Emotional symptoms and dietary patterns in early adolescence.

A school-based follow-up study

Research Article

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Abstract

Objective: To examine the relationship between early emotional symptoms and dietary patterns over three years in a school-based sample.

Design: Three-year longitudinal prospective study.

Setting: Thirteen schools of Reus (Spain).

Participants: From a sample of five hundred and sixty two pre-adolescents with and without emotional symptoms, one hundred and sixty-five adolescents were followed up and were classified as showing emotional symptoms (n=100) or without emotional symptoms (n=65).

Main Outcome Measure: Emotional symptoms were assessed at baseline, after one year and after three years. In the third year, data were collected on food consumption, Mediterranean diet (MD) adherence and physical activity.

Analysis: Dietary patterns were created by principal component analysis. Multivariate logistic regression with $p<.05$ considered significant.

Results: Girls with emotional symptoms scored significantly lower in the MD (5.41±2.19 score) and physical activity assessments (4.97±2.05 score) than the group without emotional symptoms (MD: 6.19±1.67 score; physical activity: 5.86±1.94 score). Approximately 39.68% of girls with emotional symptoms showed high adherence to a sweet and fatty food (SFF) pattern. After adjusted logistic regression, girls with emotional symptoms were four times as likely to have a high adherence to an SFF pattern (OR: 4.79, 95%CI (1.55-15.10). No differences were observed among boys.

Conclusion: Girls with emotional symptoms during early adolescence present a high adherence to a pattern rich in sweet and fat foods, low adherence to MD and engage in low levels of physical activity. These findings highlight the importance of managing emotional distress to prevent it from having a negative effect on eating behaviour.

(251 words)

Keyword: emotional symptoms, dietary pattern, adolescent, longitudinal study.

INTRODUCTION

Adolescence is a critical period of biological, psychological and social changes. These changes may make adolescents more vulnerable to suffering mental health problems. Around 47% of children and adolescents present emotional problems[1], with anxiety disorders the most prevalent condition (31.4%), followed in by mood disorders (14.3%)[2]. These emotional problems may also be accompanied by predictors for overweight or obesity[3], which has sharply increased in prevalence around the world in recent decades[4].

Cross-sectional studies in children and adolescents have mainly shown stress to be associated with high levels of sweet and fatty food[5,6] as well as lower intakes of healthy food[7,8]. However, although emotional symptoms have been considered a chronic stressor, epidemiological studies assessing the relationship between emotional symptoms and food consumption in children and adolescents have shown inconsistent results[5,6,9,10]. This relationship has been confirmed in adults and some studies have shown differences between genders [11,12].

Children and adolescents may learn to deal with their emotional problems by using unhealthy food [13–15]. Over time, this behavior may establish a habitual dietary pattern which could increase their consumption of unhealthy food. Investigating dietary patterns has important public health implications because they provide an overall overview of diet and are modifiable. Research on the relationship between emotions and dietary patterns from a longitudinal perspective could therefore be extremely useful for designing alternative non-diet, preventive and treatment obesity programs[16]. As far as we know, no similar prospective population-based studies on the relationship between emotional disorders and overall dietary patterns have been conducted on adolescents from southern European countries with similar eating habits and lifestyle.

The present study thus aims to fill this research gap by investigating the prospective relationship, according to gender, between emotional symptoms and dietary patterns in a school-based sample

followed for 3 years in early adolescence. According to the hypothesis, adolescents with emotional symptoms will have an unhealthy dietary pattern based on sweets and fat, and this relationship is stronger among girls than boys.

METHODS

Study design and participants

A total of 165 subjects (106 girls and 59 boys; mean age=13.46 SD=0.92) participated in the three-year follow-up study and provided completed data on their food consumption. The subjects were recruited from a three-phase epidemiological study of depression and anxiety disorders. Figure 1 shows an overview of the sample and the study design. In this study, a representative sample from thirteen primary schools (7 state schools and 6 state-subsidized private schools) was randomly chosen from five representative areas of the city[1]. In the first phase, 1,514 children (794 girls and 720 boys) with a mean age of 10.23 (SD=1.23) participated. Screening questionnaires for anxiety and depression were administered to select a sample at risk of emotional problems and a risk-free control sample (group without emotional symptoms). In the first phase, 47% showed anxiety symptoms and 11.5% showed depressive symptoms; moreover, 20% of them showed both symptoms[1]. The group without emotional symptoms was selected randomly, chosen from those without risk of emotional problems, matching for age, gender and type of school. In the second phase, 562 children participated, of which 405 were at risk of an emotional disorder and 157 were without emotional symptoms. At the follow-up phase, three years after the baseline, all second-phase subjects were invited to participate and 242 subjects (mean age was 13.52, SD =0.94) agreed to participate. The participation rate in the 3rd phase was 43%. 77 subjects were deleted from the analysis because they provided incomplete food consumption data. Finally, complete food consumption data were obtained for 165 schoolchildren. This final sample was classified into two groups according to the presence of emotional symptoms: 1) the group without emotional

symptoms; those scoring below the cut-off for anxiety and depression questionnaires in all three phases (n=65); 2) the emotional symptoms group; those with a score equal to or above the cut-off for anxiety and/or depression questionnaires in any of the three phases (n=100).

