the differences of FBS levels between the three occasions. If there was a significant difference, then pair T-test was used to assess any difference between each two occasions.

We designed a questionnaire and documented the results of FBS tests. If it was ≥ 126, the test was repeated, and if the second test showed the same result, HbA1C was determined. If this was lower than 7%, there was no problem regarding diabetes for giving a health certificate. Those with results between 7 and 10 were referred to an endocrinologist for further assessments. Results above 10 were asked to recheck after 3 months, and if was above 7% again, they were referred to a specialist. Furthermore, drivers with type 1 diabetes were not allowed to receive a health certificate, and were forbidden from driving. The same rule governed for noninsulin-dependent diabetics, if they had any evidence of vision abnormality or a progressive diabetic retinopathy leading to vision loss. This study approach was to refer all the diagnosed and undiagnosed patients with diabetes to an endocrinologist or a dietician.

4. Results

In our study, among 1137 registered drivers, the mean age of participants was 47.7 ± 28.7 (19 - 56) years, working on heavy vehicles for 15.3 ± 9.3 (26 - 47) years, and 743 of them were smokers (65.3%). The prevalence of hypertension was 4.7% (54 persons), and the prevalence of diagnosed diabetes was 3.3% (n = 38). The mean age of patients with diabetes was 45.5 ± 9.5 (26 - 61) years (Table 1). The duration of working on heavy vehicles was 20.9 ± 9.2 (2 - 40) years, and 65.7% [25] of them used antidiabetic agents.

Table 1. Age Distribution of the Study Cases

Age Groups, y	Total, No. (%)	Diabetics, No. (%)
19 - 34	125 (11)	11 (29.8)
34 - 49	465 (40.9)	21 (55.3)
More than 49	545 (47.9)	6 (15.8)
Total	1137 (100)	38 (100)

FBS results of the same individuals by the mentioned three annual assessments from diabetic drivers are given in Table 2. The prevalence of FBS > 127 was 6.3%, and the impaired glucose test (110 < FBS < 127) was 4.9% (Table 3). FBS mean levels in drivers with diabetes were 190.8 ± 76.0, 123.6 ± 46.4, and 141.4 ± 66.6 in the first, second and third occasions, respectively. However, the number of cases who did not attend for the third test was considerable. As all the P values of one sample K-S test for these occasions were > 0.01 (0.78, 0.10, and 0.19 for the first, second and third occasions, respectively), the distribution was normal. P value of Mauchly's test was 0.78 (P > 0.05), thus, the data sphericity was also confirmed. Therefore, the variance analysis test was assumed as the appropriate test for comparing the differences of FBS levels between these occasions. P value of this test was 0.018 (P < 0.05) indicating a significant difference in the FBS levels between these occasions. In Paired T-test, the mean differences and P values for comparing each two occasions were as follows: 6.2 and P = 0.70 for the first vs. second occasions, 49.4 and P = 0.04 for the first vs. third occasions, and finally 17.8 and P = 0.48 for the second vs. third occasions. As it could be inferred, only the difference between the first and third occasions was significant (P < 0.05).

Table 2. Fasting Blood Sugar in Drivers With Diabetes

	First Occasion, No. (%)	Second Occasion, No. (%)	Third Occasion, No (%)
FBS [a] ≤ 110	6 (15.8)	8 (21.1)	5 (13.2)
FBS > 110	31 (81.6)	30 (78.9)	5 (13.2)
Unidentified	1 (2.6)	--[b]	28 (73.7)

[a] Abbreviation: FBS, fasting blood sugar.
[b] no data available.

Table 3. Fasting Blood Sugar in the Study Cases and Drivers With Diabetes

	First Occasion		Second Occasion		Third Occasion	
	Overall, No. (%)	Diabetics, No. (%)	Overall, No. (%)	Diabetics, No. (%)	Overall, No. (%)	Diabetics, No. (%)
FBS [a] ≤ 110	996 (87.6)	6 (15.8)	912 (80.2)	8 (21.1)	414 (36.4)	5 (13.2)
110 < FBS < 127	56 (4.9)	5 (13.2)	127 (11.2)	11 (28.9)	45 (4.0)	2 (5.3)
FBS ≥ 127	72 (6.3)	26 (68.4)	93 (8.2)	19 (50.0)	28 (2.5)	3 (7.9)
Unidentified	13 (1.1)	1 (2.6)	5 (0.4)	– [b]	650 (57.2)	28 (73.7)

[a] Abbreviation: FBS, fasting blood sugar.
[b] no data available.

The means of FBS levels in all patients with and without diabetes were 92.2 ± 34.5, 97.2 ± 34.6, and 100.4 ± 30.0 in the first, second and third occasions, respectively. P values of one sample K-S tests for these occasions were 0.24, 0.28, and 0.56, respectively (for all, $P > 0.01$); thus, the distribution was normal. As the P value of Mauchly's test was 0.18 ($P > 0.05$), the data sphericity was also approved. Therefore, the variance analysis test was a suitable test to compare the differences of FBS levels between these occasions. P value of this test was < 0.001, indicating a significant difference in the FBS levels between these occasions. In Paired T-test, the mean differences and P values for comparing each pair of two occasions were as follows: 7.6 and $P < 0.001$ for the first vs. second occasions, 8.1 and $P < 0.001$ for the first vs. third occasions, and finally 3.1 and $P = 0.09$ for the second vs. third occasions. As it could be inferred, only the difference between the second and third occasions was not significant ($P > 0.05$).

