Original Article

Depression, Stress, and Cardiovascular Risk Factors in India Heart Watch: A Population-Based Cross Sectional Study

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ABSTRACT

Introduction: A population-based study to determine association of depression and stress with cardiovascular risk factors was performed.

Methodology: We evaluated 5234 urban subjects (men 2891, women 2343) in 11 cities. Prevalence of depression, and perceived stress (work, home, or financial for >12 months) and cardiovascular risk factors was determined. Associations were tested using logistic regression, odds ratio (OR) and 95% confidence intervals (CI) calculated.

Results: Age-adjusted percent prevalence (95% CI) in men and women of depression was 23.5 (21.9-25.0) and 24.7 (23.1-26.3), home stress 56.0 (54.2-57.8) and 60.5 (58.5-62.5), work stress 46.3 (44.5-48.1) and 36.5 (34.5-38.4), financial stress 54.4 (52.6-56.2) and 55.5 (34.5-38.4), all three 30.7 (29.0-32.4) and 23.8 (22.1-25.5) and depression with all three in 11.3 (10.1-12.4) and 7.8 (6.7-8.9). In individuals with depression v/s without, prevalence (%) was significantly greater for physical inactivity (men 46.6 v/s 36.4, women 51.9 v/s 45.5), high waist-hip ratio (men 80.2 v/s 67.2, women 88.5 v/s 83.4), low HDL cholesterol (men 37.7 v/s 32.3, women 58.1 v/s 52.0), and diabetes (men 17.5 v/s 15.5, women 14.5 v/s 12.4) ($p<0.05$). Subjects with different stresses had greater prevalence of physical inactivity, truncal obesity, hypertension, low HDL cholesterol, and diabetes ($p<0.05$).

Conclusions: Depression and stress are associated with decreased physical activity and greater truncal obesity, low HDL cholesterol, and diabetes in India.

Keywords: Cardiovascular risk factors, Coronary heart disease; Diabetes, Hypertension, Metabolic syndrome, Physical inactivity.

INTRODUCTION

Psychological factors such as depression, chronic anxiety, and personality types are important determinants of cardiovascular disease, especially coronary heart disease (CHD). It has been reported that depression is associated with odds ratio (OR) of 1.5-2.0 for incident CHD (angina, myocardial infarction, or cardiovascular death).[1] A meta-analysis reported that subjects with significant depression had odds of 1.34 (95% confidence intervals 1.1-1.6).[2] Most studies that evaluated association of chronic stress factors with adverse CHD outcomes reported slightly lower ORs and some did not report any association.[3-5] Acute stress has been well reported as a risk factor for acute myocardial infarction.[6] The exact mechanistic pathways responsible for the increased CHD incidence in subjects with depression or stress are not well described and appear to be multifactorial.[7] Sociological environments can lead to depression and stress which directly or through changes in health behaviors (smoking or tobacco use, physical inactivity, unhealthy diet, etc.) can lead to CHD.[1] On the other hand, presence of vascular disease can lead to depression or stress and causes greater CHD events and mortality.[8]

In India and other low and low-middle income countries cardiovascular diseases including CHD have emerged as major health problems.[9] These are also major causes of mortality and morbidity.[10,11] Depression and other stressors are also widely prevalent.[11,12] Only a few small studies have

reported association of various psychosocial factors with prevalence CHD or its risk factors in India or South Asians.[13-15] The INTERHEART case-control study reported that psychosocial factors (depression as well as chronic stress (home, work, or finance-related) were important acute myocardial infarction risk factors.[16] These factors were equally important in South Asian subjects.[17] We performed a population based multisite epidemiological study in urban middle-class subjects in India to evaluate association of depression and chronic stress (work-related, home-related, or financial) with multiple cardiovascular risk factors. This group of apparently homogenous subjects provides unique opportunity to identify association of multiple psychological factors with cardiovascular risk factors.

METHODS

A multisite study to identify prevalence of cardiovascular risk factors and their socio-demographic determinants was organized among urban subjects in India. Rationale for the study has been reported.[9] Protocol was approved by the institutional ethics committee of the national coordinating center and written informed consent was obtained from each participant. The case report form was developed according to recommendations of the World Health Organization (WHO)[18] and used earlier in our studies.[19]

We planned the study to identify prevalence of cardiometabolic risk factors and their determinants in urban subjects in India.[20] Briefly, 20 investigators were invited from all large states of India and 15 agreed to participate and 11 finally performed the surveys. The cities are in northern (Jammu, Chandigarh, Bikaner), western (Ahmadabad, Jaipur), eastern (Lucknow, Patna, Dibrugarh), and southern (Madurai, Belgaum, Nagpur) regions of the country. Data were collected in the years 2006-2010 at various locations. A sample size of about 250 men and 250 women (n=500) at each site is considered adequate by the WHO to identify 20% difference in mean level of biophysical and biochemical risk factors.[18] We invited 800-1000 subjects in each location to ensure participation of at least 500 subjects at each site estimating a response of 70% as reported in previous studies at similar locations.[19] At each site a uniform protocol of sampling and recruitment was followed.[20]

