Original Article

Prevalence of obesity, prediabetes, diabetes mellitus, prehypertension and hypertension among health checkup beneficiaries in Erode district, Tamilnadu

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The study was conducted to find out the prevalence of obesity, prediabetes (Impaired fasting glucose-IFG), diabetes mellitus (DM), prehypertension (PreHTN) and hypertension(HTN) among health checkup beneficiaries who attended the health checkup unit of a rural based Medical College Hospital in western part of Tamilnadu state, India. The data on socio demographic characteristics, anthropometric profile, fasting blood sugar and blood pressure was collected from 1273 beneficiaries. The prevalence of newly diagnosed diabetes mellitus and hypertension were found out after exclusion of self reported cases of diabetes mellitus status (132) and hypertension status (141). A two-tailed test with $P<0.05$ was used to determine statistical significance. The overall prevalence of overweight and obesity of BMI$\geq$23kg/m^2, prediabetes, diabetes mellitus, prehypertension, hypertension were 54.8%, 16.4%, 5.1%, 41.8%, 25.6% respectively. Multiple regression analysis showed that body mass index (BMI) correlated with age, sex, education, residence and known status of hypertension and diabetes mellitus. Prevalence of prediabetes, diabetes mellitus, prehypertension and hypertension were increasing as age interval was increasing. The higher prevalence of obesity, prediabetes, diabetes mellitus, pre hypertension and hypertension in this population draws attention of the health care providers to give importance for health promotion services apart from treatment services. This type of health checkup units may be established in various health care facilities for providing health education on lifestyle and behavioural changes, nutritional interventions, early diagnoses and treatment.

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Key words **: Obesity, prediabetes, diabetes mellitus, prehypertension, hypertension.**

Worldwide, the prevalence of Non Communicable Disease (NCD) is increasing at an alarming rate. Diabetes and hypertension are major predisposing factors for death of 18 million people every year from cardiovascular diseases. The growing prevalence of overweight and obesity are important causes for the increase in cases of diabetes and hypertension[1]. The risk factors viz obesity, diabetes mellitus, hypertension are leading cause of the death and disability burden in nearly all countries, regardless of economic development[2]. In a population based study conducted in Chennai, subjects with hypertension had increased body mass index (BMI) compared to Normotensives[3]. A study by Deshmukh et al suggests that there is a significant correlation between obesity indices and systolic and diastolic blood pressure[4]. Excess weight is associated with an increased incidence of disease such as type 2 diabetes mellitus, hypertension. In both genders, overweight and obesity are associated with an increased risk of coronary heart disease and heart failure[5]. In India, obesity is emerging as an important health problem particularly in urban areas. Almost 30-65% adult urban Indians are either overweight or obese. The rising prevalence of obesity in India has a direct correlation with the obesity related comorbidities, hypertension and type 2 diabetes mellitus (type 2)[6]. The information on the prevalence of risk factors of cardiovascular disease viz obesity, type 2 diabetes mellitus and hypertension in health checkup beneficiaries in a hospital setting is very much limited. Hence the present study has attempted to find out the prevalence of obesity, prediabetes, diabetes mellitus, prehypertension and hypertension among health checkup beneficiaries who attended the health checkup unit of a Medical College Hospital in western part of Tamil Nadu state.

