

## Framingham Score for Public Transportation Drivers in the City of Teresina, Piauí

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### OBJECTIVE

To estimate the absolute risk of the public transportation drivers in the city of Teresina, Piauí, to develop coronary heart disease over the course of ten years based on the Framingham risk score.

### METHODS

An observational, descriptive, cross-sectional study using the Framingham score was conducted with 107 public transportation drivers in the city of Teresina, Piauí, to assess level of risk and its association with the Framingham predictors that include: age, total cholesterol, HDL cholesterol, systolic blood pressure, diastolic blood pressure, diabetes mellitus and smoking. The significance test used was  $\chi^2$ . The prevalence rate was used as the association measurement.

### RESULTS

Mean risk was 5% and the greatest majority of the participants were situated in the low risk category (85.05%). Mean values for the variables were: 42 years of age, total cholesterol 200 mg%, HDL cholesterol 49 mg%, systolic blood pressure 130 mmHg and diastolic blood pressure 85 mmHg. The associations between diabetes mellitus, smoking and HDL cholesterol with level of risk were not statistically significant; however other variables had a great influence on the level of risk obtained.

### CONCLUSION

The mean absolute risk estimate for the public transportation drivers in the city of Teresina to develop coronary heart disease over the next ten years based on the Framingham score is low. The majority of the participants in the study (85.05%) were situated in the low risk category, that is, with a relative risk less than or equal to 10%.

### KEY WORDS

Cardiovascular disease, level of risk, profession, coronary heart disease, primary prevention, Framingham score.

An important consideration when discussing coronary heart disease (CHD) risks for specific population groups is the relation between the individual and the workplace, particularly the employee's function or occupation<sup>1</sup>. In order to simplify the epidemiological survey it is possible to use previously validated methods such as the Framingham risk score, a valuable primary prevention tool that estimates the absolute risk of an individual to develop clinically manifest CHD within a ten year timeframe for both males and females<sup>2</sup>.

A well known study conducted by Morris and associates<sup>3</sup> compared London bus conductors and drivers and found that the drivers had a higher incidence of CHD which was attributed to higher stress levels combined with other factors such as lack of physical activity. A sudden and possibly fatal coronary event during working hours could be disastrous in this type of profession, particularly considering the predictability of such an event and consequently the possibility of intervening in its natural history.

The importance of the attention dedicated to the professional category of city public transportation drivers is the possibility of assessing the primary risk and in this respect, the contribution to reduce incidence and prevalence rates of CAD. Add to this the importance of supplying the government with subsidies to establish efficient public health measures as well as safety measures for the large percentage of the population who use public transportation.

## METHODS

A descriptive, observational cross sectional study was conducted using a population base from the private city mass transportation companies headquartered in Teresina, in the state of Piauí. The individuals used in the study were male city public transportation drivers who were active registered full time employees between the ages of 30 and 74. Professionals that had a heart disease of any nature or etiology, verified by means of medical histories and physical examinations were excluded from the study.

The sample size was defined based on the prevalence of high risk individuals (45%) in a survey conducted by Ladeia and Matos<sup>4</sup>, in the state of Bahia. The percentage used was 45%, anticipating a 5% sample error and a 95% confidence level. Considering a finite population of 916 drivers, a reduction in the sample size resulted in 380 individuals and reached an appropriate size of 122 individuals.

The survey consisted of two stages carried out in December 2003. Initially four of the ten companies were selected using a random number table<sup>5</sup>. Next the names of the professionals from the selected companies were entered in a raffle to determine the study group. The number of drivers selected from each company was proportional to the participation of each one of them in relation to the total number of drivers entered in the raffle.

The absolute risk of coronary heart disease over the course of ten years was adopted as the dependent variable and was

classified as high  $\geq 20\%$ , moderate  $> 10\%$  but  $< 20\%$ , and low  $\leq 10\%$ . The independent variables considered were the risk predictors used to calculate the Framingham score which are, age, total and HDL cholesterol in mg%, systolic and diastolic blood pressure in mmHg, and whether or not the person was a smoker or had diabetes mellitus.

The diagnosis of diabetes mellitus was established by medical history, the use of hypoglycemic agents and/or casual glucose concentrations higher than or equal to 200 mg%, which is a reference for the hyperglycemia test, as due to logistic problems (difficulty to schedule in advance) it was not possible to follow the criteria of the Brazilian Diabetes Consensus<sup>6</sup>. Smoking was evaluated by asking the driver if he regularly smoked at least one cigarette per day for at least one year.