Apart from demographic history, details of socioeconomic status based on educational status, occupational class, and self-assessed socioeconomic status, type of family, history of hypertension, diabetes, lipid abnormalities, and cardiovascular disease were inquired. Smoking details were inquired for type of smoking or tobacco use. Intake of alcohol was assessed as drinks per week. Dietary fat was assessed using questions about type of cooking oil used and estimated visible fat intake (g) daily. Fruits and vegetables intake were assessed by a question that inquired number of servings (medium portions) of either fruits or green leafy vegetables.[21] Details of physical activity were assessed by questions for exact daily duration (minutes) of work related, commute related, and leisure time physical activity. All the equipment for measurements of height, weight, waist and hip size, and blood pressure were similar at all centers. Height was measured using stadiometer, weight using calibrated spring weighing machines, and waist and hip circumference was measured using standard WHO guidelines.[22] Sitting blood pressure measured after at least 5 minute rest using standardized instruments. Three readings were obtained and were averaged for the data analysis. Fasting blood sample was obtained from all individuals after 8-10 hours fasting. The blood samples were obtained at community centers by technicians from an accredited national laboratory- Thyrocare Technologies Ltd., Mumbai, India (www.thyrocare.com). Blood glucose was measured at the local biochemistry facility of these laboratories. All the blood samples were analyzed at a single laboratory and a uniform protocol was used for measurements. Cholesterol, high density lipoprotein (HDL) cholesterol, and triglyceride levels were measured using enzyme-based assays with internal and external quality control (www.thyrocare.com). Values of low density lipoprotein (LDL) cholesterol were calculated using Friedwald formula (LDL cholesterol = [total cholesterol - (HDL cholesterol + triglycerides/5)].

Criteria for diagnoses of depression and chronic stressors were based on validated questionnaire used in the INTERHEART study.[16] This questionnaire has been validated in India also.[17] Diagnosis of depression was based on affirmative response to the questions: (i) during the past twelve months were you felt depressed for >2 weeks in a row? (ii) If depressed which emotion did you feel: (a) I feel

sad, (b) I am sad all the time and I can't snap out of it, (c) I am so sad or unhappy that I can't stand it, or (d) I feel discouraged about the future. Level of work-related, finance-related,family/personal-relatedstress has been inquired and classified as nil, some occasions, several occasions, or permanent stress.[17] Depression and moderate to permanent stress were converted into dichotomous variables for analyses. Criteria for diagnosis of risk factors has been reported earlier.[20,23] The diagnostic criteria for tobacco use as well as other coronary risk factors have been advised by the WHO.[18] Those involved in any significant physical activity were classified as active and with >30 minutes of work-, leisure-, or commute-related physical activity were classified as moderately active.[20] Hypertension was diagnosed when systolic blood pressure was ≥140 mmHg and/or diastolic ≥90 mmHg or a person was a known hypertensive. Overweight was defined as body mass index ≥25 kg/m^2 and obesity defined by body mass index ≥30 kg/m^2. Truncal obesity was diagnosed when waist-hip ratio was >0.9 in men and >0.8 in women or waist circumference was >90 cm in men and >80 cm in women.[24] Dyslipidemia was defined by the presence of high total cholesterol (>5.17 mmol/L), high LDL cholesterol (>3.37 mmol/L), low HDL cholesterol (<1.04 mmol/L in men and <1.30 mmol/L in women) or high triglycerides (>1.7 mmol/L), or if the individual was on treatment with cholesterol-lowering drugs. Diabetes was diagnosed on the basis of either history of known diabetes on treatment or fasting glucose >7.0 mmol/L.

Statistical analyses: All the data were entered into SPSS database (Version 10.0, SPSS Inc, Chicago). Subjects in whom data on psychological questionnaire was available were included. Values for men and women have been analyzed separately. Numerical variables are reported as

Table 1: Demographic and lifestyle characteristics of the study subjects (N= 5234)