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Material and Method

A total of 1818 beneficiaries attended the health checkup unit for health checkup from 01.07.12 to 31.12.12. Among them only 1273 beneficiaries were selected who came on overnight fasting and the remaining 545 were excluded from the study. The data was collected by trained staff by using pretested questionnaire on socio demographic characteristics, anthropometric profile, fasting blood sugar (FBS) and blood pressure. Height and weight were measured by using standard methods. Body mass index (BMI) was calculated by using the formula: weight (Kg)/height^2(m) for all 1273 beneficiaries. The BMI cut–off points were considered to determine the obesity according to Asia-pacific guideline[7]. Body mass index (BMI) $\geq$ 23kg/m^2 was defined as overweight and obesity[8]. Blood sugar status was estimated by venous samples obtained from the beneficiaries. The diagnosis of diabetes mellitus was made using the criteria established by the American Diabetes Association. Fasting plasma glucose (FPG) $\geq$126mg/dL, 100-125 mg/dL, <100 mg/dL were defined as diabetes mellitus, prediabetes or impaired fasting glucose (IFG) and normal respectively[9]. The beneficiaries who were aware of their status of diabetes mellitus (132) and hypertension (141) status (self reported) were excluded to find out prevalence of newly diagnosed diabetes mellitus (DM) and hypertension (HT) individuals. Blood pressure was measured in the right arm in a sitting posture, with the subject in a relaxed state by using a mercury sphygmomanometer by the auscultatory method. Blood pressure was recorded twice by the same staff and the average of the two readings was taken as final. They were classified as hypertensive if he/she was already diagnosed case of hypertension or / on treatment or with a current systolic blood pressure (SBP) $\geq$ 140 mmHg or diastolic blood pressure (DBP) $\geq$ 90 mmHg or both, SBP 130-139 mmHg and DBP 80-89 mmHg as pre-hypertension, SBP <120 mmHg and diastole of <80 mm of Hg was considered as normotension[10]. Informed consent was obtained from the beneficiaries. The study was approved by the local ethical committee. Data entry and analysis was done by using SPSS (version 17). ANOVA and chi square tests were applied wherever applicable and a P$\leq$ 0.05 was considered as significant.

Observations

(1) Socio Demographic characteristics

As per Table 1, from total of 1273 study subjects 719(56.5%) were males and 554 (43.5 %) females. The age of the subjects ranged between 16 and 90 years. The mean age of the subjects was 44 years in both the sexes. Of these, 210 (16.5 %) were below 30 years of age, 496 (39%) in 31-45, 437 (34.3%) in 46-60 and 130 (10.2%) in $\geq$60 years. Of the total subjects, 1206 (94.7%) were Hindus, 44 (3.5%) Christians and 22 (1.8%) Muslims. The subjects from rural area were 835(65.6%). The literate percentage in the sample was 744(58.4%). Our results showed that 269(37.4%), and 248(34.5%) of males were alcoholics and smokers respectively. It was found that 132 (10.4%) of them were self reported diabetes and 157 (12.3%) of their parents (either mother or father or both) were diabetic. It was found that 141(11.1%) of them were self reported hypertensive and 145(11.4%) of their parents (either mother or father or both) were in hypertension.

Table 1 —. *Socio demographic characteristics of subjects*

Characteristics	Male (719)	Female (554)	Total (1273)
<30 Age (years)	127(17.7%)	83(15%)	210(16.5%)
31-45	281(39.1%)	215(38.8%)	496(39%)
46-60	227(31.6%)	210(37.9%)	437(34.3%)
$\geq$60	84(11.7%)	46(8.3%)	130(10.2%)
Married	642(89.3%)	535(96.6%)	1177(92.5%)
Unmarried	77(10.7%)	11(2%)	96(7.6%)
Hindu	685(95.3%)	521(94%)	1206(94.7%)
Christians	21(2.9%)	23(4.2%)	44(3.5%)
Muslims	13(1.8%)	10(1.8%)	23(1.8%)
Illiterate	204(28.4%)	325(58.7%)	529(41.6%)
Up to Middle school	299(41.6%)	171(30.9%)	470(36.9%)
Middle-Higher Secondary school	104(14.5%)	27(4.9%)	131(10.3%)
College	112(15.6%)	31(5.6%)	143(11.2%)
Rural area	466(64.9%)	369(66.6%)	835(65.6%)
Urban area	252(35.0%)	185(33.4%)	438(34.4%)
Skilled worker	44(6.1%)	5(0.9%)	49(3.8%)
Unskilled workers	510(70.9%)	136(24.5%)	646(50.7%)
Home Makers	2(0.3%)	362(65.3%)	364(28.6%)
No work	66(9.2%)	40(7.2%)	106(8.3%)
Professionals	97(13.5%)	11(2%)	108(8.5%)
Alcohol habit present	269(37.4%)	1(0.2%)	270(21.2%)
Smoking habit present	248(34.5%)	1(0.2%)	249(19.6%)
Self reported DM	80(11.1%)	52(9.4%)	132(10.4%)
DM status not known	639(88.9%)	502(90.6%)	1141(89.6%)
Self reported HT	71(9.9%)	70(12.6%)	141(11.1%)
HT status not known	648(90.1%)	484(87.4%)	1132(88.9%)
History of DM in one or both parents	83(11.5%)	74(13.4%)	157(12.3%)
History of HT in one or both parents	83(11.5%)	62(11.2%)	145(11.4%)

