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Validation of a questionnaire to measure overall Mediterranean lifestyle habits for research application: the MEDiterranean LIFEstyle index (MEDLIFE)

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Abstract

Background—the Mediterranean Lifestyle index (MEDLIFE) was developed as a questionnaire to capture adherence to an overall Mediterranean healthy lifestyle. The reliability of the MEDLIFE as an independent questionnaire must be evaluated prior its use in research studies.

Objective—to assess the inter-method reliability of the MEDLIFE as a short and independent research tool.

Design—the 28-item MEDLIFE questionnaire and a 142-item validated questionnaire (full-Q) from which we derived the 28-items MEDLIFE (MEDLIFE-derived) were administered simultaneously to 196 adults (mean age 41.4 ± 9.2 y) living in Madrid, Spain. The reliability was assessed by Kappa (k) statistics, intra-class correlation coefficients (ICC) and limits of agreement (LOA).

Results—overall correlation between the two instruments was 0.626. MEDLIFE had an acceptable ability to rank participants by MEDLIFE-derived from full-Q (ICC = 0.544). Absolute agreement showed very good concordance for 10.7% of the items evaluated; good to moderate concordance for most items, and fair concordance for 32.1% of the items. Intake of sweets, processed meats, low-fat dairy products and cereals were overestimated by MEDLIFE. About

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Conflict of interest

All authors declare no conflict of interest

Authorship

MSP developed the MEDLIFE, designed and coordinated the validation study, formulated the study question, conducted and designed the study and data collection, performed the statistical analysis, and interpreted and wrote the manuscript. JM interpreted data and contributed drafting the manuscript. GSB was responsible for the recruitment of participants, and data collection and interpretation of the results. PB was responsible for the recruitment of participants, and data collection. SP oversaw statistical analyses and helped draft the manuscript. JLP contribute to develop the MEDLIFE, oversaw the validation study, interpreted the results and helped draft the manuscript.

38%, 15%, 12% and 10% of participants who scored 1-point for those items in MEDLIFE also scored 1-point in the MEDLIFE-derived respectively. Bland Altman's analysis showed that LOA ranged from −4.66 to 7.45 (mean = 1.40).

Conclusion—the MEDLIFE is a valid instrument to measure overall adherence to the Mediterranean lifestyle in middle age adults from a Spanish population, and could be used as an independent questionnaire in clinical and epidemiological studies for such population. Its generalizability and predictive validity for clinical outcomes remains to be investigated.

Resumen

el índice de estilo de vida mediterráneo (MEDLIFE) fue desarrollado como un cuestionario para recoger la adherencia a un estilo de vida saludable mediterráneo. La fiabilidad del MEDLIFE como cuestionario independiente debe ser evaluada antes de su uso en estudios de investigación.

evaluar la fiabilidad inter-método del MED-LIFE como herramienta de investigación corta e independiente.

cuestionario corto del MEDLIFE de 28 ítems y un cuestionario largo validado de 142 ítems, del cual se derivó posteriormente el cuestionario del MEDLIFE de 28 ítems (MEDLIFE-derivado), se administraron simultáneamente a 196 adultos (edad media 41,4 ± 9,2 años) con residencia en Madrid, España. La fiabilidad se evaluó mediante el coeficiente kappa de Cohen, el coeficiente de correlación intraclase (CCI) y el límite de acuerdo (LOA).

el grado de correlación entre los dos instrumentos fue 0,626. El MEDLIFE tuvo una capacidad aceptable para clasificar a los participantes mediante el MEDLIFE-derivado (ICC = 0,544). El grado de acuerdo absoluto (coeficiente kappa) mostró muy buena concordancia para el 10,7% de los ítems evaluados; de buena a moderada para la mayoría de los ítems, y razonable para el 32,1% de los ítems. La ingesta de dulces, carnes procesadas, productos lácteos bajos en grasa y cereales se sobreestimó por el MEDLIFE. El 38%, 15%, 12% y 10% de los participantes que obtuvieron 1 punto para esos ítems en el MEDLIFE también obtuvieron 1 punto en el MEDLIFE-derivado, respectivamente. El análisis de Bland Altman mostró un rango de LOA de −4,66 a 7,45 (media = 1,40).

el MEDLIFE es un instrumento válido para medir la adherencia global al estilo de vida mediterráneo en adultos de mediana edad de una población española, y podría ser utilizado como cuestionario independiente en estudios clínicos y epidemiológicos para tal población. Su generalización y validez predictiva para los parámetros clínicos debe ser investigada.

Keywords

Reliability; Mediterranean diet; Dietary index; Lifestyle; Questionnaire

Keywords

Fiabilidad; La dieta mediterránea; Índices dietéticos; Estilo de vida; Cuestionario

Introduction

Several dietary indices have emerged during the last decade as an integrated measure of a healthy eating pattern and an alternative method to assess diet-disease relations[1,2]. One of these healthy eating patterns is the Mediterranean diet (MD), which has been consistently shown to protect against the development of chronic diseases[3–5]. In epidemiological research, a number of indices have been developed to study compliance with the traditional MD[6], such as the Mediterranean Diet Score (MDS)[7,8], Mediterranean Adequacy Index (MAI)[9], MedDiet Score[10], MEDAS[11], and relative Mediterranean Diet (rMED)[12], among others.

After those indices were created, the Mediterranean Diet Foundation's International Scientific Committee updated the recommendations in 2010 to include other traditional Mediterranean lifestyle behaviors, such as resting patterns, social structures, consumption of seasonal and diverse foods, and other healthy culinary techniques[13,14].

In order to address these Mediterranean lifestyle-behaviors altogether, we recently described the development of MEDLIFE (MEDiterranean LIFEstyle)[15], a new index that incorporates those revised recommendations. MEDLIFE was developed with the aim of strengthening the evidence of a protective effect of the Mediterranean lifestyle on health-related diseases and potentially support new recommendations into public health policies. Unlike prior indices, the MEDLIFE includes additional emerging lifestyle-factors beyond diet that have been also associated with cardiovascular outcomes namely sociability, sleep and rest, and conviviality[16–19], and new dietary components and eating behaviors (e.g. water as the main beverage).

