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**Title: Relationship between Subjective Well-Being and Healthy Lifestyle  
Behaviours in Older Adults: a Longitudinal Study**

**Authors:**

Natalia Martín-María, MS<sup>1,2,3</sup>; Francisco Félix Caballero, PhD<sup>4,5</sup>; Darío Moreno-  
Agostino, MS<sup>1,2,3</sup>; Beatriz Olaya, PhD<sup>2,6</sup>; Josep Maria Haro, MD, PhD<sup>2,6</sup>;  
José Luis Ayuso-Mateos, MD, PhD<sup>1,2,3</sup>; Marta Miret, PhD<sup>1,2,3\*</sup>

**Affiliations:**

<sup>1</sup>Department of Psychiatry, Universidad Autónoma de Madrid, Spain.

<sup>2</sup>Instituto de Salud Carlos III, Centro de Investigación Biomédica en Red de Salud Mental. CIBERSAM, Spain.

<sup>3</sup>Department of Psychiatry, Hospital Universitario de La Princesa, Instituto de Investigación Sanitaria Princesa (IIS-Princesa), Madrid, Spain.

<sup>4</sup>Department of Preventive Medicine, Public Health and Microbiology, Universidad Autónoma de Madrid, Spain.

<sup>5</sup>Instituto de Salud Carlos III, Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública. CIBERESP, Spain.

<sup>6</sup>Parc Sanitari Sant Joan de Déu, Universitat de Barcelona, Sant Boi de Llobregat, Barcelona, Spain.

\*Corresponding author: Marta Miret, Universidad Autónoma de Madrid, Department of Psychiatry. Arzobispo Morcillo 4, 28029 Madrid, Spain. Telephone number (00 34) 91 497 27 16; e-mail: [marta.miret@uam.es](mailto:marta.miret@uam.es)

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No conflicts of interest declared.

## **Abstract**

**Objectives:** People who report better subjective well-being tend to be healthier in their daily behaviours. The objective of this study is to assess whether different components of subjective well-being are prospectively associated with different healthy lifestyle behaviours and to assess whether these associations differ by age.

**Method:** A total of 1,892 participants aged 50+ living in Spain were interviewed in 2011-12 and 2014-15. Life satisfaction was measured with the Cantril Self-Anchoring Striving Scale. Positive and negative affect were assessed using the Day Reconstruction Method. Physical activity was assessed with the Global Physical Activity Questionnaire version 2. The remaining healthy lifestyle behaviours were self-reported. Generalised Estimating Equations (GEE) models were run.

**Results:** Not having a heavy episodic alcohol drinking was the healthy lifestyle behaviour most fulfilled (97.97%), whereas the intake of five or more fruits and vegetables was the least followed (33.12%). GEE models conducted over the 50-64 and the 65+ age groups showed that a higher life satisfaction was significantly related to a higher physical activity in both groups. Relationships between a higher negative affect and presenting a lower level of physical activity, and a higher positive affect and following the right consumption of fruits and vegetables and being a non-daily smoker, were only found in the older group.

**Conclusion:** The relationship between subjective well-being and healthy lifestyle behaviours was found fundamentally in those aged 65+ years. Interventions focused on incrementing subjective well-being would have an impact on keeping a healthy lifestyle and, therefore, on reducing morbidity and mortality.

**Keywords:** positive affect; negative affect; life satisfaction; healthy lifestyle behaviours.

## Background

The world population is aging. There are 962 million people aged 60+, a 12.8% of the total population (7.3 billion), more than double that in the eighties (United Nations, 2017). Thus, the improvement of the quality of life of older adults is an important global health issue. In this sense, previous studies have shown that subjective well-being is related to healthy lifestyle behaviours, it could have a protective effect in health maintaining and it is associated with an increase in life expectancy (Helliwell, Layard, & Sachs, 2012). Moreover, to be involved in healthy lifestyle behaviours such as physical activity, social and cognitive participation, or stress decrease, may have an impact in mental health, encouraging brain neuroplasticity and reducing cognitive, physical and functional decline (Buchman et al., 2012; Draganski et al., 2004).

Subjective well-being has been shown to positively affect health status (Miret et al., 2017). Similarly, healthy status and healthy lifestyles are also important to maintain a good level of subjective well-being (Miret et al., 2014; A. Steptoe, Deaton, & Stone, 2015; Taylor Jr, Hasselblad, Henley, Thun, & Sloan, 2002; Warburton, Nicol, & Bredin, 2006). Yet less is known about the mechanism that explains why people who inform higher levels of subjective well-being have better health than less satisfied individuals. *Subjective well-being* includes a person's satisfaction with various domains of life, his/her overall judgement of life satisfaction, and his/her current affective state measured as a time-weighted metric of the amount of negative or positive emotions (Diener, Suh, Lucas, & Smith, 1999). Two different components can be distinguished in this definition of subjective well-being: experienced and evaluative well-being. *Experienced* well-being refers to the positive and negative emotions that people experience in their daily life, whereas *evaluative* well-being can be defined as the cognitive judgments about one's own life satisfaction or in relation to different specific

domains (e.g. job, family, partner), (Diener, Emmons, Larsen, & Griffin, 1985). The assessment of both aspects is highly recommended since experienced well-being is framed in a specific temporal moment, whereas evaluative well-being is not and can be affected by memory bias (Diener et al., 1999).

