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Research Article

ABNORMAL GLUCOSE TOLERANCE AND ASSOCIATED RISK FACTORS IN STATE TRANSPORT BUS DRIVERS

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ABSTRACT
Due to their nature of job, bus drivers are prone to stress and strain and obesity, which are the predisposing factors for causation of abnormal glucose tolerance. With this background the present study was carried out to study the prevalence of abnormal glucose tolerance and associated risk factors in State Transport Bus Drivers. The study comprises of 287 State Transport Bus Drivers of Nanded Bus Depot. Demographic information was collected from study subjects. Family history of diabetes mellitus enquired and family history index was calculated. Height, weight, waist and hip circumferences were recorded as per WHO guidelines. All subjects were screened for fasting venous plasma glucose and those having levels $\geq$100 mg/dl confirmed by oral glucose tolerance test. Statistical tests used were chi square test, chi square for linear trend and percentage.
Overall prevalence of abnormal glucose tolerance in study subjects was found to be 14.6%. The risk factors significantly associated were advancing age, duration of service, lack of leisure time physical activity, alcohol consumption, family history of diabetes, high family history index, body mass index and waist hip ratio. Smoking and hypertension were not significantly associated with abnormal glucose tolerance.

Key Words: *Abnormal Glucose Tolerance, Body Mass Index, Waist Hip Ratio, Family History Index, State Transport Bus Drivers*

INTRODUCTION
Diabetes Mellitus, a chronic disease once thought to be uncommon in the developing world, has emerged as an important public health problem. Diabetes is one of the most common non communicable diseases prevalent globally and there is substantial evidence that it is an epidemic in many developing and newly industrialized nations thus posing a serious threat to be met within 21st century (Rajendra, 2002). WHO report 1991 states that diabetes in adults is now a third world problem (King Hillary *et al.*, 1998).
Type-2 diabetes, the most prevalent form is often asymptomatic in its early stages and can remain undiagnosed for many years (Zimmet, 1999). Individuals with undiagnosed type-2 diabetes are at significantly higher risk for coronary heart disease, stroke and peripheral vascular disease than the non diabetic population. Diabetic patients have about twice the prevalence of hypertension and twice the incidence of stroke as compared to non-diabetic subjects (Joshi, 1998). The population in India has an increased susceptibility to diabetes mellitus. The World health organization has recently acknowledged that India has the maximum number of diabetic patients (19.4 million) in any given country in the year 1995 and this would increase to 57.2 million by the year 2025. India would thus become the diabetic capital of the world (Premlatha *et al.*, 2000).
Long hours of stressful travel promote glucose intolerance. Overtime working and late hours of driving, working on Sunday's and holidays is a significant stress for bus drivers. Considering these facts which are prone for development of abnormal glucose tolerance (AGT), the present study was carried out with the objectives to study the prevalence of AGT and associated risk factors in State Transport Bus Drivers.

MATERIALS AND METHODS
This cross sectional study was carried out among the drivers of State Transport Bus Services, Nanded Bus Depot in Maharashtra State in 2005. The study was conducted after seeking approval from Institutional

Ethical Committee. There were 312 bus drivers working during study period among which 287 (92.0%) participated in the study. The reasons for non-participation of drivers were unwillingness (2.9%), transferred out to other bus depots (1.9%), got retired during study period (2.2%) and subjects who were on long medical leave hence not traceable (1.0%).

After obtaining written informed consent, data was collected on predesigned and semistructured proforma. Information regarding demographic factors like age, literacy status, residence, marital status, religion etc. was obtained from the study population. Length of service in years was verified from office record. Leisure time physical activity with duration was recorded. Total physical activity was assessed by combining scores of occupational and leisure time physical activity (Singh, 1997). Family history of diabetes mellitus, hypertension and ischemic heart disease was obtained from them. Positive family history of diabetes was enquired among their parents, grandparents and siblings and family history index (FHI) for diabetes was calculated. The following formula gives the index in terms of presence (= 1) or absence (= 0) of diabetes in the mother (M), the father (F), the brother (B), the sister (S), paternal grandparents (PGP) and maternal grandparents (MGP) of the subject.

$$FHI = (M + F + B + S) + (PGP + MGP)/2$$

FHI divided into three groups (0.0, 0.5 – 1.0 and > 1.0) (Morris Robert and Rimm Alfred, 1991). Personal habits like alcohol intake, smoking of cigarettes or bidi, chewing of tobacco and guthka were taken into consideration. Diet history was assessed by 24 hour recall method for each subject (Gopalan C et al, 2004). Through clinical examinations were carried out and anthropometric (Jelliffe, 1966) and blood pressure measurements (WHO, 1996) were done as per WHO guidelines.