Nevertheless, assessing the reliability of indices is an essential before an essential step before its use in epidemiological studies. While most of currently available dietary indices have been developed for epidemiological research and have been assessed as for their construct and content validity[11,20–24], only few have been further developed to independent tools or short questionnaires for utilization in clinical settings[11,25] .

We previously reported the construct and content validity of MEDLIFE[15]. The objective of this study was to assess the inter-method reliability of a 28-items MEDLIFE questionnaire as an independent tool by comparing its performance against a validated full block 142-items questionnaire.

Methods

Participants' recruitment

Participants for this study included 196 adults who worked in public schools (teacher or staff) or were involved in the school environment (family members) from 6 control schools participating in the Program SI! Intervention, which aimed to promote healthy lifestyle habits in preschoolers. No intervention was undertaken on these schools[26]. Individuals who volunteered to participate had to be older than 18 years old, and were required to not be involved in any lifestyle-related intervention. Study questionnaires were administered by a

trained dietitian. All participants gave written informed consent. The study was conducted in accordance with the Declaration of Helsinki and the protocol was approved by the Regional Committee for Clinical Research Ethics (CEIC-R) of Madrid Area.

Assessment of lifestyle behaviors

Lifestyle assessment was completed using two instruments: the MEDLIFE 28-items questionnaire, and a full-length block 142-items questionnaire (full-Q) that has been previously validated and includes a food frequency questionnaire, a physical activity questionnaire and other questions related to lifestyle habits[27–29]. From the full-Q we derived the 28-items MEDLIFE, in order to later compare whether the same information provided by both instruments (MEDLIFE 28-items questionnaire and MEDLIFE-derived from the full-Q) by the same participant agreed.

28-items MEDLIFE—MEDLIFE was created based on the Mediterranean Food Guide pyramid proposed in 2010 by the Mediterranean Diet Foundation[13,14]. In brief, a total of 28 items were developed based on its recommendations and categorized into three blocks: (1) Mediterranean food consumption (15 items); (2) Mediterranean dietary habits (7 items); (3) Physical Activity, rest, social habits and conviviality (6 items). Each item was scored as 0 for not meeting the cutoff established for the item or 1 for meeting it, so that the complete MEDLIFE ranged from 0 to 28, with a higher value indicative of greater adherence to Mediterranean lifestyle (Table I).

For this inter-method reliability study, we included the 28 items extracted from the full-Q. However, the 28-item MEDLIFE questionnaire administered to participants had four additional questions to address the seasonality and frugality included in the Mediterranean lifestyle pyramid that are not included in this analysis because this information was not assessed from the full-Q, and therefore comparison between the two tools was not possible (Supplementary material)

Full-length block 142-items questionnaire (full-Q)—Dietary intakes and habits were assessed using a semi-quantitative food frequency questionnaire (FFQ) previously validated in Spain[30], capturing long-term intake during the year preceding the examination, and taking into account seasonal variations and differences between weekday and weekend patterns. The questionnaire was based on 136 food items, including specific questions about consumption of supplements and information on adherence to restrictive diets. Each food included in the questionnaire specified the serving size and offered nine options for frequency of consumption, from “never or almost never” to “more than six times a day”.

The questionnaire also included items on physical activity based on the Spanish validated version[27] of the Nurses’ Health Study (NHS) and Health Professionals’ Follow-up (HPFS) physical activity questionnaires[28,29]. It also included questions about resting and sedentary habits such as overall sitting time (h/day), time watching television (h/day), time in front of a computer (h/day), sleeping (h/day), and time socializing with friends (h/day), differentiating between a typical weekday and a typical weekend day.

Additionally, participants completed a questionnaire about socio-demographic characteristics including education level, income status, marital status, school affiliation, number of children, and number of family members.

The complete full-Q was used to extract the questions included in the 28-items of the MEDLIFE questionnaire, and to score participants on their degree of compliance to the Mediterranean recommendations.

Assessment of other covariates—Additionally, participants completed a questionnaire about socio-demographic characteristics including education level, income status, marital status, school affiliation, number of children, and number of family members.

Statistical analysis

As per statistical analysis plan, the distribution of collected variables is studied prior to applying any statistical tests. All variables presented a normal distribution and no transformations were made for the analyses. Participants' characteristics were described using means (standard deviations) and proportions. Pearson correlation coefficients were calculated to evaluate the relationship between MEDLIFE and MEDLIFE-derived from the full-Q to establish relative validity. Absolute agreement between the MEDLIFE and MEDLIFE-derived was calculated by Cohen's kappa to assess categorical agreement between each item of the MEDLIFE (0–1) and the one obtained by MEDLIFE derived from the full-Q and by intra class correlation (ICC) and limits of agreement (LOA) methods. Agreement between the two methods was further evaluated using graphical information as described by Bland and Altman[31,32]. With this method the arithmetic differences in the MEDLIFE and MEDLIFE-derived for each individual was plotted against the mean values of the 2 methods. Polynomial contrasts were used to determine P-linear trend for continuous variables. Chi square tests were used to determine P-linear trend for categorical variables.

Statistical analyses were conducted using STATA, version 12.0 (STATACORP, College Station, Texas, USA).

Results

Table II shows the baseline characteristics of the 196 participants in the validation study across tertiles of MEDLIFE. No differences on percentage of participation between participants regarding the school affiliation were found. Those in the higher tertile were more likely to be older, non-smokers and reporting higher family income.

Table III shows the absolute agreement by kappa statistics between each component of the MEDLIFE and MEDLIFE-derived from full-Q. Very good concordance (k = 0.81–1) was observed for 'limit salt in meals', 'nibbling' and 'nap' (10.7% of the items). Good (k = 0.61–0.80) to moderate (k = 0.41–0.60) agreement was found for most of the items evaluated (21.4%) such as wine, moderate consumption of red meat, legumes, fruit and olive oil consumption) and fair (0.21–0.40) for 32.1% of the items. Sweets, processed meats, low fat dairy products and cereals were overestimated by MEDLIFE. From the participants who obtained 1-point for those items in the MEDLIFE, only 38%, 15%, 12% and 10 %

respectively achieved 1-point as well in the MEDLIFE-derived from full-Q (item 1, 3, 9, and 15).

