

Association of Coronary Protective Factors Among Patients With Acute Coronary Syndromes

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ABSTRACT

INTRODUCTION: Coronary risk factors (CRF) and acute

coronary syndromes have become a major health problem in most middle income countries, although they are decreasing in developed countries. The increased risk of ACS in South Asians is not explained by conventional CRF, hence this study examines the coronary protective factors(CPF) to explain the cause of remaining of the risk.

SUBJECTS AND METHODS: Case control study including 435 patients with ACS who were compared with 495 age and sex matched control subjects. Clinical, electrocardiographic, radiological and laboratory data were obtained in all the patients for confirmation of diagnosis by WHO and AHA criteria. Multivariate logistic regression analysis was conducted after adjustment of age, and body mass index (BMI) to determine the association of CPF with ACS,

RESULTS: Coronary protective factors; healthy diet (Fruit, vegetable legume, and nuts (> 400 g/day) (31.0 vs 52.7%) moderate physical activity (23.4 vs 68.0%), meditation and yoga (> 5 days/week) 5.7 vs 25.2 %), moderate alcohol (< 10 drinks/week) (2.7 vs 24.6%), lean body weight (BMI < 25 Kg/m²) (7.8 vs 51.5%) and never tobacco intake (48.9 vs 68.0%) were significantly lower among ACS patients compared to control subjects. Multivariate logistic regression analysis revealed that after adjustment of age, and BMI, the association of odds ratio (99% confidence interval) for healthy diet [male 0.57 (0.45-0.69)**, female 0.59 (0.48-0.68)**], moderate physical activity [male 0.62(0.51-0.69)**, female 0.67(0.55-0.75)**], meditation and yoga [male 0.46 (0.35-0.56)*, female 0.48 (0.40-0.59)*], lean body weight [male 0.61 (0.53-0.72)*, female 0.62(0.52-0.71)*], and never tobacco intake [male 0.48 (0.43-0.55)**, female 0.51 (0.45-0.67)*], as well as moderate alcohol intake [male 0.42 (0.34-0.54)*] were inversely associated with ACS. No such association of moderate alcohol was noted among females due to less numbers.

CONCLUSIONS: This study shows that decreased adherence to healthy diet and moderate physical activity were highly significant CPF of ACS. Lean body weight, meditation and yoga were also significantly less CPF but had weak association. Never tobacco and moderate alcohol intake(males) were also significant CPF but with only weak association among females with ACS. Moderate alcohol intake was not a protective factor of ACS among females.

Key words: Myocardial infarction; Angina pectoris; Coronary artery disease; Heart attack

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INTRODUCTION

There is very little evidence about adoption of healthy lifestyle behaviors among individuals with or without acute coronary syndrome (ACS) or stroke event in communities across a range of countries worldwide^[1-3]. Among a sample of patients with a ACS or stroke event from countries with varying income levels, the prevalence of healthy lifestyle behaviors was also low, with even lower levels in poorer countries^[2]. Further studies indicate that social support has a beneficial effect on health behaviors in patients with coronary artery disease (CAD)^[3]. The behavioral risk factors are actual risk factors of ACS and change in behavior from unhealthy to healthy behavior may be protective factors against CAD^[4-6]. In a recent study, dietary intake of saturated fat was not associated with risk of coronary events or mortality in patients with established CAD which has made this hypothesis controversial^[5]. Further studies are needed to find out changes in the clinical and demographic characteristics and health behaviors of patients with ACS which may identify successes and failures of risk factor identification and treatment of patients at increased risk for new cardiovascular events^[5]. Healthy diet, moderate physical activity, lean body weight, no tobacco, moderate alcohol intake, meditation, active prayer and yoga as well as low salt diet are important coronary protective factors (CPF) which are known to protect from diabetes^[6]. The greatest emphasis has been on unhealthy diet particularly in conjunction with sedentary behavior^[4-13]. Unhealthy behaviors are responsible for secondary risk factors; obesity, hypertension, hypercholesterolemia, type 2 diabetes as well as metabolic syndrome characterized with dyslipidemia^[6-13]. These secondary risk factors of CAD, may predispose ACS due to acute precipitating triggers; unhealthy behaviors; large meals, acute psychological stress, alcoholism, low and high temperature climates and acute exercise^[6,13-15]. However, CPF providing healthy behavior may prevent CVDs and diabetes. There are only very few studies examining the role of protective health behavior in patients presenting with CAD and ACS^[2,3]. Study of health behavior may be important because intervention strategy in patients with ACS improves adherence to evidence-based drugs and healthy lifestyles, and results in an improvement in clinical risk markers^[14]. Association of coronary risk factors among these patients have been reported in a earlier publication^[15]. In the present study, we examine the association of CPF among patients with ACS.