More than 40 years ago, the Alameda County Study (Belloc & Breslow, 1972) identified seven healthy practices, which were never smoking, physical activity, moderate or no alcohol consumption, maintaining an average weight, sleeping seven or eight hours per night, eating breakfast, and not snacking between meals. After this original research, the impact of healthy lifestyle behaviours on health status has been widely studied, mainly regarding prevention of cardiovascular diseases (Claas & Arnett, 2016) and cancer (Khan, Afaq, & Mukhtar, 2010) prevention. Moreover, some previous studies have informed about differences in healthy lifestyle behaviours between younger and older adults, being tobacco and alcohol consumption, as well as physical activity higher in the first than in the latter group (Y. Pan et al., 2015; Shaw, Krause, Liang, & McGeever, 2011; Shaw, Liang, Krause, Gallant, & McGeever, 2010), but the knowledge in this field is still limited, supporting the need to explore the possible factors that determine healthier lifestyles in one group than in the other. One of the mechanisms that could explain better the association between subjective well-being and health is that people with higher subjective well-being may tend to have healthier lifestyles. It is known that people with higher positive affect are more prone to practice exercise and not smoking (Boehm, Vie, & Kubzansky, 2012). In the same way, people who report higher life satisfaction engage in more physical activity, eat more fruit, use more often sun protection, and consume less tobacco, alcohol and fat across different countries from America, Europe and Asia (Grant, Wardle, & Steptoe, 2009), and over the years (Hoyt, Chase-Lansdale, McDade, & Adam, 2012) in adolescents and young

adults. Similar results are found in clinical samples. For example, a higher positive affect at baseline was found to be related to healthier behaviours after 5 years in patients with heart diseases (Sin, Moskowitz, & Whooley, 2015), being the relation between positive affect and exercise specially important on survival at follow-up, something already pointed out by previous studies (Hoen, Denollet, de Jonge, & Whooley, 2013; Hoogwegt et al., 2013).

To our knowledge, it is still unknown whether each component of subjective well-being could be associated with healthy lifestyle behaviours in the general older population, and whether these different healthy lifestyle behaviours are maintained in the long-term despite variations in the components of subjective well-being. The aim of the present study was to analyse the independent relationship between different subjective well-being components on five different healthy lifestyle behaviours -the practice of high or moderate physical activity, the consumption of five or more fruits or vegetables per day, being a non-smoker, being a non-heavy drinker and having a good sleep quality-, and to assess whether this effect is different across age groups.

## **Method**

### ***Sample and procedure***

Data were obtained from a three-year prospective longitudinal study conducted over a nationally representative sample of non-institutionalised adults from the Spanish population. The baseline data collection took place within the Collaborative Research on Ageing in Europe (COURAGE in Europe) project, comprising also nationally representative samples from Finland and Poland. Details of the COURAGE in Europe study conducted between April 2011 and May 2012 are provided elsewhere (Leonardi et



al., 2013). A second wave was undertaken between December 2014 and June 2015 in Spain. An age-stratified (18 to 49; 50 to 79; 80+ years) and a multi-stage clustered design was employed at baseline. Information on households was supplied by the Spanish Statistical Office. Specific details about the sample design can be found elsewhere (Miret et al., 2014).

Face-to-face structured interviews were conducted at respondents' homes using Computer-Assisted Personal Interviewing (CAPI). Trained interviewers who participated in a training course prior to the survey carried out the interviews. The individual response rate was 69.9% at baseline. The mean follow-up duration was 3.25 years (s.d. = 0.18). Quality assurance procedures were implemented during fieldwork (Üstun, Chatterji, Mechbal, & Murray, 2005).

The analyses conducted in the present study were focused on the older population, considering those who were aged 50+ years at baseline and completed the follow-up. For those participants who were unable to participate in the study due to a cognitive impairment, a shorter version of the questionnaire was administered to a proxy respondent. A representative sample of 4,271 individuals from Spain was interviewed at baseline and 2,528 of them completed the follow-up. After the exclusion of proxy respondents (125 individuals), and persons aged  $\leq 49$  at baseline (511 cases), the final analytical sample comprised 1,892 individuals.

### ***Ethics statement***

Ethical approvals for this longitudinal study were obtained from the Ethics Review Committees of Hospital Universitario de La Princesa (Madrid) and Parc Sanitari Sant Joan de Déu (Barcelona). Written informed consent was obtained from participants in both waves.

## *Measures*

At the beginning of the interview, participants were asked to provide sociodemographic information: age, gender, current marital status (married or cohabiting, never married or cohabiting, widowed, and separated or divorced), years of education, household income and residential setting (rural/urban).