Variables	Total (N=5234)	Men (N=2891)	Women (N=2343)
Age groups			
<30	394(7.5)	217(7.5)	177 (7.6)
30-39	988(18.9)	496(17.2)	492 (21.0)
40-49	1431(27.3)	778 (26.9)	653(27.9)
50-59	1277(24.4)	730 (25.3)	376(16.0)
60-69	828(15.8)	452 (15.6)	547 (23.3)
70+	316(6.0)	218 (7.5)	98 (4.2)
Educational status			
0-10 years	1132(21.6)	389 (13.5)	743(31.7)
11-15 years	2617(50.0)	1528(52.9)	1089(46.5)
>15 years	1161((22.2)	826(28.6)	335(14.5)
Occupational class			
Professional/Executive/Clerical	1907(36.4)	1231(42.6)	676(28.9)
Business	1523(29.1)	944(32.7)	579(24.7)
Manual skilled	344(6.6)	199(6.9)	145(6.2)
Non-manual skilled	243(4.6)	115(4.0)	128(5.5)
Manual labour	189(3.6)	67(2.3)	122(5.2)
Unemployed	903(17.3)	280(9.7)	623(26.6)
Socioeconomic status			
1-3 (Low)	306(5.8)	180(6.2)	126(5.4)
4-6 (Middle)	3170(60.6)	1700(58.8)	1470(62.7)
>6 (High)	986(18.8)	597(20.7)	389(16.6)
Rural-urban migrants	936(17.9)	551(19.1)	385(16.4)
Family type			
Nuclear	1869(35.7)	978(33.8)	891(38.0)
Extended	651(12.4)	387(13.4)	264(11.3)
Joint	2592(49.5)	1454(50.3)	1138(48.6)
Others	41(0.8)	15(0.5)	26(1.1)
Marital status			
Married	4505(86.1)	2515(87.0)	1990(84.9)
Unmarried	315(6.0)	210(7.3)	105(4.5)
Others	317(6.1)	112(3.9)	205(8.7)

means ±1 SD and categorical variables as percent. Descriptive statistics are presented. Age-adjustment was performed using direct method with 2001 Indian census population as standard. Prevalence of risk factors in the study population and in various groups is reported as percent and 95% confidence intervals (CI). Inter-group comparisons were performed using X^2 test. Univariate and age-adjusted logistic regression was performed to identify risk factors of importance. Odds ratios (OR) and 95% CI were determined. p values of <0.05 were considered significant.

RESULTS

Details of psychological questionnaire were available in 5234 of the 6198 subjects enrolled in the study (men 2891, women 2343). Demographic characteristics are shown in table 1.

The characteristics are not dissimilar to those of the overall cohort.[20] Low educational status was present in 13.5% men and 31.7% women. Majority of men (or spouses) were either professional or executives or businessmen or in clerical jobs. More than 85% men and women were married and more than half lived in either joint or extended nuclear families. Prevalence of various lifestyle and cardio-metabolic risk factors in the study cohort is shown in figure 1. There is a high prevalence of physical inactivity, high visible fat intake, overweight, truncal obesity (high WHR) hypertension, low HDL cholesterol, hypertriglyceridemia, and metabolic syndrome.

Age-adjusted prevalence (95% CI) of depression in men was 23.5% (21.9-25.0) and women 24.7% (23.1-26.3). Prevalence of risk factors in subjects with depression and without is shown in table 2.

In subjects with depression v/s. without, prevalence of physical inactivity (men 46.6 v/s. 36.4, women 51.9 v/s. 45.5%), high WHR (men 80.2 v/s. 67.2, women 88.5 v/s. 83.4%), low HDL cholesterol (men 37.7 v/s. 32.3, women 58.1 v/s. 52.0%), and diabetes (men 17.5 v/s. 15.5, women 14.5 v/s. 12.4%) was significantly greater (p<0.05). Prevalence of smoking, smokeless tobacco use, alcohol use, overweight, obesity, hypertension, high total cholesterol or high triglycerides was not significantly different in subjects with depression v/s. without. Age and sex-adjusted ORs showed that subjects with depression had

