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Special considerations for nutritional studies in elderly

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Abstract

The elderly population is increasing and it is well documented that may present some health problems related to nutritional intake. Both mental and physical impairments in the elderly may need specific adaptations to dietary assessment methods. But all self-report approaches include systematic and random errors, and under-reporting of dietary energy intake is common. Biomarkers of protein intake, as 24 hours urinary Nitrogen, may not be useful in elderly patients because of incontinence problems. Some micronutrients, like vitamin B12, have special importance in the elderly population. Also, measurement of fluid intake is also critical because elderly population is prone to dehydration. A detailed malnutrition status assessment should be included in the geriatric dietary history, and assessment. Body mass index (BMI) is not useful in the elderly, and it is important to evaluate functional status. Gait speed, handgrip strength using hand dynamometry can be used. Body Shape Index (ABSI) appears to be an accurate measure of adiposity, and is associated with total mortality. Further research is needed to clarify the best and simple methods to accurately estimate food and beverage fluid intake in the elderly population, and to evaluate nutritional and hidration status.

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CONSIDERACIONES Y RECOMENDACIONES EN EL CASO DE ESTUDIOS NUTRICIONALES REALIZADOS EN ADULTOS MAYORES

Resumen

La población de edad avanzada está aumentando y puede presentar problemas de salud relacionados con la ingesta alimentaria. Los ancianos presentan alteraciones mentales, físicas y funcionales que precisan de adaptaciones específicas en los métodos de evaluación dietética. Todas las aproximaciones auto-referidas presentan errores sistemáticos, y es frecuente que se refiera una menor ingesta energética. Los biomarcadores de ingesta proteica, como el Nitrógeno urinario de 24 horas, pueden no ser útiles debido a la incontinencia. Algunos micronutrientes, como la vitamina B12, tienen una importancia especial en la población de edad avanzada. Igualmente, la medición de la ingesta de líquidos es importante, ya que pueden sufrir deshidratación. En la evaluación geriátrica debería incluirse una evaluación de la malnutrición. El índice de masa corporal (IMC) no es muy útil en el anciano, y es mejor evaluar la situación funcional. Pueden medirse la velocidad de la marcha, y la fuerza de prensión, medida con dinamómetro. El Índice de Forma Corporal parece ser una medición fiable de la adiposidad y se asocia con la mortalidad. Son necesarios más estudios para aclarar cuál es el mejor método para estimar de forma fiable la ingesta de comida y bebida en la población anciana y para evaluar el estado nutricional.

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Palabras clave: *Tercera edad. Infraestimación. Estado nutricional. Obesidad. Cuestionario de frecuencia de consumo. Biomarcadores. Ingesta energética.*

Abbreviations

BMI: Body mass index.
ABSI: Body Shape Index.
IMC: Índice de masa corporal.
FFQs: Food frequency questionnaires.
24HDR: 24 hour dietary recall.
4DFR: 4 day food record.
WHI: Women's Health Iniciative.
EI: Energy intake.
EE: Energy expenditure.
DLW: Doubly labeled water.
SWA: Sense Wear Pro3 Armband.
PFD: Coded food diary.
ICC: Intraclass correlation coefficient.

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DH: Dietary history.
EDR: Estimated dietary record.
BM: Biomarkers.
WBQ: Water balance questionnaire.
SGA: Subjective Global Assessment.
MUST: Malnutrition Universal Screening Tool.
NRS: Nutritional Risk Screening.
MNA: Mini Nutritional Assessment.
MNA-SF: Mini Nutritional Assessment Short Form.
GNRI: Geriatric Nutritional Risk Index.
NHANES: National Health and Nutrition Examination Survey.
HALS: Health and Lifestyle Survey.

Introduction

It is predicted that elderly population will reach more than 25% by year 2050[1], and this will may make us to face present different health problems due to increasing trend of nutritional related diseasesrelated to nutritional intake. A direct relationship between dietary habits and health outcomes[2] and mortality[3] have been reported. Even more, changes that occur during aging may, directly or indirectly, influence food and beverage intake. For example, smell and taste diminish, and digestive disorders can easily appear. Poor intakes are associated with increased risk of poor health, including functional decline. So, it is really important to accurately assess the nutritional situation of the elderly population.