All subjects were investigated for fasting venous plasma glucose level by GOD-POD method after an overnight fast. Subjects whose fasting venous plasma glucose level equal to or greater than 100mg/dl were subjected to oral glucose tolerance test (OGTT). Known cases of diabetes mellitus were excluded from OGTT and included in the study as the cases of diabetes mellitus. Results of fasting venous plasma glucose level and OGTT were interpreted as per WHO standards (WHO, 1994). Statistical tests used were chi square test, chi square for linear trend and percentages. For analysis purpose impaired glucose tolerance and diabetes mellitus groups were combined and compared with normal subjects.

RESULTS

In the present study minimum age of the subject was 24 years while maximum age was 58 years.

Table 1: Demographic factors of study subjects

Demographic factors		No. of subjects	Percentage
Age group (years)	20-29	07	02.4
	30-39	53	18.5
	40-49	150	52.3
	50 & above	77	26.8
Education	Primary	25	08.7
	Middle	72	25.1
	SSC	146	50.9
	HSC	27	09.4
	Graduate & above	17	05.9
Religion	Hindu	155	54.0
	Muslim	86	30.0
	Bouddh	40	13.9
	Others	06	02.1
Family type	Nuclear	203	70.7
	Joint	84	29.3

Among 287 study subjects 223 were having fasting plasma glucose less than 100 mg/dl, 40 subjects were having it in the range of 100 to 139 mg/dl and only 24 subjects were having it equal to or greater than 140 mg/dl (Table 2).

Maximum subjects i.e. 150 (52.3%) were in the age group of 40 to 49 years followed by 77 (26.8%) in 50 & above years of age, 53 (18.5%) were in the 30 to 39 years of age group & least i.e. 7 (2.4%) in 20 to 29 years of age group. Regarding education maximum subjects i.e. 146 (50.9%) were educated upto S.S.C. followed by 72 (25.1%) upto middle school, 27 (9.4%) upto H.S.C., 25 (8.7%) upto primary school & 17 (5.9%) upto graduation & above. Among 287 study subjects 155 (54.0%) were Hindus, 86 (30.0%) were Muslim, 40 (13.9%) were Bouddha while only 6 (02.1%) subjects were belonging to other religion (5 Sikh & 1 Jain). 203 (70.7%) subjects were from nuclear family & 84 (29.3%) were from joint family(Table 1).

Table 2: Fasting plasma glucose levels of study subjects.

Fasting plasma glucose levels	Numbers	Percentages
< 100 mg / dl	223	77.7
100 -139 mg / dl	40	13.9
≥ 140 mg / dl	24	08.4
Total	287	100

A total of 64 subjects were having fasting venous plasma glucose level equal to or greater than 100 mg/dl. Of these 11 subjects were known cases of diabetes mellitus so excluded from OGTT. Hence OGTT was carried out in 53 subjects only. Among 53 subjects who were subjected to OGTT, 22 (41.5%) were having normal glucose tolerance, 12 subjects (22.6%) having impaired glucose tolerance, and 19 subjects (35.9%) were having diabetes mellitus (Table 3). Thus 11 known cases and 19 newly detected cases give 10.4% prevalence of diabetes mellitus and 4.2 % that of impaired glucose tolerance. Overall prevalence of AGT in study subjects was 14.6%.

Table 3: Results of oral glucose tolerance test of study subjects.