SUBJECTS AND METHODS

Recruitment of patients included 505 patients with suspected diagnosis of ACS presented to Medical Hospital and Research Center, Moradabad, India during a period of 3 years. The diagnosis of ACS was based on criteria modified from old WHO Criteria^[15-17]; ST elevation myocardial infarction (STEMI) ($n = 344$) with ST segment elevation and double the rise in cardiac enzymes, non ST elevation MI (NSTEMI) ($n = 71$); with ST segment depression and T wave changes with double the rise in cardiac enzymes and chest pain more

than 20 minute or unstable angina pectoris ($n = 20$); with or without ST and T wave changes and with or without increase in CPK.MB cardiac enzyme but normal troponin T, in presence of chest pain of at least 20 minute or more (total $n = 505$). Left ventricular hypertrophy (LVH) was confirmed with cardiomegaly on X ray chest and if necessary echocardiography.

Patients were excluded if they did not volunteer to participate in the study or died before giving the detailed history or had non-cardiac chest pain. All the patients were observed for 24 hours after the clinical diagnosis of ACS, to record all the clinical and laboratory data ($n = 435$). We selected 495, age and sex matched control subjects from relatives of the patients for comparison. All participating patients and subjects gave written informed consent and the study was approved by the institutional ethic committee.

Clinical, electrocardiographic, radiological, and biochemical data were obtained in all the patients and control subjects during the first 24 hours of surveillance. The diagnosis of hypertension and diabetes were also considered in presence of record of treatment from a physician. However, in all the subjects, blood pressure was obtained on the right arm with a standard mercury manometer after a five-minute rest. To minimize measurement errors, one individual was assigned to measure blood pressure for all the subjects. In accordance with the WHO guidelines, if a blood pressure of more than $\geq 140/90$ mm Hg was recorded, a repeat measurement was obtained after a 5-minute rest, with the subject in a supine position for confirmation^[16,17]. Every subject had two readings, with the average of these reading recorded as the resting blood pressure.

Coronary Protective Factors

Moderate physical activity, healthy diet, lean body weight, never tobacco intake, moderate alcohol intake, meditation and yoga; protective lifestyle factors were considered CPF. Body weights were recorded after removing clothes and shoes by the pharmacist to the nearest 0.1 kg. Moderate physical activity was assessed by a questionnaire detailing occupational, household, and spare time physical activity. Physical activity was graded in to; sedentary, mild, moderate and heavy activity based on various types of activity measures, according to the classification of activities specific to Indian populations, as previously described^[18]. Salt intake was the sum of the salt used during preparation of food and added at the table by each subject. Added ingestion of salt added to manufactured foods was also taken into account. Tobacco consumption was defined as tobacco intake, in any form, for example, chewing or smoking pipe, beedies or cigarettes^[19]. Alcohol intake was assessed by a questionnaire on the intake of all the varieties of alcohol such as hard drinks; whisky, vodka, rum, Indian liquor or beer and wine^[19]. Alcohol intake and smoking are not common in Indian women A dietitian assessed fruit, vegetable, legume and nuts intake by using a questionnaire and the 7-day diet diaries of the spouse by asking probing questions. Food measures, food samples, and food portions were used during the assessment interview of the spouse and the subject to find out exact estimate of food consumption^[20]. Meditation, active prayer and yoga are relaxation methods which provide the practitioner to examine thoughts, feelings, and sensations in a nonjudgmental fashion with the goals of achieving a state of inner calmness, physical relaxation, and psychological balance. Sleep deprivation was considered in presence sleep less than 6 hours.