Dietary intake

Several methods are available to assess dietary intake. Food frequency questionnaires (FFQs) have been used extensively used in nutritional epidemiology for assessing past and usual intake.They can be self-administered and are relatively inexpensive.The FFQ usually administered to elderly people have a range ofincluded food items included, reaching to more than 200. Other approaches are the 24 hour dietary recall (24HDR) and the 3 to 74 day food record (4DFR). The concern with short-term recalls and diet records is that they are expensive and unrepresentative of usual intake if only a few days are assessed. And all self-report approaches include systematic and random errors that can distort the described associations between diet and disease. It is well known that a general finding in dietary studies is under-reporting of energy intake, and it has been found in both adult and in elderly populations. Under-reporting in women is associated with fear of negative evaluation, weight loss history, percentage of energy from fat, or variability in number of meals per day[4]. Under-reporters usually tend to be less physically active, and they are more likely to dieting. For example, in the OPEN Study[5], a larger underreporting of dietary energy intake by overweight women was shown. In the Women's Health Iniciative (WHI), under-reporting by postmenopausic women was associated with fear of negative evaluation, weight loss history, less active, more likely to be on diet and eating less fat, restrained eating or the conscious effort to restrict calorie intake, high disinhibition or the loss of self-control in eating behaviour or anxiety and distress. In the WHI-NBS, a modest additional underreporting of energy intake was found among racial and ethnic minorities compared with white participants. In a study with 70–79 years old persons, by Sharhar et al.[6] among high-functioning community-dwelling elderly, it was shown that underreporters had significantly higher body weight than the rest of the participants.

Another important problem is that elderly population is an heterogeneous group, ranging from healthy, physically active and independently living people, to centenarians, fully dependent on care. Both mental and physical impairments may need specific adaptations to dietary assessment methods. We must keep in mind that memory may already start declining after the age of 55 years, and dietary recall ability decreases with age. So the 24HDR and, in a lower extent, the 4DFR methods may be inappropriate, due to age-associated cognitive decline and short-term memory impairment. Even more, the validity of self-reported dietary information also diminishes with increasing age of the responder, due to memory loss or visual impairment. The oldest elderly can become easily fatigued and frustrated with long dietary interviews and may take longer time to complete the questionnaire. In these circumstances, with incompetent patients, the information can be needed to get obtainedthe information from caregivers and surrogate or proxy sources. Therefore, it is very important that the choice of dietary assessment method should take into account cognitive skills and other characteristics of the elderly population. Surprisingly, few studies have assessed the use and validity of dietary assessment methods in elderly people, particularly those classified in the oldest age group[7,8].

Measurement of energy intake

As previously stated, obese individuals underreport their food intakes by 20–50% and it has been estimated that, as the degree of obesity increases, the same occurs with the degree of underestimation of energy intake (EI) [9]. Such systematic reporting errors and reporting biases consequently alter the ability of researchers to determine intake in overweight and obese individuals, and it becomes clear that methods to collect self-reported EI data are not good in overweight and obese populations. So it is important to examine the extent and nature of underreporting of food intake in obese populations.

The measurement of energy expenditure (EE) with use of the doubly labeled water (DLW) method has been used to investigate the validity of self-reported

dietary intake. This method of validation is based on the assumption that EI is equal to EE when weight is stable. As previously outlined, the largest discrepancy between self-reported EI and EE relative to DLW occurs in obese. Hise et al have performed a study to validate EI estimated from a pre-coded food diary against energy expenditure (EE) measured with the DLW method in a group of elderly men, with overweight/ obesity[10]. They evaluated the validity of the combined use of observer-recorded weighed-food records and 24-hour snack recalls in estimating energy intakes in overweight and obese individuals. EI was measured over 2 week in a university cafeteria and a 24-h snack recalls were conducted. And they concluded that the combination of observer-recorded food records and 24-h snack recalls is a valid method for measuring EI.

But the use of DLW method is limited because of its high cost, and the need for specialised equipment and trained staff. To avoid these problems, a devide has been developed, the Sense Wear Pro3 Armband (SWA; BodyMedia Inc., Pittsburg, PA, USA) that can be used to register energy expenditure in healthy adults. A reasonable level of concordance was demonstrated between SWA and DLW methods (ICC = 0.63) for measuring daily EE in free-living adults during 10 days of monitoring[11]. So, SWA can be considered a relatively inexpensive and practical method to accurate monitor EE.