5. Discussion

This study was designed to determine the prevalence of patients with diagnosed and undiagnosed diabetes mellitus and glucose intolerant in the commercial drivers of Yazd province, Iran. The prevalence of diagnosed diabetes among drivers participated in this study was 3.3%, but the true prevalence was higher since that of FBS > 127 was 6.3%. The prevalence of impaired glucose tolerance was 4.9%. High prevalence of impaired carbohydrate metabolism was previously shown by some other studies (15-17). In a study in Kashan, another city of Iran, diabetes was diagnosed in 7% of drivers (17). In Poland, nearly a half of drivers had hyperglycemia, and diabetes-related morbidity was as high as 1.4%, three times more than the general population of the same age (15). There are several possible reasons for this situation. Working for long hours in day is associated with limited physical activity and obesity and subsequent metabolic syndrome (7, 8, 18, 19). On the other hand, due to their working conditions, drivers poorly receive necessary education on healthy diet, regular physical activity, maintaining a normal body weight, and avoiding tobacco; therefore, the quality and quantity of preventive measures seem to be lower than what is needed.

Compared to the estimated prevalence of diabetes in the Iranian general population, findings of this study showed higher prevalence in comparison to Esteghamti's report on diabetes care (7.7%). However, it is not considerably high compared to the result of another recent survey on the prevalence of diabetes in Iranian adults as well as other studies on the general population of Iran and other neighbor countries (3-6, 20-23). In our study, 6.3% of the participants had a fasting blood sugar above 127 and impaired fasting glucose was seen in 4.9% of cases. This finding clearly showed that a considerable percentage of individuals had undiagnosed diabetes. This condition has been reported by several other studies (24-26). In another study in Iran, undiagnosed diabetes was reported in 5.1% of males. The prevalence of impaired fasting glucose and impaired glucose tolerance tests were 8.7% and 5.4%, respectively (3). The aim of screening tests is to detect the undiagnosed cases of disease before complications occur. This is especially important in drivers, as retinopathy and silent myocardial infarction are the two important complications of diabetes which adversely affect their job efficacy. Cataract and retinopathy are both more common in diabetics, and are associated with poor vision (9). Subsequently, this reduces the capability of reaction formation and increases the risk of accidents. Amputation secondary to vasculopathies and neuropathies can lead to early retirement and job loss (12, 27). These examples reveal that early detection of diabetes especially in drivers is highly important to prevent undesirable consequences.

It is confirmed that early detection of diabetes is not sufficient to reduce the consequences, and when the diagnosis is confirmed, disease management and follow-ups are of paramount importance. This study showed that drivers with diabetes had poor control and the mean of blood glucose levels was considerably high. Further studies and guidelines are necessary to evaluate the health conditions of Iranian diabetic drivers. Surely, this study necessitates precise and careful guidelines to control diabetes in drivers. Our findings completely approved the positive role of follow ups as we demonstrated that after a three-year follow up, the fasting blood glucose levels decreased significantly. Conversely in the general popula-

tion, the FBS levels increased. The reason of this contrast between the results of FBS in patients with diabetes and general population is possibly the role of education during the course of research. Certainly, educating drivers in the annual assessments about a healthy diet, regular physical activity, maintaining a normal body weight, and avoiding tobacco use can prevent or delay the onset of type 2 diabetes (1), and helps to appropriate control of diabetes, as well as effective prevention of the complications.

Acknowledgements

This study was financially supported by an occupational medicine company in Yazd. The authors are thankful to voluntary participants of the study.

Authors' Contribution

Dr. Faezeh Dehghan developed the original idea and the protocol, Dr. Shahnaz Tofangchiha analyzed the data and wrote the manuscript, Hamid Reza Saberi contributed to the development of the protocol, abstracted the data and prepared the manuscript.

Financial Disclosure

We did not receive any grants or consulting fees.

Funding/Support

We did not have any sponsors or support.