Criteria of Coronary Protective Factors

The criteria for moderate physical activity were; walking more than 14.5 km or climbing more than 20 flights of stairs a week during

household or occupational activities, or moderately vigorous spare time physical activity for five days or more, a week consistent with other expert groups^[18]. Lean body weight was considered in presence of a body mass index of 19.0 to 24.9 Kg/m². Obesity was diagnosed in presence of body mass index 25 Kg/m² or above. Subjects who admitted to using tobacco at least once a month were categorized as consumer of tobacco, whereas those who never consumed any type of tobacco were considered to be never tobacco consumer^[19]. Moderate alcohol intake was considered when the intake was < 10 drinks/week. One drink was considered for 60 mL whisky/vodka/rum/Indian liquor or 500 mL of beer or 300ml of wine. Salt intake was considered as low, when the daily intake from all the sources was 5.0 g/day or lesser. An intake of fruit, vegetable, nuts and legume was considered as healthy diet, for an intake of more than 400 g/day^[19]. The criteria for the presence of meditation, and yoga was regular practice of active prayer and/or pranayama breathing and yoga postures for, 20-60 min daily for minimum 5 days in a week.

All the patients remained in the hospital for 5-15 days. In all the ACS patients, diets containing meat, eggs, hydrogenated oils, butter, clarified butter were replaced with vegetarian substitutes and vegetable oils, so as to provide a prudent healthy diet reflecting the recommendations of the National Cholesterol Education Program Step 1 diet. Other health related advice, such as stopping smoking, reducing alcohol intake, counseling to relieve mental stress and on physical activity, was given to both groups. During the hospitalization, clinical data, complications, drug treatment, morbidity, and mortality were regularly recorded by the doctor. Blood pressure, heart rate, and a 12 lead electrocardiogram were recorded at frequent intervals and whenever indicated. Angina pectoris and arrhythmias were diagnosed based on criteria described earlier.

Laboratory data

In both groups, in all the participants, a venous blood sample was drawn in a fasting state (10-12 hours) and analyzed for blood counts and hemoglobin, urea, glucose, cardiac enzymes, total cholesterol, high and low density lipoprotein cholesterol and triglyceride concentrations^[21,22]. High density lipoprotein by an enzymatic method. In all patients with higher blood lipid concentrations measurements were repeated. Angiotensin converting enzyme and nitrite were obtained by colorimetric methods^[23,24].

Follow Up

All the patients were followed up for two years, weekly for 4 weeks, then monthly for one year and then after 2 years.

Statistical Analysis

Data were analyzed on the basis of intention to treat and study in the next one week, and in all outcome analyses during the study, last available clinical or laboratory data were incorporated for patients who lost during the study or who had died. Those patients admitted with chest pain who showed no signs of definite or possible acute myocardial infarction but who had unstable angina pectoris were also included in the analysis. All the data among patients were compared with age and sex matched control subjects.

Multivariate logistic regression analysis was conducted after adjustment of age and body mass index to find out the significance of association of CPF with ACS. Odds ratios and their 99% Confidence intervals (CI) for the association of CPF to myocardial infarction and their population attributable risks were calculated by dividing data in patients from data in control subjects. Only *p* values < 0.05 by the two tailed test were considered significant. We used paired *t* test for

comparison of continuous variables in the two groups and the two sample *t* test to compare proportions.

RESULTS

We observed and considered 505 subjects for entry to study, with suspected ACS during a period of 3 years. Of these 435 patients; 344 with ST segment elevation, 71 with non ST segment elevation and 20 with unstable angina were included in this study and compared with 495 age and sex matched control subjects. Table 1, shows the base lines clinical data in the two groups of subjects. Mean body weight, BMI as well as systolic and diastolic blood pressures were significantly greater in the ACS group compared to control group (Table 1). The prevalence of obesity, known hypertension, known type 2 diabetes mellitus, tobacco users were significantly higher in the ACS group compared to control group (not given in the table).

