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Original article

Endothelial function and other biomarkers of cardiovascular risk in frequent consumers of street food

Silvio Buscemi*, Vincenza Maniaci, Anna M. Barile, Giuseppe Rosafio, Alessandro Mattina, Baldassare Canino, Salvatore Verga, Giovam Battista Rini

Dipartimento di Medicina Interna e Specialistica (DIMIS), Laboratorio di Nutrizione Clinica, Facoltà di Medicina, Università di Palermo, Via del Vespro 129 – I, 90127 Palermo, Italy

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SUMMARY

Background & aims: Street food (SF) is defined as out-of-home food consumption, and generally consists of energy dense meals rich in saturated fats, and poor in fibers, vitamins and anti-oxidants. Though SF consumption may have unfavorable metabolic and cardiovascular effects, its possible association with endothelial function has not been considered.
Methods: Participants were recruited among those who took part in a previous study of ours, done in Palermo, Italy, which investigated the association between consumption of SF and health in 1002 people. In that study, a score of SF consumption was obtained by categorizing each of ten foods consumed less than or more than once a month (0 = never consumed, 1 = once a month or less, 2 = more than once a month; thus, the sum of single scores could range from 0 to 20). Based on the interquartile values of SF score distribution, in the present study we included low SF consumers, defined on the basis of the first interquartile SF score range (range: 0–1), and high SF consumers, who were those in the forth interquartile range of the SF score (range: 7–20). The group of low SF consumers had 12 participants (median value of SF score: 1; range: 0–1), that of high SF consumers had 13 (median value of SF score: 11; range: 10–16). The brachial artery flow-mediated dilatation (FMD), a measure of endothelial function, and other cardiovascular biomarkers were investigated.
Results: High SF consumers had higher BMI ($P = 0.026$), larger waist circumference ($P = 0.041$), higher levels of cholesterol ($P = 0.013$) and uric acid serum concentrations ($P = 0.002$) compared with low SF consumers. The high SF consumers had a significantly lower FMD (5.4 ± 2.1 versus $8.8 \pm 2.8\%$; ANCOVA with BMI and waist circumpherence as covariates: $P = 0.025$) than the high consumers. Other cardiovascular biomarkers did not significantly differ between the two groups.
Conclusions: This study suggests that high SF consumption in Palermo may be associated with endothelial dysfunction in healthy people, probably indicating that this category of foods should be limited, especially in people at high cardiovascular risk.

1. Introduction

Fast food consumption is greatly increasing worldwide, especially among the younger age groups.[1] Fast food is generally perceived as unhealthy, and consists of energy dense meals that are rich in saturated fats, and poor in fibers, vitamins, and anti-oxidants. Frequent consumption of fast food promotes weight gain[2–4] and may have unfavorable cardiovascular effects.[5] Therefore, strategies are actually under consideration for reducing the consumption of these foods.[6]

Closely linked to fast food is another version of out-of-home food consumption, termed street food (SF). Street food has old, historical roots, with complex socio-economic and cultural implications.[7] Street food is found even in less developed countries, and has occasionally been considered a hallmark of the early development of fast food.[8,9] It is quickly available and consumed, and generally affordable for large parts of the population. Despite the emergence of modern fast food, traditional SF persists worldwide, especially in Europe, and in Mediterranean countries (Maniaci V. Il

Abbreviations: SF, street food; FMD, flow-mediated dilatation; FFM, fat-free mass; RMR, resting metabolic rate; RQ, respiratory quotient; IMT, intima-media thickness; RI, resistance index; PI, pulsatility index.

* Corresponding author. Tel./fax: +39 91 6554580.
E-mail address: silbus@tin.it (S. Buscemi).

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cibo di strada e la comunità palermitana: indagine circa gli aspetti nutrizionali. University of Palermo, Thesis, 2009).

Impaired endothelial function is central to the atherosclerotic disease process, and is a strong independent risk factor for future cardiovascular disease and mortality.[10–13] Though high-fat meals have been found to have detrimental effects on endothelial function,[14] the effects of fast food consumption on the endothelial function have not been extensively investigated, or have produced conflicting results.[15] To the best of our knowledge, no study has ever considered the relationship of SF consumption to endothelial function in the Western world. We recently investigated the possible effects of SF consumption on health in Palermo, the largest city in Sicily, Italy.[16] In the present study we investigated endothelial function and other cardiovascular biomarkers in clinically healthy low and high SF consumers selected from the cohort of our previous study.

2. Materials and methods

The participants in this study were recruited among those who took part in our previous study, which investigated the relationship between consumption of SF and health in 1002 people.[16] That study was done from September 17 to October 19, 2009. Every Thursday through Sunday, groups composed of physicians and dieticians asked study participants to answer a questionnaire concerning their health conditions, general nutritional/dietary preferences/habits, usual frequency of consumption of SF or restaurant food in the past year. The four page questionnaire was administered in Italian, and was designed to be completed in under 5 min.