Initially the mean, standard deviation, maximum and minimum values were established for absolute risk (dependent variable), age, total cholesterol, HDL cholesterol, systolic blood pressure and diastolic blood pressure (independent variables). The drivers were distributed according to absolute risk levels, age group, total cholesterol levels, HDL cholesterol levels, systolic and diastolic blood pressure measurements and whether or not they had diabetes or were smokers.

An association was made between the dependent variable and the independent variables. Risk levels were classified as low  $\leq 10\%$  and moderate/high  $> 10\%$ . The independent variables were also classified. Classifications for age groups were 31 to 35 years, 36 to 40 years, 41 to 45 years, 46 to 50 years and 51 to 55 years. Total cholesterol was classified as  $< 200$  mg% (lower susceptibility) and  $\geq 200$  mg% (higher susceptibility). HDL cholesterol was classified as  $\geq 40$  mg% (lower susceptibility) and  $< 40$  mg% (higher susceptibility). Systolic blood pressure was classified as  $< 140$  mmHg (lower susceptibility) and  $\geq 140$  mmHg (higher susceptibility). Diastolic blood pressure was classified as  $< 90$  mmHg (lower susceptibility) and  $\geq 90$  mmHg (higher susceptibility).

The prevalence rate was used as the association measurement, comparing the prevalence of moderate to high risk among the groups with lower and higher susceptibility for each independent variable. The confidence interval was 95%, with a significance level of 5% ( $p < 0.05$ ). The prevalence rate was calculated for the association between absolute risk and age using the age groups of 31 to 45 years (lower susceptibility) and 46 to 55 years (higher susceptibility).

Data were processed using the computer program SPSS (Statistical Package for Social Science), version 10.5, that furnished the results in a previously established tabulation format in accordance with the study objectives. The significance test used was  $\chi^2$  (verisimilitude rate), with a significance level of 5% ( $p < 0.05$ ). The prevalence rate, 95% confidence interval (CI) and significance estimate ( $p < 0.05$ ) were calculated using the Bioestat<sup>®</sup> 2.0 computer program.

The project was approved by the Human Research Ethics Committee of the Center of Health Sciences of the Universidade Federal de Pernambuco.

## RESULTS

Fifteen of the 122 drivers chosen for the study were excluded as they refused to participate. All were city bus drivers. The mean absolute risk was 5% ( $\pm$  4.7), the mean age was 42 years ( $\pm$  6), mean total cholesterol was 200 mg% ( $\pm$  38.8), mean HDL cholesterol was 49 mg% ( $\pm$  7.7), mean systolic blood pressure (SBP) was 130 mmHg ( $\pm$  18.9) and mean diastolic blood pressure (DBP) was 85 mmHg ( $\pm$  12.9) (tab. 1).

**Table 1 – Maximum, minimum, mean and standard deviation values for risk, age, total cholesterol, HDL cholesterol, systolic and diastolic blood pressure for 107 public transportation drivers in the city of Teresina (PI), 2004**

	Maximum	Minimum	Mean	Standard Deviation
Risk (%)	25	2	5.00	4.70
Age (years)	55	31	42.00	6.06
Total Cholesterol (mg%)	320	100	200.00	38.80
HDL Cholesterol (mg%)	73	31	49.00	7.70
Systolic Blood Pressure (mmHg)	210	80	130.00	18.95
Diastolic Blood Pressure (mmHg)	125	40	85.00	12.88

From the drivers included in the study, 85.05% were placed in the low risk group ( $\leq$ 10%), 10.28% in the moderate risk group ( $>$ 10% but  $<$ 20%) and 4.67% in the high risk group ( $\geq$ 20%).

The drivers ranged from 31 to 55 years. Distribution of the variables in relation to the drivers revealed that the majority were between the ages of 36 and 40 years; for total cholesterol levels (mg%) the majority were between the ranges of  $<$ 200 and  $\geq$ 200; for HDL cholesterol levels (mg%) the majority were in the range of  $\geq$ 40; for systolic blood pressure (mmHg) the majority were in the range below 140 and for diastolic blood pressure (mmHg) the majority were in the range below 90. The prevalence of diabetes was 3.7% and smoking 18.7%.