Correlation between the two instruments was 0.626. No difference by sex was observed. Consistency between both methods was assessed by ICC. A value of 0.544 (95% CI, 0.3–0.7) was calculated, suggesting that MEDLIFE has an adequate ability to rank participants by MEDLIFE-derived. Correlations between MEDLIFE and MEDLIFE individual blocks was 0.494 for MD food frequency consumption, 0.717 for MD dietary habits, and 0.663 for physical activity, rest, social habits, and conviviality. The MEDLIFE overestimated MEDLIFE-derived (15.7 ± 3.2 *vs* 14.1 ± 2.8, respectively) (Figure 1). In the classification analysis 52.1 % of the participants were classified in the same tertile by both instruments whereas only 7.1% were classified in the opposite tertile.

Despite the extensive use of correlation analyses to validate dietary assessment methods, correlation coefficients provide only limited measure of the level of agreement between two measurements[31,32]. Therefore, we calculated Limits of Agreement (LOA) and showed a Bland-Altman graphic (Figure 2). LOA mean was 1.40 and the range was −4.66 to 7.45, indicating an acceptable concordance despite the overestimation bias.

Discussion

Validating an instrument designed to capture lifestyle behaviors is essential before it can be applied and extended to the general population. Few studies have verified the inter-method reliability of the indices assessing adherence to the MD[11,24,25], with most studies being limited to contrasting the indices against the FFQ validity, and therefore establishing construct and content validity only. In addition, most of the indices have not been developed to be used as an independent tool in clinical or epidemiological research.

The present study was conducted to evaluate the validity of a short 28 item-questionnaire assessed by comparing it to a full, 147-item, questionnaire that included validated FFQ, physical activity questionnaire, and other questions related to traditional Mediterranean lifestyle[33]. Of the 28 items evaluated, nearly 60% (16 items) had an absolute agreement from very good to moderate (kappa = 0.41–1). Only three items had a poor agreement (kappa < 0.2), namely dairy products, cereals and processed meats. These results agree with the findings from several studies assessing the validity of dietary indices that supported that some specific foods (dairy products and meats) tend to show poor correlations with the dietary indices[34–38]. Indeed, this issue was detected during content validation of the MEDLIFE[15], where these items showed a weaker correlation (dairy products ρ- = 0.11, cereals = 0.17, and processed meats = 0.18). It is likely though that the intrinsic limitations of the FFQ as a dietary assessment tool, could explain the lack of agreement in the present external validation study: The limitation to measure diet accurately seems to matter more when classifying foods into a single food category, especially because arbitrary decisions are made. These subjective choices vary between studies for specific food groups, specifically dairy foods (low-fat dairy products vs. whole fat) and cereals (whole vs. refined). Likewise, portion size and the type of processed meat are also difficult to assess. To help overcome this limitation, MEDLIFE contains specific questions on low-fat dairy products (item 9)

and distinguishes between refined and whole-grain cereal products (items 15 and 19). Additionally, the lack of awareness about standard food portions and serving sizes in the general population and the different serving sizes listed in the MEDLIFE and FFQ-items could also explain some of the discrepancies for some items (e.g. for cereals, in MEDLIFE (item 15) one serving of white and whole grain bread is 40 g, for rice and pasta is one plate, and for breakfast cereals is 40 g whereas in the FFQ the serving size of white and whole grain bread is 75g, for rice and pasta is 60 g dried, before cooking, and for breakfast cereals is 30g).

In general, agreement results (kappa values) indicated a correct classification for more than half of the participants evaluated. This allows for the identification of individuals or populations with poorer adherence that could benefit from lifestyle education interventions, enhancing the efficiency of public health strategies.

Furthermore, the present study evaluated the correlation of the final composite score between both instruments showing a moderate-to-good correlation ($r = 0.626$, $p < 0.05$). These estimators of validity are comparable, or better in some instances, to those obtained in other studies[11,24,25,39,40], for example MEDAS[11] ($r = 0.52$ between the questionnaire and the FFQ), DQI-R[39] ($r = 0.66$ between 1 week diet record and FFQ), MEDFICTS[25] ($r = 0.50$ by block correlations except for total fat intake ($r = 0.30$)), and Spanish dietary history and the mean of seven 24-hour recalls $r = 0.53$[40]. In addition, when analyzing MEDLIFE by blocks, a high correlation was obtained for Mediterranean dietary habits (0.717) and social and physical activity patterns (0.663), but lower for the food frequency consumption (0.494). MEDLIFE's questions about usual diet consumption may be more easily and accurately collected than the frequencies and portion sizes of a long list of foods in a FFQ, which could explain the lower correlation for the food frequency consumption.

Despite the accepted use of correlations to assess reliability in the analysis of dietary validation methods, its used could be misleading as they provide a limited measure of the level of agreement between two measurements[31]. Using an alternative graphical approach, we showed that the MEDLIFE limits of agreement (LOA) on a Bland and Altman plot were within a correct range and similar to previously validated instruments[11,41–44]. ICC also indicated moderate agreement (0.54) between both methods, which also compares to that of other dietary indices[11,40].

The MEDLIFE, apart from being designed as a potentially easy and user-friendly independent research tool, comprises consumption of specific foods as well as other lifestyle behaviors items that belong to the traditional Mediterranean lifestyle. Yet, some of the items that we included in MEDLIFE were difficult to formulate because they have not been assessed accurately, or at all, in previous epidemiological studies. In our study, we aimed to include some of the new recommendations of the MD pyramid related to seasonality and frugality of the foods as well as conviviality, such as eating in company or the time spent having meals, which are unique cultural aspects of the Mediterranean culture. Thus, we included 4 additional items to the previous 28-items (supplementary material) but could not assess the validity of those 4 questions because they have not been included in the full-Q from which we extracted the MEDLIFE-derived to assess the validity between both

instruments. Despite including three diverse groups of participants (teachers, school staff, and families) to enhance representation of the sample, more than half of the final sample had a high educational level, which could carry some bias and limit generalizability. Therefore, validating MEDLIFE in populations with lower educational levels would add further value to the applicability and optimal performance of the questionnaire. Another limitation is that the MD pyramid recommendations are targeted to a healthy adult population and may not apply to the specific needs of children, pregnant women, or people with certain health conditions. MEDLIFE should be then adapted and validated for special populations before further applications. Finally, we did not measure any biomarker in this population, therefore its predictive validity to assess clinical endpoints it is another step that should be tested in future studies.