### *Subjective well-being indicators*

*Experienced well-being* was measured using an abbreviated version (Ayuso-Mateos et al., 2013) of the Day Reconstruction Method (DRM) (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004). Respondents reconstructed a portion of their previous day's activities, answering specific questions about the activity itself: its nature (e.g. listening to the radio, doing housework), and the extent to which they experienced a total of seven emotions (worried, rushed, irritated or angry, depressed, tense or stressed, calm or relaxed and enjoying), using a seven-point response scale ranging from 0 (not at all) to 6 (very much). *Positive affect* was defined as the average of the positive emotions (calm/relaxed and enjoying) whereas *negative affect* was operationalised as the average of the negative ones (worried, rushed, irritated/angry, depressed, and tense/stressed) (Kahneman et al., 2004). Both measures were weighted by the duration of the activities (Krueger & Stone, 2008). Global scores ranged from 0 to 6, with higher values indicating higher positive and higher negative affect, respectively. The omega coefficient, used to measure internal consistency for composite reliability, was used for both positive affect and negative affect measures: omega values were 0.84 and 0.93 for positive and negative affect, respectively, in the overall sample.

*Evaluative well-being (life satisfaction)* was assessed with the Cantril Self-Anchoring Striving Scale (Cantril, 1965). Participants were asked to place themselves in

a ladder with steps from 0 (representing worst possible life) to 10 (representing best possible life), and report on which step of the ladder they felt they were standing at that time.

#### *Healthy lifestyle behaviours*

*Physical activity* was assessed with the Global Physical Activity Questionnaire version 2 (GPAQ v2) developed by the World Health Organization (WHO) (Bull, Maslin, & Armstrong, 2009). It collects information on physical activity participation in three settings (activity at work, travel to and from places, and recreational activities), as well as sedentary behaviour. Answers of participants were translated to Metabolic Equivalent of Task (MET) values, and then physical activity levels were categorised according to the GPAQ v2 guidelines (World Health Organization, 2012). The resulting categories were *high* (vigorous-intensity activity on at least 3 days achieving a minimum of at least 1500 MET-minutes per week, or 7 or more days of any combination of walking, moderate or vigorous intensity activities achieving a minimum of at least 3000 MET-minutes per week), *moderate* (three or more days of vigorous-intensity activity of at least 20 minutes per day, or five or more days of moderate-intensity activity or walking of at least 30 minutes per day, or five or more days of any combination of walking, moderate or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes per week), or *low* (a person not meeting any of the above-mentioned criteria).

*Adequate consumption of fruit and vegetables* was collected and operationalised as fruit and vegetable combined intake of five or more servings per day, according to the WHO and Food and Agriculture Organization recommendations (2003).

*Tobacco smoking* was measured considering two different categories: non-daily smokers and daily smokers.

*Alcohol consumption* was assessed and categorised into two groups: “heavy” drinkers for consumers of at least five (in men) or four (in women) standard alcoholic drinks per day on at least one day during the week before the interview, and “non-heavy” drinkers for those who had never consumed alcohol or had ever consumed alcohol but were not heavy drinkers (World Health Organization, 2000a).

*Sleep quality* was measured using a single question referred to the day before the interview: “Please rate the quality of your sleep last night. Was it very good, good, moderate, poor or very poor?”. Following the classification proposed in a previous study (Sin et al., 2015), the variable was dichotomised in good sleep quality (comprising “good” and “very good” categories) and poor sleep quality (including the categories that were originally coded as “moderate”, “poor” and “very poor”).

#### *Covariates*

Other potential confounders were also analysed. *Height* was quantified with a stadiometer and *weight* was measured with an electronic scale in order to calculate body mass index (BMI). Using the standard WHO (2000b) definition, BMI was categorised as underweight ( $<18.5 \text{ kg/m}^2$ ), normal weight ( $18.5\text{-}24.9 \text{ kg/m}^2$ ), overweight ( $25\text{-}29.9 \text{ kg/m}^2$ ), and obesity ( $\geq 30.0 \text{ kg/m}^2$ ). *Physical multimorbidity* was defined as the presence of two or more physical chronic conditions from the following list: chronic lung disease and asthma, diabetes, hypertension, angina pectoris, stroke, and osteoarthritis. These chronic physical conditions were assessed by asking the participants whether they had received medical diagnosis and treatment during the previous 12 months (with the exception of diabetes, which was based only on self-report). In addition, questions about

specific symptoms were included to detect undiagnosed cases. Hypertension was measured by blood pressure assessment. People with systolic blood pressure  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq 90$  mmHg were considered to have hypertension (World Health Organization, 2013). *Lifetime depression* was assessed according to the definitions and criteria of ICD-10 and DSM-IV classifications of mental and behavioural disorders: diagnostic criteria for research (Frances, 1994; World Health Organization, 1993), with an adapted version (Haro et al., 2006) of the depression module of the World Health Organization Composite International Diagnostic Interview (CIDI 3.0), (Kessler & Üstun, 2004).

### ***Statistical analysis***

Weights were used to account for sampling design and post-stratified corrections were made to adjust for the population distribution obtained from the Spanish national census in 2011 (baseline time) and for non-response (Moussavi et al., 2007).

According to previous research, an age effect for subjective well-being has been described (Von Dem Knesebeck, Wahrendorf, Hyde, & Siegrist, 2007), so the analyses were conducted separately for two different age groups (50–64 and 65+ years).