The level of risk was classified as low and moderate/high and was associated with each independent variable. When those pertaining to the age groups of 31 to 45 and 46 to 55 years were separated, there was a higher percentage of drivers between the ages of 31 and 45 in the low risk group (94%) than in the moderate to high risk group (6%). For the drivers between 46 and 55 this proportion was 66% and 34%, respectively ( $p <$ 0.05), (table 2). The prevalence rate was 5.92, confidence interval 95% (CI 95%) 2.05 – 17.05 ( $p <$ 0.05).

In reference to total cholesterol, for both the lower susceptibility group ( $<$ 200 mg%) and the higher

**Table 2 – Risk of developing coronary heart disease by age group according to the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

Age group (years)		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
31 a 35	17	100.00	-	-	17	100.00	
36 a 40	27	96.42	1	3.57	28	100.00	
41 a 45	23	88.46	3	11.53	26	100.00	
46 a 50	20	76.92	6	23.07	26	100.00	
51 a 55	4	40.00	6	60.00	10	100.00	
Total	91	85.05	16	14.95	107	100.00	

- no data;  $p <$ 0.05.

susceptibility group ( $\geq$ 200 mg%), a greater number of drivers were classified as low risk, 96.23% and 74.04% respectively ( $p <$ 0.05) (tab. 3). Prevalence rate 6.87; CI 95% 1.64 – 28.78 ( $p <$ 0.05). The same trend was seen for HDL cholesterol (240 and  $<$ 40), 85.56% and 80% respectively, however without any significance ( $p >$ 0.05) (tab. 4). Prevalence rate 1.38; CI 95% 0.37 – 5.24 ( $p >$ 0.05).

The association between risk and SBP for the lower susceptibility group ( $<$ 140 mmHg) classified 95.83% of drivers as low risk and 4.17% as moderate/high risk. For the higher susceptibility group ( $>$ 140 mmHg), the proportion of drivers classified as low risk fell to 62.86%

**Table 3 – Risk of developing coronary heart disease according to total cholesterol, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

Total Cholesterol (mg%)		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
$<$ 200	51	96.23	2	3.77	53	100.00	
$>$ 200	40	74.07	14	25.93	54	100.00	
Total	91	85.05	16	14.95	107	100.00	

$p <$  0.05.

**Table 4 – Risk of developing coronary heart disease according to HDL cholesterol, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

HDL Cholesterol (mg%)		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
$<$ 40	8	80.00	2	20.00	10	100.00	
$>$ 40	83	85.56	14	14.44	97	100.00	
Total	91	85.05	16	14.95	107	100.00	

$p <$  0.05.



and 37.14% were classified as moderate/high risk ( $p < 0.05$ ) (tab. 5). Prevalence rate 8.9; CI 95% 2.72 – 29.26 ( $p < 0.05$ ). DBP trends were similar with 96.61% classified as low risk ( $< 90$  mmHg) and 70.83% classified as moderate/high risk ( $> 90$  mmHg), ( $p < 0.05$ ) (tab. 6). Prevalence rate 8.6; CI 95% 2.05 – 36.02 ( $p < 0.05$ ).

**Table 5 – Risk of developing coronary heart disease according to systolic blood pressure, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
Systolic Blood Pressure (mmHg)	< 140	69	95.83	3	4.17	72	100.00
	> 140	22	62.86	13	37.14	35	100.00
Total		91	85.05	16	14.95	107	100.00

$p < 0.05$ .

**Table 6 – Risk of developing coronary heart disease according to diastolic blood pressure, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
Diastolic Blood Pressure (mmHg)	< 90	57	96.61	2	3.39	59	100.00
	> 90	34	70.83	14	29.17	48	100.00
Total		91	85.05	16	14.95	107	100.00

$p < 0.05$ .

For the drivers without diabetes (not susceptible) the majority were classified as low risk (86.41%) and 13.59% as moderate/high risk. However, the diabetics (susceptible) were distributed equally (50%) in both risk categories ( $p > 0.05$ ) (tab. 7). For nonsmokers (not susceptible) 87.36% were classified as low risk, however, for the smokers (susceptible) this proportion fell to 75% ( $p > 0.05$ ), (tab. 8). Neither diabetes nor smoking revealed a statistical

**Table 7 – Risk of developing coronary heart disease according to diabetes mellitus, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
Diabetes mellitus	No	89	86.41	14	13.59	103	100.00
	Yes	2	50.00	2	50.00	4	100.00
Total		91	85.05	16	14.95	107	100.00

$p < 0.05$ .

significance. The prevalence rate for diabetes mellitus was 3.68; CI 95% 1.23 – 10.98 ( $p > 0.05$ ). The prevalence rate for smokers was 1.98; CI 95% 0.77 – 5.05 ( $p > 0.05$ ).

