

Cynical hostility and the metabolic syndrome: A case-control study

Paola Gremigni

ABSTRACT: *Cynical hostility and the metabolic syndrome: A case-control study. P. Gremigni.*

Background: Evidence suggests that metabolic syndrome and hostility are independent risk factors for the development of coronary heart disease. Recently, the combined effect of metabolic syndrome and hostility has shown to predict the incidence of myocardial infarction. This study tested whether cynical hostility was associated with the metabolic syndrome in a sample of Italian adults.

Methods: 992 subjects participated in the study. Among them, 546 participants were classified as having metabolic syndrome and 446 as controls, not having any of the risk factors that constitute the metabolic syndrome. Cynicism, the cognitive component of hostility, was measured with a self-report questionnaire derived from the Cook-Medley Hostility Scale. Metabolic syndrome was based on having

the following risk factors: obesity, hyperinsulinemia, dyslipidemia, and elevated arterial blood pressure.

Results: The cross-sectional association of cynical hostility with metabolic syndrome was statistically significant ($p < 0.0001$). Hostility was also associated with age ($p < 0.0001$) and educational level ($p < 0.02$). Predictors of having metabolic syndrome were higher cynicism (O.R. 1.12), older age (O.R. 1.39), and lower educational level (O.R. 1.05).

Conclusions: The results highlight the potential importance of intervention on psychological factors (i.e. hostility) to prevent coronary heart disease.

Keywords: *coronary heart disease, cynicism, hostility, metabolic syndrome.*

Monaldi Arch Chest Dis 2006; 66: 224-229.

Department of Psychology, University of Bologna, Italy.

Corresponding author: Paola Gremigni, Dipartimento di Psicologia, Università degli Studi di Bologna, Viale Berti Pichat, 5, 40127 Bologna, Italia; E-mail address: paola.gremigni2@unibo.it

Epidemiological studies have established that obesity, hyperinsulinemia, dyslipidemia, and hypertension, independently and in combination, predict cardiovascular morbidity and mortality in adults [1-5]. Coexistence of these physiologic risk factors has been termed the "metabolic syndrome". Although a controversy exists as to whether the metabolic syndrome adds to cardiovascular risk above and beyond the sum of its independent metabolic components, it is commonly recognized as a risk factor for cardiovascular disease and progression to type 2 diabetes mellitus [6]. Poor health habits, such as an excessive caloric intake, smoking and sedentary lifestyle, are also shown to predict CVD, independently and through their direct influence on the metabolic syndrome [7].

Clear evidence suggests that psychological attributes, in particular hostility – the tendency to think cynically, to feel anger, and to behave antagonistically [8] – are shown as important correlates of the metabolic syndrome [9-13]. For example, a longitudinal study indicated that hostility, in a sample of American children, predicted the metabolic syndrome risk factors 3 years later [14]. Another study suggested that, in older men, hostility was associated with a pattern of obesity, central adiposity, and insulin resistance, which can exert effects on blood pressure and serum lipids [15]. This study also suggested that effects of hostility on the metabolic syndrome was mediated by body mass index and waist/hip ratio. A recent study showed a fourfold increase in the odds of developing a MI in a large

sample of healthy men who had both the metabolic syndrome and high level of hostility [13]. In most of the studies in this area, the generalizability of results is limited by the use of samples including only males.

Evidence suggests that hostility may be established as an independent risk factor for coronary heart disease (CHD) [16, 17]. Certain components of hostility measures seemed to be better predictors of CHD than others. Cynicism, that is the cognitive component of hostility, showed a cross-sectional association with CVD [18], as well as a longitudinal association with the progression of carotid atherosclerosis [19]. A previous study on a sample of Italian population showed a cross-sectional association between cynicism and CVD [20].

A recent contribution indicated that the metabolic syndrome significantly mediates the association between hostility and CVD [21]. Nevertheless, the direct contribution of hostility to the aetiology of CVD is still controversial, as far as other prospective studies suggested that the hostility effects on CHD may be mediated through mechanisms other than factors that constitute the metabolic syndrome [9].

The association between hostility and coronary-prone risk behaviour suggests that hostility might increase the risk of CHD through affecting individual's behaviour.

Should hostility be associated with CVD risk factors, comprising the metabolic syndrome, it should have long-lasting effects that may lead to the development of major CVD. Awareness that hostili-

ty contributes to risk behaviours and disease may help in the design of interventions aimed at risk reduction.