Stea el al[12] validated the EI, estimated from a pre-coded food diary (PFD) against EE measured with the SWA, in a group of Norwegian elderly men aged 60–80 years. Participants recorded their food intake for four consecutive days using food diaries and wore the SWA during the same period. The group average EI was 17% lower at baseline and 18% lower at post-test compared to measured EE. Mean difference from Bland-Altman plot for EI and EE was 21.5 MJ/day (61.96 SD: 27.0, 4.0 MJ/day) at baseline and 21.6 MJ/day (26.6, 3.4 MJ/day) at post-test. The intraclass correlation coefficient (ICC) was 0.30 (95% CI: 0.02, 0.54, p = 0.018) at baseline and 0.34 (0.06, 0.57, p = 0.009) at post-test. Higher values of underreporting was shown among overweight/obese compared to normal weight participants at both baseline and post-test (p< 0.001), respectively. So, the authors conclude that the PFD could be a useful tool for estimating energy intake in normal weight elderly men, but it seems to be less suitable for estimating energy intake in overweight/obese elderly men.

Measurement of protein intake

When measuring protein intake, biomarkers of meat intake, as 24 hours urinary Nitrogen, can be used. Using this biomarker of protein intake, a potentially positive association of protein intake with risk of diabetes in postmenopausal women after calibration and body mass index (BMI) adjustment was found in the WHI study. This result suggested that protein consumption could contribute to diabetes risk through mechanisms other than body fat deposition. And this new described association is important to consider when counseling persons at risk of developing diabetes. But again, this method can not be useful in elderly patients because of incontinence problems.

Measurement of micronutrients intake

This is an area of concern because there are some micronutrients with special importance in the elderly population. For example, B12 vitamin is related to cognitive decline, that can even arise without the typical haematological abnormalities. But the estimation of micronutrient intake is a difficult task and can present extra challenges in elderly people. Grootenhuis et al.[13] used a semiquantitative food frequency questionnaire for epidemiologic research among the elderly and validated it comparing with dietary history (DH). They found that good agreement of mean nutrient intake and high correlation coefficients between the estimates of the self-administered semi-quantitative questionnaire and the DH method, the absence of non-constant bias for most nutrients and the ability of the questionnaire to classify individuals adequately into broad categories, demonstrated an acceptable relative validity. Using 4-dayFDR as the reference method, Dumartheray et al.[14] demonstrated a good level of nutrient intake estimation by FFQ for the majority of the micronutrients assessed. This demonstrates that the variability of the nutrient consumption is related to energy intake. Messerer et al. [15] assessed the validity of a self-administered FFQ and showed that overall, adding information about dietary supplement use increased the validity of micronutrient estimates by 13% based on a self-administered FFQ. Klipstein-Grobusch et al.[16] evaluated the relative validity of micronutrient intake estimated by a FFQ adapted for dietary assessment in the elderly as compared to 15-day estimated dietary record (EDR). The correlation coefficients observed in the present study ranged from 0-5 to 0-9 for crude and from 0-4 to 0-8 for adjusted data, indicating relatively good validity and being similar to results of validation studies in which either a FFQ or DH were administered to an elderly population. van de Rest et al. developed a FFQ to assess folate intake over the past 3 months in Dutch elderly people and showed a weak positive correlation between folate intakes estimated with the FFQ and serum folate concentrations (r 0-14), but not erythrocyte folate (r 0-05)[17]. This could be explained by the fact that the serum folate reflects recent intake and the erythrocyte folate reflects long-term intake and in this study, FFQ assessed food intake in the previous 3 months.

Dietary intakes of b-carotene estimated by different FFQ can be validated against plasma concentrations of this micronutrient. Vioque et al. demons-

trated that plasma concentrations of carotenoids and vitamin C are better correlated with dietary intake in normal weight than overweight and obese elderly subjects and that the correlations between usual intake of this micronutrient assessed by FFQ and their plasma concentration changed when the participants were grouped by BMI category[18].