**Tabela 8 – Risk of developing coronary heart disease according to smoking, based on the Framingham score for 107 public transportation drivers in the city of Teresina (PI), 2004**

		Risk Level				Total	
		low		moderate/high		n°	%
		n°	%	n°	%		
Smokers	No	76	87.36	11	12.64	87	100.00
	Yes	15	75.00	5	25.00	20	100.00
Total		91	85.05	16	14.95	107	100.00

$p < 0.05$ .

## DISCUSSION

The score system developed by the Framingham researchers to estimate risk considers the following variables: age, total or LDL cholesterol, HDL cholesterol, the highest systolic and diastolic blood pressure measurements, diabetes mellitus and smoking<sup>2</sup>. Other risk factors that are not included in this calculation have currently been earmarked as important indicators for cardiovascular disease, in particular CHD, which has limited the usefulness of the Framingham risk calculation.

The mean absolute risk for a cardiovascular event to occur over the following ten years for this sample was 5%. In terms of the intervention measures proposed by the latest Brazilian Guidelines for Dyslipidemia and the Guidelines for the Prevention of Atherosclerosis<sup>7</sup>, this percentage is considered very low as more than 80% of the study group was classified as low risk.

Grundy<sup>8</sup> endeavored to prove that the aging of our arteries and bodies is proportional. It can be presumed that the mean age of 42 years in this sample was the factor that influenced the low risk estimate found as the oldest member was 55 and the youngest was 31.

The population sample was young and the majority of the members were in the age range of 36 to 40 years. This fact could be due to an intentional selection process on the part of the bus company owners. It is well known by the owners that the routine of these professionals is extremely stressful and demanding with a limited scope for decision making. They must deal with traffic that generally speaking is complicated and at times chaotic, are required to keep a punctual schedule, are subject to weather conditions that are not always pleasant as well as the sedentary nature of the job. It is worth noting that the study sample was from Teresina that is located in the central-northern region of Brazil where the average temperature is quite high.

The Brazilian Cardiology Society<sup>7</sup> has established that an age of 45 years or older is a risk factor for males which can lower the optimum LDL cholesterol level limits for individuals requiring interventions. An association

between risk level and age groups would have produced a higher prevalence of drivers classified as low risk, in the age groups of 45 years or younger and a higher risk in the older age groups. The prevalence rate found for age group was 5.92 (CI 95% 2.05 – 17.05) when compared the prevalence rates for moderate/high risk between the ages of 31 to 45 and 46 to 55 years old.

Mean total cholesterol of 200 mg% shows that the levels of this variable are close to normal limits. When observing the group as a whole, we note that the levels of roughly one-half of the sample are considered as lower susceptibility or, in other words, less than 200 mg% while the other half have more troubling levels above 200mg%. The cut-off point used is in accordance with the guidelines of the Brazilian Cardiology Society<sup>7</sup>, that classifies cholesterol levels below 200 mg% as excellent.

The association between total cholesterol and CHD risk revealed a similar trend in relation to age group, with a higher proportion of low risk drivers within the limits of the lower susceptibility group (<200 mg%) in comparison to those classified as moderate/high risk. For higher cholesterol levels the difference between these proportions is lower. A prevalence rate of 6.87 (CI 95% 1.64 – 28.78) demonstrates the strength of this variable as a CHD risk factor.

Studies that attempt to clarify the role of dyslipidemia in the atherogenesis, concentrate on non-high density cholesterol, calculated by subtracting HDL cholesterol from the total cholesterol index as an important indicator to predict cardiovascular mortality<sup>9</sup>. Although clinical studies have suggested that LDL cholesterol is the main atherogenic lipoprotein and have established it as the lipid target with clinical advantages in its dosage, the Framingham data demonstrates that the impact of total cholesterol and LDL cholesterol on risk estimates are similar<sup>2</sup>. The authors of the Framingham score explain that for risk evaluation total cholesterol is simply a valid alternative to LDL cholesterol measurements.

The mean HDL cholesterol found was considerably above the limit values in which the protector effect is more pronounced. A large proportion of the drivers had levels greater than or equal to 40mg%, with a lower susceptibility in relation to the risk estimate. The use of 40mg% or higher as an indication of lower susceptibility is also in agreement with the latest Brazilian guidelines<sup>7</sup> that establish this value as the cut-off point to classify HDL cholesterol as high or low.