The current case-control study investigated whether cynicism, the cognitive component of hostility, was associated with a classic clustering of cardiovascular disease risk factors, known as the metabolic syndrome, in a sample of Italian adults, men and women.

Methods

Participants

Data were used from a survey on prevention of CVD in a sample of population of a North-East Italian area. A cohort of 1309 adults (men and women), aged 30 to 89 years, was enrolled into the study, participated in a comprehensive physiologic and laboratory assessment, and completed a brief self-report questionnaire on cynical hostility. The examination included blood work (fasting serum levels of glucose, insulin, and lipids) on a blood sample taken at 8:00 a.m.; blood pressure measurement; evaluation of body mass index (BMI), and assessment of smoking. As regards smoking condition, participants were classified as smokers if they were smoking on a regular base >1 cigarette per day.

To be included in the present study, the survey participants were required to have no history of CHD, diabetes mellitus, cancer, or any other long-term medical condition. 131 participants were excluded for their medical condition as follows: 34 were affected by cancer, 42 had a cardiac disease, 42 a chronic disease of the digestive apparatus, and 13 were suffering from respiratory diseases.

Several studies have previously demonstrated that demographic variables such as age group, gender, and education are correlated with hostility; therefore, these data were obtained upon entry into the study and recorded during the administration of the psychological questionnaire [21-23]. Age, recorded in years (mean 49.17 ± 10 years), was then transformed in a categorical variable, and participants were classified in three groups: younger than 41 years, aged between 41 and 56 years, and older than 56 years. Educational level was measured as a categorical variable, and participants were classified as having received less than or more than a high school education.

Measures

Metabolic syndrome. The metabolic syndrome was defined as having >2 of the following physiologic risk factors: BMI (weight in kilograms divided by height in meters squared) >27, used as an index of obesity in other large epidemiological studies [17, 24]; abnormal glucose metabolism, measured during the preprandial state; high triglyceride level; high-density lipoprotein cholesterol level; high blood pressure levels, measured using an automated sphygmomanometer. As regards blood pressure, three measures were taken during a 10-min resting period and the last two were averaged.

To classify participants into those with and without metabolic syndrome, subjects were first classified whether they had high scores compared to the distributions for each age and gender group for each of the five risk factors described above. Hereafter, participants were described as having the metabolic syndrome if they had more than two of the risk factors evaluated as high.

Cynical Hostility. For measuring hostility we used an Italian version of the Cynical Distrust Scale (CynDis) [25], a 8-item scale factor-analytically derived from the Cook-Medley Hostility Scale (Ho) [26]. This scale was found a reliable, valid, and more specific measure of cynicism and distrust as compared with the total Ho, yet significantly correlated with the total Ho and other measures of cynicism [27, 28]. The answer format was changed from 4-point to 5-point from "completely agree" to "completely disagree". The CynDis Scale measures the cognitive component of hostility, that consists of negative beliefs about others who are seen as unreliable and selfish. High level of hostility, measured with the CynDis Scale, were associated with increased risk of all-cause, cause-specific mortality and incident myocardial infarction [28].

Statistical Analyses

Differences in the mean values of measures of hostility between subjects classified as exhibiting or not exhibiting the metabolic syndrome were compared by analysis of variance (ANOVA). Binomial logistic regression was used to predict having the metabolic syndrome on the basis of level of cynical hostility, gender, age, educational level, and smoking condition. Significance was set at 0.05 level. All analyses were performed using SPSS 13.0 statistical package.

Results

According to the diagnostic criteria for the metabolic syndrome described above, among the 1178 subjects participating in the study, 546 (46%) participants were classified as having the metabolic syndrome (MS group). Among participants classified as not having the metabolic syndrome (i.e. 632, 54%), were included in the study only those who were free of high values in any of the five physiologic risk factors that constitute the metabolic syndrome. According to this criterion, 186 (29%) subjects having one or two risk factors were excluded, while 446 (71%) formed the absence of metabolic syndrome risk-factor group (ARF group). The MS group and the ARF group differed as regards age (ANOVA: $F = 87.50$, $p < 0.0001$); the MS group was mean aged 51.78 ± 10 years, while the ARF group was mean aged 45.97 ± 9 years. Characteristics of study participants are presented in table 1.