A unique feature of the MEDLIFE that is worth highlighting is that this is the first index to measure the Mediterranean lifestyle as a whole by incorporating other traditional healthy lifestyle and cultural elements pointed out by international committees in the MD pyramid. In addition, most of the dietary indices have been developed with epidemiological purposes (derived from detailed FFQ, with complex scoring cutoffs) and unlikely the MEDLIFE its application in the general population as an independent tool to capture adherence to a healthy diet is not possible. The fact that the MEDLIFE relies on scoring positively or negatively on the different recommendations for compliance to the Mediterranean lifestyle avoids classifications or scoring based on the distribution of any particular population. The practical benefits of the MEDLIFE as a short and user-friendly structure could enhance its applications as an educational tool to promote the Mediterranean pattern or as a clinical tool to evaluate adherence.

Because educational interventions to achieve a simultaneous change in multiple health-related behaviors may be a better approach rather than only focusing on single behaviors[45], the MEDLIFE could be used as an adaptable measure for researchers and policy-makers to identify key areas of concerns on which future intervention studies should focus.

In conclusion, the MEDLIFE is a reliable instrument to measure overall Mediterranean lifestyle in middle age adults from Spain that could be used as a short questionnaire in clinical and epidemiological studies. Its potential application as a predictive tool of health-related diseases and the generalization to other populations should be further explored in future studies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Patterson RE, Haines PS, Popkin BM. DIET QUALITY INDEX - CAPTURING A MULTIDIMENSIONAL BEHAVIOR. J Am Diet Assoc. 1994; Jan; 94 (1) 57–64. [PubMed: 8270756]
2. Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: design and applications. J Am Diet Assoc. 1995; Oct; 95 (10) 1103–1108. [PubMed: 7560680]
3. Estruch R, Ros E, Salas-Salvado J, et al. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet. New England Journal of Medicine. 2013; Apr 4; 368 (14) 1279–1290.
4. Sotos-Prieto M, Angeles Zulet M, Corella D. Scientific evidence of the mediterranean diet effects in determining intermediate and final cardiovascular disease phenotypes. Medicina Clinica. 2010; Jan 23; 134 (1) 22–29. [PubMed: 19457510]
5. Kant AK. Dietary patterns and health outcomes. J Am Diet Assoc. 2004; Apr; 104 (4) 615–635. [PubMed: 15054348]
6. Willett WC, Sacks F, Trichopoulou A, et al. Mediterranean diet pyramid - a cultural model for healthy eating. Am J Clin Nutr. 1995; Jun; 61 (6) S1402–S1406.
7. Trichopoulou A, Kourisblazos A, Wahlqvist ML, et al. Diet and overall survival in elderly people. British Medical Journal. 1995; Dec 2; 311 (7018) 1457–1460. [PubMed: 8520331]
8. Trichopoulou A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. N Engl J Med. 2003; Jun 26; 348 (26) 2599–2608. [PubMed: 12826634]
9. Alberti-Fidanza A, Fidanza F. Mediterranean Adequacy Index of Italian diets. Public Health Nutrition. 2004; Oct; 7 (7) 937–941. [PubMed: 15482621]
10. Schroder H, Marrugat J, Vila J, Covas MI, Elosua R. Adherence to the traditional Mediterranean diet is inversely associated with body mass index and obesity in a Spanish population. Journal of Nutrition. 2004; Dec; 134 (12) 3355–3361.
11. Schroder H, Fito M, Estruch R, et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011; Jun; 141 (6) 1140–1145. [PubMed: 21508208]
12. Buckland G, Gonzalez CA, Agudo A, et al. Adherence to the Mediterranean Diet and Risk of Coronary Heart Disease in the Spanish EPIC Cohort Study. American Journal of Epidemiology. 2009; Dec 15; 170 (12) 1518–1529. [PubMed: 19903723]
13. Bach-Faig A, Berry EM, Lairon D, et al. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutrition. 2011; Dec; 14 (12) 2274–2284. [PubMed: 22166184]
14. Mediterranean Diet Pyramid: a lifestyle for today. 2015. June. http://dietame-diterranea.com/dietamed/piramide_INGLES.pdf
15. Sotos-Prieto M, Moreno-Franco B, Ordovas JM, Leon M, Casasnovas JA, Penalvo JL. Design and development of an instrument to measure overall lifestyle habits for epidemiological research: the Mediterranean Lifestyle (MEDLIFE) index. Public Health Nutr. 2014; Jul. 15: 1–9.
16. Behrens G, Fischer B, Kohler S, Park Y, Hollenbeck AR, Leitzmann MF. Healthy lifestyle behaviors and decreased risk of mortality in a large prospective study of U.S. women and men. European Journal of Epidemiology. 2013; 28 (5) 361–372. [PubMed: 23532745]
17. Laugero KD, Falcon LM, Tucker KL. Relationship between perceived stress and dietary and activity patterns in older adults participating in the Boston Puerto Rican Health Study. Appetite. 2011; Feb; 56 (1) 194–204. [PubMed: 21070827]
18. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. Sleep. 2010; May; 33 (5) 585–592. [PubMed: 20469800]