Coronary protective factors; healthy diet (Fruit, vegetable legume, and nuts (> 400 g/day) (31.0 vs 52.7%) moderate physical activity (23.4 vs 68.0%), meditation and yoga (> 5 days/week) 5.7 vs 25.2 %), moderate alcohol (< 10 drinks/week) (2.7 vs 24.6%), lean body weight (BMI < 25 Kg/m²) (7.8 vs 51.5%) and never tobacco intake (48.9 vs 68.0%) were significantly lower among ACS patients compared to control subjects (Table 1).

Table 2 shows the laboratory data in two groups of this study. Mean total cholesterol, LDL cholesterol and triglycerides as well as blood glucose were significantly higher in the ACS group compared to control group. Mean HDL cholesterol, and nitrite levels were significantly lower in the ACS group compared to control group. Mean serum angiotensin converting enzyme level was significantly higher in the ACS group compared control subjects.

Table 3 shows the results of multivariate logistic regression analysis indicating association of CPF with ACS. The findings revealed that after adjustment of age and BMI, odds ratio (99% confidence interval) for healthy diet [male 0.57 (0.45-0.69)**, female 0.59 (0.48-0.68)**], moderate physical activity [male 0.62(0.51-0.69)**, female 0.67(0.55-0.75)**], meditation and yoga [male 0.46 (0.35-0.56)* female 0.48 (0.40-0.59)*], lean body weight [male 0.61 (0.53-0.72)* female 0.62(0.52-0.71)*], and never tobacco intake [male 0.48 (0.43-0.55)** female 0.51 (0.45-0.67)*] as well as moderate alcohol intake [male 0.42 (0.34-0.54)*] were inversely associated with ACS (Figure 1). No such association of moderate alcohol was noted among females due to less numbers.

Table 1 Protective factors among patients with acute coronary syndrome and control subjects.

Male Sex, n (%)	382 (80.9)	408 (82.4)
Mean age, years	51.0 (9.8)	52.5 (11.4)
Mean body weight, Kg	66.8 (11.3)*	63.0 (9.7)
Body mass index, Kg/m ²	24.4 (2.4)*	22.2 (3.3)
Blood pressures (mm Hg):		
Systolic	133.5 (12.8)**	124.5 (9.8)
Diastolic	86.6 (4.6)*	84 (4.2)
Healthy diet(Fruit, vegetable legume, and nuts (> 400 g/day)	105 (31.0)**	261 (52.7)
Moderate physical activity	102 (23.4)**	252 (50.9)
Never tobacco intake	213 (48.9)**	337 (68.0)
Meditation and yoga (> 5 days/week)	25 (5.7)**	125 (25.2)
Moderate alcohol (< 10 drinks/week)	12 (2.7)**	122 (24.6)
Lean body weight (BMI < 25 Kg/m ²)	34 (7.8)**	255 (51.5)
No sleep deprivation (Less than 6 hours/day)	111 (33.7)**	103 (20.8)

Values are n(%) and mean (Standard deviation), * = *p* < 0.05, ** = *p* < 0.01.

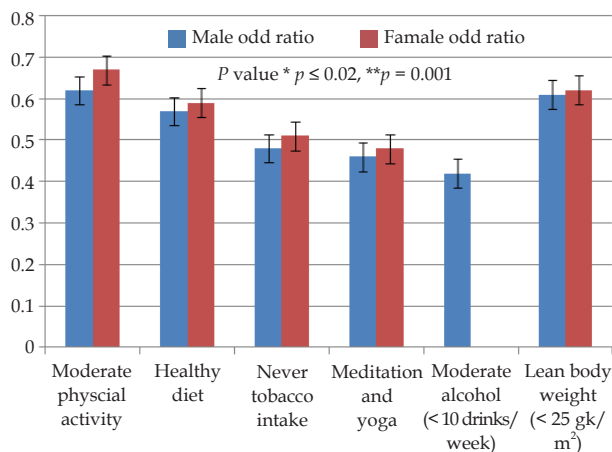


Figure 1 Association of protective factors with acute coronary syndrome by multivariate logistic regression analysis, after adjustment of age and body mass index.