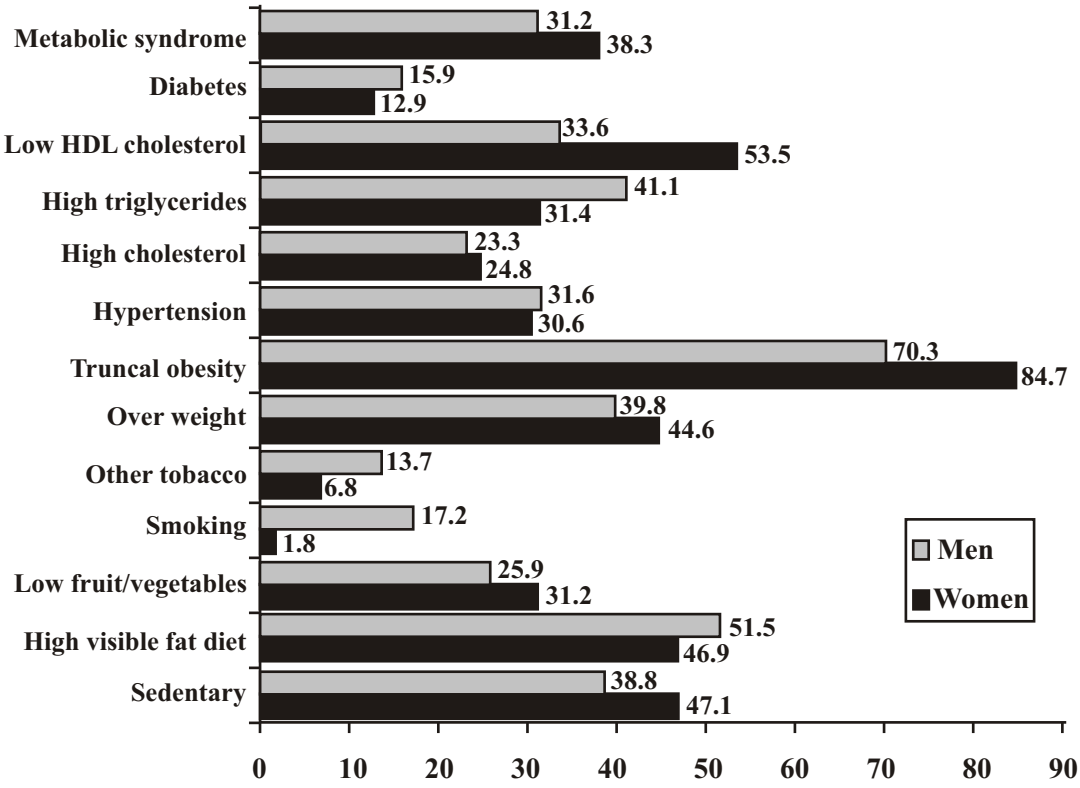

Figure 1: Prevalence (%) of various lifestyle and cardio-metabolic risk factors in men and women in the study population (n=5238).

Table 2: Age-adjusted prevalence (95% confidence intervals) of lifestyle and cardio-metabolic risk factors in men and women with depression

	Men		Women	
	Depression	No depression	Depression	No depression
Numbers	**681**	**2210**	**578**	**1764**
Physical inactive	47.4 (43.6-51.1)	36.2 (34.2-38.2)	50.8 (46.7-54.9)	45.8 (43.5-48.1)
High visible fat intake >40 g/day	52.1 (48.3-55.8)	51.3 (49.2-53.4)	45.1 (41.0-49.1)	47.5 (45.2-49.8)
Low fruits and vegetables intake (<2 servings/day)	27.0 (23.7-30.3)	25.6 (23.8-27.4)	32.5 (28.7-36.3)	30.8 (28.6-32.9)
Smoking (current/ex-smokers)	17.3 (14.5-20.1)	17.2 (15.6-18.8)	1.2 (0.31-2.09)	2.0 (1.35-2.65)
Other tobacco use	13.1 (10.6-15.6)	13.9 (12.4-15.3)	3.4 (1.9-4.9)	7.9 (6.6-9.2)
Alcohol consumption >7 drinks/week	0.4 (-0.07-0.87)	0.80 (0.43-1.17)	–	–
Obesity: BMI >25 kg/m^2	37.4 (33.8-41.0)	40.5 (38.4-42.5)	44.3 (40.2-48.3)	44.9 (42.6-47.2)
Obesity: BMI >30 kg/m^2	7.0 (5.1-8.9)	7.6 (6.5-8.7)	12.4 (9.7-15.1)	14.5 (12.8-16.1)
Truncal obesity: WHR >0.9/>0.8, men/women	81.5 (78.6-84.4)	66.9 (64.9-68.8)	86.7 (83.9-89.5)	84.0 (82.3-85.7)
Hypertension	30.1 (26.6-33.5)	32.2 (30.2-34.1)	29.4 (25.7-33.1)	31.0 (28.8-33.1)
High total cholesterol >5.17 mmol/L	21.4 (18.3-24.5)	23.1 (21.3-24.8)	25.4 (21.8-28.9)	24.7 (22.7-26.7)
High triglycerides >1.7 mmol/L	41.5 (37.8-45.2)	40.9 (38.8-42.9)	29.2 (25.5-32.9)	32.2 (30.0-34.4)
Low HDL cholesterol <1.03/<1.30 mmol/L, men/women	38.8 (34.6-41.9)	32.2 (30.1-34.0)	56.9 (52.8-60.9)	52.3 (49.9-54.6)
Diabetes (known or fasting glucose >7.0 mmol/L)	17.7 (14.8-20.6)	15.4 (13.9-16.9)	14.2 (11.3-17.0)	12.5 (10.9-14.0)
Metabolic syndrome	31.4 (27.9-34.9)	31.1 (29.7-33.0)	37.0 (33.0-40.9)	38.7 (36.4-40.9)

*X^2 test, *p<0.05, **p<0.01, ***p<0.001

greater physical inactivity (men 1.35, CI 1.13-1.61; women 1.40, 1.19-1.92), high waist-hip ratio in (men 1.63, CI 1.26-2.10; women 1.20, CI 0.83-1.72), low HDL cholesterol (men 1.32, CI 1.10-1.58; women 1.17, CI 0.96-1.41), and diabetes (men 1.15, CI 0.93-1.41; women 1.13, 0.88-1.45). Other risk factors were not significantly different (Figure 2).

