Original Research Article

A cross-sectional study of prevalenceof cardiovascular risk factors and Its association with socio-economic variables amongst adolescentsof rural Maharashtra

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Abstract

Background: Prevalence of cardio-metabolic risk factors are rapidly increasing amongst the children and adolescents and is topic of concerned due to risk of development of cardiovascular diseases and diabetes in adulthood. The aim of this study is to determine the prevalence and associated Cardio-metabolic risk factors with sociodemographic variables amongst the teenagers of rural population.**Methods**: A cross sectional study carried out on 405 teenagers (13-19year)in a rural population of central India. We collected socio–demographic data and cardio metabolic risk factors using predesigned proforma. Their blood pressure and body mass indices were also recorded. Blood samples were collected for lipid profile and blood sugar. Data was analyzed with EPI – INFO software version 6.04.**Results:** A total of 405 subjects was studied of which 182 were male and 223 were female. The prevalence of metabolic syndrome was found to be 9.9% (95%CI: 7.3-13.1). The prevalence of cardiometabolic risk factors like low level of HDLc, impaired fasting glucose, were found to be 58.3% (95%CI:53.4-63.0) and 13.8% (95% CI:10.7-17.5) respectively. 2.2%of teenagers had a waist circumference more than the cut off (> 90th percentile) while high blood pressure was found in 24.40% (95%CI: 18.6-26.7) i.e.,≥90th percentile for age, sex and height. Similarly, risk factors like obesity and overweight were found significant (p<**0. 05**) in teenagers with family history of obesity.**Conclusion**: Cardiometabolic risk factors slowly extending to rural areas. Therefore, early detection of these risk factors can be an attempt to prevent or delay the metabolic syndrome, diabetes and cardiovascular disease.

Keywords: Cross-sectional study**,**cardiovascular riskfactors,children,socio-economic variable.

Introduction

Metabolic syndrome (MS) is rapidly becoming a global health issue and a topic of concern for epidemiologists and clinicians due to risk of development of cardiovascular disease (CVD) and diabetes in early adult life [1].There has been an increase in the prevalence of cardio-metabolic risk factors amongst the children and adolescents worldwide in the last decades [2]. It has been estimated that by the year 2025, 80% of the global diabetes and CVD burden shall be in low- and middle-income countries with the bulk being in South Asian countries like India and China [3].

Epidemiological evidence suggests that a high level of risk factors and a high mortality burden of cardiometabolic diseases in rural India as well, which is of concern, as 68% of India's population live in rural areas [4]. The socio – economic patterning of cardiometabolic risk factors also has an important implication for individuals and households in low- and middle-income countries like India, where the reach of preventative health programs and health care services remain substantially underdeveloped [4].

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Metabolic syndrome in children is characterized by obesity with increased waist-hip ratio, dyslipidemia, insulin resistance, hypertension and non-alcoholic fatty liver disease (NAFLD) [5]. The prevalence of MS in adolescents is increasing, in parallel with the increasing trends in obesity, as 90% of obese adolescents have at least one feature of the MS [5]. Obesity plays a central role for initiating the other risk factors which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease [6]. Excess adipose tissue in obese children releases inflammatory cytokines, leading to proinflammatory state, and simultaneously the production of the potentially protective adipokine, adiponectin, is reduced [5].

In India the prevalence of obesity in adolescents is around 19.3% [5]. Reduced physical activity; unhealthy dietary habits had a major role in the causation of childhood obesity [6].However, very little data is available in thisregard, especially in rural areas of India. Therefore, the aim of this study is to know the prevalence and associated cardiometabolic risk factors with sociodemographic variables in teenagers of rural population.