Weights were employed to report mean estimates for the well-being variables. Frequency analysis and descriptive statistics were performed to characterise the sample in the three-year follow-up, describing socio-demographics and healthy lifestyle behaviours patterns. Potential differences between the age groups considered were tested for the variables abovementioned, using unpaired *t*-tests for the quantitative variables and chi-squared-tests for the categorical ones. Significance tests for differences in the prevalence by sociodemographic characteristics were conducted for the entire population and separated by age groups, using the Rao-Scott chi-square

statistic, which adjusts for complex sample designs (Rao & Scott, 1984). As an attrition analysis, differences in baseline characteristics between participants who completed the follow-up and participants who did not participate were assessed, reporting effect sizes when significant differences at the 95% confidence interval were found. Hedges'  $g$  for unpaired  $t$ -tests and Cramer's  $V$  for chi-square-tests were reported as effect size measures. Cohen's guidelines were used as reference (Cohen, 1988) to assess the magnitude associated to these differences. Hedges'  $g$  values of 0.20, 0.50, and 0.80 constitute small, medium, and large effect sizes, respectively; for Cramer's  $V$ , these values are 0.10, 0.30, and 0.50.

Generalised Estimating Equation (GEE) models (Hilbe & Hardin, 2008) were conducted to examine the association between life satisfaction, positive affect and negative affect, and each of the five healthy lifestyle behaviours considered in the present study: high or moderate level of physical activity, adequate consumption of fruit and vegetables, being a non-daily smoker, being a “non-heavy” drinker and having a good sleep quality. GEE analyses were conducted for panel data, clustered by the personal identification number, and run using a population-averaged model. An exchangeable correlation structure and a logit link function were respectively used to account for the correlation between baseline and follow-up observations in the same individual and the dichotomous nature of the dependent variable considered in each case. The robust variance estimator (W. Pan, 2001) was employed to account for the within-subject correlation and to obtain reliable standard errors.

Before conducting the GEE models, a preliminary analysis was carried out to determine which covariates should be included in each of the final GEE models considered, in order to reduce the number of independent variables in the models and consider only those covariates that could have a potential significant relationship with

healthy lifestyle behaviour patterns. For each potential confounder (age, gender, marital status, years of education, household income, residential setting, BMI, physical multimorbidity, and lifetime presence of a depression episode), a preliminary GEE model was run to predict each healthy lifestyle behaviour, controlling only for age and gender. Covariates that had associated a  $p$ -value lower than 0.10 were included in the final GEE model in each case (i.e., in the model assessing the relationship with each healthy lifestyle behaviour pattern), and the model was conducted separately for the subsamples based on the age group considered. Each GEE model examines the relationship between well-being variables (the independent variables in each model: positive affect, negative affect and life satisfaction) and the different healthy lifestyle behaviours considered in the present study, adjusting in each case for potential confounders.

As an additional analysis, the additive effect of healthy lifestyle behaviours was tested, creating a dichotomous variable based on the sum of the healthy lifestyle behaviours presented (i.e., high or moderate physical activity, five or more fruits and vegetables per day, non-daily smoker, non-heavy drinker, good sleep quality). In each case, '1' was assigned when the participant fulfilled the criterion and '0' otherwise. The total score ranging from 0 to 5 was dichotomised according to the median value observed in the sample. The same GEE procedure described above was used in this case to test the relationship between subjective well-being and a high number (based on the median value observed in the sample) of healthy lifestyle behaviours.

All analyses were carried out with Stata software, version 14 (StataCorp, 2015). Confidence intervals (CI) for hypotheses tests were constructed at the 95% confidence level.

## Results

A total of 3,169 individuals were interviewed at baseline after the exclusion of those who participated in the survey via a proxy respondent and persons aged  $\leq 49$ . From this number, at wave two, 717 individuals (22.63%) finally refused to continue in the study, 220 (6.94%) were uninhabited houses or their occupants were elsewhere (on vacation or in another residence), 211 (6.66%) participants were not found, 120 subjects (3.79%) had passed away, and the remaining sample (0.28%) were lost to follow-up for other different reasons (partial interview and unsafe or dangerous area). Finally, the follow-up was completed by 1,892 participants who comprise the analytical sample of the present study. Baseline sociodemographic characteristics of individuals who were included in the analysis ( $n = 1,892$ ) to those who were eligible for our analyses from wave 1 but did not have a follow-up interview ( $n = 1,277$ ) were examined in terms of the attrition analysis (Table 1).

<INSERT TABLE 1 ABOUT HERE>

The excluded sample was significantly older ( $p < 0.001$ , Hedges'  $g = 0.13$ ), with less people married or living with a partner ( $p = 0.004$ , Cramer's  $V = 0.05$ ), less individuals living in a rural setting ( $p = 0.013$ , Cramer's  $V = 0.04$ ), and fewer years of education ( $p = 0.031$ , Cramer's  $V = 0.08$ ), although the effect sizes associated were small in all cases, indicating that substantial differences were not found based on the sample excluded from the analysis. There were no significant differences between the two groups in terms of lifetime depression or physical multimorbidity.