Prevalence (95% CI) of different types of stressors in men and women, respectively was, home-related stress 56.0% (54.2-57.8) and 60.5% (58.5-62.5), work-related stress 46.3% (44.5-48.1) and 36.5% (34.5-38.4), financial stress 54.4% (52.6-56.2) and 55.5% (34.5-38.4), and all three in 30.7% (29.0-32.4)and 23.8% (22.1-25.5). Age- and sex-adjusted ORs of prevalence of cardiovascular risk factors in subjects with different forms of stress are shown in figure 3. As compared to subjects with no reported stress, those with any form of stress had greater physical inactivity, truncal obesity, hypertension, low HDL cholesterol, diabetes and metabolic syndrome. Age-adjusted ORs show that home-based stress is associated with significantly greater prevalence of physical inactivity (OR 1.15, CI 1.03-1.29), other tobacco use (OR 1.63, CI 1.37-1.94), truncal obesity (OR 1.71, CI 1.45-2.02) and low HD cholesterol (OR 1.41, CI 1.25-1.58) and marginally greater prevalence of diabetes (OR 1.10, CI 0.95-1.27) and metabolic syndrome (OR 1.11, CI 0.99-1.25). Work related stress was associated with greater prevalence of smoking (OR 1.63, CI 1.37-1.94), other tobacco use (OR 1.53, CI 1.29-1.81), truncal obesity (OR 1.17, CI 0.99-1.39), hypertension (OR 1.20, 1.05-1.34), diabetes (OR 1.30, CI 1.12-1.50), and metabolic syndrome (OR 1.10, CI 0.98-1.23). Financial stress was associated with greater physical inactivity (OR 1.14, CI 1.02-1.28), other tobacco use (OR 2.38, CI 1.99-2.86), truncal obesity (OR 1.93, 1.64-2.28), high triglycerides (OR 1.20, CI 1.07-1.35), low HDL cholesterol (OR 1.51, CI 1.34-1.69) and metabolic syndrome (OR 1.08, CI 0.96-1.21). Presence of all the three stressors was associated with greater smoking (OR 1.36, CI 1.12-1.63), other tobacco use (OR 1.67, CI 1.1-2.00), obesity (OR 1.31, CI 1.08, 1.59), truncal obesity (OR 1.36, CI 1.13-1.65), low HDL cholesterol (OR 1.18, CI 1.05-1.34), and diabetes (OR 1.15, CI 0.99-1.34). Prevalence of depression with all three stressors in men was 11.3% (10.1-12.4) and women 7.8% (6.7-8.9). These subjects had greater prevalence of physical inactivity (men OR 1.51,

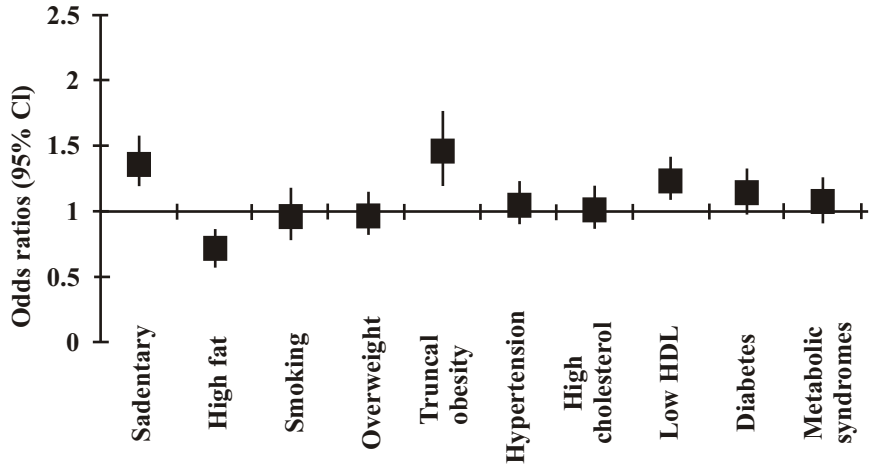

Figure 2: Odds ratios (95% confidence intervals) of prevalence of various cardiovascular risk factors in subjects with depression as compared to those without (age-and sex-adjusted logistic regression).

1.19-1.92; women OR 1.36, 1.01-1.83), high total cholesterol (men OR 1.37, 1.03-1.81) and the metabolic syndrome (women OR 1.07, 079-1.45). Other risk factors were not significantly different.

DISCUSSION

A number of psychosocial factors have been linked to the progression or prevention of cardiovascular diseases. These include negative thought patterns and emotions (depressive syndromes, anxiety syndromes, hostility and anger, worry, and pessimism); and chronic stress (work stress, marital stress, social isolation and lack of social support, caregiver strain, perceived injustice, and adverse childhood experience).[25] Our study shows a high prevalence of depression and other chronic stressors (work-related, home-related, or financial) in urban middle-class Indian men and women. Both depression and chronic stress are associated with sedentary lifestyle, high waist-hip ratio, and greater prevalence of low HDL cholesterol and diabetes.

