



## Research report

## Eating behaviors and their relationship with cardiovascular disease. A case/case-control study <sup>☆</sup>



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## ABSTRACT

The aim of the present work was to evaluate the combined role of eating behaviors and to investigate their effect on the likelihood of developing an acute coronary syndrome (ACS) or an ischemic stroke. During 2009–2010, 1000 participants were enrolled; 250 consecutive patients with a first ACS (83% males, 60 ± 12 years) and 250 control subjects, as well as 250 consecutive patients with a first ischemic stroke (56% males, 77 ± 9 years) and 250 controls. The controls were population-based and age–sex matched with the patients. Detailed information regarding their anthropometric data, medical records and life-style characteristics (dietary and smoking habits, physical activity, psychological state and eating practices –using a special questionnaire–) were recorded. Five eating behaviors were selected to compose an eating behavior score for the purposes of this work: adherence to the Mediterranean diet (using the MedDietScore), frequency of breakfast consumption, eating while being stressed, eating while working and skipping meals. Eating behaviors with beneficial health effects were scored with 0, while those with negative effects were assigned score 1. The total range of the score was between 0 and 5. Higher scores reveal “unhealthier” eating practices. After controlling for potential confounding factors, each unit increase of the eating behavior score was associated with 70% (95%CI: 1.29–2.22) higher likelihood of developing an ACS. Insignificant associations were observed regarding ischemic stroke. The overall adoption of specific “unhealthy” eating practices seems to have a detrimental effect on cardiovascular health, and especially coronary heart disease.

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## Introduction

Diet exerts a crucial role on cardiovascular health. This is emphasized by the recent acknowledgement of the adoption of a healthy diet as the cornerstone of cardiovascular disease (CVD) prevention (Perk et al., 2012). A healthy diet is not only associated with favorable effects on many CVD risk factors, such as blood cholesterol levels, blood pressure, diabetes mellitus and obesity, but can also reduce the risk of developing CVD through independent ways (Perk et al., 2012).

Nonetheless, in addition to dietary habits, the context of eating (i.e., eating behaviors), may be of significant importance. In more detail, people consume their food integrating their dietary choices in a frame of eating behaviors. These behaviors could be considered as an integral part of dietary habits and thus it is possible to interact with them, influencing human health. For example, regular breakfast consumption has been related to a lower body mass index (BMI), a healthier diet, and a better metabolic profile (Timlin &

Pereira, 2007), while skipping meals has been suggested to induce the opposite effects (Cho, Dietrich, Brown, Clark, & Block, 2003; Farshchi, Taylor, & Macdonald, 2005). Furthermore, eating while watching television has been associated with increased waist circumference (Cleland, Schmidt, Dwyer, & Venn, 2008), as well as unhealthy dietary choices (Horodyski, Stommel, Brophy-Herb, & Weatherspoon, 2010). However, the way eating behaviors affect CVD risk has not been thoroughly examined. It has been recently revealed that some eating behaviors, like eating while being stressed or while watching television, were associated with the likelihood of ACS or ischemic stroke presence (Kastorini et al., 2013). However, people do not adopt isolated eating practices, but a set of eating behaviors that may play a role on CVD development. With this in mind and due to the fact that eating behaviors may have a synergistic and/or antagonistic effect on cardiovascular health, their influence should be examined through a holistic approach, in accordance with the one proposed for dietary habits (Panagiotakos, Pitsavos, & Stefanadis, 2006). Thus, the aim of the present work was to investigate the overall effect that eating practices may exert on ACS and ischemic stroke.