Materials and Methods

Study design and setting

A cross sectional study was carried out in the rural area of Primary health center (PHC) Anji, Wardha District from June 2014 to June 2016. All the teenagers in the age group of 10-19 years of PHC were included in the study. The study protocol was approved by Institutional Human Ethical Committee IRB Reference No. Mahatma Gandhi Institute of Medical sciences Wardha /IEC/MS/257/14.Prior to the commencement.Considering the prevalence of metabolic

syndrome among teenagers to be 4.2% [7],a sample size of 405 was required at α-error of 5%, the allowable error of 2%, and non-response rate 5%. The subjects were selected by using simple random sampling. The sampling frame available with the Department of Community Medicine was used for drawing the sample. The subjects were selected after obtaining written informed consent from the parents, in case of children aged 18 years and above, consent was taken from them. The subjects who were not willing to participate in the study or not willing to remain fasting during sample collection were excluded.We collected sociodemographic data in a predefined proforma by house-to-house visit. Data pertaining to age, sex, education, caste, and physical activity, type of family, family income, family history of obesity, hypertension and diabetes was recorded.

Physical activity was calculated using close-ended questions probing self-perceived, self-reported (domestic activity, leisure time and transport related) and intensity of physical activity. The physical activity scores based on intensity and time spent were allotted to each activity and the scores were added together to assess the overall physical activity [8].Height and weight of the subjects were measured (without shoes) with a standard measuring tape and weighing machine to the nearest 0.1 cm and 0.1 kg, respectively. Waist circumference was measured in centimeters (cm) to the nearest 0.1 cm at a level midway between the lower rib margin and the iliac crest, when subjects were lightly clothed. Body mass index (BMI) was assessed by dividing weight (kilograms) by height (meter square). Blood pressure was recorded in the right arm in sitting position, three times in subjects after giving a rest of 10 minutes between each recording with a mercury sphygmomanometer (which was regularly calibrated against a standard B.P instruments). The systolic and diastolic high BP is defined by the blood pressure value >90 th percentile for age, sex, and height [9].

The obesity in the family was assessed by measuring BMI of parents, at least one parent being obese was considered as family history of obesity [10]. Likewise, blood pressure measurements of parents were taken, for family history of hypertension. At least one parent being hypertensive by JNC-VII criteria were considered as family history of hypertension. Parents were asked whether they are known diabetics, or on medication for family history of diabetes.

Biochemical analysis

After an overnight fast (8-10 hour), early morning blood sample samples were taken from subjects. All the collected samples were stored and transported to the laboratory in blood transport box [maintained temperature at 2^0C to 6^0C], processing of samples done within 4-6 hours of sample collection. Fasting plasma glucose was measured by the glucose oxidase peroxidase method [11]. Total cholesterol by Cholesterol Oxidase Peroxidase method [12], Triglyceride by Glycerol Peroxidase Oxidase method [13] and HDLc by a phospotungstic acid method using XL-300 autoanalyser (Company ErbaTranasia Germany) LDL cholesterol value was calculated. In our laboratory coefficient of variation (CV) of glucose, total cholesterol, triglyceride, and HDLc by the above stated method lies within 4%, 3.5%, 6.5%, and 7%, respectively, indicating a good precision of the methods in use.The National Cholesterol Education Program (ATP III) definition modified for age is used to define abnormal levels of cardio-metabolic risk factors in adolescent [14].

The criteria are as follow

1) Abdominal obesity (≥ 90th percentile waist circumference).
2) Triglyceride level≥110mg/dl.
3) HDL cholesterol level ≤40mg/dl.
4) Systolic or diastolic high blood pressure was defined by blood pressure value ≥90th percentile for age sex and height.
5) Fasting blood glucose levels ≥100mg/dl [15].

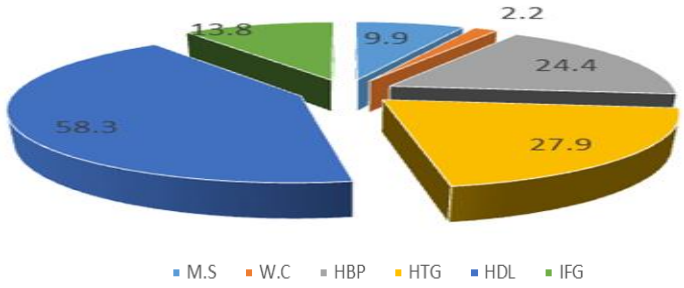
Presence of any three of five risk factors mentioned above were consider as metabolic syndrome.