High prevalence of depression as well as chronic stressors is observed in the present study subjects. Global Burden of Diseases (2010) reported that globally 54% of all disability adjusted life years lost (DALYs) are due to non-communicable diseases.[11] Cardiovascular diseases and cancer accounted for 19% of global DALYs while a third of global burden of diseases was due to other non-communicable diseases. Mental and behavioral disorders account for 7.4% of DALYs (185 million DALYs) and the main causes were major depressive disorders (2.5%), anxiety disorders (1.1%), drug use disorders (0.8%), alcohol use disorders (0.7%), and schizophrenia (0.6%).[11] Since 1990, there has been a 37% increase in DALYs due to major depressive disorders and it has changed rank from 15th most common cause of DALYs in 1990 to 11th in 2010.[11] In South Asian region, major depressive disorders were ranked 20th in 1990 and has since increased by 58% to reach 14th rank in 2010.[26] On the other hand, depression is the second most important cause of disability globally (after low back pain) and is ranked third in South Asian region (after iron deficiency anemia and low back pain). Anxiety disorders also lead to a substantial disability and are ranked as 7th most important cause of disability and are at 6th rank in the South Asian region. Prevalence of depression has been reported from India in various population and clinic-based studies and varies from 10-30%.[27] A large study in South India reported depression prevalence of 14.3% among urban subjects.[28] The present study shows depression prevalence of 23.5% in men and 24.7% in women which is similar to previous reports from India.[27] Psychosocial factors (stress or depression) were reported in 82.6% of controls in the South Asian subjects and among 76.5% in subjects from India in INTERHEART study.[17] Prevalence of depression in the present study is similar to population based studies from India but lower than INTERHEART study. This could be due to contextual differences as the present study is population based while controls in the INTERHEART were recruited from hospitals. Prevalence of mild to

moderate anxiety has not been well studied from India and Global Burden of Diseases study from South Asian region did not include this among the top 30 causes of disability.[26] National Commission on Macroeconomics and Health reported that prevalence of common mental disorders (anxiety disorders, somatoform disorders, dissociative disorders, mixed anxiety, and depression and depression) varied from 13% in community based studies to more than 50% in hospital clinics.[27] More studies which are focused on prevalence of mild to moderate depression or stress factors are required to validate our epidemiological results.

Depression is associated with widespread systematic effects due to stimulation of autonomic nervous system and hypophyseal-pituitary axis. This leads to increased sympathetic activity and autonomic nervous system dysfunction.[25] Increase in metabolic activity leads to greater prevalence of insulin resistance, metabolic syndrome, visceral fat, and diabetes. It has been reported that depressed patients have a 2-3 fold greater prevalence of metabolic syndrome and diabetes.[29] The present study shows lower odds for metabolic syndrome and diabetes (Figure 2) which may be due to inclusion of population based subjects with all categories of depression. Moreover, we used the INTERHEART depression questionnaire which is a very short form of standard Beck Depression Inventory.[25] Studies have also reported that depression is linked to adverse health behaviors such as poor diet and overeating, smoking, lack of exercise, poor sleep hygiene. Social isolation and lower adherence to recommended health habit change.[25] Our study also shows greater prevalence of sedentary lifestyle and truncal obesity in subjects with depression and suggests these are pathways for depression induced metabolic abnormalities reported in international studies.[25] Smoking was not significantly greater in subjects with depression and this may be due to its low prevalence. We did not study other negative emotions such as anger and hostility, worry, rumination and pessimism, and this is a study limitation.

Mild to moderate anxiety state (work, family, or financial) leads to multiple peripheral pathophysiological effects including autonomic nervous system dysfunction, insulin resistance, central obesity, hypertension, platelet activa-