Comparisons across risk-factor groups

Differences in the mean values of measure of cynicism between subjects classified as exhibiting or not exhibiting the metabolic syndrome were compared by analysis of variance (ANOVA), taking into account, as independent variables, gender, age

Table 1. - Subject Characteristics (n = 992)

Group	N	Gender N (%)	Age group N (%)	Educational Level N (%)	Smoking status N (%)
MS	546	Male 204 (37)	<41 yrs 78 (14)	A 370 (68)	NS 426 (78)
		Female 342 (63)	41-56 yrs 273 (50)	B 176 (32)	S 120 (22)
			>56 yrs 195 (36)		
ARF	446	Male 220 (49)	<41 yrs 142 (32)	A 228 (51)	NS 332 (74)
		Female 226 (51)	41-56 yrs 227 (51)	B 218 (49)	S 114 (26)
			>56 yrs 77 (17)		

Legend: MS = metabolic syndrome group; ARF absence of risk-factor group; A = Primary school; B = High school; NS = No Smoking; S = Smoking.

group, educational level and smoking condition. As expected, a significant main effect for the metabolic condition was found, $F(1, 944) = 35.70$, $p < 0.0001$: Participants in the MS group reported higher level of cynicism than those in the ARF group. The ANOVA yielded non-significant main effects for gender or smoking condition in relation to cynicism, $F(1, 944) = 0.01$, $p = 0.92$, and $F(1, 944) = 0.76$, $p = 0.06$, respectively. Significant differences were found for age and educational level: Older patients reported higher level of cynicism than younger patients, $F(2, 944) = 7.86$, $p = 0.02$, and less educated patients reported higher level of cynicism than more educated patients, $F(1, 944) = 3.65$, $p = 0.0004$. No significant interaction was found for the independent variables, showing the independent effects of the metabolic syndrome, age, and education on level of cynicism. Table 2 shows the main descriptive statistics for cynicism as related to the metabolic syndrome condition, age group, and educational level. The Distrust-Cynicism Scale produced a rather normal distribution of data for all the subgroups of subjects (skewness included between -1 and $+1$). The lowest level of cynicism was reported by the subgroup with absence of risk factors, higher level of education and

age <41 years, while the highest level of cynicism was reported by the metabolic syndrome subgroup, aged >56 years, with lower level of education.

Effects on the incidence of the metabolic syndrome

To examine the effects of cynicism, smoking, and socio-demographic variables on the incidence of the metabolic syndrome, we used hierarchical logistic regression analyses. In the first model, cynicism was entered alone and it significantly predicted the MS incidence (odds ratio 1.15, 95% confidence interval 1.11 to 1.18, $p < 0.0001$). The second model examined the effect of cynicism, adjusting for smoking and socio-demographic variables (gender, age, education). The association between cynicism and MS incidence, similar to the univariate model, was not significantly attenuated by the effect of the added variables (odds ratio 1.12, 95% confidence interval 1.09 to 1.16, $p < 0.0001$). Results, reported in table 3, indicated that age (odds ratio 1.05, 95% confidence interval 1.03 to 1.06, $p < 0.0001$), and educational level (odds ratio 1.39, 95% confidence interval 1.05 to 1.85, $p = 0.02$) were also associated with the inci-

Table 2. - Descriptive statistics of Cynicism scores (n = 992)

Groups	n	Mean	SD	Minimum	Maximum	Skewness
MS, <41 years, A	33	31.67	3.88	26	39	0.21
ARF, <41 years, A	40	30.60	4.57	16	37	-0.63
MS, <41 years, B	45	31.13	4.68	23	41	0.15
ARF, <41 years, B	102	29.09	4.47	16	37	-0.68
MS, 41-56 years, A	189	33.14	4.41	24	41	-0.05
ARF, 41-56 years, A	135	30.67	4.82	18	39	-0.60
MS, 41-56 years, B	84	32.45	3.88	25	39	-0.22
ARF, 41-56 years, B	92	29.79	4.86	11	38	-0.99
MS, >56 years, A	148	34.43	4.51	24	45	-0.22
ARF, >56 years, A	53	31.38	4.06	23	38	-0.30
MS, >56 years, B	47	33.40	4.61	25	45	0.46
ARF, >56 years, B	24	31.33	5.31	21	39	-0.45

Legend: SD = standard deviation; MS = metabolic syndrome group; ARF absence of risk-factor group; A = Primary school; B = High school.