19. Burazeri G, Gofin J, Kark JD. Over 8 hours of sleep--marker of increased mortality in Mediterranean population: follow-up population study. Croat Med J. 2003; Apr; 44 (2) 193–198. [PubMed: 12698511]
20. Haines PS, Siega-Riz AM, Popkin BM. The Diet Quality Index revised: a measurement instrument for populations. J Am Diet Assoc. 1999; Jun; 99 (6) 697–704. [PubMed: 10361532]
21. Miller PE, Mitchell DC, Harala PL, Pettit JM, Smiciklas-Wright H, Hartman TJ. Development and evaluation of a method for calculating the Healthy Eating Index-2005 using the Nutrition Data System for Research. Public Health Nutrition. 2011; Feb; 14 (2) 306–313. [PubMed: 20576195]
22. Toft U, Kristoffersen LH, Lau C, Borch-Johnsen K, Jorgensen T. The Dietary Quality Score: validation and association with cardiovascular risk factors: the Inter99 study. European Journal of Clinical Nutrition. 2007; Feb; 61 (2) 270–278. [PubMed: 16929244]
23. Taechangam S, Pinitchun U, Pachotikarn C. Development of nutrition education tool: healthy eating index in Thailand. Asia Pacific Journal of Clinical Nutrition. 2008; 17: 365–367. [PubMed: 18296380]
24. Kris-Etherton P, Eissenstat B, Jaax S, et al. Validation for MEDFICTS, a Dietary Assessment Instrument for Evaluating Adherence to Total and Saturated Fat Recommendations of the National Cholesterol Education Program Step 1 and Step 2 Diets. J Am Diet Assoc. 2001; 101 (1) 81–86. [PubMed: 11209589]
25. Mochari H, Gao Q, Mosca L. Validation of the MEDFICTS dietary assessment questionnaire in a diverse population. J Am Diet Assoc. 2008; May; 108 (5) 817–822. [PubMed: 18442505]
26. Penalvo JL, Santos-Beneit G, Sotos-Prieto M, et al. A cluster randomized trial to evaluate the efficacy of a school-based behavioral intervention for health promotion among children aged 3 to 5. BMC Public Health. 2013; 13: 656. [PubMed: 23855415]
27. Martinez-Gonzalez MA, Lopez-Fontana C, Varo JJ, Sanchez-Villegas A, Martinez JA. Validation of the Spanish version of the physical activity questionnaire used in the Nurses' Health Study and the Health Professionals' Follow-up Study. Public Health Nutr. 2005; Oct; 8 (7) 920–927. [PubMed: 16277809]
28. Chasan-Taber S, Rimm EB, Stampfer MJ, et al. Reproducibility and validity of a self-administered physical activity questionnaire for male health professionals. Epidemiology. 1996; Jan; 7 (1) 81–86. [PubMed: 8664406]
29. Wolf AM, Hunter DJ, Colditz GA, et al. Reproducibility and validity of a self-administered physical activity questionnaire. Int J Epidemiol. 1994; Oct; 23 (5) 991–999. [PubMed: 7860180]
30. de la Fuente-Arrillaga C, Ruiz ZV, Bes-Rastrollo M, Sampson L, Martinez-Gonzalez MA. Reproducibility of an FFQ validated in Spain. Public Health Nutr. 2010; Sep; 13 (9) 1364–1372. [PubMed: 20105389]
31. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986; Feb 8; 1 (8476) 307–310. [PubMed: 2868172]
32. Bland JM, Altman DG. Measuring agreement in method comparison studies. Stat Methods Med Res. 1999; Jun; 8 (2) 135–160. [PubMed: 10501650]
33. Casasnovas JA, Alcaide V, Civeira F, et al. Aragon workers' health study--design and cohort description. BMC Cardiovasc Disord. 2012; 12: 45. [PubMed: 22712826]
34. McCullough ML, Feskanich D, Rimm EB, et al. Adherence to the Dietary Guidelines for Americans and risk of major chronic disease in men. Am J Clin Nutr. 2000; Nov; 72 (5) 1223–1231. [PubMed: 11063453]
35. Guenther PM, Reedy J, Krebs-Smith SM. Development of the Healthy Eating Index-2005. J Am Diet Assoc. 2008; Nov; 108 (11) 1896–1901. [PubMed: 18954580]
36. Lagiou P, Trichopoulos D, Sandin S, et al. Mediterranean dietary pattern and mortality among young women: a cohort study in Sweden. British Journal of Nutrition. 2006; Aug; 96 (2) 384–392.
37. Waijers PMCM, Feskens EJM, Ocke MC. A critical review of predefined diet quality scores. British Journal of Nutrition. 2007; Feb; 97 (2) 219–231.
38. Guenther PM, Kirkpatrick SI, Reedy J, et al. The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. J Nutr. 2014; Mar; 144 (3) 399–407. [PubMed: 24453128]

39. Newby PK, Hu FB, Rimm EB, et al. Reproducibility and validity of the Diet Quality Index Revised as assessed by use of a food-frequency questionnaire. Am J Clin Nutr. 2003; Nov; 78 (5) 941–949. [PubMed: 14594780]

40. Guallar-Castillon P, Sagardui-Villamor J, Balboa-Castillo T, et al. Validity and reproducibility of a Spanish dietary history. PLoS One. 2014; 9 (1) e86074. [PubMed: 24465878]

41. Schroder H, Benitez Arciniega A, Soler C, Covas MI, Baena-Diez JM, Marrugat J. Validity of two short screeners for diet quality in time-limited settings. Public Health Nutr. 2012; Apr; 15 (4) 618–626. [PubMed: 21859517]

42. Rumawas ME, Dwyer JT, McKeown NM, Meigs JB, Rogers G, Jacques PF. The Development of the Mediterranean-Style Dietary Pattern Score and Its Application to the American Diet in the Framingham Offspring Cohort. Journal of Nutrition. 2009; Jun; 139 (6) 1150–1156.

43. Panagiotakos DB, Pitsavos C, Stefanadis C. Dietary patterns: A Mediterranean diet score and its relation to clinical and biological markers of cardiovascular disease risk. Nutrition Metabolism and Cardiovascular Diseases. 2006; Dec; 16 (8) 559–568.

