

## Article

# Is a Mediterranean diet associated with subjective well-being among adults with overweight and obesity? The key role of fruit and vegetable consumption and body satisfaction

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**Abstract:** Recent evidence suggests that among behavioral-lifestyle factors, adherence to a healthy dietary pattern such as the Mediterranean Diet (MedDiet) is linked not only to better psychological health and mental positive status but also to increased subjective well-being (SWB). Nevertheless, this association has been unexplored among individuals with excessive weight. This study explored whether adherence to the MedDiet and the intake of healthy foods such as fruits and vegetables (FV) are associated with increased happiness and life satisfaction among Spanish adults with overweight or obesity when weight, body image, and body satisfaction are also considered. A convenience sample of adult individuals with excessive weight completed self-reports on the study variables, and weight and BMI were measured by bioimpedance. No evidence of a relationship with SWB indicators was obtained for MedDiet global indicators, probably due to the low adherence to a healthy diet by these individuals. In contrast, FV intake, as a powerful indicator of healthy eating, was associated with life satisfaction when BMI and body image dimensions were considered, among which body satisfaction also had a key role. Moreover, life satisfaction fully mediated the relationship between FV consumption and happiness. Our findings are expected to make a relevant contribution to knowledge on the positive correlates or protective factors for overall well-being in obesity, including dietary habits and body appreciation. Our results may inform obesity management actions focused on inclusive, positive aesthetic models and promoting a healthy lifestyle for happiness in obesity.

**Keywords:** healthy diet; fruits and vegetables; body image; happiness; excessive weight

## 1. Introduction

Overweight (body mass index,  $BMI \geq 25 \text{ kg/m}^2$ ) and obesity ( $BMI \geq 30 \text{ kg/m}^2$ ) are recognized as major public health concerns, as they are linked to higher risks for chronic or severe somatic, mental, and social comorbidities. Body weight is associated with psychosocial well-being in individuals with excessive weight; however, in addition to shape and weight concerns, weight-related stigma, psychological distress and psycho-

pathological symptoms, unhealthy attitudes and behaviors, the risk of chronic or fatal diseases and eating disorders, weight loss failure, and diminished quality of life, research on positive states of well-being and protective factors is unfortunately scarce (Godoy-Izquierdo et al., 2020).

It has been observed that happiness is diminished among people with excess weight (Blanchflower et al., 2009; Böckerman et al., 2014; Katsaiti, 2010; Kuroki, 2016; Latif, 2014; Oswald & Powdthavee, 2007; Robertson et al., 2015; Ul-Haq et al., 2014; Wadsworth & Pendergast, 2014). It is well established that subjective well-being (SWB) shows an inverse relationship with BMI. It has also been found that BMI is related to decreased happiness only among individuals with obesity, not among individuals with overweight and normal weight (Böckerman et al., 2014; Robertson et al., 2015). However, many individuals with obesity are happy (e.g., Green et al., 2015; Jansen et al., 2008), and many more pursue the highest hedonic well-being and life satisfaction as much as possible. To what extent eating habits and dietary quality contribute to happiness in these individuals is unknown and constitutes the main interest in the present study.

In addition to physical functioning, health, and quality of life benefits, high-quality eating patterns such as the Mediterranean Diet (MedDiet) and the consumption of some of its most healthy components such as plant-based foods, particularly fruit and vegetables (FV) consumption, are associated –cross-sectionally, prospectively, and meta-analytically– with decreased psychological distress and mental illness, including the risk of depression (e.g., Molendijk et al., 2018). With respect to positive psychological functioning and well-being, above and beyond mental disturbances, research supporting the association of the MedDiet and its components with indicators of positive well-being has increased in recent years. There is at least one narrative review (Rooney et al., 2013) and two systematic reviews with 10 prospective (Tuck et al., 2019) and 61 observational (both longitudinal and cross-sectional) studies (Głabska et al., 2020) supporting that the regular consumption of some components of the MedDiet, such as high FV, is associated with better psychological well-being, mental health, and SWB in healthy and clinical populations. There are two more reviews on the specific effects of a healthy diet and FV consumption on indicators of SWB, one being a research synthesis of 20 papers based mainly on registers in the World Database of Happiness (Veenhoven, 2019) and the other being a systematic review of 43 cross-sectional and longitudinal, observational studies and experimental studies on the MedDiet and FV consumption (Godoy-Izquierdo et al., in press).

All these sources support that a rather linear, dose-response effect exists linking positive indicators of mental well-being and happiness per portion of healthy foods consumed (Godoy-Izquierdo et al., in press; Tuck et al., 2019; Veenhoven, 2019), with benefits with consumptions as low as 3 servings/day and peaking rates for 7-8 servings/day of preferably fresh but also processed (frozen, canned, cooked...) products. It has also been observed that lower baseline intakes may yield stronger enhancing benefits and that a low amount of increased intake is required for meaningful changes (Godoy-Izquierdo et al., in press; Tuck et al., 2019). Moreover, increased FV consumption has been found to have enhancing effects on positive states after brief periods of time (2-3 weeks) and for the long term (up to 2-3 years) (Godoy-Izquierdo et al., in press; Tuck et al., 2019). Furthermore, a possible reverse direction of the links has been discarded (Głabska et al., 2020; Godoy-Izquierdo et al., in press). In summary, regularly consuming close to recommended or higher amounts of healthy foods, particularly FV, results in enhanced psychological health and SWB in the short run, and greater improvements are to be gained when regular consumption is particularly low. Together, the findings provide strong evidence of a causal effect of healthy eating on happiness, a pattern that seems to be universal across people, times, and places and robust to the influence of confounders (Veenhoven, 2019). In addition, this research supports the FV-happiness link, but contradictory findings have been obtained when fruits and vegetables or their combination have been compared (e.g., Tuck et al., 2019), indicating that these types of

plant-based foods might have differential effects on psychological health, mental well-being, and happiness indicators.

Unfortunately, weight status or BMI has been scarcely considered in this research, usually taken as a controlled covariate, with some research finding no effect attributable to it (e.g., Blanchflower et al., 2013; Mujcic & Oswald, 2016). Some research has included individuals with overweight and obesity in the sample studied (e.g., Andrade et al., 2020; Ford et al., 2013; Moreno-Agostino et al., 2019) but did not analyze possible differences. A few studies aiming to explore its influence did not support an influence for positive indicators of well-being, and contradictory findings were obtained for negative indicators; however, these studies were conducted with young adults on average in the normal range of weight status (e.g., Brookie et al., 2018; McMillan et al., 2011; White et al., 2013; Wickham et al., 2020), yet some findings with population-based samples (e.g., Moreno-Agostino et al., 2019) tend to support the same pattern. Thus, the impact of overweight or obesity on the association between healthy eating (i.e., MedDiet adherence and specific healthy food consumption, such as FV) and happiness has been largely unexplored.