A systematic literature review identified studies validating the methodology used in elderly people for measuring usual dietary micronutrient intake[19]. The quality of each validation study selected was assessed using a EURRECA-developed scoring system. The validation studies were categorized according to whether the reference method applied reflected short-term intake (<7 d), long-term intake (>7 d) or used biomarkers (BM). A total of 33 publications were included, 25 used different FFQ, 6 diet histories (DH), one 24-h recall (24HR) and one videotaped dietary assessment method. A total of 5 publications analysed BM, which were used to validate four FFQ, and one 24HR, presenting very good correlations only for vitamin E. The analysis of weighted correlation coefficients classified by FFQ or DH showed that most of the micronutrients had higher correlations when the DH was used as the dietary method. Comparing only FFQ results showed very good correlations for measuring short-term intakes of riboflavin and thiamin and long-term intakes of P and Mg. When frequency methods are used, the inclusion of dietary supplements improves their reliability for most micronutrients. Comparing FFQ methods used for assessing micronutrient intake with short-term reference methods, very good correlations were observed for thiamin and riboflavin. Nevertheless, a poor correlation was observed for b-carotene. When FFQ using longterm intakes as reference methods are compared, we have observed that a greater number of micronutrients present good correlations. They are also very good for measuring long-term intake of P and Mg. Micronutrients with poor correlations were not observed when the reference method used reflected long-term intake. Micronutrient intake correlates better with long-term rather than short-term daily intake. Additionally, BM used as reference methods present very good correlations for vitamin E and poor correlations for folate. According to this systematic review, when comparing different validation methods, the DH presents better correlations when EDR are used as the reference method. When we analyse the mean of correlation coefficients weighted by study quality and their distribution by FFQ or DH as validated dietary methods, we observed that most of the micronutrients improved the correlation when the DH was used as the study instrument. Overall, when frequency methods are used for assessing micronutrient intake, the inclusion of dietary supplements improves their reliability for most nutrients, with notable differences observed for folate, retinol, vitamins A, D, E and Zn. So, future research to clarify the number of food items and frequency categories that are to be included in the questionnaires needs to be developed for this population group.

Fluid intake

Measurement of fluid intake is critical in the elderly because elderly population isn prone to dehydration. Several factors can favor dehydration: Hypodipsia, use of diuretics, incontinency, gastrointestinal diseases and hot environments. Several approaches have been used to assess beverage intake for the general population, but the validity of these approaches has not been well established in the aged population. Most of the studies about fluid intake have focused on assessment of beverage-associated nutrients, or alcohol[20], or have been performed with or for other segments of the population, as the children and adolescents[21]. In most of the studies, FFQ, multiple-day food records and 24-hour dietary recalls have been used to estimate beverage intake. Biomarkers of beverage intake are able to assess dietary intake / hydration status without the bias of self-reported dietary intake errors and also the intra-individual variability. Various biomarkers have been proposed to assess hydration, however, to date; there is a lack of universally accepted biomarker that reflects changes of hydration status in response to changes in beverage intake. A recent review has validated different beverage intake methods *vs*. hydration biomarker[22]. The authors conducted a review to find out the questionnaires of beverage intake available in the scientific literature to assess water beverage intake and hydration status, previouslyand validated-them against hydration biomarkers. Only two articles were selected, in which, two different beverage intake questionnaires designed to capture the usual beverage intake were validated against Urine Specific Gravidity biomarker. The "Water balance questionnaire" (WBQ)[23] reported no correlations in the first study and the Beverage Intake Questionnaire[24], a quantitative Food frequency questionnaire in the second study, also found a negative correlation. FFQ appears to measure better beverage intake than WBQ when compared with biomarkers. However, the WBQ seems to be a more complete method to evaluate the hydration balance of a given population. The authors conclude that further research is needed to understand the meaning of the different correlations between intake estimates and biomarkers of hydration in distinct population groups and environments.

Assesment of malnutrition in the elderly

Malnutrition is highly prevalent among hospitalized elderly patients, ranging from 30% to 50% depending on the patient population and the criteria used for diagnosis. The prevalence of malnutrition in com-

munity-dwelling elderly is lower, about 2%, and the risk of malnutrition is 24%. Home care elderly use to haves a prevalence of undernutrition around 109%, and risk of malnutrition up to 45%. Malnutrition is associated with functional and cognitive impairment. Thus, identifying at early stages those who are malnourished and at risk of malnutrition is important to treat them early at an early stage and to improve patients overall prognosis, reducingand reduce the health costs. Many nutrition screening and assessment tools are available, to identify the risk of malnutrition and to diagnose this condition. Ideally, nutritional assessment should be practical, easy to perform, non-invasive, well tolerated, inexpensive, requiring no use of devices or supplementary examinations, applicable at the bedside, showing appropriate sensitivity and specificity and yield immediate results. Subjective Global Assessment (SGA) is one of the most commonly used nutrition assessment tools and reliably detects patients with established malnutrition[25]. The Malnutrition Universal Screening Tool (MUST) was developed to detect both under-nutrition and obesity in adults[26]. The Nutritional Risk Screening (NRS) is the preferred screening tool for hospitalized patients[27]. TheBut Mini Nutritional Assessment (MNA) and its Short Form (MNA-SF) were specifically developed to assess nutritional risk in elders[28]. Both are sensitive, specific, and accurate in identifying nutrition risk. The MNA is a screening and assessment tool with a reliable scale and clearly defined thresholds, usable by health care professionals. A low MNA score is associated with an increase in mortality, and length of hospital stay. The MNA detects risk of malnutrition before severe change in weight or serum proteins occurs. The MNA can also be used as a follow up assessment tool. So, it should be included in the geriatric assessment and is proposed in the minimum data set for nutritional interventions.