<INSERT TABLE 2 ABOUT HERE>

In the sample considered (with 1,007 subjects aged between 50 and 64 years and 885 aged 65+), there were more women than men (53.49%) and more people married or



cohabiting (65.27%). They had 10.36 years of education on average (s.d. = 6.36), and most of them (85.78%) lived in an urban setting (Table 2). Not having a heavy episodic alcohol drinking was the healthy lifestyle behaviour most fulfilled by the sample (97.97%). The only behaviour complied by less than half of participants (33.12%), was the intake of five or more fruits or vegetables per day. Overall, mean scores (95% CI) for positive affect, negative affect and life satisfaction were 4.93 (4.87, 4.98), 0.70 (0.65, 0.76) and 6.59 (6.51, 6.68), respectively. The proportion of people married or living in a partnership was significantly higher in the 50-64 years age group (Cramer's  $V = 0.14$ ), which presented also a higher mean value of years of education, with a medium effect size (Hedges'  $g = 0.54$ ). Regarding healthy lifestyle behaviours, the older group smoked and drunk less, resulting the alcohol intake associated with a medium effect size (Cramer's  $V = 0.22$ ) and the tobacco use with a small effect size (Cramer's  $V = 0.08$ ), but on the other hand, this group showed less sleep quality than the younger one (Cramer's  $V = 0.05$ ). Positive affect was the only well-being dimension that significantly differed between both groups, being the older age group the one that presented more positive emotions (Hedges'  $g = 0.19$ ).

<INSERT TABLE 3 ABOUT HERE>

Table 3 shows GEE models conducted separately over each of the age groups considered: 50-64 years and 65+, reporting the Odds Ratios (OR) and their 95% confidence interval (CI) associated to each healthy lifestyle behaviour. In these models, potential confounders included were those found significant in a preliminary analysis. While a higher score in life satisfaction was significantly related to a high or moderate level of physical activity in both groups in the three-year follow-up ( $p = 0.012$  in those aged between 50 and 64 years;  $p < 0.001$  in those aged 65+ years), the relationship between negative affect and physical activity was only found in the older group ( $p =$

0.004), with higher scores in negative affect being associated with a lower level of physical activity. A higher score in positive affect was the only subjective well-being aspect significantly related to the consumption of five or more fruits or vegetables per day and with being a non-daily smoker three years later, and these associations were only found in the older group ( $p = 0.015$  and  $p = 0.047$ , respectively). None of the subjective well-being aspects were related to being a non-heavy drinker or having a good sleep quality over each of the age groups considered.

The median value observed in the sample in the distribution of healthy lifestyle behaviours was 4. Based on this value, a GEE model was conducted to assess the relationship between well-being measures and the presence of a high number of healthy lifestyle behaviours, adjusting for potential confounders. Life satisfaction was significantly related with a higher number of healthy lifestyle behaviours in both groups: OR = 1.14 ( $p < 0.001$ ) in the 50-64 age group and OR = 1.15 ( $p < 0.001$ ) in the 65+ age group, whereas higher negative affect was significantly related with less healthy lifestyle behaviours only in the oldest group: OR = 0.89 ( $p = 0.022$ ). Significant results were not observed for positive and negative affect in the younger group.

## **Discussion**

The present study aimed to analyse the independent relationship between different subjective well-being components and five different healthy lifestyle behaviours, and to assess whether this effect was different across age groups. This relationship was found fundamentally in those aged 65+ years. To be precise, higher positive affect, higher life satisfaction and lower negative affect were significantly related to the consumption of five or more fruits or vegetables per day, being a non-daily smoker and engaging in a

high or moderate level of physical activity respectively. These results are encouraging, since the older population who reports higher subjective well-being, would see their health increased through healthy lifestyle behaviours (Chei, Lee, Ma, & Malhotra, 2018; Dillon, McMahon, O'Regan, & Perry, 2018; A. Steptoe et al., 2015).

People aged 65+ presented significantly more positive emotions than their younger counterparts. In the same line, previous studies have found that older adults inform higher calm, happiness and energy, less sadness and anxiety, and as well as greater emotional stability and co-occurrence of positive and negative feelings than younger population (Carstensen et al., 2011; Machado, Thompson, & Brett, 2018).

A low negative affect, together with a high life satisfaction in the older group makes them more likely to engage in physical activities than middle-aged adults. This association may be related to retirement, in the sense that although employed younger adults can experience well-being, the stress related to employment could be a more important issue for them than exercise (Hannan et al., 2015). In line with the results found in the present study, recent findings also suggest that subjective well-being might be a precursor of healthy lifestyle behaviours in older adults, such as following a diet rich in fruits and vegetables (Boehm et al., 2018) and not smoking (Thorne, 2018). This relationship was not found in the younger group, which suggests that positive emotions become important for healthy living when people reach the age of 65 years, but not before.