We also found a higher proportion of low risk drivers in the group with HDL cholesterol  $\geq$  40 mg%, a proportion that was reduced when a value lower than 40 mg% was considered; however, no statistical significance was found for this association. The prevalence rate found was 1.38 (CI 95% 0.37 – 5.24) that had no statistical significance in our sample ( $p > 0.05$ ) and therefore did not reveal an important association between HDL cholesterol and risk level.

The prevalence of systolic hypertension found was 32.71% and diastolic hypertension was 44.86% based

on the limits of 140/90 mmHg. The mean systolic and diastolic blood pressure measurements obtained were lower than the levels considered as hypertension stage 1, as defined by national and international consensus. These mean values are classified in the JNC VII<sup>10</sup> as pre-hypertension which established these values as ranging from 120 to 139 mmHg for SBP and from 80 to 89 mmHg for DBP. Vasan and associates<sup>11</sup> attempted to demonstrate the impact of systolic blood pressure on the risk of cardiovascular events. It is important to note that these are mean values and that any individual prevention measures should be evaluated on a case by case basis.

The association of both blood pressure readings with risk levels reveals a higher proportion of low risk at the lower levels, <140 mmHg and <90 mmHg, respectively. The cut-off points considered for this study are in accordance with the criteria of the 4<sup>th</sup> Brazilian Hypertension Guidelines<sup>12</sup> that classifies hypertensive individuals as those with blood pressure measurements equal to or higher than these values. This proportion is reduced when we analyze higher blood pressure levels,  $\geq$ 140 mmHg and  $\geq$ 90 mmHg. The prevalence rate was 8.9 (CI 95% 2.72 – 29.26) ( $p \leq 0.05$ ), for systolic blood pressure and 8.6 (CI 95% 2.05 – 36.02) ( $p \leq 0.05$ ), for diastolic blood pressure, substantiating the importance of this variable for risk estimation in the sample.

The numbers revealed in this report to a certain extent are surprising, since they demonstrate that of all the variables included in the Framingham risk score, it is possible that systemic blood pressure is more closely related to the professional's or worker's lifestyle. Higher values were expected in this study as the stress levels for this work category are known to be high. Steptoe and associates<sup>13</sup> were able to demonstrate that work related stress is associated with blood pressure which is elevated by uncontrollable tasks, or in other words, those that limit decision making power.

A low prevalence rate of 3.7% for diabetes mellitus was found in this sample. Medical literature does not furnish data regarding the prevalence of this clinical condition in specific population groups, such as those pertaining to particular professional categories. The fact that this was a small sample does not dismiss the preoccupation of the consequences these workers could suffer if they do not strictly control their blood glucose levels.

The prevalence of smoking in the sample group was also minimal, roughly 20%. This could be an indication that the anti-smoking campaigns developed by government agencies along with the participation of society as a whole have had a positive effect.

The socioeconomic conditions of public transportation drivers in various, if not all, cities throughout Brazil do not promote favorable tendencies. It is a priority to find ways to educate and involve them in anti-smoking campaigns and clarify the consequences not only for the cardiovascular system but for the body as a whole.

The association of diabetes mellitus to risk revealed a higher prevalence of low risk for non-diabetic individuals in comparison to diabetics, however there was no statistical significance for the prevalence rate was 3.68 (CI 95% 1.23 – 10.98) ( $p > 0.05$ ). The trend for the association between smoking and risk was similar to that found for diabetes, with a greater number of drivers in the low risk category when compared to the moderate/high level. This proportion was lower for smokers. These tests did not demonstrate a statistical significance. The prevalence rate was 1.98 (CI 95% 0.77 – 5.05) ( $p > 0.05$ ).

In closing it should be emphasized that the independent variables used in the study were closely related to risk level, that is, the higher the values of age, total cholesterol, SBP and DBP, the higher the risk of developing CHD within the following ten years. An exception occurred with the

HDL cholesterol, diabetes mellitus and smoking that did not have a statistically significant influence on the level of risk for the sample.

Preventative and educational campaigns supported by governmental agencies and society with an active participation from Brazil's research and teaching institutions are indispensable in the workplace.

## Acknowledgements

We would like to thank everyone directly or indirectly involved in this study for their efforts and in particular the owners and drivers of the public transportation companies in Teresina.

## Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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