In the present study, we aimed to explore whether adherence to the MedDiet is associated with happiness indicators among Spanish adults with overweight and obesity, controlling for BMI, sex/gender, and age. Whereas research has been mostly focused on the harmful consequences of obesity for psychological ill-being, our aim is to contribute by exploring happiness and promoting psychosocial factors such as healthy diet in individuals with excessive weight. Moreover, given that negative body image and body dissatisfaction have been consistently related to decreased functioning and well-being among individuals with excessive weight, subjective dimensions of body perceptions, i.e., desired weight change and body satisfaction, were also considered. To our knowledge, this is the first study exploring such relationships among individuals with excess weight. We expected to support in this population previous research conducted with general samples confirming the positive relationship between the MedDiet and SWB. Moreover, we expected to support the key role of FV consumption in this relationship. We also expected to find a key role of body satisfaction in such a relationship.

## 2. Materials and Methods

### *Participants and Procedure*

A total of 100 adults from 19 to 57 years old (average age:  $42.03 \pm 10.74$ , 60% women) residing in southern Spain voluntarily participated in the study. All participants had a  $BMI \geq 25$  (69% overweight; 31% obesity). All participants were white and had an average socioeconomic status (see OMITTED for more details). Recruitment was conducted with a convenient, nonprobabilistic procedure according to the inclusion criteria (i.e., having overweight or obesity, not suffering from severe physical and mental diseases, being 18-65 years old) in local medical settings.

Specifically, recruitment was conducted in two primary healthcare centers among individuals with obesity who sought consultation for weight and health during March 2019. After inviting the individuals to voluntarily participate and after informing them about a study on well-being and health in adults with excessive weight, the anonymous nature of the data, and the research participants' rights, written consent was obtained. Then, assessment was conducted in a medical examination room. First, sociodemographic data and self-reported weight and height were collected in an interview format. Then, self-reported data on body perceptions, adherence to the MedDiet, and happiness were collected. The order of the questionnaires was counterbalanced to avoid order biases. Finally, objective measures of weight and height were obtained.

Approval was obtained from the ethics committee of the authors' university (CIEB-2018-1-36). The procedures used in this study adhere to the tenets of the Declaration of Helsinki of 1975, revised in 2013.

### Study Variables and Measures

Sociodemographic data were collected from the participants. Weight and height as well as BMI were measured with a mobile anthropometer with bioelectrical impedance (Aicok Weight Scale, mod. CF398BLE, USA). BMI was then categorized according to international standards on nutritional status in the adult population (WHO, 2017), i.e., <18.5 low weight, 18.5-24.9 normal weight, 25.0-29.9 overweight, and  $\geq 30.0$  obesity.

The perceptual component of body image was explored by using silhouettes corresponding to different BMI ranges and levels of muscularity (Godoy-Izquierdo et al., 2019). A total of 15 male or female body figures were presented to the individuals to assess their own perceived bodies (perceived body image, PBI) and ideal bodies (ideal body image, IBI) (in both cases, 1=excessively obese, 8=excessively thin and flaccid, 15=excessively muscular). Based on these, we calculated the desire to change weight and body appearance by computing the discrepancy PBI-IBI (i.e., negative difference values indicate a desire for a slimmer and/or more muscular body; positive difference values indicate a desire for a heavier and/or less muscular body) (Godoy-Izquierdo et al., 2020). In addition, body satisfaction was assessed by a single face-valid item ("How satisfied are you with your current body weight and appearance?" 1=extremely dissatisfied, 7=extremely satisfied) (Godoy-Izquierdo et al., 2020). Body satisfaction is considered a key dimension in the evaluative-subjective component of body image (Grogan, 2017).

Life satisfaction was assessed with one item from the Spanish version (Heikamp et al., 2014) of the 8-item Positivity Scale (Caprara et al., 2012). The item regarding life satisfaction ("Overall, I'm satisfied with my life", 1=completely disagree, 5=completely agree) was used in the present study.

SWB was self-reported with the Happiness Scale (Godoy-Izquierdo et al., 2012). The single-item indicator of current happiness ("How happy are you at the present, i.e., the last few days or weeks?" 0=extremely unhappy, 10=extremely happy) was used. Single-item indicators of happiness are usually used in national surveys and individual research (Cheung & Lucas, 2014). Thus, besides life satisfaction, SWB was also measured at a molar level (Diener et al., 1999).

Adherence to a healthy diet was assessed with the 14-point Mediterranean Diet Adherence Screener (MEDAS) (Schröder et al., 2011). It assesses adherence to the Med-Diet with 14 dichotomic items for different diet nutrients or food intake habits characteristic of this diet (0=no adherence to recommendations, 1=adherence to recommendations). The Spanish Society of Obesity (SEEDO; [www.seedo.es](http://www.seedo.es)) has introduced a few modifications to the MEDAS to adapt the score to a healthier diet for Spanish individuals (specifically, the recommended intake of olive oil was reduced from  $\geq 4$  to  $\geq 2$  tablespoons/day, of wine from  $\geq 7$  to  $\geq 3$  glasses/week, and of nuts from  $\geq 3$  to  $\geq 1$  serving/week). Although cutoffs have been stated for low (total score  $\leq 5$  or  $\leq 6$ ), moderate (6-9 or 7-10), and high adherence ( $\geq 10$  or  $\geq 11$ ) (Martinez-Gonzalez et al., 2012; SEEDO), in the present study, a MEDAS total score below 9 was considered low MedDiet adherence, and a score equal to 9 or above was considered high adherence (Álvarez-Fernández et al., 2020; Moreno-Agostino et al., 2019). Moreover, several composed categories of nutrients were computed combining the following items: vegetable + fruit intake (items 3 and 4; alternatively, vegetable + fruit + legume + nut + sofrito intake, items 3, 4, 9, 13, and 14); sugar intake (items 7 and 11); and animal-based protein and fat intake (items 5, 10, and 13). The remaining items were not considered for compound scores (e.g., the consumption of olive oil, butter, margarine, or creams was hardly categorized exclusively into one of the abovementioned categories).