References

1. World Health Organization . *Diabetes, Fact sheet N°312*. 2011. Available from: http://www.who.int/mediacentre/factsheets/fs312/en/index.htmlLast.
2. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract.* 2010;**87**(1):4–14.
3. Azimi-Nezhad M, Ghayour-Mobarhan M, Parizadeh MR, Safarian M, Esmaeili H, Parizadeh SM, et al. Prevalence of type 2 diabetes mellitus in Iran and its relationship with gender, urbanisation, education, marital status and occupation. *Singapore Med J.* 2008;**49**(7):571–6.
4. Azizi F, Salehi P, Etemadi A, Zahedi-Asl S. Prevalence of metabolic syndrome in an urban population: Tehran Lipid and Glucose Study. *Diabetes Res Clin Pract.* 2003;**61**(1):29–37.
5. Adeghate E, Schattner P, Dunn E. An update on the etiology and epidemiology of diabetes mellitus. *Ann N Y Acad Sci.* 2006;**1084**:1–29.
6. Azizi F, Gouya MM, Vazirian P, Dolatshahi P, Habibian S. The diabetes prevention and control programme of the Islamic Republic of Iran. *East Mediterr Health J.* 2003;**9**(5-6):1114–21.
7. Aguilar-Zinser JV, Irigoyen-Camacho ME, Ruiz-Garcia-Rubio V, Perez-Ramirez M, Guzman-Carranza S, Velazquez-Alva Mdel C, et al. [Prevalance of overweight and obesity among professional bus drivers in Mexico]. *Gac Med Mex.* 2007;**143**(1):21–5.
8. Siedlecka J. [Selected work-related health problems in drivers of public transport vehicles]. *Med Pr.* 2006;**57**(1):47–52.
9. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. *Lancet.* 2010;**376**(9735):124–36.
10. Zhang W, Liu H, Al-Shabrawey M, Caldwell RW, Caldwell RB. Inflammation and diabetic retinal microvascular complications. *J Cardiovasc Dis Res.* 2011;**2**(2):96–103.
11. Laube I, Seeger R, Russi EW, Bloch KE. Accidents related to sleepiness: review of medical causes and prevention with special reference to Switzerland. *Schweiz Med Wochenschr.* 1998;**128**(40):1487–99.
12. Uccioli L, Gandini R, Giurato L, Fabiano S, Pampana E, Spallone V, et al. Long-term outcomes of diabetic patients with critical limb ischemia followed in a tertiary referral diabetic foot clinic. *Diabetes Care.* 2010;**33**(5):977–82.
13. Szubert Z, Sobala W. [Health reasons for work disability among municipal transport drivers]. *Med Pr.* 2005;**56**(4):285–93.
14. Marcinkiewicz A, Szosland D. [Medical certification for diabetic drivers in the selected European Union member states]. *Med Pr.* 2007;**58**(6):541–6.
15. Marcinkiewicz A, Szosland D, Hanke W. [Prevalence of impaired carbohydrate metabolism among public transport drivers]. *Med Pr.* 2008;**59**(4):271–7.
16. Szosland D, Marcinkiewicz A. Carbohydrate metabolism disturbances among public transport drivers–the need for regulations in Poland. *Int J Occup Med Environ Health.* 2008;**21**(3):247–52.
17. Saberi HR, Moravveji AR, Fakharian E, Kashani MM, Dehdashti AR. Prevalence of metabolic syndrome in bus and truck drivers in Kashan, Iran. *Diabetol Metab Syndr.* 2011;**3**(1):8.
18. Korelitz JJ, Fernandez AA, Uyeda VJ, Spivey GH, Browdy BL, Schmidt RT. Health habits and risk factors among truck drivers visiting a health booth during a trucker trade show. *Am J Health Promot.* 1993;**8**(2):117–23.
19. Cavagioni LC, Bensenor IM, Halpern A, Pierin AM. [Metabolic Syndrome in professional truck drivers who work on Highway BR-116 within the area of Sao Paulo City - Regis Bittencourt]. *Arq Bras Endocrinol Metabol.* 2008;**52**(6):1015–23.
20. Doria A. Genetics of diabetes complications. *Curr Diab Rep.* 2010;**10**(6):467–75.
21. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, et al. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants. *Lancet.* 2011;**378**(9785):31–40.
22. Mathew E, Sreedharan J, Muttappallymyalil J, Al Sharbatti S. Comment on: Prevalence of diabetes mellitus in a Saudi community. Ann Saudi Med 2011;31(1):19-23. *Ann Saudi Med.* 2011;**31**(3):315.
23. Karim A, Ogbeide DO, Siddiqui S, Al-Khalifa IM. Prevalence of diabetes mellitus in a Saudi community. *Saudi Med J.* 2000;**21**(5):438–42.
24. Unwin N, Shaw J, Zimmet P, Alberti KG. Impaired glucose tolerance and impaired fasting glycaemia: the current status on definition and intervention. *Diabet Med.* 2002;**19**(9):708–23.
25. Gupta A, Gupta R, Sarna M, Rastogi S, Gupta VP, Kothari K. Prevalence of diabetes, impaired fasting glucose and insulin resistance syndrome in an urban Indian population. *Diabetes Res Clin Pract.* 2003;**61**(1):69–76.
26. Kuzuya T, Nakagawa S, Satoh J, Kanazawa Y, Iwamoto Y, Kobayashi M, et al. Report of the Committee on the classification and diagnostic criteria of diabetes mellitus. *Diabetes Res Clin Pract.* 2002;**55**(1):65–85.
27. Edmonds ME, Foster AV. Diabetic foot ulcers. *BMJ.* 2006;**332**(7538):407–10.