Follow up: of patients initially included revealed that 11 patients were lost in the follow up.

Mortality: Data on deaths were collected at two years which was not the intention of the study. However, data were analyzed and end points were obtained on the basis of intention to treat analysis. Fatal ACS, sudden cardiac death, total cardiac mortality, total cardiovascular mortality and total mortality remained significantly higher in the ACS group compared to control group (Table 4). Deaths due to stroke ($n = 4$), cancer ($n = 1$), suspected cardiac deaths ($n = 4$) were obviously not significantly different in the two groups respectively, due to less number of cases.

DISCUSSION

Despite increases in the use of antiplatelet therapies and the development of more potent antiplatelet therapies (prasugrel and ticagrelor), thrombolysis and statins, the residual risk of death, myocardial infarction, or stroke up to 1 year after ACS remains high^[25]. Can we control this risk by preventing adverse effects of glucose, low HDL and triglycerides in people of South Asian origin where cause of ACS appears to be metabolic syndrome, although fat intakes are within limits of National Cholesterol Education Program^[26-28]. Only few studies have examined the association of CPF in patients with ACS^[2-4]. This study shows that after adjustment of age and BMI, odds ratio (confidence interval) for healthy diet; [male 0.57 (0.45-0.69)**, female 0.59 (0.48-0.72)**], moderate physical activity; [male 0.62 (0.51-0.69)**, female 0.67(0.55-0.75)**], meditation and yoga; [male 0.46 (0.35-0.56)*, female 0.48 (0.40-0.59)*], lean body weight, [male 0.61 (0.53-0.72)* female 0.62(0.52-0.71)*], and never tobacco intake; [male 0.48 (0.43-0.55)**, female 0.51 (0.45-0.67)*] as well as moderate alcohol intake; [male 0.42 (0.34-0.54)*] were inversely associated with ACS.

In the PURE study, that used an epidemiological survey of 153 996 adults, aged 35 to 70 years, from 628 urban and rural communities in 3 high-income countries (HIC), 7 upper-middle-income countries (UMIC), 3 lower-middle-income countries (LMIC), and 4 low-income countries (LIC)^[2]. Smoking status (current, former, never), level of exercise [low, < 600 metabolic equivalent task (MET)-min/wk; moderate, 600-3000 MET-min/wk; high, > 3000 MET-min/wk], and diet were the healthy CPF. Among 7519 subjects with self-reported CAD {past event: median, 5.0 [interquartile range (IQR), 2.0-10.0] years ago} or stroke [past event: median, 4.0 (IQR, 2.0-

Table 2 Differences in biochemical variables at baseline. Values are means (SDs).

Biochemical factors	Acute coronary syndrome ($n = 435$)	Control group ($n = 495$)
Total cholesterol (mmol/L)	5.85 (1.28)**	5.61 (1.11)
Low density lipoprotein cholesterol (mmol/L)	4.47 (0.82)**	4.18 (0.78)
High density lipoprotein cholesterol (mmol/L)	1.12 (0.34)*	1.18 (0.21)
Triglyceride (mmol/L)	1.96 (0.38)**	1.71 (0.46)
Fasting blood glucose (mmol/L)	6.98 (0.68)**	6.67 (0.52)
Nitrite ($\mu\text{mol/L}$)	0.44 (0.9)*	0.74 (0.12)
Angiotensin converting enzyme (IU)	118.5 (19.8)*	62.5 (12.6)
Blood pressures (mm Hg):		
Systolic	133.5 (12.8)*	124.5 (9.8)
Diastolic	86.6 (4.6)*	83.0 (4.2)

**= $p < 0.01$, *= $p < 0.05$ by two sample t test.

Table 3 Association of protective factors with acute coronary syndrome by multivariate logistic regression analysis, after adjustment of age and body mass index.

