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Correlates of low dietary energy reporting in free-living elderly: The MEDIS study

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ABSTRACT

Objectives: To evaluate the prevalence of low energy reporting (LER) and associations between LER and lifestyle, psychological and clinical parameters, in elderly people living in eastern Mediterranean islands.
Methods: 1190 men and women, aged 65–100 years, participated in this cross-sectional study. Socio-demographic, clinical and lifestyle characteristics were recorded for the study participants. Among others, the ratio of energy intake to estimated basal metabolic rate (EI/BMR) was calculated and was used for the assessment of LER.
Results: Prevalence of LER was 47.7%. Lower EI/BMR (i.e., higher risk for LER) was associated with older age ($p = 0.001$), male sex ($p < 0.001$), higher body mass index (BMI; $p = 0.04$), lower adherence to the Mediterranean diet ($p < 0.001$) and non-current smoking ($p = 0.007$). The sex-specific analysis revealed that, lower EI/BMR values were associated with lower adherence to the Mediterranean diet and being non-current smoker in both men and women ($p \leq 0.05$), as well as with older age ($p = 0.01$), higher BMI ($p = 0.02$) and hypercholesterolemia ($p = 0.02$), only in women.
Conclusion: In elderly, several clinical and lifestyle factors seem to be related to LER, and they should be taken into account in their nutritional assessment.

1. Introduction

Accurate assessment of the dietary intake is essential for evaluating nutritional status and undertaking preventive and/or therapeutic measures. A few methods can be used alone or in combination for the dietary assessment [1]. Available evidence indicates that, regardless of the method used, there is a substantial degree of under- or low-reporting of the usual food intake, a phenomenon described as low energy reporting (LER) [2–4]. Several factors have been extensively studied in relation to LER, like sex and obesity status [5–9], with women and overweight individuals being more prone to underreport. Dieting, specific eating behaviours, psychological characteristics and physical activity parameters have also been evaluated in relation to their effect on LER [9,10]. With regard to socioeconomic characteristics, there is also inconsistency among studies regarding their effect [8,11–14].

Although LER has been recognized to increase with age or to be more prevalent among older people [5–7], few studies have specifically focused on the elderly [15–20]. People of older age may be particularly prone to non-accurately reporting their dietary intake due to lower motivation, cognitive impairments, physical and social limitations and health problems [21–23]. Recognizing lifestyle and psychological factors associated with LER in the elderly would improve the quality of the dietary data obtained, and thus the assessment of energy imbalances, known to be associated with higher rates of limitation, chronic disease, and mortality [24,25]. Most studies so far exploring LER in the elderly refer to populations with "westernized" lifestyle habits. The lifestyle factors influencing the accuracy of underreporting may not be different compared to corresponding adult populations. Thus, it would be interesting and novel to evaluate the prevalence of dietary misreporting in populations that maintain, at least, part of their traditional way of living, including dietary habits, and, to recognize associations between mis-reporting and socio-economic, psychological and clinical measures. The older inhabitants of the Greek islands and Cyprus provide such as a population sample. They were studied in early 1960s, where the Seven Countries Study investigators [26] enrolled people from two Mediterranean islands (Crete and Corfu) and revealed, among other findings, the protective role of the Mediterranean diet on cardiovascular disease.

Under this perspective, the aim of the present work was to evaluate the prevalence of LER, as well as associations between LER and various dietary, lifestyle, psychological and clinical parame-

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ters, in a population-based sample of older men and women, living in the insular area of Greece (i.e., 7 islands were included) and Cyprus.

2. Methods

2.1. Participants

The MEDIS (Mediterranean Islands) study is health and nutrition survey that aimed to evaluate bio-clinical, lifestyle and behavioural characteristics of elderly people living in the Mediterranean islands [27]. A random, population-based, multistage sampling method [(i.e., three age group levels (65–75, 75–85, and >85) and two sex levels)] was used to select a representative sample of men and women, from the Cyprus Republic and 7 Greek islands (i.e., Lesvos, Samothraki, Cephalonia, Crete, Corfu, Lemnos and Zakynthos). The sampling was based on a volunteer and feasibility basis; individuals were allocated in public areas or in their homes and were asked to participate in the study. People residing in assisted-living centres, as well as those with a clinical history of CVD or cancer were not included in the sampling. The target sample size (based on statistical power analysis) was: 300 people from Cyprus and 150 from each one of the other seven islands. Finally, 553 men (76 ± 7 years) and 637 women (74 ± 7 years) ($n = 1190$) agreed to participate (Cyprus, $n = 300$; Lesvos, $n = 142$; Samothraki, $n = 100$; Cephalonia, $n = 115$; Crete, $n = 131$; Corfu, $n = 149$; Lemnos $n = 150$; Zakynthos, $n = 103$). Out of them, 460 (39%) were living in rural areas. The participation rate varied from 75% to 89% among the islands (people who denied participating provided various reasons, mainly lack of time). A group of experienced field investigators (i.e., physicians, dietitians and nurses) collected all the required information, using a quantitative questionnaire and standard clinical and biochemical procedures.