## Methods

### Design and sampling procedure

The study was multicenter, case-control, with individual (one-for-one) matching by age (within  $\pm 3$  years) and sex. From October 2009 to December 2010, 250 of the 296 consecutive patients with a first ACS event ( $n = 209$  with acute myocardial infarction and  $n = 41$  with unstable angina), and 250 of the 319 consecutive patients with ischemic stroke, who entered in the cardiology or pathology clinics or the emergency units of three major General Hospitals, in Greece (i.e., University General Hospital of Ioannina, “Hellenic Red Cross” Korgialeneio-Benakeio Hospital, Athens and Alexandra Hospital, Athens) agreed to participate in the study (participation rate 81.3%). All patients were diagnosed by physicians as lacking any suspicion of previous CVD. Patients with chronic neo-plasmatic disease or chronic inflammatory disease, as well as individuals with recent changes in their dietary habits were also excluded. For the stroke patients who were unable to communicate, the information was obtained by a valid surrogate respondent (first degree relative living in the same home with the patient who is aware of the participant's dietary habits and medical history). Moreover, 500 control subjects without any history of CVD (250 matched one-for-one with ACS patients and another 250 matched one-for-one with stroke patients) were selected concurrently with the patients on a volunteer, population basis, and from the same region of the patients. Controls were without any clinical symptoms or suspicions of CVD in their medical history, as this was assessed by a physician. Based on the a priori statistical power analysis that was performed, the sample size of the 500 enrolled patients (250 ACS, 250 stroke) and 500 age- and sex-matched healthy subjects was adequate to evaluate two-sided hypotheses of odds ratios (ORs) equal to 1.20 for a 1-unit increase of a continuous covariate (e.g., eating behavior score), achieving statistical power equal to 82% at 0.05 significance level ( $P$ -value). In order to achieve more robust estimates of the effect sized measures, bootstrap resampling method was also applied (see details in statistical analysis section).

### Bioethics

The study was approved by the ethics committee of the University Hospital of Ioannina and was carried out in accordance with the Declaration of Helsinki (1989) of the World Medical Association. Prior to the collection of any information, participants (or valid surrogate respondents) were informed about the aims and proce-

dures of the study and were asked to provide their signed consents.

### Diagnosis of ACS or stroke

Regarding the ACS patients, their clinical symptoms were evaluated at hospital entry and a 12-lead electrocardiogram was performed by a cardiologist. The evidence of myocardial cell death was assessed through blood tests and measurement of the levels of troponin I and the MB fraction of total creatinine phosphokinase (Thygesen, Alpert, White, & on behalf of the Joint ESC/ACC/AHA/WHF Task Force for the Redefinition of Myocardial Infarction, 2007). Unstable angina was defined by the occurrence of one or more angina episodes at rest within the preceding 48-hours, corresponding to class III of the Braunwald classification (Braunwald, 1997). Ischemic strokes were defined through symptoms of neurologic dysfunction of acute onset of any severity, consistent with focal brain ischemia and imaging/laboratory confirmation of an acute vascular ischemic pathology (Kidwell & Warach, 2003).

### Dietary assessment and evaluation of eating practices and dietary behaviors

Usual eating practices and dietary habits of the past year were assessed through a 90-item, validated semi-quantitative food-frequency questionnaire (FFQ) that has been previously described (Bountziouka et al., 2012; Kastorini, Milionis, Goudevenos, & Panagiotakos, 2011). Level of adherence to the Mediterranean diet was assessed using a validated 11-item composite index, the MedDietScore (Panagiotakos et al., 2006). The theoretical range of the MedDietScore was between 0 and 55. Higher values of this score indicate greater adherence to the Mediterranean diet. Regarding eating practices: frequency of breakfast consumption (rarely, 1–2 times/week, 3–5 times/week, almost every day) and frequency of skipping a meal (<1 time/3 months, 1–3 times/month, 2–4 times/week, almost every day) due to (i) work obligations, (ii) intention to lose weight, and (iii) absence of hunger, were recorded. Participants were, also, asked about how often (rarely, 1–2 times/week, 3–5 times/week, almost every day) they consume a meal while working and, finally, how frequently (rarely, 1–2 times/week, 3–5 times/week, almost every day) they consume a meal while being stressed (rush, anxiety).

### Anthropometric characteristics

Weight (in kg) and height (in cm) of the participants were measured by study's trained investigators, to the nearest 0.5 kg and 0.5 cm respectively (in most cases TANITA SC-240 was used), with participants dressed in light indoor clothing and without footwear. BMI was then calculated as weight (measured in kilograms) divided by standing height (measured in meters squared); overweight and obesity were defined as BMI 25.0–29.9 kg/m<sup>2</sup> and >29.9 kg/m<sup>2</sup>, respectively.

### Medical history and clinical status

In all participants detailed medical history was recorded, including family history of CVD, as well as personal and family history of hypertension, hypercholesterolemia, hypertriglyceridemia and diabetes. Patients whose average blood pressure levels were greater or equal to 140/90 mmHg or were under antihypertensive medication were classified as having hypertension. Hypercholesterolemia was defined as total serum cholesterol concentrations  $\geq 200$  mg/dL ( $\geq 5.2$  mmol/L) or the use of lipid-lowering agents, and diabetes

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