Statistical analysis

Statistical analysis was done using SPSS 12.0 software version 6.04 & Health Watch Pro version 3.1 software. P value < 0.05 considered as significant and the Chi square test was used to test the significance. The odd ratio was calculated to evaluate the risk factors along with their 95% confidence interval.

Results

405 teenagersin the age group of 10-19 years were included of these 185 were male and 223 were female with male female ratio of 0.8:1. The Overall prevalence of metabolic syndrome was about 9.9% (95%CI:7.3-13.1) in the study population. The prevalence of individuals cardiometabolic risk factors like low level of HDLc, hypertriglyceridemia and impaired fasting glucose, were found to be 58.3% (95%CI:53.4-63.0), 27.9% (95%CI:23.7-32.4) and 13.8% (95%CI:10.7-17.5) respectively. 2.2% (95%CI: 1.1-4.0) of the teenagers had a waist circumference more than the cut off (> 90th percentile) while high blood pressure was found in 24.40 % (95%CI: 18.6-26.7) i.e.≥90th percentile for age, sex and height. [Figure 1]



[M.S- metabolic syndrome, W.C- waist circumference, HBP- high blood pressure, HTG- high triglyceride, HDL- high density lipoprotein, IFG- impaired fasting glucose]

Fig 1: Prevalence of Metabolic syndrome & Cardiometabolic risk factors in study population

Association of sociodemographic variable with metabolic syndrome and Cardiometabolic risk factors

Age, sex and physical activity

The prevalence of metabolic syndrome did not differ significantly (p≥0.05) by age, sex and physical activity. Prevalence of individual cardiometabolic risk factors such as high blood pressure, obesity, overweight, lower level of HDLc, hypertriglyceridemia,impaired fasting glucose did not differ significantly (p≥0.05) with sociodemographic variable like age, sex and physical activity group. **[Table 1]**

Table 1: Association of age, sex and physical activity with cardio metabolic risk factors and metabolic syndrome

Age group(in year	Total(n)	M.S n(%)	HBP n(%)	WC n(%)	BMI n(%)	HDLc n(%)	HTG n(%)	IFG n(%)
<15	159	17(10.7)	37(23.3)	3(1.9)	9(5.7)	86(54.1)	47(29.6)	20(12.6)
≥ 15	246	23(9.3)	62(25.2)	6(2.4)	13(5.3)	150(61.0)	66(26.8)	36(14.6)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p- Value	--	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05
sex								
Male	182	14(7.7)	43(23.6)	3(1.6)	14(7.7)	103(56.6)	47(25.8)	27(14.8)
Female	223	26(11.5)	56(25.1)	6(2.7)	8(3.6)	133(59.6)	66((29.6)	29(13.0)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p- Value	--	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05
Physical activity	Total(n)							
Light	291	25(8.6)	69(23.7)	9(3.1)	16(5.5)	161(55.3)	76(26.1)	35(12.0)
Moderate	114	15(13.2)	30(26.3)	0	6(5.3)	75(65.8)	37(32.5)	21(18.4)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value	--	>0.05	>0.05	--	>0.05	>0.05	>0.05	>0.05

Family income and family history of obesity

The prevalence of metabolic syndrome (p≥0.05) and cardio metabolic risk factors such as high blood pressure, obesity, overweight, lower level of HDLc, hypertriglyceridemia, impaired fasting glucose did not differ significantly (p≥0.05) with family income.

