Metabolic syndrome and cognitive performance in the elderly

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Abstract

Metabolic syndrome (MetS) is a cluster of conditions, each of which represents a risk factor for cardiovascular disease: central obesity, hyperglycemia, dyslipidemia and hypertension. In different recent studies, MetS has been associated with an accelerate cognitive decline in the elderly. The aim of our research was to investigate the relationship between MetS and cognitive performance in 174 italian elderly people living in Val Cenischia (Piedmont, Italy). Mini mental state examination (MMSE) has been administered to assess the cognitive status of all participants. The prevalence of MetS is 50.3% (51.3 and 49.5% for males and females, respectively). Our results confirm the association between MetS and worse cognitive performance in the elderly: an increased number of MetS components is associated with an increased risk of developing cognitive impairment (odds ratio=1.54; confidence interval 95%:1.04-2.28; P<0.05).

Introduction

Metabolic syndrome (MetS) is a cluster of conditions, each of which represents a risk factor for cardiovascular disease: central obesity, hyperglycemia, dyslipidemia and hypertension. MetS can be diagnosed when three or more of these criteria are present [National Cholesterol Education Program - Adult Treatment Panel III (NCEP ATP III) criteria]: waist circumference ≥102 cm (male) or ≥88 cm (female); triglycerides >150 mg/dL or lipid lowering drug use; high-density lipoprotein cholesterol (HDL-C) <40 mg/dL (male) or <50 mg/dL (female); blood pressure >130/85 mmHg or antihypertensive drug use; fasting plasma glucose >100 mg/dL or hypoglycemic drug use.[1] Any of these conditions and MetS itself have been associated to an increased risk of age-related cognitive decline, Alzheimer's disease (AD) and vascular dementia.[2-6]

The aim of our research was to assess the prevalence of MetS in a sample of elderly people belonging to a rural alpine community and investigate the relationship between MetS and cognitive performance.

The research has been reviewed and received ethics approval by the Bioethics Committee of the University of Turin, Italy.

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Materials and Methods

We evaluated 174 people (97 women and 77 men) aged 60 and over (mean age 73.4±7.3 years for males and 75.1±8.7 years for females) living in the villages of Venaus, Mompantero and Novalesa (Cenischia Valley, Piedmont, Italy). They were recruited through the local healthcare service (ASL TO3) and they all are people whose families have been living in the valley for at least three generations. Blood samples were collected from each participant in the morning to determine plasma total, HDL-C, triglycerides and fasting plasma glucose level. Blood pressure, waist circumference, height and weight were measured and a detailed pharmacological anamnesis was recorded in order to define current assumption of drugs.

Cognitive status was assessed with the mini mental state examination (MMSE) which is the screening test most widely used for cognitive impairment (CI).[7] MMSE allows the quantification of cognitive abilities and their changes over time and it has a good reliability (sensitivity=87%; specificity=82%). The MMSE total combines scores from five cognitive domains (orientation, language and comprehension, memory, attention, calculation and praxis), where each domain contributes approximately equal weight to the overall score. The total score was corrected by age and educational level using the score-adjustment coefficients proposed by Magni *et al*. in the 1996.[8] A score <24.0 has been accepted as indicating the presence of CI.[9]

All data were entered into Excel® spreadsheets (Microsoft 2007) and analyzed with SPSS Statistics 20.0.

Results

The characteristics of the participants with (MMSE<24.0) and without CI (MMSE≥24.0) are resumed in Table 1. The average HDL-C level is lower among people with CI compared to people without CI (48.7 *vs* 55.9 mg/dL, P=0.034). HDL-C levels lower than the recommended values (<40 mg/dL for males and <50mg/dL for females) are significantly associated with CI [odds ratio (OR)=3.22; P=0.017)]. In our sample,

Table 1. Characteristics of 174 participants with (mini mental state examination<24.0) and without cognitive impairment (mini mental state examination≥24.0).