### Statistical Analyses

This was a cross-sectional correlational study. The nature and adequacy of the data were checked, and parametric assumptions were confirmed before conducting the analyses. Frequency analysis and descriptive statistics (n and % for categorical variables, and mean and standard deviation [ $M \pm SD$ ] for continuous variables) as well as Pearson's  $r$

zero-order pairwise correlations were calculated. In addition, hierarchical multivariate linear regression analysis was used to examine the predictive role of healthy diet indicators on happiness endpoints, namely, happiness and life satisfaction. Specifically, two multiple regression models were built for each well-being variable considered as criterion. The first included the global score on the MEDAS, and the second included each of its 14 items as well as composite scores. In each model, BMI (as a continuous variable), desired weight change (i.e., PBI-IBI; we selected this variable instead of body image perceptions (i.e., PBI and IBI) as a better reflection of body valorations), and body satisfaction were also introduced to test their influences. All models included age and sex/gender as potential confounders. In each of the analyses, demographic variables were entered in step 1; BMI, desired weight change, and body satisfaction were entered in step 2; and the indicators of a healthy diet were entered in step 3. In all regression models, nonstandardized (*b*) and standardized beta ( $\beta$ ) regression coefficients, the latter as a measure of the effect sizes associated with the former regression coefficients, were calculated.

Indirect mediation analyses were conducted to explore in depth the relationships indicated by the abovementioned analyses. Specifically, both simple and multiple mediation with mediators operating in serial were tested with Hayes' PROCESS SPSS macros (models 4 and 6, respectively) (Hayes, 2013). A 5000-sample bias-adjusted bootstrap procedure was performed to generate upper and lower 95% confidence intervals for indirect effect coefficients. Covariates (age, sex/gender, and BMI) did not affect the results and were removed from the final models for simplicity.

The significance level for all analyses was set at  $p<.05$ . Statistical analyses for the current study were conducted using SPSS 25.0 (SPSS Inc., Chicago, IL, USA, 2017).

### 3. Results

Table 1 shows the descriptive statistics and correlation results for BMI, body perceptions, desired body change, body satisfaction, healthy diet, and SWB indicators (happiness and life satisfaction).

**Table 1.** Descriptive results and correlations for the study variables and correlations between happiness and dietary components.

	M	SD	LS	HAP	FI	MI	SI	cFV	cFV+	cAN	cSU
BMI	28.76	3.57		-.22							
Perceived body image (PBI)	6.17	1.96									
Ideal body image (IBI)	8.29	1.85									
PBI-IBI discrepancy	-2.12	1.79									
Body satisfaction (BS)	4.73	1.41	.24	.44							
MedDiet (MD, MEDAS total)	7.18	2.09		.17							
Life satisfaction (LS)	3.88	1.09		.31	.25		.19	.26	.19		
Happiness (HAP)	7.46	1.79				.25	.21	.18		.23	.19

Healthy diet-related indicators: FI: fruit intake; MI: red meat intake; SI: sugar-enriched or carbonated drinks intake; cFV: composed score of FV intake; cFV+: composed score of fruit, vegetables, legumes, nuts, and sofrito intake; cAN: composed score of animal-based proteins and fats; cSU: composed score of sugar intake. Nonitalic letter:  $p<.05$ ; italic letter:  $p<.10$ .

Table 2 shows the frequencies of positive scores for each of the items in the MEDAS, the mean total score over 14 and the percentage of individuals in each of the adherence categories. Notably, only two in ten participants were considered to adhere to the healthy eating pattern of the MedDiet. A total of six out of the 14 items of the questionnaire were positively scored by more than half of the sample; these were mostly related to the use of olive oil as the main culinary fat (items 1, 2, and 14; almost all of the participants) and the

consumption of nuts (9 in ten of the participants), legumes (2/3 of the participants), and seafood (1/2 of participants). In contrast, approximately 1/3 of the participants ate at least two servings of vegetables or three fruit units per day, and the majority of the sample (7-8 of ten) reported an intake above the recommendations in terms of red meat, fats, and sugar-added drinks and foods.

**Table 2.** Response frequencies to the Mediterranean Diet Adherence Screener (MEDAS).

	Positive Scores
<b>MEDAS items</b>	<b>N %</b>
Use of olive oil as main culinary fat	91
Consumption of $\geq 2$ tablespoons of olive oil per day <sup>a</sup> (including all fresh and cooked meals)	93
Consumption of $\geq 2$ servings (200 g <sup>b</sup> ) of vegetables per day (at least 1 in salad or fresh; garnish or accompaniments, 100 g)	39
Consumption of $\geq 3$ fruit units per day (including fruit juices)	35
Consumption of $< 1$ serving (100–150 g) of red meat or meat products (hamburger, ham, sausage, etc.) per day	20
Consumption of $< 1$ serving (12 g) of butter, margarine, or cream per day	17
Consumption of $< 1$ sweet and/or carbonated beverages per day	28
Consumption of $\geq 3$ glasses of wine per week <sup>a</sup>	16
Consumption of $\geq 3$ servings (150 g) of legumes per week	66
Consumption of $\geq 3$ servings (100–150 g of fish, or 4–5 units or 200 g of shellfish) per week	51
Consumption of $< 3$ commercial (not homemade) sweets or pastries	34
Consumption of $\geq 1$ serving (30 g) of nuts per week <sup>a</sup>	91
Preference for consumption of chicken, turkey, or rabbit meat (100–150 g/serving) instead of red meat, pork, or processed meat	39
Consumption of $\geq 2$ times of vegetables, pasta, rice, or other dishes seasoned with "sofrito"	98
<b>Global MEDAS score</b>	<b>M<math>\pm</math>SD</b>
	7.18 $\pm$ 2.09
<b>Categories of adherence</b>	<b>N %</b>
Low	78
High	22

Note. <sup>a</sup> Modified by the SEEDO. <sup>b</sup> Grams are indicated for each portion, serving, or piece.

We used hierarchical multiple regression to examine the effect of adherence to the MedDiet eating pattern along with BMI, desired weight change, and body satisfaction on SWB indicators while controlling for confounders. When the MEDAS total score, adherence category or each of the MEDAS items were introduced as predictors, only body satisfaction emerged as a significant predictor (for happiness,  $\beta$ s ranged from .43 to .46,  $p= .000$ ; for life satisfaction, a constant  $\beta$  of .24 was obtained,  $p< .05$ ; detailed results available upon request).