(2) Risk of co-morbidities (diabetes mellitus and hypertension) according to Body Mass Index

According to Table 2, the prevalence of overweight and obesity (BMI$\geq$23) was 697(54.8%). Increased risk was found among 472 (37.1%) and 225(17.7%) were with higher risk. The proportion of increased risk and higher risk categories were generally raised significantly as age interval increased. That is, the proportion was 33.8%, 59.4%, 60%, 53% in the age-groups of < 30, 31-45, 46-60 and $\geq$60 years respectively. Sex-wise analysis showed that the percentage of increased and high-risk category was 402 (55.9%) among male and 295(53.2%) among females. The difference in distribution observed in male and female was not statistically significant. Multiple Regression Analysis showed that BMI was correlated with age, sex, education, residence and known or unknown status of HT and DM. It explained only 7% (R-square = 0.067) of the total variation. The analysis of beta coefficients showed that age and education correlated positively with the BMI and urban residents and females were at increased risk over their counterparts.

(3) Prevalence of prediabetes and newly detected cases of diabetes mellitus.

To find out the prevalence of new cases of DM and prediabetes, self reported cases were excluded from the analysis. Among 1141 subjects, 639(56%), 502(44%) were male and female respectively. The prevalence of DM and prediabetes were 58(5.1%) and 187 (16.4%). Among them, 44(6.9%) male and 14(2.8%) female had diabetes. In the case of prediabetes, 99(15.5%), 88(17.5%) were male and female. The differences observed in gender were not statistically significant. As per Fig 1, proportion of DM increased as age interval increased and it was 1.9% among below 30 years, 4.8% in 31-45, 6.8% in 46- 60, 7% in ≥60 years. Prediabetes was 9.6% in below 30, 16.8% in 31-45, 18.4% in 46-60 and 21% in ≥60 years. The differences observed in age group were statistically significant (P<0.01). Only variables namely age and history of presence of DM in either parent were found to be significantly correlated with the FPG. Multiple correlation coefficient R-squared value was found to be 0.063, implying that age and DM history of either parent explain 6 % of the total variation in FPG. However, the ANOVA results showed that the correlation is statistically significant at (P < 0.01). The signs of beta coefficients implied that age was positively correlated with the FPG.

(4) Prevalence of prehypertension and hypertension

As Table 3 shows, in 1132 study subjects 648(57.2%), 484(42.8%) were male and female respectively. Among them 290(25.6%) were in hypertension. The prevalence among men and women were 181(27.9%) and 109(22.5%) and the difference observed was significant (P<0.01). The proportion of hypertension increased as the age interval increased. That is, 13.4% of subjects were in below 30 age group, 20.9% in 31-45, 34.4% in 46-60 and 40.9% in 60 years and above had hypertension. The proportion of hypertension stage 2 was 77 (6.8%). The differences observed was highly significant (P<0.01). In the case of prehypertension a total of 473(41.9%) subjects were in this stage. The proportion of prehypertensive cases was more than 40% in all the age-groups except <30 years. An R-squared value of 0.129 in multiple regression analysis implies that age, BMI and sex explain only 13% of the total variation in hypertension. However, the ANOVA results showed that the relation is statistically significant at (P<0.01). The study of the signs of beta coefficients revealed that age and BMI correlated positively with the blood pressure levels.

Table 2 — *Age wise distribution of risk according to BMI*

BMI Categories(kg/m²)	Age (Years)				Total (1273)
	<30	31-45	46-60	60 ≥	
Underweight (<18.5)	58(27.6%)	58(11.7%)	38(8.7%)	14(10.8%)	168(13.2%)
Increasing but acceptable (18.5-23)	81(38.6%)	143(28.8%)	137(31.4%)	47(36.2%)	408(32.1%)
Increased risk (23-27.5)	53(25.2%)	203(40.9%)	162(37.1%)	54(41.5%)	472(37.1%)
Higher risk (:>27.5)	18(8.6%)	92(18.5%)	100(22.9%)	15(11.5%)	225(17.7%)
Total	210(100%)	496(100%)	437(100%)	130(100%)	1273(100%)