The findings of the present study are in line with the research conducted by Grant et al. (2009), in which they found that life satisfaction was positively associated with several healthy lifestyle behaviours, after adjusting for age, gender, and different geopolitical region (Western Europe and America, Central and Eastern Europe, and Pacific Asia). They also found that the association was independent of beliefs in the

health benefits of the behaviours. Despite collecting information from more than 20 countries all over the world, this study only focused on students aged 17-30 years, thus data on older adults was not analysed. A similar conclusion was achieved by Hoyt et al. (2012) in young adults aged 18-27 years, showing that adolescents' subjective well-being predicted fewer risky health behaviours in young adulthood. Finally, a study on women aged 45-65 years with breast diseases, found that those with a higher overall life satisfaction were more prone to have a healthy lifestyle, consciousness of breast cancer, and followed ordinary physical examinations, which led to a lower screening rate of breast disorders (Bai et al., 2016). In particular, satisfied women were less likely to be smokers, practised more exercise, and ate less fried, smoked, pickled and grilled foods (Bai et al., 2016), similar results to those found in this study. None of the subjective well-being aspects were related to being a non-heavy drinker or having a good sleep quality in any of the groups analysed. Sleep quality and alcoholism may depend more on other factors not so attitudinal such as exercising regularly and having a healthful diet. In this regard, Madrid-Valero, Sánchez-Romera, Gregory, Martínez-Selva, and Ordoñana (2018) found that there was a moderate genetic influence on most dimensions of sleep quality in a sample of adult male and female twins. Moreover, Andrew Steptoe, O'Donnell, Marmot, and Wardle (2008) found that subjective well-being was directly associated with good sleep. Differences in used scales and the fact that they measured eudaimonic well-being as well, may account for this discrepancy.

Fruit and vegetable consumption is associated with a reduced risk of stroke, cognitive impairment and dementia (He, Nowson, & MacGregor, 2006; Jiang et al., 2017). Notwithstanding the above, and in line with previous research (Guenther, Dodd, Reedy, & Krebs-Smith, 2006), the results of the present study show that only a third of participants followed the healthy lifestyle recommendations related to fruit and

vegetable intake (World Health Organization & Food and Agriculture Organization, 2003). Moreover, the less years of education, the less likely was the adequate fruit and vegetable consumption, which is in line with other studies that suggest that adults coming from the lowest socio-economic levels in Europe may present an unhealthy nutrition behaviour (De Irala-Estevez et al., 2000). These findings underline the need of analysing how to engage people in healthier lifestyles and the need of nutritional education programmes addressing people with low levels of education.

The results of this study should be interpreted taking into account some limitations. Despite the attrition of the sample, what conforms one drawback of the present study, a socio-demographic comparison was carried out between people who completed the follow-up and those who did not, and in general terms, all the effect sizes associated with the differences found could be explained because of the large sample size of the study. Another limitation is that evaluative well-being was assessed by means of a single-item question. Although the use of single-item measures has sometimes been discouraged, if the construct under study is sufficiently unidimensional, single-item measures are not necessarily inferior to multiple-item measures (Fuchs & Diamantopoulos, 2009). The eudaimonic component of well-being was not assessed. Since previous studies have found a relationship between sense of coherence and healthy lifestyle behaviours (Kuuppelomäki & Utriainen, 2003; Lindmark, Stegmayr, Nilsson, Lindahl, & Johansson, 2005; Wainwright et al., 2007), future studies should also include this subjective well-being component. Despite being a longitudinal study, further studies are needed to infer causality from the previously reported associations, since it could be possible that presenting healthy lifestyle behaviours help older people to improve their well-being (McAuley & Rudolph, 1995). Additional confounding variables (such as perceived stress, anxiety symptoms, use of medication or other

variables relating to social connections such as living alone or experiencing feelings of loneliness) were not measured, and they may have contributed to both subjective well-being components and healthy lifestyle behaviours. Besides, the measures used in this study were all self-reported, and thus susceptible to recall or response biases. However, self-reported measures have been shown to be valid and reliable (Gehi, Ali, Na, & Whooley, 2007; Kurtze, Rangul, Hustvedt, & Flanders, 2008).

To our knowledge, this is the first study that analysed the association between life satisfaction, negative affect and positive affect, and healthy lifestyle behaviours, considering the follow-up of a nationally representative sample of the Spanish population, comparing different age groups. The results showed that subjective well-being is associated with the healthy patterns of physical activity, consumption of fruits or vegetables and not smoking in elderly population, even after controlling for potential confounders that could influence this relationship (including BMI, physical multimorbidity and lifetime depression). It could be possible that interventions focused on incrementing life satisfaction and positive emotions and reducing the negative ones would have an impact on keeping a healthy lifestyle and, therefore, on increasing longevity and reducing morbidity and mortality.

At policy level, since in both the younger and the older group a relationship between life satisfaction and a several healthy lifestyle behaviours was found, interventions aiming to reduce tobacco use and improve physical activity and healthier food habits may benefit from incorporating components to improve life satisfaction in the aging population, helping them to live longer and in a healthier way.

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**Table 1.** Baseline sociodemographic characteristics (2011-12) for eligible participants with and without follow-up data (n=3169), the COURAGE in Europe Study, Spain.