	No cognitive impairment (n=156)	Cognitive impairment (n=18)	Univariate statistics
Age (years)	73,7 ± 7,9	80,0 ± 7,8	t=-3,190; DF=172; p=0,002
Gender (Male)	44,9% (n=70)	38,9% (n=7)	n.s.
BMI (kg/m2)	27,2 ± 4,7	26,9 ± 3,2	n.s.
AO	51,6% (n=80)	61,1% (n=11)	n.s.
HTN	76,3% (n=134)	66,7% (n=12)	n.s.
Systolic BP (mmHg)	137,9 ± 13,6	134,7 ± 13,1	n.s.
Diastolic BP (mmHg)	74,4 ± 5,9	72,8 ± 4,6	n.s.
Glucose (mg/dl)	109,6 ± 29,7	115,1 ± 25,3	n.s.
NIDDM	23,2% (n=32)	27,8% (n=5)	n.s.
TG (mg/dl)	131,3 ± 45,7	165,1 ± 74,5	n.s.
HTG	40,8% (n=58)	58,8% (n=10)	n.s.
TC (mg/dl)	214,3 ± 47,6	181,6 ± 47,3	t=2,770; DF=172; p=0,006
HTC	44,2% (n=69)	27,8% (n=5)	n.s.
HDL-C (mg/dl)	55,9 ± 13,7	48,7 ± 10,2	t=2,135; DF=172; p=0,034
Low HDL-C	23,7% (n=37)	50,0% (n=9)	O.R.=3,22 (IC95%: 1,19-8,70; p=0,017)
TC/HDL-C	4,0 ± 1,1	3,8 ± 1,0	n.s.
MetS	49,4% (n=77)	61,1% (n=11)	n.s.
NCEP ATPIII criteria	2,1 ± 1,3	2,9 ± 1,6	t=-2,471; DF=157; p=0,015

DF, degree of freedom; n.s., not significant; BMI, body mass index; AO, abdominal obesity (defined by a waist circumference ≥102 cm for males and ≥88 cm for females); HTN, hypertension (BP>135/85 mmHg and/or antihypertensive drugs); BP, blood pressure; NIDDM, non insulin-dependent diabetes mellitus; TG, triglycerides; HTG, hypertriglyceridemia (TG>150 mg/dL and/or lipid-lowering drugs); TC, total cholesterol; HTC, hypercholesterolemia (TC≥240 mg/dL and/or lipid-lowering drugs); HDL-C, high density lipoprotein cholesterol (Low HDL-C when <40 mg/dL for males and <50 mg/dL for females); MetS, metabolic syndrome; NCEP ATPIII, National Cholesterol Education Program - Adult Treatment Panel III.
Values are mean±standard deviation or percentages (n=number of cases).

however, the average total cholesterol (TC) level is lower in the group with CI and this could account for the association between low HDL-C and CI. In fact, if we compare the TC/HDL-C ratio between the two groups we cannot find any difference.

The group with CI shows an increased number of MetS components (NCEP ATPIII criteria) compared to the group without CI (2.9 *vs* 2.1; P=0.015).

All the variables with statistical significance (P<0.05) in the univariate analysis were introduced into multivariate logistic regression analysis that showed CI is associated with age (OR=1.087; P=0.009) and an increased number of MetS components (OR=1.54; P=0.042) (Table 2).

Table 2. Multivariate association of age and numbers of National Cholesterol Education Program - Adult Treatment Panel III criteria with cognitive impairment.

	OR (95% CI)	P - value
Age (years)	1,087 (1,021-1,157)	0,009
NCEP ATPIII criteria	1,540 (1,039-2,284)	0,042

OR, odds ratio; CI, confidence interval; NCEP ATPIII, National Cholesterol Education Program - Adult Treatment Panel III.

Discussion

MetS is characterized by a clustering of risk factors for cardiovascular disease and its prevalence, similar to that for cognitive disorders, increases dramatically with age. A growing body of epidemiological evidence suggested that MetS components may be important in the development of age-related cognitive decline, vascular dementia, and AD.[10,11] Several possible mechanisms may explain an association between MetS and CI including microvascular and macrovascular disease, inflammation, adiposity, and insulin resistance.[12] Our study has some limitations, the most important the small sample size, but our results are consistent with a recent study that found an association between MetS, the number of its components and risk of developing CI in older women from clinical centers.[13] In fact, although the prevalence of MetS in our sample is not significantly different between people with

and without CI, both univariate and multivariate statistics show an association between an increased number of MetS components and CI.

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