Body mass index (BMI) ≥23kg/m² was defined as overweight and obesity

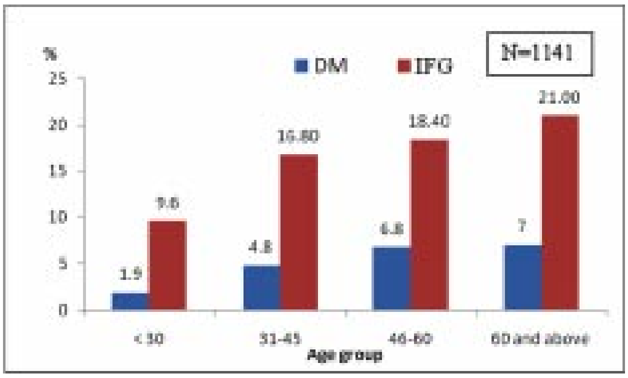

Fig 1 — Agewise DM and Pre Diabetes

Discussion

The overall prevalence of (54.8%) overweight and obesity in this study is higher than (45.9%) in a study conducted among urban Asian Indian population in Chennai, India[11] and the prevalence in females (53.2%) is higher than a community based survey in urban and rural adult females (43.8%) of Punjab[12]. Newly detected DM and prediabetes are found to be (5.1%) and (16.4%) respectively. More than (15%) of the subjects are in prediabetes in all age groups except in <30 years. Even in less than 30 years, prediabetes is (9.6%). Similar to the findings of the various studies, the percentage of DM is increasing significantly with age and it is most pronounced in the fourth and fifth decade of life. Even though, this study is conducted in a hospital setting, proportion of self reported cases diabetes mellitus (10.4%) and newly detected cases (5.1%) ie, (15.6%) are almost similar to the prevalence of population based studies conducted in central Kerala (14.6%) and coastal region of Karnataka

Table 3 — *Newly detected hypertension age wise distribution*

Blood pressure	Age (Years)				Total
	<30	31-45	46-60	≥60	
Normal	112(53.2%)	158(34.1%)	81(22.9%)	18(17.1%)	369(32.6%)
Prehypertension	70(33.3%)	208(44.9%)	151(42.7%)	44(41.9%)	473(41.8%)
Hypertension (stage-1)	27(12.9%)	76(16.4%)	79(22.3%)	31(29.5%)	213(18.8%)
Hypertension (stage-2)	1(0.5%)	21(4.5%)	43(12.1%)	12(11.4%)	77(6.8%)
Total	210(100%)	463(100%)	354(100%)	105(100%)	1132(100%)

(Normal : <120/80 mm of Hg,) (Prehypertension :120-139/80-89 mmHg,)
(Hypertension stage-1 : =140-159/90-99mmHg), (Hypertension stage-2 : =160/100 mmHg)

(16%)[13-16]. Prediabetes subjects are on their way to develop diabetes, which is an important risk for developing coronary artery disease in Indians[17]. More than (40%) of the subjects are in pre-hypertension and more than (25%) of them are newly detected hypertension in all age groups except <30 years. Even in less than 30 years, more than 30% of the study subjects are in pre hypertension and (13%) are suffering from hypertension. The prevalence of hypertension observed in this study (25.6 %) is higher than the prevalence of (20%) in Chennai urban rural population[18], (18.3%) in a cross sectional rural based study conducted in Devanagere[19], (19.33%) in Bangladesh. Similar prevalence of hypertension is observed (24.9%) in West Bengal[20] and the prevalence of the present study is less than the prevalence of (33%) in a community based study conducted in Dindigul[21]and (54.3%) from central part of kerala[22].

Conclusion

The findings of the present study showed that more than half of the subjects were either in increased or high risk category of BMI, one-fourth of them were hypertensive, 5.1% of them were in diabetes mellitus. We have also documented a large number of prediabetes, prehypertensive individuals who are young and they need special attention to avoid early progression to hypertension and diabetes and possibly coronary artery disease that is common in India. These findings suggest that by providing regular health checkup services, the centre based service facilities will be effective in detecting more number of cases in addition to their routine services. This type of health checkup services in various settings (Government, Private, NGO& Voluntary sector) will be beneficial for all health care providers for the early diagnosis, enrolling for treatment and promoting health education services on life style modifications. As diabetes and cardiovascular diseases rapidly becoming the major causes of death in adults of all populations, there is an urgent need to adopt health checkup services as one of the strategy to enhance treatment and health promotion services in all types of existing health care facilities.

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