	<b>Participants not followed-up (n=1277)</b>	<b>Participants followed-up (n=1892)</b>	<b><i>t</i>/<sup>2</sup> (<i>d.f.</i>)</b>	<b><i>p</i></b>	<b>Effect size</b>
Age, mean $\pm$ s.d.	66.01 $\pm$ 10.50	64.72 $\pm$ 9.83	3.53	<0.001***	0.13
Women, <i>n</i> (%)	724 (56.70)	1012 (53.49)	-3.17	0.075	-
Married or living in a partnership, <i>n</i> (%)	769 (60.22)	1235 (65.27)	8.38	0.004**	0.05
Years of education, mean $\pm$ s.d.	9.88 $\pm$ 0.17	10.36 $\pm$ 0.15	-2.16	0.031*	0.08
3 <sup>rd</sup> /4 <sup>th</sup> /5 <sup>th</sup> quintile of household income, <i>n</i> (%)	693 (60.16)	1019 (6.05)	0.01	0.953	-
Living in a rural setting, <i>n</i> (%)	143 (11.20)	269 (14.22)	6.15	0.013*	0.04
Lifetime depression, <i>n</i> (%)	241 (18.87)	369 (19.55)	0.23	0.633	-
Normal BMI, <i>n</i> (%)	266 (22.20)	410 (22.70)	-0.10	0.749	-
Physical multimorbidity, <i>n</i> (%)	461 (36.13)	745 (39.44)	3.54	0.060	-

*Note.* *d.f.*: degrees of freedom. s.d.: standard deviation. BMI: body mass index. -: Effect size was not provided since significant differences were not found.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

**Table 2.** Baseline characteristics: socio-demographics, estimated percentages for healthy lifestyle behaviours and mean estimates on subjective well-being (overall and by age groups), the COURAGE in Europe Study, Spain, 2012–2015.

	<b>Total sample (n=1892)</b>	<b>50-64 years (n=1007)</b>	<b>65+ years (n=885)</b>	<b>t/x<sup>2</sup> (d.f.)</b>	<b>p</b>	<b>Effect size</b>
<b>SOCIO-DEMOGRAPHICS</b>						
Women, n (%)	1012 (53.49)	526 (52.23)	486 (54.92)	1.36 (1)	0.24	-
Married or living in a partnership, n (%)	1235 (65.27)	718 (71.30)	517 (58.42)	-34.49 (1)	<0.001***	0.14
Years of education, mean ± s.d.	10.36 ± 6.36	11.98 ± 5.99	8.50 ± 6.26	11.55 (1864)	<0.001***	0.54
3 <sup>rd</sup> /4 <sup>th</sup> /5 <sup>th</sup> quintile of household income, n (%)	1019 (60.05)	549 (61.62)	470 (58.31)	1.93 (1)	0.17	-
Living in a rural setting, n (%)	269 (14.22)	140 (13.90)	129 (14.58)	0.18 (1)	0.68	-
<b>HEALTHY LIFESTYLE BEHAVIOURS</b>						
High or moderate physical activity, % (95% CI)	69.70 (0.67, 0.72)	70.92 (0.68, 0.74)	68.53 (0.65, 0.72)	0.98 (1)	0.32	-
Five or more fruits and vegetables per day, % (95% CI)	33.12 (0.30, 0.36)	31.57 (0.28, 0.35)	34.60 (0.30, 0.39)	1.31 (1)	0.25	-
Non-daily smokers, % (95% CI)	83.06 (0.81, 0.85)	73.88 (0.71, 0.77)	91.79 (0.90, 0.94)	93.67 (1)	<0.001***	0.22
Non-heavy drinkers, % (95% CI)	97.97 (0.97, 0.99)	96.70 (0.95, 0.98)	99.18 (0.99, 1.00)	11.96 (1)	0.001**	0.08
Good sleep quality, % (95% CI)	77.50 (0.75, 0.80)	79.88 (0.77, 0.83)	75.24 (0.72, 0.78)	4.70 (1)	0.031*	0.05
<b>SUBJECTIVE WELL-BEING</b>						
Positive affect, mean estimate (95% CI)	4.93 (4.87, 4.98)	4.82 (4.73, 4.91)	5.03 (4.95, 5.10)	-3.54 (1885)	<0.001***	0.19
Negative affect, mean estimate (95% CI)	0.70 (0.65, 0.76)	0.75 (0.67, 0.82)	0.66 (0.59, 0.73)	1.66 (1885)	0.10	-
Life satisfaction, mean estimate (95% CI)	6.59 (6.51, 6.68)	6.63 (6.51, 6.74)	6.57 (6.43, 6.70)	0.67 (1877)	0.50	-

*Note:* d.f.: degrees of freedom. 95% CI: 95% confidence interval.

Cramer's V for chi-square-tests (categorical variables) and Hedges' g for unpaired t-tests (quantitative variables) were considered as effect size measures for statistically significant differences.

Estimates are based in weighted data.

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$

**Table 3.** Odds ratios (95% confidence intervals) for associations between subjective well-being variables and healthy lifestyle behaviours in the 50-64 and 65+ age groups, GEE models, the COURAGE in Europe Study, Spain, 2012–2015.