Whereas the prevalence of metabolic syndrome was found to be higher (18.6%) in the subject with family history of obesity as compared with the subjects (8.8%) without a family history of obesity. The prevalence differs significantly with a family history of obesity **(p<0.05). [**Table 2]

Table 2: Association of cardio metabolic risk factors & metabolic Syndrome with family income and family history of obesity

Family Income in Quartiles	Total(n)	M.S(n%).	HBP (n %)	WC (n %)	BMI (n %)	HDLc (n %)	HTG (n %)	IFG (n %)
1st Quartile	117	9(22.5)	23(23.2)	1(11.1)	5(22.7)	67(28.4)	32(28.3)	13(23.2)
2nd Quartile	115	10(25.0)	22(22.2)	1(11.1)	6(27.3)	75(31.8)	29(25.6)	14(25.0)
3rd Quartile	89	11(27.5)	28(28.3)	2(22.2)	4(18.2)	49(20.8)	26(23.0)	15(26.8)
4thQuartile	84	10(25.0)	26(26.3)	5(55.6)	7(31.8)	45(19.1)	26(23.0)	14(25.0)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value		≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05	≥0.05
Family history of Obesity								
Yes	43	8(18.6)	13(30.2)	6(14.0)	6(14.0)	29(67.4)	12(27.9)	10(23.3)
No	362	32(8.8)	86(23.8)	3(0.8)	16(4.4)	207(57.2)	101(27.9)	46(12.7)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value	--	**<0.05**	>0.05	**<0.05**	**<0.05**	>0.05	>0.05	>0.05

The prevalence of obesity (14.0%) and overweight (14.0%) was also found higher in the subjects with a family history of obesity than the subjects without a family history of obesity (0.8%) and overweight (0.8%). The prevalence was found to be statistically significant **(p<0.05)**But, the prevalence of high blood pressure, low level of HDLc, hypertriglyceridemia and IFG did not differ significantly (**p≥0.05**) with a family history of obesity.

Family history of hypertension and diabetes

The prevalence of metabolic syndrome was found to be higher (25.0%) in the subjects with a family history of hypertension and lower (8.9%) in the subjects with no family history of hypertension. Thus, the metabolic syndrome differs significantly **(p<0. 05)** in the subjects with a family history of hypertension**.** Also, the prevalence of overweight, impaired fasting glucose was significantly **(p<0. 05)** different in subjects with a family history of hypertension.

But, the prevalence of high blood pressure, low level of HDLc and hypertriglyceridemia were not significantly different in subjects with a family history of hypertension (p≥0.05).While in family with history of diabetes, obesity and overweight were found higher (15.4%) & (23.1%) respectively**.** Thus, the prevalence of obesity and overweight differ significantly **(p<0. 05)** with family history of diabetes.

The prevalence of metabolic syndrome, high blood pressure, lower level of HDLc, hypertriglyceridemia and impaired fasting glucose did not differ significantly (p≥0.05) to family history of diabetes. **[**Table 3]

Table 3: Association of family history of hypertension and Diabetes with metabolic risk factors & metabolic syndrome

Family History of Hypertension	Total(n)	M.S. n(%)	HBP n(%)	WC n(%)	BMI n(%)	HDLc n(%)	HTG n(%)	IFG n(%)
Yes	24	6(25.0)	7(29.2)	4(16.7)	5(20.8)	16(66.7)	8(33.3)	8(33.3)
No	381	34(8.9)	92(24.1)	5(1.3)	17(4.5)	220(57.7)	105(27.6)	48(12.6)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value	--	**<0.05**	≥0.05	--	**<0.05**	≥0.05	≥0.05	**<0.05**
Family History of Diabetics								
Yes	13	2(15.4)	2(15.4)	2(15.4)	3(23.1)	9(69.2)	4(30.8)	4(30.8)

No	392	38(9.7)	97(24.7	7(1.8)	19(4.9)	227(57.9)	109(27.8)	52(13.3)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value	--	>0.05	>0.05	**<0.05**	**<0.05**	>0.05	>0.05	>0.05