Table 3. - Logistic Model Coefficients for having the Metabolic Syndrome (N = 992)

	OR	95% CI	B	SE	Chi ²	p-value
Cynicism	1.12	1.09-1.16	0.12	0.02	54.22	0.0001
Gender - Male	0.93	0.69-1.24	-0.07	0.15	0.25	0.62
Age	1.05	1.03-1.06	0.05	0.01	5.99	0.0001
Education - A	1.37	1.02-1.83	0.31	0.15	4.47	0.03
Smoking	0.87	0.63-1.20	-0.14	0.16	2.11	0.39

Legend: OR = odds ratio; CI = confidence interval; SE = standard error; A = Primary school.

dence of the metabolic syndrome in this sample of subjects. The final logistic whole model fit for having the metabolic syndrome explained 11% of the total variance, Likelihood Ratio Chi² (5, 816) = 153.85, $p < 0.0001$, Adjusted R² = 0.11.

Discussion

The purpose of this study was to investigate whether cynicism, the cognitive component of hostility, was associated with the metabolic syndrome in a sample of Italian adults. In the study, cynical hostility was assessed in a sample (n = 546) having the metabolic syndrome and in a control group (n = 446) not having any of the five risk factors that constitute the metabolic syndrome, using a well-known hostility measure.

It was important to control for sex, age, and education because these variables were correlated with hostility: Higher hostility scores were found in men, in those of lower educational status, and in oldest age groups [16].

Controlling for other behavioural risk factors, such as smoking, was also important because hostility was related to cigarette smoking and other unhealthy behaviours [29].

In this study, comparisons across groups indicated that patients with the metabolic syndrome reported higher level of cynical hostility than controls, independently from socio-demographic characteristics and smoking. Age and education showed independent main effects on level of hostility as found in other studies [21], older and less educated subjects reporting higher hostility than those who were younger and more educated. Gender and smoking did not appear to influence the results.

Further, subjects with higher level of cynical hostility, older age and lower educational level were more likely to exhibit the metabolic syndrome than the others. The predictive role of cynical hostility on incidence of the metabolic syndrome only slightly diminished after controlling for socio-demographic (gender, age, and education) and smoking variables, still remaining significant.

Previous studies have found an association of hostility with components of the metabolic syndrome, such as waist-hip-ratio, body mass index, hypertension, total cholesterol level, increased triglycerides, and high fasting glucose level [30-35]. Data of the present study suggest that hostility might be taken into consideration as a psychological risk

factor associated with a clustering of these risk factors, namely the metabolic syndrome.

This association might be explained through the mediating role of poor health habits. Cynically hostile individuals, both men and women, tend to engage in health-damaging behaviours such as less physical exercise, drinking more alcohol, overeating and/or preference for foods high in cholesterol, fat, and sodium [36, 37]. Reasons may be low regard for themselves, oppositional reactions to other people's advice on health-promoting behaviours, decreased perceived importance of health warnings, and other motivations that are specifically linked to cynical hostility. This study did not evaluate these unhealthy behaviours which may represent important dimensions for future research to clarify the mechanisms linking hostility to the metabolic syndrome.

Further, this study did not examine other promising markers of the metabolic syndrome, which may help to understand the mechanisms linking hostility, the metabolic syndrome and the incidence of CHD.

Awareness that hostility contributes to risk behaviours and disease such as the metabolic syndrome may help in the design of interventions aimed at risk reduction. A randomized controlled study showed that a brief hostility-reduction intervention yielded a reduction in hostility level in a sample of high hostile young adult males [38]. These findings were replicated and extended to a CHD sample that reported lower level of hostility as well as a reduction in diastolic blood pressure assessed immediately and two months post-treatment [39]. The treatment for modifying hostility targeted specific components that were known to be predictive of CHD, such as cynical cognitions, angry feelings, and antagonistic behaviours [8]. This cognitive-behavioural treatment, consisting of eight, 90-minute, weekly meetings, was a relatively brief intervention, which might be easily implemented in clinical settings. Future research might use this model of intervention to modify hostility in people with the metabolic syndrome and assess longitudinally its efficacy on preventing CHD.

In summary, the present study showed that the cynical component of hostility is associated to the metabolic syndrome, independently from socio-demographic risk factors. As far as this pathogenic dimension could be modified by means of a specific psychotherapeutic intervention, cynical hostility might be taken into consideration by behavioural medicine to extend its strategies of CHD prevention.

Riassunto

Introduzione: Gli studi empirici indicano che la sindrome metabolica e l'ostilità sono fattori indipendenti di rischio per lo sviluppo delle malattie coronariche. Recentemente si è visto che l'effetto combinato di ostilità e sindrome metabolica è predittivo dell'incidenza d'infarto del miocardio. Questo studio ha valutato se l'ostilità cinica fosse associata alla sindrome metabolica in un campione di adulti italiani.