In contrast, the combination of nutrients emerged as a significant predictor. Table 3 shows the main findings. For the regression model involving happiness (upper panel), demographic variables accounted for 1% of the variance in step 1, and neither sex/gender nor age significantly contributed to the explained variance (corr.  $R^2=.01$ ,  $F=.490$ ,  $p=.614$ ); in the second step, age, sex/gender, BMI, and PBI-IBI were not significant independent

predictors, and only body satisfaction emerged as a significant predictor ( $\beta=.46$ ,  $p=.000$ ), accounting for 17% of the variance (corr.  $R^2=.17$ ,  $F=5.000$ ,  $p=.000$ ). In step 3, when all the diet-related composite scores were also introduced, only body satisfaction remained a significant predictor ( $\beta=.44$ ,  $p=.000$ ), accounting for 17% of the variance (corr.  $R^2=.17$ ,  $F=3.512$ ,  $p=.001$ ). Hence, as body satisfaction increases, independent of other factors, individuals are more likely to report being happy, and healthy diet indicators did not contribute to such a relationship.

For the regression model involving life satisfaction (Table 3, lower panel), demographic variables accounted for less than 1% of the variance in step 1, and neither sex/gender nor age significantly contributed to the explained variance (corr.  $R^2=.009$ ,  $F=1.442$ ,  $p=.241$ ); in the second step, age, sex/gender, BMI, and PBI-IBI were not significant independent predictors, and only body satisfaction emerged as a significant predictor ( $\beta=.24$ ,  $p<.05$ ), accounting for 4% of the variance (corr.  $R^2=.036$ ,  $F=1.737$ ,  $p=.134$ ). In step 3, when all the diet-related composite scores were introduced, FV intake ( $\beta=.29$ ,  $p<.01$ ) and body satisfaction ( $\beta=.23$ ,  $p<.05$ ) emerged as independent predictors, accounting for 9% of the variance (corr.  $R^2=.085$ ,  $F=2.146$ ,  $p<.05$ ). Hence, as both FV consumption and body satisfaction increase, individuals are more likely to report being satisfied with their lives independently of other factors; no other healthy diet indicator contributed to such a relationship.

When the compound variable of vegetables + fruits + legumes + nuts + sofrito was used instead of the composite relative to FV intake, similar findings were obtained. Specifically,  $\beta$ s were .24,  $p<.05$  for body satisfaction and .21,  $p<.05$  for the diet indicator for life satisfaction ( $\beta=.44$ ,  $p=.000$ , and  $\beta=.05$ ,  $p>.05$ , respectively, for happiness), thus indicating that the main contribution of plant-based foods was due to FV (detailed results available upon request).

**Table 3.** Hierarchical multiple regression of happiness (up) and life satisfaction (down) on sociodemographics, weight status, body perceptions and satisfaction, and MedDiet indicators (final model).

Happiness	Stand.	Stand.	t	p
	Beta	Error		
Age	-.05	.016	-.474	.636
Sex/gender	-.06	.381	-.567	.572
BMI kg/m2	-.01	.056	-.042	.967
PBI-IBI	-.02	.099	-.220	.826
Body satisfaction	.44	.139	4.011	.000**
Fruit & Vegetables (items 3 & 4)	.13	.240	1.289	.201
Sugar (items 7 & 11)	.01	.281	.125	.901
Animal-based Proteins & Fats (items 5, 10, & 13)	.06	.219	.565	.574
Life satisfaction	Stand.	Stand.	t	p
	Beta	Error		
Age	-.16	.011	-1.517	.133
Sex/gender	.01	.244	.049	.961
BMI kg/m2	.03	.036	.237	.813
PBI-IBI	.05	.064	.502	.617
Body satisfaction	.23	.089	2.034	.045*
Fruit & Vegetables (items 3 & 4)	.29	.154	2.687	.009**
Sugar (items 7 & 11)	.06	.180	.523	.602

Animal-based Proteins & Fats (items 5, 10, & 13)	-.13	.140	-1.080	.283
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Note. Standard errors were robust to heteroskedasticity. \*  $p<.05$ , \*\*  $p<.01$

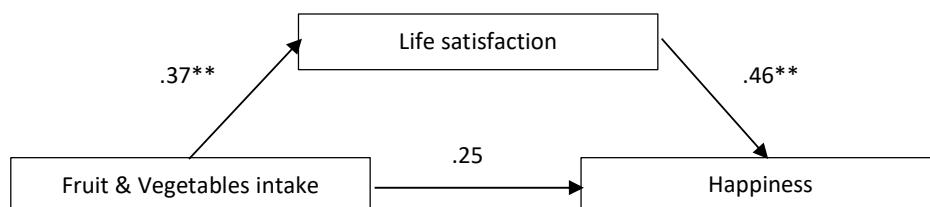
Given the previous results, we expected to find that life satisfaction, as the cognitive component of SWB (Diener et al., 1999), was predicted by healthy eating and in turn predicted happiness. We tested this hypothesis with a mediation analysis (PROCESS model 4) where FV intake was the predictor, life satisfaction was the mediator, and happiness was the predicted variable. Such a mediation effect was confirmed (see Figure 1). FV consumption explained happiness through the full mediation of life satisfaction. Table 4 displays the findings. We tentatively tested the role of body satisfaction in such a relationship. Thus, body satisfaction was proposed as mediator 1, transmitting its effects to life satisfaction as mediator 2 –both being predicted by FV intake– which in turn influenced happiness. However, no mediation effect was supported by the findings (results available upon request). This latter finding excludes body satisfaction as a possible intervening variable in the relationship between FV intake, life satisfaction, and happiness.

**Table 4.** Indirect mediational effects.

Path	Coeff.	SE	t, p	LLCI - ULCI
FV intake $\rightarrow$ Life satisfaction ( $R^2=.07$ ; $F=7.169$ , $p=.009$ )	.37	.147	2.677, .009**	.096 - .643
Life satisfaction $\rightarrow$ Happiness ( $R^2=.11$ ; $F=5.854$ , $p=.004$ )	.46	.163	2.850, .005**	.141 - .788
FV intake $\rightarrow$ Happiness	.25	.231	1.084, .281	-.208 - .707
Indirect effect	<b>Coeff.</b>	<b>Boot SE</b>		
	.17	.091		.040 - .411

LLCI: Lower limit 95% confidence interval; ULCI: Upper limit 95% confidence interval; \*\*  $p<.01$

**Figure 1.** Mediational effect of life satisfaction in the relationship between FV intake and happiness.



#### 4. Discussion

The literature on SWB has largely ignored the substantial influence of diet-related factors until very recently, and research specifically with individuals with excessive weight is completely lacking. In the present study, we explored predictors of happiness, including BMI, body image perceptual and evaluative-subjective dimensions, and healthy diet, in adults with overweight or obesity. This study contributes to the evidence linking the MedDiet, particularly FV consumption, to higher levels of well-being, such as positive mood, happiness, psychological well-being, and flourishing (e.g., Godoy-Izquierdo et al., in press; Veenhoven, 2019), underscoring the relationship between lifestyle and well-being by showing a positive association between FV consumption and SWB. With a focus shifted towards a more positive and well-being-centered perspective on eating behavior, the present study contributes to the literature by exploring such a link in individuals with excessive weight.