44. Ambrosini GL, Mackerras D, de Klerk NH, Musk AW. Comparison of an Australian food-frequency questionnaire with diet records: implications for nutrition surveillance. Public Health Nutr. 2003; Jun; 6 (4) 415–422. [PubMed: 12795831]

45. Lichtenstein AH, Appel LJ, Brands M, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. Circulation. 2006; Jul 4; 114 (1) 82–96. [PubMed: 16785338]

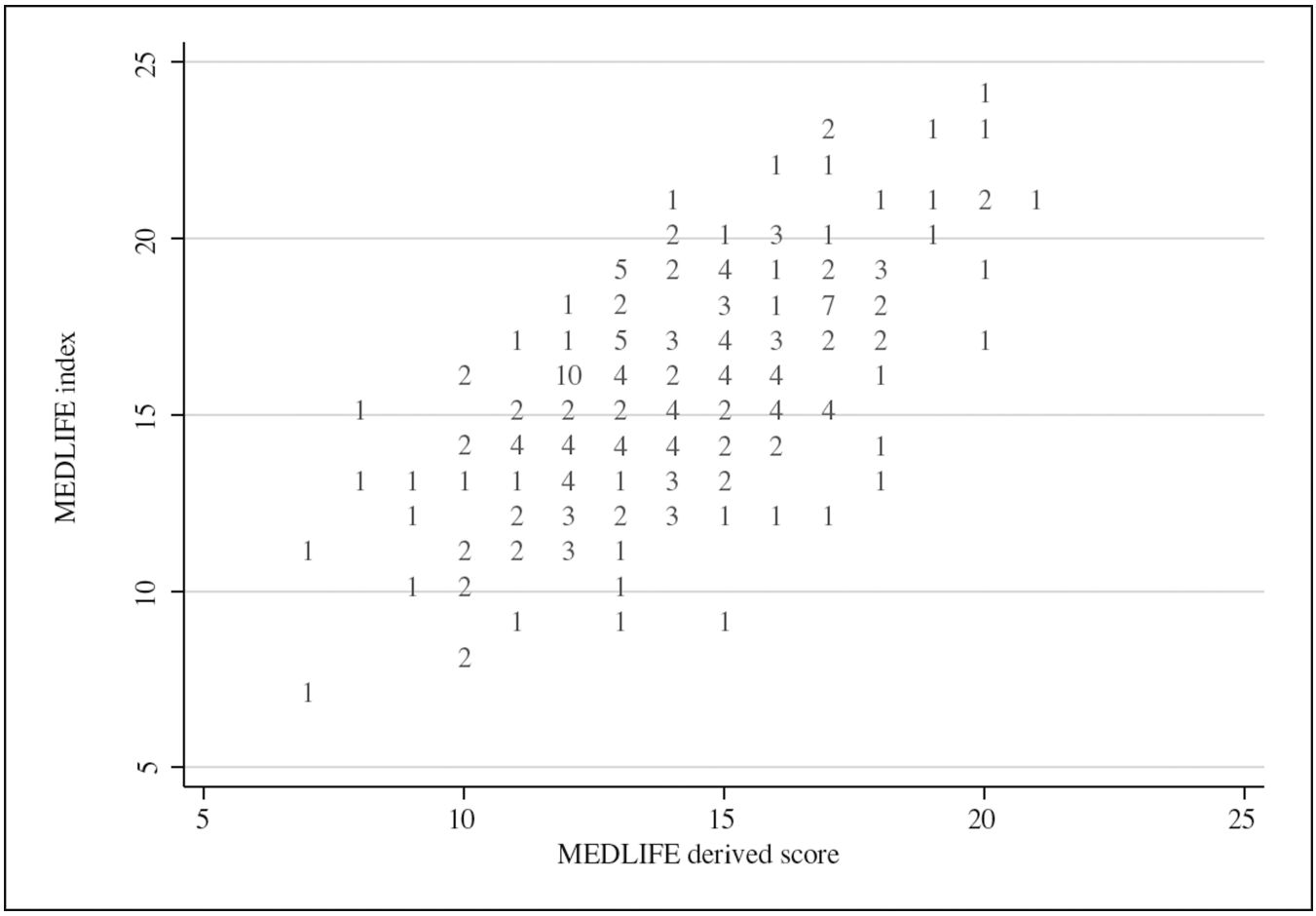

Fig. 1.
Scatter plot of MEDLIFE by MEDLI-FE derived score (numbers of plot indicate repeat values).