Metodi: 992 soggetti hanno partecipato allo studio. Fra questi, 546 sono stati classificati come aventi la sindrome metabolica e 446 come controlli, senza alcuno dei fattori di rischio che costituiscono la sindrome metabolica. Il cinismo, componente cognitiva dell'ostilità, è stata misurata con un questionario di auto-valutazione derivato dalla scala dell'ostilità di Cook e Medley. Per la sindrome metabolica ci si è basati sulla presenza dei seguenti fattori di rischio: obesità, iperinsulinemia, dislipidemia ed elevata pressione sanguigna.

Risultati: L'associazione fra ostilità cinica e sindrome metabolica è risultata statisticamente significativa ($p < 0.0001$). L'ostilità è risultata associata anche con l'età ($p < 0.0001$) e con il grado di istruzione ($p < 0.02$). Sono risultati predittivi della sindrome metabolica una maggiore ostilità (O.R. 1.12), un'età più avanzata (O.R. 1.39) ed un grado di istruzione più basso (O.R. 1.05).

Conclusioni: I risultati sottolineano la potenziale importanza degli interventi sui fattori psicologici, quali l'ostilità, per prevenire le malattie coronariche.

Parole chiave: malattie coronariche, cinismo, ostilità, sindrome metabolica.

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA: analysis of variance
ARF: absence of risk factors
BMI: body mass index
CHD: coronary heart disease
CVD: cardiovascular disease
MS: metabolic syndrome
OR: odds ratio

References

- DeFronzo RA, Ferrannini E. Insulin resistance. A multifaceted syndrome responsible for NIDDM, obesity, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. *Diabetes Care* 1991; 14: 173-194.
- Isomaa B, Almgren P, Tuomi T, et al. Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care* 2001; 24: 683-689.
- Lakka HM, Laaksonen DE, Lakka TA, et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. *JAMA* 2002; 288: 2709-2716.
- National Cholesterol Education Program. Detection, evaluation and treatment of high blood cholesterol in adults (Adult treatment panel III) (NIH Publication No. 01-3670). Washington, DC: U.S. Government Printing Office, 2001.
- Reaven GM. Banting lecture 1988: Role of insulin resistance in human disease. *Diabetes* 1988; 37: 1595-1607.
- Zarich SW. Metabolic syndrome, diabetes and cardiovascular events: current controversies and recommendations. *Minerva Cardioangiologica* 2006; 54: 195-214.
- Ferguson MA, Gutin B, Le NA, Karp W, Humphries M, Okuyama T, et al. Effects of exercise training and its cessation on components of the insulin resistance syndrome in obese children. *Int J Obes* 1999; 22: 889-895.
- Barefoot JC. Developments in the measurement of hostility. In: Friedman HS, ed. *Hostility, coping and health*. Washington, DC: American Psychological Association, 1992: 13-31.
- Niaura R, Todaro JF, Stroud L, Spiro A III, Ward KD, Weiss S. Hostility, the metabolic syndrome, and incidence coronary heart disease. *Health Psychol* 2002; 21: 588-593.
- Raïkkönen K, Keltikangas-Järvinen L, Adlercreutz H, Hautanen A. Psychosocial stress and the insulin resistance syndrome. *Metabolism* 1996; 45: 1533-1538.
- Raïkkönen K, Matthews KA, Kuller LH. Trajectory of psychological risk and incident hypertension in middle-aged women. *Hypertension* 2001; 38: 798-802.
- Raïkkönen K, Matthews KA, Kuller LH, Reiber C, Bunker CH. Anger, hostility and visceral adipose tissue in healthy postmenopausal women. *Metab Clin Exp* 1999; 48: 1146-1151.
- Todaro JF, Con A, Niaura R, et al. Combined effect of the metabolic syndrome and hostility on the incidence of myocardial infarction (The Normative Aging Group). *Am J Cardiol* 2005; 96: 221-226.
- Raïkkönen K, Matthews KA, Salomon K. Hostility predicts metabolic syndrome risk factors in children and adolescents. *Health Psychol* 2003; 22: 279-286.
- Niaura R, Banks SM, Ward KD, et al. Hostility and the metabolic syndrome in older males: the normative aging study. *Psychosom Med* 2000; 62: 7-16.
- Miller TQ, Smith TW, Turner CW, Guijarro ML, Hallet AJ. A meta-analytic review of research on hostility and physical health. *Psychol Bull* 1996; 119: 322-348.
- Ridker PM, Buring JE, Cook NR, Rifai N. C-reactive protein, the metabolic syndrome, and risk of incident cardiovascular events: an 8-year follow-up of 14 719 initially healthy American women. *Circulation* 2003; 107: 391-397.
- Nelson TL, Palmer RF, Pedersen NL. The metabolic syndrome mediates the relationship between cynical hostility and cardiovascular disease. *Exp Aging Res* 2004; 30: 163-177.
- Julkunen J, Salonen R, Kaplan GA, Chesney MA, Salonen JT. Hostility and the progression of carotid atherosclerosis. *Psychosom Med* 1994; 56: 519-525.
- Ricci Bitti PE, Gremigni P, Bertolotti G, Zotti AM. Dimensions of anger and hostility in cardiac patients, hypertensive patients, and controls. *Psychother Psychosom* 1995; 64: 162-172.
- Barefoot JC, Peterson BL, Dahalstrom WG, Siegler IC, Anderson NB, Williams RB. Hostility patterns and health implications: correlates of Cook-Medley Hostility Scale scores in a national survey. *Health Psychol* 1991; 10: 18-24.
- Scherwitz L, Perkins L, Chesney M, Hughes G. Cook-Medley Hostility Scale and subsets: Relationship to demographic and psychosocial characteristics in young adults in the CARDIA study. *Psychosom Med* 1991; 53: 36-49.
- Gump BB, Matthews KA, Raïkkönen K. Modeling relationships among socioeconomic status, hostility, cardiovascular reactivity and left ventricular mass in African American and White children. *Health Psychol* 1999; 18: 140-150.
- Alexander CM, Landsman PB, Teusch SM, Haffner SM. NCEP-defined metabolic syndrome, diabetes, and prevalence of coronary heart disease among NHANES III participants age 50 years and older. *Diabetes* 2003; 52: 1210-1214.
- Greenglass ER, Julkunen J. Cook-Medley hostility, anger and Type A behavior pattern in Finland. *Psychol Rep* 1991; 68: 1059-1066.
- Cook WW, Medley DM. Proposed hostility and pharisaic-virtue scales from the MMPI. *J Appl Psychology* 1954; 38: 414-418.