Our findings are parallel to other reports on SWB in Spanish adults with excess weight, which are lower than that reported for adults in all-range weight (e.g., Godoy-Izquierdo et al., 2020; Moreno-Agostino et al., 2019).

Regarding the mean total score of the sample on the MEDAS, as expected, it was lower than that reported in studies with national samples of adults from Spain (García-Conesa et al., 2020; Martínez-González et al., 2012; Moreno-Agostino et al., 2019) and other Mediterranean nations (Andrade et al., 2020) not restricted to individuals with excessive weight. This result supports recent data suggesting that adherence to healthy eating is lower for the higher weight categories (Álvarez-Fernández et al., 2020; García-Conesa et al., 2020; Martínez-González et al., 2012). In terms of percentages of adherence, it has been reported that approximately 35% of the Spanish adult population shows high adherence (total score  $\geq 9$ ) to recommendations (Álvarez-Fernández et al., 2020; Martínez-González et al., 2012); in our study, supporting expectations, lower rates were observed, paralleling findings obtained with individuals with excessive weight and metabolic syndrome (Álvarez-Alvarez et al., 2019). Our findings stress the low proportion of individuals with overweight and obesity who fully adhere to the healthy dietary patterns of the MedDiet and, moreover, that individuals with excessive weight may show divergences that might largely contribute to their weight. For example, when rates of adherence to each of the items of the MEDAS are compared with those reported by others for population-based samples (e.g., Álvarez-Fernández et al., 2020; García-Conesa et al., 2020; Lahoz et al., 2018; Martínez-González et al., 2012; Moreno-Agostino et al., 2019), the participants in our study reported a lower consumption of basic foods such as fruits but considerably higher intakes of solid, animal-based fats and high-sugar foods (e.g., red meat and processed meats, butter, margarine, and creams, sugared drinks, sweets and pastries) and of healthy yet high caloric foods (e.g., olive oil, nuts, legumes, fish, and sofrito), probably at higher quantities than that recommended. The quantity, not only the quality, of foods plays an important role in weight status (de Ridder et al., 2017). It has been indicated that Spanish and other Mediterranean-based individuals are distancing from the MedDiet patterns, which is also associated with national increasing rates of excessive weight (Andrade et al., 2020; Benhannou et al., 2016; Denoth et al., 2016; García-Conesa et al., 2020; Gomez-Donoso et al., 2019; Lecube et al., 2020; Moreno-Agostino et al., 2019; Rodriguez-Rodríguez et al., 2017). Recent studies suggest that the percentage of individuals who report never consuming or consuming less than 5 servings per day of FV is significantly higher in those with obesity than in subjects with normal weight (Lecube et al., 2020; Rodriguez-Rodríguez et al., 2017). Our findings, compared to other samples with a wider range of weight categories, may also indicate that the dietary patterns of individuals with overweight and obesity are poorer and unhealthier than those of individuals with a healthier body weight.

It has been proposed that studying dietary patterns as a whole rather than single food components or nutrients better allows to assess the health effects of diet because it accounts for potentially cumulative effects and synergies between nutrients and foods and for possible dietary confounders; moreover, the effects of individual dietary factors may be too small to be detected. Posterior analyses of diet components can shed light on potential specific effects of some food groups or habits over others (de Ridder et al., 2017; Moreno-Agostino et al., 2019). We approached our aims by using both types of dietary indicators. However, no effects were found when the total score on the MEDAS or the categories of adherence to the MedDiet were used, and limited findings were established for categories of foods, as we discuss in depth below. Nevertheless, correlation analyses (Table 1) demonstrated that the SWB of individuals with excessive weight is significantly or marginally related not only to the intake of healthy nutrients such as FV but also to the consumption of unhealthy foods, such as animal-based proteins and fats, including red meat/processed meat products, and sugar-enriched foods such as carbonated drinks. This finding has also been confirmed with other samples (e.g., Blanchflower et al., 2013;

Conner et al., 2015; Moreno-Agostino et al., 2019; Veenhoven, 2019). This issue is something that future research should address.

The results of the regression models tested with each of the SWB endpoints as criterion variables and the MEDAS global score, categories of adherence, and each of the MEDAS items as independent variables did not reveal a significant relationship with any of the SWB indicators. Nevertheless, when we took into consideration the consumption of FV, we found that a higher intake of FV servings/day was related to higher life satisfaction. We could not demonstrate such an effect for happiness, with other researchers also finding discrepant results when several indicators of well-being were considered, including happiness (Andrade et al., 2020; Blanchflower et al., 2013; Conner et al., 2017; Moreno-Agostino et al., 2019). However, a mediated relationship was supported in which FV intake predicted happiness fully mediated by life satisfaction. Our findings support previous evidence, including in Spanish samples (e.g., Moreno-Agostino et al., 2019), linking FV intake to better SWB. The consumption of FV per day of at least 5 servings/units in total (MEDAS items 3 and 4) is considered one of the most relevant or common indicators of adherence to a healthy diet, since these foods are at the basis of the MedDiet pyramid (Aune et al., 2017; Onvani et al., 2017; Schwingshakl et al., 2017). Several tentative explanations for the unexpected results related to the happiness indicator and the two indicators of FV consumption considered include the following. It is possible that our results are due to insufficient consideration of the exact amount of FV servings per day; it has been stated that FV consumption and SWB indicators have a linear, dose-response relationship (Blanchflower et al., 2013; Conner et al., 2017; Mujcic & Oswald, 2016; Ocean et al., 2019; Warner et al., 2017) and that optimal intake is  $\geq 7\text{-}8$  servings per day (Blanchflower et al., 2013; Mujcic & Oswald, 2016; White et al., 2013), something that has also been postulated for physical and mental health outcomes (Oyebode et al., 2014), although others have indicated that minimal increments in consumption not reaching the "5-a-day" recommendation are also associated with substantial increases in happiness (Conner et al., 2017; Ocean et al., 2019) and overall health and quality of life (Lalji et al., 2018). Another possible explanation is that it has been demonstrated that raw compared to prepared FV is more associated with increments in SWB (Brookie et al., 2018; Wickham et al., 2020). Future research is needed to reach more consistent findings.