The consumption of traditional Palermo SF (panelle, rascatura, crocchè, arancine, focaccia with milza, sfincione, frittola, musso and quarume, stigghiole) was considered. A more complete gastronomic and nutritional description of Palermo SF has been given elsewhere,[16] and is also available on the Internet at http://www.scribd.com/doc/60786261/Palermo-Street-Food. Participants were asked if they consumed any of these foods (yes/no), and self-reported frequency of consumption of each food was categorized as less than or more than once a month.

A score of SF consumption was arbitrarily calculated in that study by categorizing the habitual consumption of each food as less (rarely) than or more (frequently) than once a month. The 10 above-mentioned SFs were considered, and each was arbitrarily assigned a score as follows: 0 = never consumed, 1 = once a month or less, 2 = more than once a month. Thus, the sum of single scores could range from 0 to 20. The interquartile values of SF score distribution were also calculated for our previous SF study.[16]

In the present study, we included low SF consumers, defined on the basis of the first interquartile SF score range (range: 0–1), and high SF consumers, who were those in the forth interquartile range of the SF score (range: 7–20). Patients with any hypertension, diabetes, cardiovascular or systemic disease, on any medications, or who were pregnant or lactating in the past 6 months were excluded.

The study protocol was approved by our hospital's Ethics Committee, and an approved informed consent form was signed by each participant.

All participants were examined between April and May, 2011 on two separate occasions, in the morning, and in postabsorptive fasting condition. A fasting blood sample was obtained for biochemical measurements. Height, body weight, systolic and diastolic arterial blood pressure (two measurements at 5-min intervals in seated position) were measured according to standardized procedures. A 12-lead electrocardiogram (Esaote; Italy) was performed in all participants.

2.1. Body composition and fat distribution

All participants had height and body weight measured, and body mass index (BMI) was calculated as body weight (kg)/height (m).[2] Fat mass (FM, % body weight) and fat-free mass (FFM, kg) were estimated, as previously described,[17] by means of bioelectrical impedance analysis (BIA-103, RJL, Detroit, MI, USA/Akern, Florence, Italy). Waist circumference was obtained at the umbilicus and was considered an indirect measure of visceral fat. Abdominal visceral and subcutaneous adipose fat values were also measured by means of high-resolution B-mode ultrasound (Sonoline G50; Siemens; Germany).[18] Transverse scans were obtained 5 cm above the umbilicus along the xipho-umbilical line. A 10-MHz linear probe was used to measure the distance between the cutis and the conjunction of rectus muscles at the linea alba (cutis-rectis thickness; CR), as a measure of the subcutaneous fat. A 3.5-MHz convex probe measured the distance between the linea alba and the anterior wall of the abdominal aorta (rectis-aorta thickness, RA), as a measure of visceral abdominal fat. A single physician (SB) was responsible for performing the ultrasonographic body fat thickness examinations. Our laboratory intra-observer coefficient of variation for CR is 1.2% and that for RA is 3.9% including participants with a BMI range of 18–45 kg/m.[2]

2.2. Carotid and renal ultrasound analysis

Images of the right and left extracranial carotid artery walls were obtained in several projections by high-resolution ultrasonographic 10-MHz linear array probe. End-diastolic intima-media thickness (IMT) of the far wall of both common carotid arteries was measured 10 mm caudal to the bulb, from the anterior, lateral and posterior approaches using two-dimensional longitudinal sections of the vessel and the distance from the first echogenic line to the second echogenic line. The mean measurement of both carotids was considered for calculations.[19] Renal Doppler flow (3.5 MHz probe) of the interlobar arteries was obtained by placing the Doppler sample volume at three different positions (superior, mid and inferior) in each kidney, guided by color flow mapping.[20] The mean of resistive indices of both kidneys (RI; [peak systolic velocity − end-diastolic velocity]/peak systolic velocity) and pulsatility index (PI; [peak systolic velocity − end-diastolic velocity]/mean velocity) were obtained.

2.3. Endothelial function

Endothelium-dependent reactivity in the macrocirculation, measured by FMD of the brachial artery, was determined using high-resolution vascular ultrasound (Sonoline G50; Siemens, Germany) with a 10 MHz linear array transducer. The transducer was held at the same position throughout the test by a stereotactic clamp with micrometer adjustment (EDI Progetti e Sviluppo; Pisa, Italy) to ensure image consistency. Reactive hyperemia was produced by inflating a sphygmomanometer cuff 2 cm below the antecubital fossa to occlude the artery for 5 min at approximately 220–250 mm Hg, then deflating it. Twenty minutes after the FMD measurement, the endothelium-independent dilatation was assessed after sublingual administration of 300 μg sublingual glyceryl-trinitrate (GTN).

A video processing system computed the brachial artery diameter in real-time by analyzing B-mode ultrasound images (FMD Studio; Institute of Physiology CNR; Pisa, Italy). Briefly, the device captures the analog video signal from the ultrasound equipment. An edge detection algorithm, based on the localization of gray level discontinuities, automatically locates the two walls of the vessel. The diameter is obtained with subpixel precision and temporal