Discussion

The overall prevalence of metabolic syndrome in our study was 9.9%, which was on the higher side compared to study by Panda PK [5]Singh et al [16]and Gupta et al [17] from India which were 3.8 % 2.6% and 3.3% respectively. Within the capital city of Iran, Esmaillzadeh et al, reported a prevalence of 10.1% for the metabolic syndrome in adolescents aged 10-19 years **(**10.3% of boys and 9.9% in girls) [18].Cook et al also reported 4.2% of the prevalence of metabolic syndrome in adolescents 12-19 years of age group and it increased to 6.4% in the NHANES study during 1999-2000 [14]. A comparatively higher prevalence of metabolic syndrome reported in our study can be attributed to difference in study setting, population and difference in the definition used for metabolic syndrome.

Metabolic syndrome, in the present study, was significantly associated with a family history of obesity (p<0. 05). We found that the prevalence of metabolic syndrome was significantly higher being 25 % among those with a family history of hypertension as against 8.9% without a family history of hypertension (p<0. 05). Similarly, the prevalence of metabolic syndrome was significantly higher being 18.6 % among those with a family history of obesity as against 8.8% among those without family history of obesity (p<0.05). Recent models identified some genes causing human obesity, which include LEP, leptin receptor (*LEPR*), the melanocortin4 receptor (*MC4R*), and pro-opiomelanocortin (*POMC*) genes [19].Deletion in *POMC* gene affects body weight and food motivation, thereby showing the importance of the overall leptin/melanocortin pathway on the obese phenotype [19].The prevalence of metabolic syndrome was higher in females 182 (11.7%) than in males 223 (7.7%), though it was not statistically significant. There were a considerable number of reports suggesting no significant difference in prevalence of metabolic syndrome with age and sex. The cross-sectional survey of adolescents in Ho Chi Minh City, showed an overall prevalence of metabolic syndrome was 4.6% and there was no difference by gender (p = 0.9) but the prevalence of metabolic syndrome slightly higher in female (4.7%) than in male (4.6%) [20]. In contrary to our finding, Cook et al study showed higher prevalence in males (6.1%) than in female (2.1%) [14]. Whereas Panda PK [5] found a nearly equal prevalence of metabolic syndrome in (males 3.9% and females 3.8%). The reason for the gender differences in prevalence of metabolic syndrome in our study might be due to different cutoff points set as criteria for metabolic syndrome like waist circumference and HDL-C. Also increase the prevalence of the metabolic syndrome was higher in females than in males worldwide, including developing South Asian countries, is driven by increased obesity in females [21].In the present study the prevalence of obesity was found 2.2% (95% CI:1.1-4.0) by waist percentile and that of overweight was 5.4% by body mass index. Similarly, Prasad et al also showed that the prevalence of overweight was 9.7% and of obesity was 4.3% of teenagers aged 10 to 18 years [22]. Study conducted by George et al. in Kerala among rural adolescent showed prevalence of overweight and obesity of 16% and 7%, respectively [23]. However, another study from Kerala among the rural school going girls, showed that nearly 42.66% of subjects were overweight, whereas 8.7% were obese [25].In the present study, the prevalence of overweight found to be significantly higher in subjects with a family history of obesity, hypertension and diabetes (p<0. 05). Also, the prevalence of obesity was found to be higher in children of families with higher (55.6%) monthly income (4th quartile) than less monthly income (first Quartile) and less educational achievements (< 7th class). Similarly, Goyal RK, et al showed the positive association of obesity with a family history of obesity and higher economic group [25]. **Whereas in USA prevalence of obesity is more in** children of parents with lower monthly income and less educational achievement [5].The overall prevalence of high blood pressure was found to be 24.4% (95%CI: 18.6-26.7), 25.1% in females as against 23.6% in males. Another study from the rural central India found the prevalence of hypertension in 6.8% and 7.0% of males and females, respectively [26].Also, the prevalence of adolescents' hypertension has varied between different populations within India. Goel et al in their study on students aged 14–19 years in New Delhi found 6.4% of adolescents to be hypertensive [27].Kumar et al from Patna, India showed overall prevalence of pre hypertension was 10.9% in adolescent [28].The prevalence of hypertension in teenagers is high in India compared to western countries like the USA where it was found to be 2.7%–3.7% in different population-based surveys [26].Variations in the prevalence of hypertension among these studies could partly be attributed to differences in the study design, selection of different cutoff points for defining hypertension, age difference, the number of visits made for measurement of BP, and type of instruments used for recording of the blood pressure.