The contribution of third variables is another possible reason for our findings. In the association between FV intake and SWB among individuals with excess weight, our findings also confirmed the key role of body image dimensions added to the effects of diet-related indicators for overall well-being. Previous research has stressed the relevance of body image among individuals with excessive weight, with body dissatisfaction being higher with increasing BMI levels (Latner & Wilson, 2011; Silva et al., 2019; Weinberger et al., 2016). Most people with excess weight perceive themselves as so, even when they might not have completely accurate perceptions of their weight (Godoy-Izquierdo et al., 2019). A considerable number of persons, particularly females, with overweight and obesity have negative body self-perceptions and are dissatisfied with their bodies and wish they were thinner. Nevertheless, we further tested whether body satisfaction could have a mediating role in the relationship between dietary quality and SWB but could not confirm it. A review has also discarded a mediation effect by better health status (Veenhoven, 2019). Research testing possible mediation effects is urgently needed.

Our findings have theoretical and clinical utility, guiding both research and treatment. Although previous evidence suggests that happiness is lower among individuals with obesity, research on the correlates of SWB in this population is warranted to increase our knowledge. This study contributes to research on happiness and its correlates in obese individuals (Godoy-Izquierdo et al., 2020). While weight loss has been associated with some benefits in terms of mental health and psychological well-being (Jones et al., 2020), adhering to the MedDiet could become an ecological approach to improve the affective experience and life evaluation of the population, particularly individuals who are

overweight and obese, entailing benefits for and beyond happiness. Public policy programs to encourage healthy eating can stress that happiness gains from healthy eating may occur much more quickly than any long-distance improvement to people's physical health (Conner et al., 2015, 2017; Ford et al., 2013; McMillan et al., 2011; Mujcic & Oswald, 2016; White et al., 2013). Nevertheless, our understanding of the complexity and heterogeneity of obesity has to improve for a more successful prevention and management of obesity, and both well-being- and dieting-related factors should be monitored and targeted for their possible role in the causation and maintenance of overweight. Furthermore, whether these associations reflect a positive cause-effect reciprocal synergism remains to be established. If so, interventions aimed at promoting a healthier lifestyle may result in increasing well-being, and vice versa.

Despite the contributions of the present study, which included considering several dimensions of body perceptions, dietary habits, and two indicators of SWB in men and women with overweight and obesity, our conclusions should be interpreted in light of some limitations. First, the sample was limited in size and constituted a nonrandom sample of individuals with excessive weight, which restricts the generalizability of our findings. Thus, the findings need to be replicated with broader and more heterogeneous samples. Second, our study relied on self-report measures that may be susceptible to various errors and biases. For instance, the use of questionnaires to assess dietary patterns may introduce an overestimation of foods considered healthy and underestimation of foods considered nonhealthy. Further research using multimodal assessment is warranted. Furthermore, it has been suggested that both hedonic and eudemonic constructs of SWB should be included to best capture associations of psychological well-being with health, quality of life, and longevity, but we restricted our analyses to indicators of hedonic well-being.

Moreover, since age, sex/gender, socioeconomic status, and lifestyle factors might have an influence on dietary behaviors, body image dimensions, and well-being indicators but have usually been controlled for and not fully explored in the research to date on the associations between the MedDiet and SWB (Godoy-Izquierdo et al., *in press*; Veenhoven, 2019), future investigations should address their contribution to the link between healthy eating and happiness. Finally, due to the correlational and cross-sectional nature of the data, causal inferences cannot be stated. The utility of our findings may best be determined in future research testing the generalizability of the findings in other samples of individuals with overweight and obesity and, preferably, with experimental and longitudinal analyses (e.g., whether an intervention focused on increasing adherence to the MedDiet translates into higher happiness).

In conclusion, despite the limitations, our results are pioneering and interesting. In summary, this investigation provides initial evidence that FV intake, as the basis of the MedDiet, is associated with life satisfaction in adults with overweight and obesity when BMI and body image dimensions were considered. Moreover, life satisfaction fully mediated the relationship between FV consumption and happiness. Our findings highlight the relevance of addressing both positive body image and healthy eating habits in the management of obesity and for increasing happiness in this population. The current study also offers new directions for the study of well-being in obesity. Future research is required to investigate ways in which weight, body satisfaction, and dieting patterns may interact to affect functioning and well-being in individuals with excess weight and to explore how accumulated evidence may be used to inform health interventions for preventing and managing obesity in all its dimensions.

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## References

Alvarez-Alvarez, I., Toledo, E., Lecea, O., Salas-Salvadó, J., Corella, D., Buil-Cosiales, P., ... & Martínez-González, M. A. (2019). Adherence to a priori dietary indexes and baseline prevalence of cardiovascular risk factors in the PREDIMED-Plus randomised trial. *European Journal of Nutrition*, 59, 1219-1232. DOI: 10.1007/s00394-019-01982-x

Álvarez-Fernández, C., Romero-Saldaña, M., Álvarez-López, A., Molina-Luque, R., Molina-Recio, G., & Vaquero-Abellán, M. (2020). Adherence to the Mediterranean diet according to occupation-based social classifications and gender. *Archives of Environmental & Occupational Health*, 1-7. DOI: 10.1080/19338244.2020.1825210

Andrade, V., Jorge, R., García-Conesa, M. T., Philippou, E., Massaro, M., Chervenkov, M., ... & Pinto, P. (2020). Mediterranean diet adherence and subjective well-being in a sample of Portuguese adults. *Nutrients*, 12(12), 3837. DOI: 10.3390/nu12123837

Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N., Norat, T., ... & Tonstad, S. (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—A systematic review and dose-response meta-analysis of prospective studies. *International Journal of Epidemiology*, 46(3), 1029-1056. DOI: 10.1093/ije/dyw319

Benhammou, S., Heras-Gonzalez, L., Ibanez-Peinado, D., Barcelo, C., Hamdan, M., Rivas, A., ... & Monteagudo, C. (2016). Comparison of Mediterranean diet compliance between European and non-European populations in the Mediterranean basin. *Appetite*, 107, 521-526. DOI: 10.1016/j.appet.2016.08.117

Blanchflower, D. G., Oswald, A. J., & Stewart-Brown, S. (2013). Is psychological well-being linked to the consumption of fruit and vegetables? *Social Indicators Research*, 114(3), 785-801. DOI: 10.1007/s11205-012-0173-y

Blanchflower, D. G., Oswald, A. J., & van Landeghem, B. (2009). *Imitative obesity and relative utility*. Discussion Paper No. 4010. Bonn, Germany: Institut zur Zukunft der Arbeit.