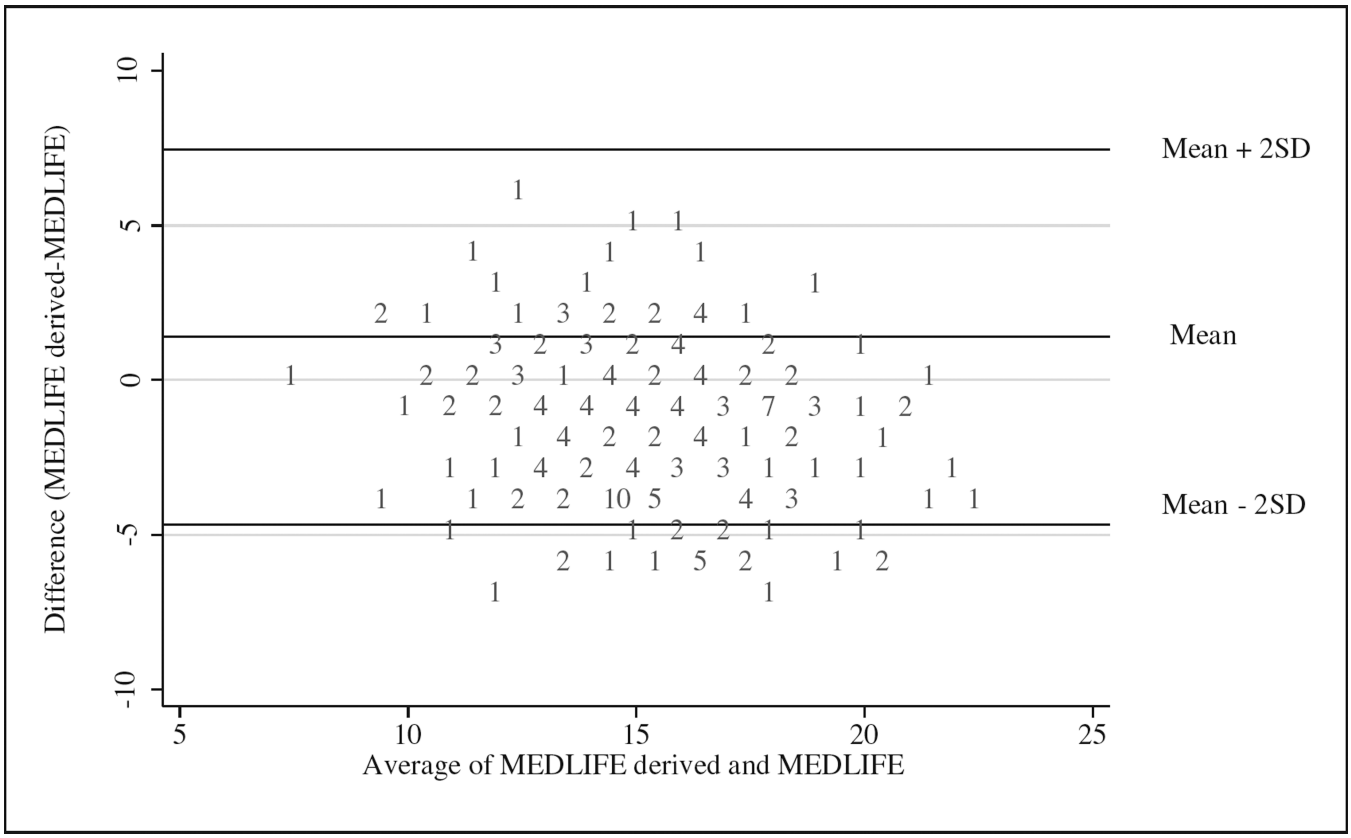

Fig. 2.

Bland-Altman plot indicating the mean difference between indices obtained from the full-Q and the corresponding to MEDLIFE vs the mean of the two indices.

Table I

The Mediterranean Lifestyle index (MEDLIFE) questionnaire

Items	Criteria for 1 point*
Block 1: Mediterranean food consumption	
How many serving of pastries do you consume per week? (*candy (1s = 1 unit or 50 g), chocolates (1 s = 30gr), biscuits (1 s = 4–6 units), nougat ("turrón") (1s = 40 g)*)	≤ 2 s/week
How many servings of red meat do you consume per week? (*Beef, pork, lamb (1 s = 100–150g)*)	< 2 s/week
How many serving of processed meat do you consume per week? (*Ham (1 s = 1 slice or 30 g), sausage, soft spicy sausage, bacon (1 s = 50 g), hamburger (1 s = 1 unit), liver (1 s = 100–150g), paté (1s = 25g)*)	≤ 1 s/week
How many eggs do you consume per week? (*Eggs (1 egg)*)	2–4 s/week
How many serving of legumes do you consume per week? (*Lentils, beans, peas, chickpeas (1 s = 1 plate or 150 g)*)	≥ 2/ week
How many servings of white meat do you consume per week? (*Poultry, rabbit (1 s = 100–150 g)*)	2 s/ week
How many serving of fish or seafood portions do you consume per week? (*White/fatty fish (1 s = 100–150 g), canned fish (1 s = 1 can or 50 g), seafood (1 s = 200g)*)	≥ 2/ week
How many potatoes do you consume per week? (*Roasted/boiled potatoes, French fries (1 s = 150–200 g)*)	≤ 3 s/week
How many low-fat dairy products do you consume per day? (*Skimmed dairy milk (1s = 200 ml milk, two yogurts, 1 portion soft cheese)*)	2 s/day
How many nuts and olives do you consume per day? (*Walnuts, almonds, hazelnuts (1s = 1 handful or 30 g), olives (1 s = 10 units)*)	1–2 s/day
How many times do you use herbs, spices or garnish for cooking per day? (*Onion, garlic, herbs (parsley, oregano)*)	≥ 1 s/day
How many pieces of fruit do you consume per day? (*All fruit and fresh fruit-based juices (1 s = 150–200g)*)	3–6 s/day
How many servings of vegetables do you consume per day? (*All vegetables except potatoes (1 s = 150–200 g)*)	≥ 2 s/day
How many tablespoons of olive oil do you consume per day (cooking or salad dressing)? (*Olive oil, virgin olive oil (1s = 1Tablespoon)*)	≥ 3 s/day
How many servings of cereals do you consume per day? (*White and whole-grain bread (1s = 40 g), cereals (1s = 1 plate rice, pasta or 40g breakfast cereals) and derivatives*)	3–6 s /day
Block 2: Mediterranean dietary habits	
Do you drink more than 6 glasses of water or at least one cup of tea per day? (*Water or tea (1 s = 1 glass)*)	Yes
Do you drink wine at mealtime every day? (*White/red wine (1 s = 1 glass of wine)*)	1–2 s/ day
Do you limit added salt in meals?	Yes
Do you usually choose whole grain products? (*bread, pasta, rice, breakfast cereals*)	Yes
Do you consume snacks 2 or less times per week? (*potatoes chips, tortilla chips, popcorn (1 s = 1 bag or 50 g)*)	Yes
Do you usually limit nibbling between meals?	Yes
Do you limit intake of sugar in beverages? (*including sugar-sweetened beverages*)	Yes
Block 3: Physical activity, rest, social habits and conviviality	
Do you engage in physical activity (> 150min/week or 30 min/day)? (*jogging, walk at a fast pace, dance, aerobics, gardening*)	Yes
Do you sleep siesta/nap?	Yes
How many hours do you sleep a day? (*During weekdays*)	6–8 hour/day
How many hours do you spend watching TV per day? (*During weekdays*)	≤ 1hour/day
How many hours do you spend going out with friends during the free time (e.g. weekends)?	≥ 2hour/weekend
How many hours do you practice team sports per week?	≥ 2hour/week

* 0 points if these criteria were not met. s = serving

Table II

Demographic characteristics of study participants (n = 196) by tertile (tertile 1 = low; tertile 2 = medium; tertile 3 = high) of MEDLIFE[1]