In contrast to several other studies, present study didn't find significant association of family history of hypertension in adolescent with high blood pressure. Ezeudu CE et alfound that the prevalence of hypertension was higher among subjects with positive family history of hypertension [29].The prevalence of hypertriglyceridemia and increased lower level of high-density lipoprotein cholesterol were found be27.9 % (95%CI: 23.7-32.4) and 58.3 % (95%CI:53.4-63.0) respectively. The prevalence of hypertriglyceridemia was found to higher in females (29.6%) than in males (25.8%). Similarly, Krishna et al found that the prevalence of hypertriglyceridemia was observed in 62.1% of girls and 47.8% of boys.In the present study, the prevalence of dyslipidemia was found to be higher, among other backward class [Table 4]. Possibility of dyslipidemia in upper caste may because of they were from higher socioeconomic groups, over eating dietary habit, low physical activity and sedentary lifestyle.

Table 4: Association of caste with cardio metabolic risk factors and metabolic syndrome

Caste	Total(n)	M.S n(%)	HBP n(%)	WC n(%)	BMI n(%)	HDLc n(%)	HTG n(%)	IFG n(%)
General	47	4(8.5)	9(19.1)	1(2.1)	2(4.3)	27(57.4)	12(25.5)	10(21.3)
OBC	187	24(12.8)	54(28.9)	7(3.7)	13(7.0)	113(60.4)	57(30.5)	30(16.0)
ST/SC	171	12(7.0)	36(21.1)	1(0.6)	7(4.1)	96(56.1)	44(25.7)	16(9.4)
Total	405	40(9.9)	99(24.4)	9(2.2)	22(5.4)	236(58.3)	113(27.9)	56(13.8)
p-Value		≥0.05	≥0.05	<0.05	≥0.05	≥0.05	≥0.05	≥0.05

We found prevalence of dyslipidemia to be higher in the subjects with family history of obesity, hypertension and diabetes. Thus, the subjects from these families were at more risk of developing disease, including cardiovascular and diabetes in the future.In our study, 13.8% of subjects had impaired fasting glucose was 13.8% and 86,2% of subjects had normal glucose levels. The prevalence of impaired fasting glucose differs significantly (p<0.05) with a family history of Diabetes. Similarly, findings were also noted by Andrabi

SM et al [7] in their study on prevalence of MS in 758 school-going children (8 –18-year-old) of Kashmir, India.The results of the present study revealed that clustering of cardio metabolic risk factors and metabolic syndrome is a major health problem in rural area of developing countries also. Therefore, awareness of cluster of risk factors and preventive measures should be emphasized in population-wide prevention strategies in rural areas, primarily focusing on children and teenagers[30]

Conclusion

The prevalence of Metabolic syndrome is concerning even in rural India. Identification of cardiometabolic risk factors, i.e., family history of diabetes and hypertension at the early age can be useful to prevent consequent cardiovascular disorders and diabetes in early adulthood. Families and health workers should be educated on integrated healthful lifestyles as measures to prevent early development and progression of cardiometabolic risk factors. Our study is limited by its relatively small sample size and cross-sectional design; we recommend a larger, prospective cohort study, which will include all cardiometabolic risk factors and sociodemographic variables in the evolution of metabolic syndrome in teenagers.

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