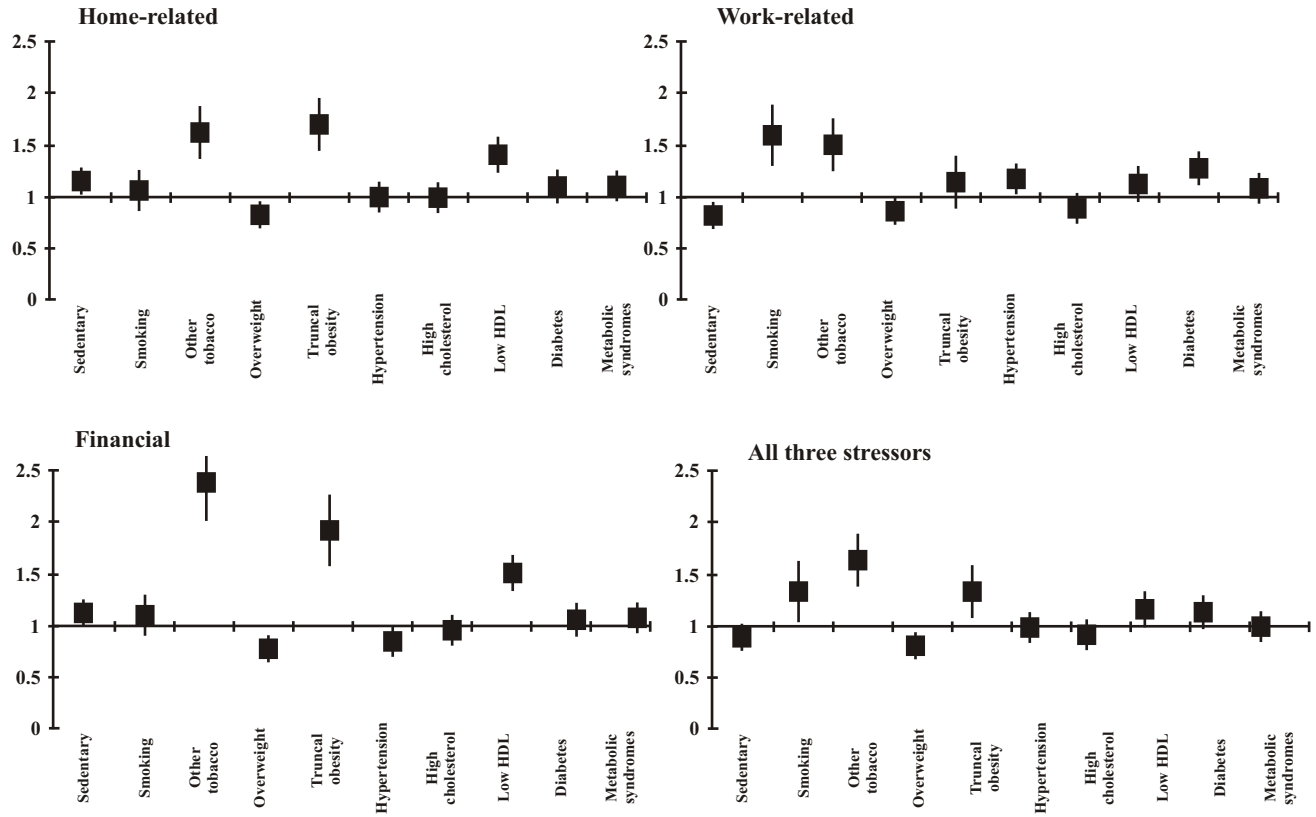

Figure 3: Odds ratios (95% confidence intervals) of prevalence of various cardiovascular risk factors in subjects with home-related, work-related, financial, or all three stressors as compared to those without (age- and sex-adjusted logistic regression).

tion, endothelial dysfunction, and inflammation.[25] Our study shows greater prevalence of smoking, smokeless tobacco use, truncal obesity, metabolic syndrome and diabetes in subjects with different types of stress (Figure 3). These physiological and behavioral associations are similar to the previous studies.[30] We also studied risk factors in depressed subjects who had all three stressors and results show a greater prevalence of smoking, smokeless tobacco use, low HDL cholesterol and diabetes. We did not study association of positive psychological factors (positive emotions, optimism, social support, sense of purpose, etc.) with cardiovascular risks and cannot comment on their influence. Our data indicate that more than 85% subjects were married and two-thirds lived in extended or joint families. This indicates a good social support environment and may be a reason of weaker cardiometabolic risk factor associations observed in the present study in contrast to studies from Europe and North

Table 3: Age adjusted prevalence (95% confidence intervals) of risk factors in subjects with home-related, work-related, financial stress, and all three types of stress factors