Protective factor	Male, Odds Ratio (99% confidence interval)	Female, Odds Ratio (99% confidence interval)
Moderate physical activity	0.62 (0.51-0.69)**	0.67(0.55-0.78)**
Healthy diet	0.57 (0.45-0.69)**	0.59 (0.48-0.68)**
Never tobacco intake	0.48 (0.43-0.55)**	0.51 (0.45-0.67)*
Meditation and yoga	0.46 (0.35-0.56)*	0.48 (0.40-0.59)*
Moderate alcohol (<10 drinks/week)	0.42 (0.34-0.54)*	--- --- ---
Lean body weight (<25 Kg/m ²)	0.61 (0.53-0.72)*	0.62(0.52-0.71)*

*= $p < 0.02$, **= $p < 0.001$

Table 4 Numbers and rate ratios for end points in the acute coronary syndrome group and control group after 2 years of follow up.

Events	Acute coronary syndrome ($n = 435$)	Control group ($n = 495$)	Adjusted Rate Ratio (95% confidence interval)
Total Cardiac mortality	77 (17.70)**	2 (0.40)	0.37 (0.32-0.45)
Fatal myocardial infarction	48 (4.13)**	5 (0.80)	0.36 (0.31-0.43)
Sudden cardiac death	28 (6.43)*	2 (0.40)	0.30 (0.26-0.36)
Total cardiovascular mortality	86 (19.77)**	8 (1.6)	0.30 (0.25-0.36)
Total mortality	87 (20.00)**	9 (1.81)	0.29 (0.25-0.36)

Values are number (%), **= $p < 0.0001$, *= $p < 0.001$. (11 patients and 10 control group subjects lost in follow up. Total deaths; adjustment made for base line age, gender, body mass index, cholesterol and blood pressure.

8.0) years ago], 18.5% (95% CI, 17.6%-19.4%) continued to smoke; only 35.1% (95% CI, 29.6%-41.0%) undertook high levels of work- or leisure-related physical activity, and 39.0% (95% CI, 30.0%-48.7%) had healthy diets; 14.3% (95% CI, 11.7%-17.3%) did not undertake any of the 3 healthy lifestyle behaviors and 4.3% (95% CI, 3.1%-5.8%) had all 3. In total, 52.5% (95% CI, 50.7%-54.3%) of subjects quit smoking [by income country classification: 74.9% (95% CI, 71.1%-78.6%) in HIC; 56.5% (95% CI, 53.4%-58.6%) in UMIC; 42.6% (95% CI, 39.6%-45.6%) in LMIC; and 38.1% (95% CI, 33.1%-43.2%) in LIC]. The interesting point was that levels of physical activity increased with increasing country income

but this trend was not statistically significant. Unfortunately, the lowest prevalence of eating healthy diets was in LIC (25.8%; 95% CI, 13.0%-44.8%) compared with LMIC (43.2%; 95% CI, 30.0%-57.4%), UMIC (45.1%, 95% CI, 30.9%-60.1%), and HIC (43.4%, 95% CI, 21.0%-68.7%). It is clear that in patients with CAD or stroke, from countries with varying income levels, the prevalence of CPF or healthy lifestyle behaviors may be graded; low in lower middle income and lowest in low income communities and poorer countries. This study did not report the association of moderate alcohol intake and meditation and yoga with CAD^[2].

The INTERHEART Study Investigators reported, effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries among 15152 cases and 14820 controls^[25]. Smoking (odds ratio 2.87 for current vs never, population attributable risk (PAR) 35.7% for current and former vs never), raised abdominal obesity (1.12 for top vs lowest tertile and 1.62 for middle vs lowest tertile, PAR 20.1% for top two tertiles vs lowest tertile), psychosocial factors (2.67, PAR 32.5%), daily consumption of fruits and vegetables (0.70, PAR 13.7% for lack of daily consumption), regular alcohol consumption (0.91, PAR 6.7%), and regular physical activity (0.86, PAR 12.2%), were all significantly related to ACS ($p < 0.0001$ for all risk factors and $p = 0.03$ for alcohol). The associations were noted in men and women, old and young, and in all regions of the world. Collectively, these risk factors accounted for 90% of the PAR in men and 94% in women. The findings confirmed that abnormality in lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, consumption of fruits, vegetables, and alcohol, and regular physical activity account for most of the risk of myocardial infarction worldwide in both sexes and at all ages in all regions. The study emphasized that high risk of ACS among people of South Asian origin, can be duly explained by the presence of primary and secondary risk factors among these subjects^[25-28]. This finding suggests that approaches to prevention can be based on similar principles worldwide and have the potential to prevent most premature cases of myocardial infarction and CAD^[26-28].