<b>High or moderate physical activity</b>	<b>50-64 years</b>			<b>65+ years</b>		
	<b>OR</b>	<b>95% CI</b>	<b>p</b>	<b>OR</b>	<b>95% CI</b>	<b>p</b>
Positive affect	1.03	0.92, 1.14	0.61	0.99	0.88, 1.12	0.92
Negative affect	0.93	0.82, 1.05	0.23	0.82	0.72, 0.94	0.004**
Life satisfaction	1.09	1.02, 1.17	0.012*	1.18	1.10, 1.27	<0.001***
Residential setting (ref.=urban)	0.89	0.65, 1.22	0.48	0.74	0.53, 1.03	0.08
Marital status (ref.=never married or cohabiting)	0.90	0.70, 1.16	0.43	1.15	0.88, 1.50	0.31
Years of education	1.03	1.01, 1.05	0.005**	0.99	0.97, 1.01	0.16
Gender (ref.=male)	1.03	0.82, 1.30	0.80	0.73	0.56, 0.97	0.030*
Age	1.03	1.00, 1.05	0.029*	0.95	0.93, 0.97	<0.001***
Lifetime depression (ref.=no)	0.78	0.60, 1.01	0.06	0.72	0.55, 0.96	0.027*
BMI (ref.=normal)	0.91	0.78, 1.05	0.21	0.80	0.68, 0.94	0.007**
Physical multimorbidity (ref.=no)	0.92	0.72, 1.18	0.52	0.75	0.58, 0.95	0.020*
<b>Five or more fruits and vegetables per day</b>						
Positive affect	1.03	0.93, 1.14	0.54	1.15	1.03, 1.29	0.015*
Negative affect	1.00	0.89, 1.13	0.95	1.01	0.89, 1.15	0.90
Life satisfaction	1.04	0.98, 1.11	0.23	1.03	0.96, 1.10	0.40
Marital status (ref.=never married or cohabiting)	1.20	0.94, 1.52	0.14	1.07	0.83, 1.39	0.58
Years of education	1.03	1.01, 1.05	0.001***	1.02	1.01, 1.04	0.009**
Gender (ref.=male)	1.97	1.57, 2.47	<0.001***	1.21	0.94, 1.57	0.14
Age	1.03	1.00, 1.05	0.019*	0.99	0.97, 1.01	0.29
<b>Non-daily smokers</b>						
Positive affect	1.03	0.94, 1.11	0.58	1.18	1.00, 1.40	0.047*
Negative affect	0.98	0.89, 1.08	0.73	1.09	0.88, 1.34	0.45
Life satisfaction	1.03	0.97, 1.09	0.30	1.05	0.95, 1.17	0.33
Marital status (ref.=never married or cohabiting)	1.28	0.98, 1.68	0.07	2.78	1.70, 4.56	<0.001***
Years of education	1.02	1.00, 1.04	0.07	0.99	0.96, 1.03	0.78
Household income (ref.=1 <sup>st</sup> /2 <sup>nd</sup> quintile)	0.89	0.75, 1.05	0.17	0.87	0.62, 1.22	0.43
Gender (ref.=male)	2.03	1.52, 2.72	<0.001***	6.41	3.49, 11.75	<0.001***
Age	1.06	1.03, 1.09	<0.001***	1.07	1.03, 1.10	<0.001***
Lifetime depression (ref.=no)	0.75	0.55, 1.04	0.08	1.04	0.56, 1.93	0.91
BMI (ref.=normal)	1.30	1.12, 1.50	<0.001***	1.12	0.85, 1.46	0.42
Physical multimorbidity (ref.=no)	1.18	0.92, 1.50	0.19	1.01	0.67, 1.53	0.94
<b>Non-heavy drinkers</b>						
Positive affect	0.96	0.74, 1.25	0.78	1.15	0.69, 1.92	0.60
Negative affect	0.92	0.68, 1.23	0.55	1.11	0.56, 2.18	0.76
Life satisfaction	0.94	0.81, 1.10	0.47	0.78	0.57, 1.06	0.11
Residential setting (ref.=urban)	0.92	0.45, 1.89	0.82	0.99	0.20, 5.03	0.99
Marital status (ref.=never married or cohabiting)	1.41	0.79, 2.52	0.24	0.96	0.26, 3.51	0.95
Gender (ref.=male)	4.05	2.18, 7.52	<0.001***	2.65	0.71, 9.88	0.22
Age	1.01	0.96, 1.07	0.20	1.01	0.93, 1.09	0.83
<b>Good sleep quality</b>						
Positive affect	1.00	0.99, 1.01	0.92	1.00	0.98, 1.02	0.82
Negative affect	1.00	0.99, 1.01	0.93	1.00	0.97, 1.02	0.89
Life satisfaction	1.00	0.99, 1.01	0.77	1.00	0.99, 1.01	0.72
Gender (ref.=male)	0.53	0.38, 0.73	<0.001***	0.72	0.52, 1.00	0.05
Lifetime depression (ref.=no)	0.52	0.38, 0.72	<0.001***	0.44	0.31, 0.61	<0.001***

Note: BMI: body mass index. \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$