	Overall (n = 196)	Low (n = 71)	Medium (n = 70)	High (n = 55)	P-trend
Female	166 (84.7)	55 (77.5)	64 (91.4)	47 (85.5)	0.168
School affiliation					
Teacher	75 (38.3)	21 (29.6)	33 (47.1)	21 (38.2)	0.132
Parent	59 (30.1)	22 (31.0)	18 (25.7)	19 (34.5)	
School staff	62 (31.6)	28 (39.4)	19 (27.1)	15 (27.3)	
Age	41.4 (9.0)	40.6 (8.9)	39.5 (8.8)	44.8 (8.7)	0.010
BMI (Kg/m)	24.1 (4.1)	24.5 (4.5)	23.9 (3.9)	23.9 (3.6)	0.383
Household income, > 22,500 €	115 (58.7)	23 (32.9)	27 (38.6)	29 (53.7)	0.022
Education level, high *	132 (67.3)	54 (76.1)	54 (77.1)	45 (81.8)	0.541
Smoking					
Current smoker	27 (13.8)	14 (19.7)	9 (13)	4 (7.3)	0.044
Non-smoker/former	168 (85.7)	57 (80.3)	60 (87.0)	51 (92.7)	0.044
Self-perceived job strain (range 0–5 points)	3.1 (1.1)	3.1 (1.1)	3.1 (1.1)	3.2 (1.0)	0.483
Self-perceived overall stress in life (range 0–5 points)	3.1 (1.0)	3.1 (1.1)	3.1 (1.1)	3.1 (0.9)	0.923
Self-perceived healthy lifestyle	135 (68.9)	34 (47.9)	52 (74.3)	49 (89.1)	< 0.001

Values are mean and (standard deviation) or n and (percentage).

The polynomial contrast and chi square test were used to determine P-linear trend for continuous and categorical variables, respectively.

* Education level was first classified according to the guidelines of the Instituto Nacional de Estadística (INE; www.ine.es) and then categorized into three bands according to the International Standard Classification of Education (ISCED; http://www.uis.unesco.org/Education/Pages/internationalstandard-classification-of-education.aspx, 2011): low (none or primary studies; ISDED 0–2), medium (completed high school; ISCED 3 or 4) and high (high qualification or completed university degree; ISCED 5 or 6).

Table III

Absolute agreement between lifestyle variables measures by MEDLIFE and MEDLIFE derived from full questionnaire

		MEDLIFE						
	Criteria for 1 point	**YES[a]**	**Of whom YES in MEDLIFE derived[b]**		**NO[a]**	**Of whom NO in MEDLIFE derived[c]**		**kappa**
Total MEDLIFE	***0–28***	N	N	(%)	N	N	(%)	
Sweets	≤ 2 s/week	116	44	(37.9)	80	78	(97.5)	0.312
Red meat	< 2 s/week	83	56	(67.5)	113	107	(94.7)	0.643
Processed meat	≤ 1 s/week	80	12	(15.0)	116	102	(87.9)	0.033*
Eggs	2–4 s/week	136	133	(97.8)	60	37	(61.7)	0.656
Legumes	≥ 2/ week	90	80	(88.9)	106	73	(68.9)	0.567
White meat	2 s/ week	99	79	(79.8)	97	40	(41.2)	0.211
Fish/seafood	≥ 2/ week	148	147	(99.3)	48	7	(14.6)	0.194
Potatoes	≤ 3 s/week	164	107	(65.2)	32	27	(84.4)	0.300
Low fat dairy products	2 s/day	49	6	(12.2)	147	140	(95.2)	0.099
Nuts and olives	1–2 s/day	37	16	(43.2)	159	147	(92.5)	0.394
Herbs, spices and garnish	≥ 1 s/day	157	101	(64.3)	39	33	(84.6)	0.330
Fruit	3–6 s/day	84	53	(63.1)	112	95	(84.8)	0.489
Vegetables	≥ 2 s/day	132	127	(96.2)	64	17	(26.6)	0.274
Olive oil	≥ 3 s/day	129	88	(68.2)	67	51	(76.1)	0.407
Cereals	3–6 s /day	82	8	(9.8)	114	111	(97.4)	0.081
Water or teas	6–8 s/day or ≥ 3 s/ week	139	69	(49.6)	57	44	(77.2)	0.207
Wine	1–2 s/ day	11	7	(63.6)	185	184	(99.5)	0.724
Limit salt in meals	Yes	119	112	(94.1)	77	75	(97.4)	0.905
Preference of whole grain products	yes / > 25g/day	86	64	(55.8)	110	103	(93.6)	0.694
Snacks	≤ 2 s/week	170	159	(93.5)	26	16	(61.5)	0.542
Limit nibbling between meals	Yes	113	106	(93.8)	83	80	(96.4)	0.896
Limit sugar in beverages (including sugar-sweetened beverages)	Yes	144	83	(57.6)	52	44	(84.6)	0.319
Physical activity (> 150min/week or 30 min/day)	Yes	122	97	(79.5)	74	42	(56.8)	0.370
Siesta/Nap	Yes	85	82	(96.5)	111	102	(91.9)	0.876

	Criteria for 1 point	MEDLIFE						kappa
		YES[a]	Of whom YES in MEDLIFE derived[b]		NO[a]	Of whom NO in MEDLIFE derived[c]		
Hours' Sleep	6–8 hour/day	160	160	(100)	36	19	(52.8)	0.646
TV hours	< 1hour/day	115	113	(98.3)	81	63	(77.8)	0.783
Go out with friends	≥ 2hour/weekend	174	163	(93.7)	22	14	(63.6)	0.541
Collective sports	≥ 2hour/week	47	38	(80.9)	149	114	(76.5)	0.482

[a] Number (N) of participants scoring 1 point in MEDLIFE (YES) or scoring 0 points in the MEDLIFE (NO).

[b] MEDLIFE derived: MEDLIFE derived from the full FFQ. Number of participants (percentage) from those who scored 1 point (YES) in MEDLIFE and scored as well 1-point in the MEDLIFE derived from the full-Q.

[c] MEDLIFE derived from the full FFQ. Number of participants (percentage) from those who scored 0 point (NO) in MEDLIFE and scored as well 0-point in the MEDLIFE derived from the full-Q.

[*] $p > 0.05$; all other kappa values are statistically significant at $p < 0.0001$ except for low-fat dairy products ($p = 0.034$).

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