Oral glucose tolerance test	Numbers	Percentages
Normal (< 140 mg %)	22	41.5
Impaired Glucose Tolerance (140 – 199 mg %)	12	22.6
Diabetes Mellitus (≥ 200 mg %)	19	35.9
Total	53	100

No one was having abnormal glucose tolerance below 30 years of age but during later years of life abnormal glucose tolerance was found to be increasing as age advances (Table 4). The chi square for linear trend for age and abnormal glucose tolerance was 10.7, $P < 0.001$ i.e. statistically significant. Similarly chi square for linear trend for duration of service and AGT was also found to be statistically significant. (χ^2 for linear trend = 14.4, $P < 0.001$). This means as duration of service increases, the chances of AGT also increases.

The prevalence of AGT in subjects performing heavy physical activity was 13.5%, in subjects performing moderate physical activity was 9.7% and highest i.e. 24.7% in subjects performing mild physical activity. The association between physical activity and AGT was statistically significant (χ^2 =9.57, df = 2, P < 0.01).

Regarding family history of diabetes mellitus and AGT out of 55 subjects with family history of diabetes mellitus 23.7% were having AGT compared to 76.3% normal subjects. Among 232 subjects with no family history of diabetes mellitus, 12.5% were having AGT compared to 87.5% normal subjects. The association between family history of diabetes and AGT was found to be statistically significant (χ^2 = 4.4, P < 0.05).

Table 4: Risk factors and glucose tolerance of study subjects.

Risk factors		Abnormal glucose tolerance *IGT No.(%)	**DM No.(%)	Normal No.(%)	P value
Age groups (yrs)	20 -29	00 (0.0)	00 (0.0)	07 (100)	P<0.001
	30 -39	00 (0.0)	01 (1.9)	52 (98.1)	
	40 -49	06 (4.0)	18 (12.0)	126 (84.0)	
	50 and above	06 (7.8)	11 (14.3)	60 (77.9)	
Duration of service (yrs)	<10	00 (0.0)	01 (1.5)	66 (98.5)	P<0.001
	10 -19	04 (4.4)	08 (8.9)	78 (86.7)	
	20 -29	08 (6.5)	20 (16.1)	96 (77.4)	
	≥ 30	00 (0.0)	01 (16.7)	05 (83.3)	
Physical activity	Mild	04 (4.9)	16 (19.8)	61 (75.3)	P<0.01
	Moderate	05 (3.2)	10 (6.5)	139 (90.3)	
	Heavy	03 (5.8)	04 (7.7)	45 (86.5)	
Family H/O DM	Yes	04 (7.3)	09 (16.4)	42 (76.3)	P<0.05
	No	08 (3.4)	21 (9.10	203 (87.5)	
FHI	≥0.5	04 (9.5)	08 (19.1)	30 (71.4)	P<0.01
	0	08 (3.3)	22 (9.0)	215 (87.7)	
Calorie Intake	≥ Recommended level	08 (9.6)	21 (25.3)	54 (65.1)	P<0.001
	< Recommended level	04 (2.0)	09 (4.4)	191 (93.6)	
BMI	<18.5	00 (0.0)	00 (0.0)	11 (100)	P<0.01
	18.5-24.99	04 (2.3)	16 (9.3)	152 (88.4)	
	25-29.99	06 (6.6)	11 (12.1)	74 (81.3)	
	≥30	02 (15.4)	03 (23.1)	08 (61.5)	
WHR	>1	09 (6.7)	24 (17.8)	102 (75.5)	P<0.001
	Upto 1	03 (2.0)	06 (3.9)	143 (94.1)	
Hypertension	Yes	04 (9.3)	04 (9.3)	35 (81.4)	P>0.05
	No	08 (3.3)	26 (10.6)	210 (86.1)	
Smoking	Yes	05 (4.3)	12 (10.2)	100 (85.5)	>0.05
	No	07 (4.1)	18 (10.6)	145 (85.3)	
Alcohol consumption	Yes	12 (6.8)	20 (11.4)	144 (81.8)	P<0.05
	No	00 (0.0)	10 (9.0)	101 (91.0)	

In analysis *IGT and **DM groups were combined and compared with normal subjects.