27. Greenglass ER, Julkunen J. Construct validity and sex differences in Cook-Medley hostility. *Person Indiv Diff* 1989; 10: 209-218.
28. Everson SA, Kauhanen J, Kaplan GA, *et al*. Hostility and increased risk of mortality and acute myocardial infarction: the mediating role of behavioral risk factors. *Am J Epidemiol* 1997; 146: 142-152.
29. Musante L, Treiber FA, Davis H, Strong WB, Levy M. Hostility: relationship to lifestyle behaviors and physical risk factors. *Behav Med* 1992; 18: 21-26.
30. Houston BK, Vavak CR. Cynical hostility: development factors, psychological correlates, and health behaviors. *Health Psychol* 1991; 10: 9-17.
31. Suls J, Wan CK, Costa PT Jr. Relationship of trait anger to resting blood pressure: a meta-analysis. *Health Psychol* 1995; 14: 444-456.
32. Voegelé C. Serum lipid concentrations, hostility and cardiovascular reactions to mental stress. *Int J Psychophysiol* 1998; 28: 167-179.
33. Raikkönen K, KeltinKangas-Jarvinen L, Adlercreutz H, Hautanen A. Psychosocial stress and the insulin resistance syndrome. *Metabolism* 1996; 45: 1533-1538.
34. Vitaliano PP, Scanlan JM, Krenz C, Fujimoto W. Insulin and glucose: relationship with hassles, anger, and hostility in nondiabetic older adults. *Psychosom Med* 1996; 58: 489-499.
35. Barefoot JC, Larsen S, von der Lieth L, Schroll M. Hostility, incidence of acute myocardial infarction, and mortality in a sample of older Danish men and women. *Am J Epidemiol* 1995; 142: 477-484.
36. Leiker M, Hailey BJ. A link between hostility and disease: poor health habits? *Behav Med* 1988; 3: 129-133.
37. Bettinardi O, Gremigni P, Toniolo S, Mizzi P. Ostilità, variabili cognitivo-comportamentali e profilo di soddisfazione soggettiva in pazienti cardiooperati. *Psicologia della Salute* 1998; 2-3: 99-104.
38. Gidron Y, Davidson K. Development and preliminary testing of a brief intervention for modifying CHD-predictive hostility components. *J Behav Med* 1996; 19: 203-220.
39. Gidron Y, Davidson K, Bata I. The short-term effects of a hostility-reduction intervention on male coronary heart disease patients. *Health Psychol* 1999; 18: 416-420.