Böckerman, P., Johansson, E., Saarni, S. I., & Saarni, S. E. (2014). The negative association of obesity with subjective well-being: is it all about health? *Journal of Happiness Studies*, 15(4), 857-867. DOI: 10.1007/s10902-013-9453-8

Brookie, K. L., Best, G. I., & Conner, T. S. (2018). Intake of raw fruits and vegetables is associated with better mental health than intake of processed fruits and vegetables. *Frontiers in Psychology*, 9, 487. DOI: 10.3389/fpsyg.2018.00487

Caprara, G., Alessandri, G., Eisenberg, N., Kupfer, A., Steca, P., Caprara, M., & Abela, J. (2012). The positivity Scale. *Psychological Assessment*, 24(3), 701-712. DOI: 10.1016/j.paid.2014.07.012

Cheung, F., & Lucas, R. (2014). Assessing the validity of single-item life satisfaction measures: Results from three large samples. *Quality of Life Research*, 23(10), 2809-2818. DOI: 10.1007/s11136-014-0726-4

Conner, T. S., Brookie, K. L., Carr, A. C., Mainvil, L. A., & Vissers, M. C. (2017). Let them eat fruit! The effect of fruit and vegetable consumption on psychological well-being in young adults: A randomized controlled trial. *PLoS One*, 12(2), e0171206. DOI: 10.1371/journal.pone.0171206

Conner, T. S., Brookie, K. L., Richardson, A. C., & Polak, M. A. (2015). On carrots and curiosity: eating fruit and vegetables is associated with greater flourishing in daily life. *British Journal of Health Psychology*, 20(2), 413-427. DOI: 10.1111/bjhp.12113

de Ridder, D., Kroese, F., Evers, C., Adriaanse, M., & Gillebaart, M. (2017). Healthy diet: Health impact, prevalence, correlates, and interventions. *Psychology & Health*, 32(8), 907-941. DOI: 10.1080/08870446.2017.1316849

Denoth, F., Scalese, M., Siciliano, V., Di Renzo, L., De Lorenzo, A., & Molinaro, S. (2016). Clustering eating habits: frequent consumption of different dietary patterns among the Italian general population in the association with obesity, physical activity, sociocultural characteristics and psychological factors. *Eating and Weight Disorders*, 21(2), 257-268. DOI: 10.1007/s40519-015-0225-9

Diener, E., Suh, E., Lucas, R., & Smith, H. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, 125(2), 276-302.

Ford, P. A., Jaceldo-Siegl, K., Lee, J. W., Youngberg, W., & Tonstad, S. (2013). Intake of Mediterranean foods associated with positive affect and low negative affect. *Journal of Psychosomatic Research*, 74(2), 142-148. DOI: 10.1016/j.jpsychores.2012.11.002

García-Conesa, M. T., Philippou, E., Pafilas, C., Massaro, M., Quarta, S., Andrade, V., ... & Pinto, P. (2020). Exploring the validity of the 14-item Mediterranean diet adherence screener (MEDAS): A cross-national study in seven European countries around the Mediterranean region. *Nutrients*, 12(10), 2960. DOI: 10.3390/nu12102960

Glabska, D., Guzek, D., Groele, B., & Gutkowska, K. (2020). Fruit and vegetable intake and mental health in adults: A systematic review. *Nutrients*, 12, 115. DOI: 10.3390/nu12010115

Godoy-Izquierdo, D., Gonzalez, J., Lara, R., Rodriguez-Tadeo, A., Ramirez, M. J., Navarrón, E., ... & Arbinaga, F. (2020). Considering BMI, body image and desired weight change for suitable obesity management options. *The Spanish Journal of Psychology*, 23, e35, 1-14. DOI: 10.1017/SJP.2020.36

Godoy-Izquierdo, D., González, J., Rodríguez, A., Ramírez, M., Navarrón, E., Lara, R., & Jiménez, M. (2019). «Oberexia»: The desire to be fat (ter) in adults with excess weight. *Cuadernos de Psicología del Deporte*, 19(2), 186-197. DOI: 10.6018/cpd.371781

Godoy-Izquierdo, D., González-Hernández, J., Rodríguez-Tadeo, A., Lara, R., Ogallar, A., Navarrón, E., ... & Arbinaga, F. (2020). Body satisfaction, weight stigma, positivity, and happiness among Spanish adults with overweight and obesity. *International Journal of Environmental Research and Public Health*, 17(12), 4186. DOI: 10.3390/ijerph17124186

Godoy-Izquierdo, D., Lara, R., Vázquez, M.L., Araque, F., & Godoy, J.F. (2012). Correlates of happiness among older Spanish institutionalised and non-institutionalised adults. *Journal of Happiness Studies*, 14(2), 389-414. DOI: 10.1007/s10902-012-9335-5

Gómez-Donoso, C., Martínez-González, M. A., Martínez, J. A., Sayón-Orea, C., de la Fuente-Arrillaga, C., & Bes-Rastrollo, M. (2019). Adherence to dietary guidelines for the Spanish population and risk of overweight/obesity in the SUN cohort. *PLoS One*, 14(12), e0226565. DOI: 10.1371/journal.pone.0226565

Green, M. A., Strong, M., Razak, F., Subramanian, S. V., Relton, C., & Bissell, P. (2015). Who are the obese? A cluster analysis exploring subgroups of the obese. *Journal of Public Health*, 38(2), 258-264. DOI: 10.1093/pubmed/fdv040

Grogan, S. (2017). *Body image: Understanding body dissatisfaction in men, women, and children* (3rd ed.). New York, NY: Routledge.

Hayes, A. F. (2013). *Methodology in the social sciences. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford.

Heikamp, T., Alessandri, G., Laguna, M., Petrovic, V., Caprara, M., & Trommsdorff, G. (2014). Cross-cultural validation of the Positivity Scale in five European countries. *Personality and Individual Differences*, 71, 140-145. DOI: 10.1016/j.paid.2014.07.012

Jansen, A., Havermans, R., Nederkoorn, C., & Roefs, A. (2008). Jolly fat or sad fat? Subtyping non-eating disordered overweight and obesity along an affect dimension. *Appetite*, 51, 635-640. DOI: 10.1016/j.appet.2008.05.055

Jones, R. A., Lawlor, E. R., Birch, J. M., Patel, M. I., Werneck, A. O., Hoare, E., ... & Ahern, A. L. (2020). The impact of adult behavioural weight management interventions on mental health: A systematic review and meta-analysis. *Obesity Reviews*, DOI: 10.1111/obr.13150

Katsaiti, M. S. (2010). *Obesity and happiness. SOEP papers on Multidisciplinary Panel Data Research*, No. 270 [Also published in Applied Economics (2012), 44, 4101-4114]. DOI: 10.2139/ssrn.1551192

Kuroki, M. (2016). Life satisfaction, overweightness and obesity. *International Journal of Wellbeing*, 6(2), 93-110. DOI: 10.5502/ijw.v6i2.519

Lahoz, C., Castillo, E., Mostaza, J. M., De Dios, O., Salinero-Fort, M. A., González-Alegre, T., ... & Garcés, C. (2018). Relationship of the adherence to a mediterranean diet and its main components with CRP levels in the Spanish population. *Nutrients*, 10(3), 379. DOI: 10.3390/nu10030379

Lalji, C., Pakrashi, D., & Smyth, R. (2018). Can eating five fruit and veg a day really keep the doctor away? *Economic Modelling*, 70, 320-330. DOI: 10.1016/j.econmod.2017.07.024

Latif, E. (2014). Obesity and happiness: does gender matter? *Economics & Business Letters*, 3(1), 59-67.