Variables	Men					Women				
	Home	Work	Financial	All three	All three and Depression	Home	Work	Financial	All three	All three and Depression
Numbers	**1619**	**1340**	**1575**	**888**	**328**	**1419**	**855**	**1301**	**557**	**183**
Physical Inactive	42.5 (40.1-44.9)	39.9 (37.3-42.5)	43.0 (40.5-45.4)	43.2 (39.9-46.4)	53.6(48.2-59.0)	48 (45.4-50.6)	43.8 (40.6-47.1)	47.9 (45.2-50.6)	41.8 (37.7-45.9)	55.2 (53.2-57.2)
High visible fat intake	56.6 (54.2-59.0)	55.0 (52.3-57.7)	57.1 (54.7-59.5)	54.3 (51.0-57.6)	14.3(10.5-18.1)	46.7 (44.1-49.3)	46.9 (43.5-50.2)	46.7 (44.0-49.4)	38.2 (34.1-42.2)	12.5 (7.7-17.3)
Low fruits and vegetables intake	25.9 (23.8-28.0)	28 (25.6-30.4)	24.4 (22.3-26.5)	26.1 (23.2-29.0)	31.7(26.7-36.7)	30.2 (27.8-32.6)	36.4 (33.2-39.6)	28.7 (26.2-31.1)	33.9 (30.0-37.8)	39.3 (32.2-46.4)
Smoking (current/ex smokers)	18.7 (16.8-20.6)	20.4 (18.2-22.5)	18.5 (16.6-20.4)	19.8 (17.2-22.4)	16.7(12.7-20.7)	1.41 (0.8-2.0)	1.05 (0.37-1.73)	1.7 (1.0-2.4)	0.90 (0.12-1.68)	1.1 (0.41-2.6)
Other tobacco use	15.7 (13.9-17.5)	14.8 (12.9-16.7)	16.4 (14.6-18.2)	15.1 (12.7-17.4)	11.6(8.1-15.1)	8.74 (7.3-10.2)	9.6 (7.63-11.5)	(8.7-12.0) - 43.3	() - 43.3	3.8 (1.0-6.6)
High alcohol consumption	0.7 (0.3-1.1)	1.04 (0.5-1.6)	0.6 (0.22-0.98)	0.9 (0.28-1.52)	18.3(14.1-22.5)	- 43.3 (40.7-45.9)	- 43.5 (40.2-46.8)	(38.7-46.0) 12.7 (10.9-14.5)	(39.2-47.4) 10.9 (8.3-13.5)	3.3(0.7-5.9)
Obesity: BMI >25 kg/m^2	39.5 (37.1-41.9)	40.5 (37.9-43.1)	38.3 (35.9-40.7)	39.1 (35.9-42.3)	38.0(32.7-43.2)	13.0 (11.2-14.7)	11.5 (9.36-13.6)	92.9 (91.5-94.3)	93.2 (91.1-95.3)	43.7 (36.5-50.9)
Obesity: BMI >30 kg/m^2	7.3 (6.0-8.6)	6.8 (5.4-8.1)	7.0 (5.7-8.2)	6.9 (5.2-8.6)	6.1(3.5-8.7)	89.7 (88.1-91.3)	89.0 (86.9-91.1)	30.9 (28.4-33.4)	29.4 (25.6-33.2)	11.5 (6.9-16.1)
Truncal obesity: high WHR	76.7 (74.6-78.7)	72.5 (70.1-74.9)	(75.2-79.4) 31.0	(74.3-79.8) 32.4	78.9(74.5-83.3)	31.3 (28.9-33.7)	30.8 (27.7-33.9)	25.5 (23.1-27.9)	27.3 (23.6-31.0)	87.4 (82.6-92.2)
Hypertension	30.7 (28.4-32.9)	55.4 (52.7-58.0)	(28.7-33.3) 24.4	(29.3-35.5) 21.7	28.9(24.0-33.8)	24.7 (22.4-26.9)	25.5 (22.5-28.4)	33.1 (30.5-35.7)	32.7 (28.8-36.6)	31.1 (24.4-37.8)
High total cholesterol	24.3 (22.6-26.8)	22.5 (20.2-24.7)	(22.3-26.5) 45.5	(19.0-24.4) 44.1	16.7(12.7-20.7)	31.6 (29.2-34.0)	33.7 (22.6-28.4)	56.5 (53.8-59.2)	58.7 (54.6-62.8)	28.4 (21.9-34.9)
High triglycerides	44.0 (41.6-46.4)	41.0 (38.4-43.6)	(43.0-47.9) 37.5	(40.8-47.4) 38.7	41.4(36.1-46.7)	56.7 (54.1-59.3)	57.7 (54.4-61.0)	13.5 (11.6-15.3)	14.3 (11.4-17.2)	31.1 (24.4-37.8)
Low HDL cholesterol	37.8 (40.1-44.9)	37.3 (34.7-39.9)	(35.1-39.9) 17.8	(35.5-41.9) 20.3	40.8(35.5-46.1)	13.4 (11.6-15.2)	13.8 (11.5-16.1)	38.3 (35.7-40.9s)	34.1 (30.2-38.0)	60.6 (53.5-67.7)
Diabetes	18.3 (16.4-20.2)	18.7 (16.6-21.0)	(15.9-19.7) 33.1	(17.6-22.9) 35.3	20.7(16.3-25.1)	37.9 (35.4-40.4)	36.4 (33.2-39.6)			13.6 (8.6-18.6)
Metabolic syndrome	32.5 (30.2-34.8)	34.3 (31.7-36.8)	(30.8-35.4)	(32.2-38.4)	32.0(26.9-37.0)					33.9 (27.0-40.7)

America.[25] Other limitations of the study relate to sample size and external validity. These have been discussed earlier.[20] Low response rate in the study (62%) is a concern, however these response rates are similar to other population based studies in India.[9] Use of limited questions in a psychological study could be considered a major limitation. On the other hand, evaluation of a large population based sample for multiple risk factor associations warrant a simple questionnaire and we used the validated INTER HEART study questions.[16]

In conclusion, this study shows that psychological factors such as depression and anxiety are important determinants of cardiovascular risk behaviors (sedentary lifestyle, smoking) and factors (truncal obesity, low HDL cholesterol, diabetes, and metabolic syndrome). Prospective Urban Rural Epidemiology (PURE) study has recently reported greater cardiovascular events among individuals with depression.[31]American Heart Association Science Advisory calls for routine screening for depression in patients with CHD,[32] there is insufficient evidence for population-wide screening for either depression or anxiety.[33] A combination of population wide interventions (promotion of family systems, network support, etc) and individual level motivational perspective should be encouraged to overcome various psychological factors.

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