Meditation and yoga as well as some of the prayers by religious groups, have been regarded as a type of physical activity as well as a stress management strategies^[29-31]. Recent studies suggest the beneficial effects of yoga on various ailments. However, the effectiveness of yoga for secondary prevention in CAD remains uncertain unless large randomized controlled trials of high quality are conducted^[30]. In a recent study, 58 subjects, mean age of 50.0 ± 11.06 years comprising the yoga group practiced yoga for at least 1 h a day for over 2 years^[29]. Their results were compared with those in 54 age-matched controls (mean age of 48 ± 11.86 years) performing a regular aerobic physical activity for at least 7 h a week. The yoga group showed significantly higher maximum performance per kilogram ($p = 0.007$) and maximum oxygen consumption per kilogram per minute ($p = 0.028$). It is possible that despite low energy expenditure, yoga practices are better in some cardiorespiratory fitness parameters than other aerobic activities recommended by current guidelines for prevention of CVDs. Several studies have demonstrated the beneficial effects of meditation on various CVD risk factors^[31]. Apart from reducing CVD mortality, meditation has also been shown to improve conditions such as hypertension, type 2 diabetes mellitus, dyslipidemia, and high cortisol levels^[29-31]. Meditation may be defined as an state of contemplation, concentration, reflection and relaxation to achieve sound total health, which is in practice for the thousands of years that improves spiritual and emotional well-being.

Our study also show that lean body weight was inversely associated with ACS. The role of lean body weight particularly due

to moderate physical activity has also been observed to be useful in other studies^[32-34]. Among 70 obese subjects, low energy diet and aerobic exercise decreased total and LDL lipoprotein^[34]. Low energy diet was superior in decreasing atherogenicity assessed by a shift in density profile and increased particle size. Effect on low-grade inflammation was limited. We observed an inverse association of fruit, vegetable, legume and nuts intake which is similar to other studies^[2,7,25]. Apart from these foods, lower intake of sugars and saturated fat, trans fat and omega-6 fat have also been reported to be protective, and excess of these agents hazardous in patients with CVDs, obesity and diabetes^[8-14]. Randomized, controlled trials have demonstrated the beneficial effects of fruits, vegetables, legumes and nuts in patients with ACS^[7,35-37].

This study shows that low HDL cholesterol and high triglycerides and blood glucose were highly common among ACS patients in this sample of Indians (Table 2). These risk factors indicate the possibility of presence of high risk of metabolic syndrome, to explain the higher risk of ACS and type 2 diabetes among people of South Asian origin living any where in the world^[1,26-28]. Prevalence of CAD and CRF in rural and urban populations of north India showed that CRF and CAD are 2-3 fold more common in urban compared to rural subjects^[26,27]. However, when compared to Asian Indians in USA, CAD prevalence was lower in South Asian urban subjects indicating a gradient in the coronary risk from rural to urban and immigrant populations^[27]. Higher social classes also have higher risk of CAD and type 2 diabetes in South Asia compared to lower social classes^[26-28]. The risk of risk factors appears to be greater in people of South Asian origin than in other population groups^[27]. Our study also shows that total and LDL cholesterol as well as systolic and diastolic blood pressure were significantly more common among ACS patients than control subjects. Other studies from developed countries also confirm that conventional risk factors can duly explain the cause of ACS^[2-4]. Blood concentration of nitrite (adverse effects on ACS) was significantly lower whereas angiotensin converting enzyme (adverse effects on ACS) was significantly higher in ACS, which is consistent with an earlier study and explains high risk among ACS patients^[38].