The Geriatric Nutritional Risk Index (GNRI) is a tool initially proposed to predict nutrition-related complications in sub-acute care setting[29]. It has been validated in hospitalized elderly patients by testing its ability to predict patients outcome through the comparison with Mini Nutritional Assessment (MNA), in a prospective cohort with 131 patients (mean age 69.32 ± 8.17 years) admitted consecutively to the acute geriatrics medical ward. Patients were followed for 6 months for the occurrence of major health complications as prolonged length of stay, infectious complications and mortality. GNRI showed a higher prognostic value for describing and classification of nutritional status and nutritional-related complications in hospitalized elderly patients, in addition to its simplicity[30]. An study was performed to compare the correlation between MNA and GNRI with anthropometric, biochemical, functional status measure (Barthel Index) and nutritional relation complications (such as infection and bedsores) in a sample of older subjects admitted to hospital[31]. The concordance of MNA and GNRI was 39%. The most significant differences were detected in weight, BMI, arm and calf circumference and weight loss parameters. Barthel index was significantly different in both tests. The MNA and GRNI had significant correlations with albumin, total protein, transferring, arm and calf circumference, weight loss and BMI parameters. So, it would be reasonable to use GRNI in cases where MNA is not applicable, or even use GRNI as a complement to MNA in hospitalized elderly patients, because patients could benefit from more effective nutritional intervention.

Measuring obesity in the elderly: sarcopenic obesity

Obesity is recognized as a major risk factor in the development of cardiovascular diseases and diabetes, but in several chronic diseases, a higher BMI may be associated with a lower mortality and a better outcome compared with their normal-weight counterparts. This protective effect of obesity has been described as the "obesity paradox" or "reverse epidemiology". The obesity paradox was mostly reported in elderly. Lainscak et al evaluated nine large-scale studies about obesity paradox in chronic diseases[32]. Eight of the studies included subjects at mean age >62 years. The obesity paradox may be partly explained by the lack of the discriminatory power of BMI to differentiate between lean body mass and fat mass, because BMI does not take into account body fat distribution. In the elderly, the prevalence of abdominal obesity defined by waist circumference is higher than the prevalence of obesity defined by BMI[33]. Higher mortality in the low BMI categories may be due to the sarcopenic obesity that is characterized by low muscle mass and strength while fat mass may be preserved or even increased. Changes in muscle composition (fat infiltration into muscle or marbling) are also important. Sarcopenia exacerbates insulin resistance and dysglycemia in both nonobese and obese individuals, and increase the risk of adverse outcomes, such as physical disability, poor quality of life and death. So, in the elderly the body mass index is not useful and it is better to evaluate functional status, through the amount of muscle mass and its function, mainly strength and physical performance. The challenge is to determine how best to measure them accurately. Gait speed measurement has been demonstrated to be the most reliable way to screen sarcopenia in clinical practice. A cut-off point of >0.8 m/s identifies risk for sarcopenia[34]. A relationship between handgrip strength and mortality in the oldest old population has been described in the Leiden 85-plus study[35] and normal reference values for handgrip strength in healthy adult subjects using hand dynamometry have been established[36].

Body Shape Index (ABSI) is a promising index recently developed to quantify the risk associated with abdominal obesity, independently of body mass index[37] ABSI appears to outperform other popular

anthropometry-based measures of adiposity, such as Waist-Hip-Ratio. Several studies have found associations between ABSI and other adverse outcomes, as diabetes[38], metabolic syndrome[39], and high blood pressure[40] . Above average ABSI was associated with substantially higher risk of death in the National Health and Nutrition Examination Survey (NHANES) 1999–2004 sample[41]. Even more, ABSI was found to be a robust predictor of mortality hazard in the Health and Lifestyle Survey (HALS)[42,43], a large national sample of United Kingdom.

In summary, from this review we underline the difficultiesy in performing nutritional studies in the elderly population. Although important advances in knowledge have been achieved during the last two decades, further research is still needed to clarify the better and simpler methods to accurately estimate food and fluid intake in the elderly population, and to evaluate nutritional status.

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