Latner, J., & Wilson, R. (2011). Obesity and body image in adulthood. In T. Cash, & L. Smolak (Eds.), *Body image: A handbook of science, practice, and prevention* (pp. 189-197). New York, NY: Guilford.

Lecube, A., Sanchez, E., Monereo, S., Medina-Gomez, G., Bellido, D., Garcia-Almeida, J. M., ... & Tinahones, F. J. (2020). Factors accounting for obesity and its perception among the adult Spanish population: Data from 1,000 computer-assisted telephone interviews. *Obesity Facts*, 13(4), 322-332. DOI: 10.1159/000508111

Martínez-González, M. A., García-Arellano, A., Toledo, E., Salas-Salvado, J., Buil-Cosiales, P., Corella, D., ... & Gómez-Gracia, E. (2012). A 14-item mediterranean diet assessment tool and obesity indexes among high-risk subjects: The predimed trial. *PLoS One*, 7, e43134. DOI: 10.1371/journal.pone.0043134

McMillan, L., Owen, L., Kras, M., & Scholey, A. (2011). Behavioural effects of a 10-day Mediterranean diet. Results from a pilot study evaluating mood and cognitive performance. *Appetite*, 56, 143-147. DOI: 10.1016/j.appet.2010.11.149

Molendijk, M., Molero, P., Sánchez-Pedreño, F. O., Van der Does, W., & Martínez-González, M. A. (2018). Diet quality and depression risk: a systematic review and dose-response meta-analysis of prospective studies. *Journal of Affective Disorders*, 226, 346-354. DOI: 10.1016/j.jad.2017.09.022

Moreno-Agostino, D., Caballero, F. F., Martín-María, N., Tyrovolas, S., López-García, P., Rodríguez-Artalejo, F., ... & Miret, M. (2019). Mediterranean diet and wellbeing: evidence from a nationwide survey. *Psychology & Health*, 34(3), 321-335. DOI: 10.1080/08870446.2018.1525492

Mujcic, R., & Oswald, A. J. (2016). Evolution of well-being and happiness after increases in consumption of fruit and vegetables. *American Journal of Public Health*, 106, 1504-1510. DOI: 10.2105/AJPH.2016.303260

Ocean, N., Howley, P., & Ensor, J. (2019). Lettuce be happy: A longitudinal UK study on the relationship between fruit and vegetable consumption and well-being. *Social Science & Medicine*, 222, 335-345. DOI: 10.1016/j.socscimed.2018.12.017

Onvani, S., Haghishatdoost, F., Surkan, P. J., Larijani, B., & Azadbakht, L. (2017). Adherence to the Healthy Eating Index and Alternative Healthy Eating Index dietary patterns and mortality from all causes, cardiovascular disease and cancer: A meta-analysis of observational studies. *Journal of Human Nutrition and Dietetics*, 30(2), 216-226. DOI: 10.1111/jhn.12415

Oswald, A., & Powdthavee, N. (2007). *Obesity, unhappiness, and the challenge of affluence: Theory and evidence*. IZA Discussion Paper No. 2717.

Oyebode, O., Gordon-Dseagu, V., Walker, A., & Mindell, J. S. (2014). Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data. *Journal of Epidemiology and Community Health*, 68(9), 856-862. DOI: 10.1136/jech-2013-203500

Robertson, S., Davies, M., & Winefield, H. (2015). Why weight for happiness? Correlates of BMI and SWB in Australia. *Obesity Research & Clinical Practice*, 9(6), 609-612. DOI: 10.1016/j.orcp.2015.04.011

Rodriguez-Rodriguez, E., Aparicio, A., Aranceta-Bartrina, J., Gil, A., Gonzalez-Gross, M., Serra-Majem, L., ... & Ortega, R. M. (2017). Low adherence to dietary guidelines in Spain, especially in the overweight/obese population: The ANIBES Study. *Journal of the American College of Nutrition*, 36(4), 240-247. DOI: 10.1080/07315724.2016.1248246

Rooney, C., McKinley, M. C., & Woodside, J. V. (2013). The potential role of fruit and vegetables in aspects of psychological well-being: a review of the literature and future directions. *Proceedings of the Nutrition Society*, 72, 420-432. DOI: 10.1017/S0029665113003388

Schröder, H., Fitó, M., Estruch, R., Martínez-González, M. A., Corella, D., Salas-Salvadó, J., ... & Covas, M. I. (2011). A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. *Journal of Nutrition*, 141, 1140-1145. DOI: 10.3945/jn.110.135566

Schwingshackl, L., Schwedhelm, C., Hoffmann, G., Lampousi, A. M., Knüppel, S., Iqbal, K., ... & Boeing, H. (2017). Food groups and risk of all-cause mortality: A systematic review and meta-analysis of prospective studies. *American Journal of Clinical Nutrition*, 105(6), 1462-1473. DOI: 10.3945/ajcn.117.153148

Silva, D., Ferriani, L., & Viana, M. (2019). Depression, anthropometric parameters, and body image in adults: a systematic review. *Revista da Associação Médica Brasileira*, 65(5), 731-738. DOI: 10.1590/1806-9282.65.5.731

Tuck, N. J., Farrow, C., & Thomas, J. M. (2019). Assessing the effects of vegetable consumption on the psychological health of healthy adults: a systematic review of prospective research. *American Journal of Clinical Nutrition*, 110, 196-211. DOI: 10.1093/ajcn/nqz080

Ul-Haq, Z., Mackay, D., Martin, D., Smith, D., Gill, J., Nicholl, B., ... & Gallacher, J. (2014). Heaviness, health and happiness: a cross-sectional study of 163066 UK Biobank participants. *Journal of Epidemiology and Community Health*, 68(4), 340-348. DOI: 10.1136/jech-2013-203077