ACS patients represent a distinct, highly select subgroup of the general population which are exposed to adverse effects of lifestyle or behavioral risk factors^[39-41]. Alteration in the extent and distribution of these specific risk factors and CPF over time in patients with ACS provide insight into the overall burden of disease in individuals at the highest risk for CAD^[42]. Our current understanding of the causal relationship between patient- and population-specific exposures, or risk factors, and clinical outcomes underscores the association of risk factors with ACS^[1-7]. CPF appear to have relevance from demographic and public health perspectives, given the increasing number of individuals in the general population at risk for ACS and the increasing number of survivors of ACS. Clinical studies have shown that social support improves health behaviors in patients with coronary artery disease hence knowledge of CPF appears to be important in the prevention of (CAD)^[3].

A recent study among 133 patients with CAD, examined the relationship between adherence to a healthy lifestyle, and social support and selected socio-demographics among patients with CAD^[3]. Social support was the most significant predictor [$t(124) = 9.51, p < 0.001$] which explained 60% of variance in adherence to a healthy lifestyle due to social support. Elderly and patients with low income need greater social support to enhance adherence to a healthy lifestyle. The applications of this study in practice provide a guide for nursing clinical assessment of social support for patients facing CAD. In a further study among 806 ACS patients from 14 hospitals in India,

randomly assigned to treatment with the help of trained community health worker, used various methods to increase adherence to drug therapy and healthy lifestyle^[15]. Of 750 patients who were included in the analysis (375 in each group) overall adherence ($\geq 80\%$) to prescribed evidence-based drugs was higher in the intervention group than in the control group [97% vs 92%, odds ratio (OR) 2.62, 95% CI 1.32–5.19; $p = 0.006$]. The intervention group had significantly greater adherence to smoking cessation [85% (110/129) vs 52% (71/138), OR 5.46, 95% CI 3.03–9.86; $p < 0.0001$], regular physical activity [89% (333/375) vs 60% (226/375), OR 5.23, 95% CI 3.57–7.66; $p < 0.0001$], and healthy diet (score 5.0 vs 3.0, OR 2.47, 95% CI 1.88–3.25; $p < 0.0001$). More patients in the intervention group had stopped alcohol use at 1 year [87% (64/74) vs 46% (46/67), OR 2.92, 95% CI 1.26–6.79; $p = 0.010$]. At 1 year, the mean weight [65.0 kg (11.0) vs 66.5 kg (11.5); $p < 0.0001$], and BMI [24.4 kg/m² (SD 3.7) vs 25.0 kg/m² (3.8); $p < 0.0001$] were lower in the intervention group than in the control group. It is possible that a community health worker-based personalized intervention strategy in patients with ACS may improve adherence to evidence-based drugs and healthy lifestyles, may cause an improvement in clinical risk markers and can improve secondary prevention in patients with ACS. Among genetic risk factors, carriers of E40K and other inactivating mutations in *ANGPTL4* had lower levels of triglycerides and a lower risk of coronary CAD than did non-carriers^[43]. In an experiment, the inhibition of *Angptl4* in mice and monkeys also resulted in corresponding reductions in these values. Activation of lipoprotein lipase, an enzyme that is inhibited by angiopoietin-like 4 (*ANGPTL4*), has been shown to reduce levels of circulating triglycerides indicating that this approach may be used among certain patients who may not respond to the adherence to CPF.

In brief, healthy diet and moderate physical activity as well as no tobacco intake were highly significant CPF in this sample of ACS. Lean body weight and moderation in alcohol intake (in males) were also weakly but significantly associated CPF with ACS. More studies are needed to find out changes in the clinical and demographic characteristics of patients with ACS which may identify successes and failures of CPF identification and treatment of patients at increased risk for new cardiovascular events, particularly in newly industrialized countries where risk of risk factors has established and social support from family is decreasing.

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