Participants were informed on the aims and procedures of the study and provided their consent. The collected data were confidential, and the study followed the ethical considerations provided by the World Medical Association (52nd WMA General Assembly, Edinburgh, Scotland, October 2000). Moreover, the Institutional Review Board of Harokopio University approved the design, procedures and aims of the study.

2.2. Measurements

Weight and height were measured following standard procedures (i.e., height was measured to the nearest 0.5 cm, without shoes, back square against the wall tape, eyes looking straight ahead, while weight was measured on a levelled platform scale, to the nearest 100 g, without shoes, in light undergarments) and body mass index (BMI) values were calculated as weight in kg divided by height in m^2. Overweight was defined as BMI between 25.0 and 29.9 kg/m^2, while obesity was defined as BMI > 29.9 kg/m^2 [28]. Waist circumference was measured in cm in the middle between the 12th rib and the iliac crest and hip circumference was measured in cm around the buttocks. The waist-to-hip ratio was calculated; a waist-to-hip ratio greater or equal to 0.95 in men and 0.80 in women was considered as a measure of central obesity [28]. Moreover, presence of diabetes mellitus (type 2) was determined by fasting plasma glucose measurements and was defined in accordance to the American Diabetes Association diagnostic criteria (i.e., fasting blood glucose levels greater than 125 mg/dL or use of special medication indicated the presence of diabetes). Participants who had blood pressure levels $\geq$140/90 mm Hg or used antihypertensive medications were classified as hypertensive. Fasting blood lipid levels were measured and hypercholesterolemia was defined as total serum cholesterol levels >200 mg/dL or the use of lipid-lowering agents [29]. HDL-, LDL-cholesterol and triglycerides were also recorded.

Basic demographic characteristics, such as age, gender, annual income and lifestyle factors, were recorded for the study participants. Current smokers were classified those who smoked at least one cigarette per day or have stopped cigarette smoking during the past 12 months and former smokers those who previously smoked, but have quit smoking at least 12 months or more. The remaining participants were defined as nonsmokers. For creating a dichotomous smoking habit variable, participants who were former smokers and those defined as nonsmokers were combined under a unified "non-current smokers" category.

Dietary habits were assessed through a validated and reproducible questionnaire [30], containing questions about the frequency of use (e.g., never, rare, sometimes per month or week, daily) of pre-specified servings of foods or food groups, also allowing for a limited quantification of serving size, i.e., a semi-quantitative food-frequency questionnaire, a widely used method in epidemiological studies. In specific, the frequencies of consumption of meat and meat products, fish and seafood, milk and other dairy, fruits, vegetables, greens and salads, legumes, cereals, coffee and tea and soft-drinks were assessed on a daily, weekly or monthly basis. Furthermore, intake of various alcoholic beverages (i.e., wine, beer, etc.) was measured in terms of wineglasses adjusted for ethanol intake (e.g., one 100 ml glass of wine was considered to have 12% ethanol).

In order to evaluate the level of adherence to the Mediterranean diet the MedDietScore (theoretical range of score values 0–55) was used [31]. In particular, for the consumption of foods presumed to be close to this pattern (i.e., those recommended to be consumed on a daily basis or more than 4 servings per week) scores 0–5 were assigned (from no consumption to daily consumption, respectively). On the other hand, for the consumption of foods presumed to be away from this diet (like meat and meat products) the opposite scores were assigned (i.e., 0 when a participant reported almost daily consumption to 5 for rare or no consumption). Regarding alcohol intake, score 5 was assigned for consumption of less than 3 wineglasses per day, score 0 for none or consumption of more than 7 wineglasses per day and scores of 4, 3, 2, and 1 for the consumption of 3, 4–5, 6, and 7 glasses, respectively. Higher values of this diet score indicate greater adherence to the Mediterranean diet (value range 0–55). Energy and macronutrient intakes were calculated for each participant through the dietary information and using local and international food composition tables [32–34].

For the assessment of LER, the following steps have been taken: the basal metabolic rate (BMR) was estimated using the Schofield prediction equations [35], adopted by the 2004 FAO/WHO/UNU report [36], using age and weight information. The energy intake (EI) was taken from the food frequency questionnaire analysis. Then, the ratio of the energy intake/basal metabolic rate (EI/BMR) was calculated for each individual. Participants with EI/BMR < 1.14 were classified as "low energy reporters" (LERs) based on the cut-off limits developed by Goldberg et al. [35], whereas those with EI/BMR > 2.4 as "energy over-reporters", for the range 2.0–2.4 was suggested as the maximum for sustainable lifestyle [36]. "Acceptable energy reporters" or non-LERs were participants with $1.14 \leq \text{EI/BMR} \leq 2.4$. This method has been proposed as an indirect assessment of the plausibility of dietary intake [35] and it has been extensively used in previous studies [20,37,38].

Physical activity was assessed through the shortened version of the self-report International Physical Activity Questionnaire (IPAQ) [39]. Frequency (times per week), duration (minutes per time) and intensity of physical activity during sports, occupation and/or free-time activities were recorded. Only episodes of activities of at least 10 min were reported. Participants were classified as [40]: (a) *HEPA active* (health enhancing physical activity; a high active category),