Subjects having family history index zero, 12.3 % were having abnormal glucose tolerance and 87.7% were normal subjects. Subjects having FHI equal to or greater than 0.5, 28.6% were abnormal glucose tolerant and 71.4% were normal subjects. The association between FHI and abnormal glucose tolerance was statistically significant (χ^2 = 7.64, P < 0.01). The prevalence of AGT in subjects consuming calories at or above recommended level (2875 Kcal) was 34.9% while it was 6.4% in those consuming calories

below recommended level. The association between calorie intake and AGT was also statistically significant. (χ^2 =38.52, P < 0.001).

In 11 subjects, whose BMI was below normal no one was found to have AGT. The linear trend of chi square for BMI and AGT was found statistically significant (χ^2 for trend = 9.2, p<0.01). This means that as BMI increases the chances of AGT also increases.

The prevalence of AGT in subjects having waist hip ratio more than 1 was 24.5% and 5.9 % in those having WHR upto 1. The association between WHR and AGT was statistically highly significant. (χ^2 = 19.62, P < 0.001).

Out of 43 subjects having hypertension, the prevalence of AGT was 18.6% while it was 13.9% in normotensive subjects. The association between hypertension and AGT was statistically not significant. (χ^2 = 0.63, P > 0.05). Hypertensive subjects were having 1.4 times more risk of AGT than normotensive subjects (Odds ratio =1.41, CI = 0.55-3.51).

The prevalence of AGT in smokers was 14.5% and it was 14.7% in non smokers. The association between smoking and AGT was not statistically significant (Yates corrected χ^2 = 0.02, P > 0.05).

The prevalence of AGT in alcoholics was 18.2% and it was 9.0% in non alcoholics. The association of alcohol consumption and AGT was statistically significant (χ^2 = 4.58, P < 0.05).

DISCUSSION

In this study prevalence of diabetes mellitus and impaired glucose tolerance was found to be 10.4% and 4.2% respectively. Ramchandran *et al.,* (1992) showed prevalence of NIDDM and IGT in south Asian population to be 8.2% and 8.7% respectively. Ghotekar LH and Meena HS (1995) showed prevalence of IGT in North Indian population as 4.4% which is exactly similar in the present study. Other studies showing similar range of prevalence of diabetes mellitus and IGT are Mohan *et al.,* (2003), Gupta *et al.,* (2003).

There were 11 known cases of diabetes mellitus in the study population. We found 12 cases of IGT and 19 cases of diabetes mellitus which were undiagnosed. That means there is a huge burden of abnormal glucose tolerance even in bus drivers. Therefore periodic health check-up is necessary to detect hidden AGT at an early stage and prevent further complications.

In this study increasing age, more duration of service , lack of leisure time physical exercise , family history of diabetes mellitus, calorie intake above recommended level, higher BMI , waist hip ratio more than one and alcohol consumption were found to be significantly associated with risk of diabetes mellitus and IGT. Similar risk factors were observed by Ramchandran *et al.,* (1992), Mohan *et al.,* (2003). On the other hand smoking and hypertension were not found to be significantly associated with the risk of diabetes mellitus and impaired glucose tolerance. Morris Robert and Rimm Alfred (1991) and Laakso Markku *et al.,* (1992) also observed that smoking was not significantly associated with diabetes mellitus. Laakso Markku *et al.,* (1992), Mohan *et al.,* (2003) observed that hypertensive patients were having more prevalence of diabetes mellitus compared to normotensive people. In the present study the proportion of hypertensive in abnormally glucose tolerant subjects was more (18.6%) compared to normal subjects (13.9%). As hypertension is a compounding factor for diabetes mellitus so it may be or may not be significantly associated with the prevalence of diabetes mellitus.

Modifiable risk factors for development of AGT found in this study were lack of leisure time physical activity, calorie intake above recommended level, high BMI, waist hip ratio more than one and alcohol consumption which should be taken care off.

Conclusion

The prevalence of abnormal glucose tolerance in Bus Drivers was found to be at higher level i.e. 14.6%. The risk factors associated significantly with the prevalence of abnormal glucose tolerance in the study population were advancing age, duration of service, family history of diabetes mellitus, high FHI, lack of leisure time physical activity, calorie intake above recommended level, alcohol consumption, high BMI and waist hip ratio.

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