Procedure

The project was approved by the ethics committee for research on individuals. Subsequently, the schools' boards of governors accepted to participate. The parents provided written informed consent in the baseline and follow-up phases. Adolescents were asked to participate in the third phase.

The study was conducted in three phases. In the first phase, emotional symptoms and anthropometric and socio-demographic data were recorded. One year later, in the second phase, subjects at risk of emotional symptoms and subjects from the group without risk were reassessed. In the third phase, subjects who agreed to participate completed self-reported questionnaires on depression, anxiety and eating disorders symptoms, a dietary quality-Mediterranean Diet questionnaire, a physical activity questionnaire and provided anthropometric parameters. Parents and their children filled in self-administered questionnaires about the children's food consumption using a validated food frequency questionnaire.

Instruments and Measures

Emotional symptoms: assessment of depressive and anxiety symptoms

Screen for Childhood Anxiety and Related Emotional Disorders (SCARED)[17]. This is a 41-item questionnaire to screen for anxiety symptoms in children and adolescents. The validated Spanish version[18] was used, which has good levels of reliability (overall Cronbach's alpha of .86). Although the cut-off score for detecting anxiety symptoms was 25[17,19], in this study a score of 32 (sensitivity

of 53.3% and specificity of 88.8%) was used to obtain a group of adolescents with more severe anxiety. The SCARED was administered in three phases.

Children's Depression Inventory (CDI)[20]. This is a 27-item questionnaire for assessing depression in children and adolescents aged 7–17 years old. The Spanish version has good internal consistency and good test–retest reliability (Cronbach's alpha between .70 and .94). A score of 17 as the cut-off point for depressive symptoms[21] was used. The CDI was administered in the first and second phase.

Youth's Inventory-4 (YI-4)[22]. This is a 120-item self-report rating scale that assesses emotional and behavior disorders in adolescents aged 12 to 18 years old. In this study, internal consistency of YI-4 was satisfactory (α=.95). The depression category included symptoms of major depression and/or dysthymia. The YI-4 was administered in the third phase.

Dietary intake data assessment

Food Frequency Questionnaire[23]. This is a semi-quantitative food frequency questionnaire validated previously in the adult and adolescent population of Reus. This questionnaire contains 45 food groupings which ask about the usual frequency of consumption per week or per month for food and beverages. The frequency categories were converted to a consumption frequency per day. The size and weight of serving portions were standardized, grams per day were calculated for each item and daily energy intake was estimated using the French Regal food composition table[24].

Other variables

Krece plus food questionnaire[25]. This assessed the extent to which the diet corresponded to the Mediterranean Diet (MD), which is considered nutritionally adequate. The questionnaire was developed and validated in the EnKid study by Serra et al. (2003)[26]. It consists of 16 items. Each item has a score of 1 or -1 and the total score for the questionnaire ranges from -5 to 11. The higher the score, the more closely the respondent's diet matched the MD.

Krece Plus short physical activity test[27]. This was also developed and validated in the EnKid study by Serra et al. (2003)[26]. This questionnaire consists of two questions. The first question asks how many hours per week they spent on extracurricular physical activities and the second questions asks how many hours per day they spent on watching television and playing videogames. Each question has six responses, with a score from 0 to 5. The total score for the questionnaire ranges from 0 to 10.

Anthropometry. Weight and height were measured with participants in light clothing, barefoot and without heavy objects in pockets. Weight was measured using the Tanita® TBF-300 scale, which has an accuracy of 100 g and a maximum weight of 200 kg. Height was measured to the nearest ± 1 mm using an inextensible tape measure. The body mass index (BMI, kg/m^2) was then calculated and standardized (BMI z-score), adjusting for age and gender using data obtained for the Spanish population[28].

Eating Disorder Inventory-2 (EDI-2)[29]. This is a 91-item self-report measure of the cognitive and behavioral characteristics associated with anorexia nervosa and bulimia nervosa. The validated Spanish version[30] was used. In this study the internal consistency was α=.80. This was administered in the third phase.

Socio-economic status. The socio-economic level was calculated by Hollingshead index[31] according to the parents' professions and education.

Statistical Analysis

Statistical analysis was performed using SPSS 22.0 software. The results were expressed as means and standard deviations for the quantitative variables, and as percentages for the qualitative variables. Compliance with the statistical tests' conditions of use was verified. Either the chi-square test or the Student *t*- test were used depending on the types of variables compared. To test the relationship between emotional symptoms and dietary patterns, multiple logistic regression analysis was applied and adjusted for potential confounders (age, socioeconomic level, BMI, eating disorder symptoms, physical activity and energy intake). These confounding factors were selected from factors that, according to the literature, may influence dietary intake. The following are particularly prominent: age[32], socio-demographic status[33], physical activity[34], eating disorder symptoms[35], BMI[34]. Analyses were run separately for gender. For all analyses, the level of statistical significance was a p value <.05.

Principal Component Analysis was used to identify dietary pattern and followed similar parameters to those used in other studies[36,37]. Dietary patterns based on factor analysis were used in several settings and provided a description of habitual food intake and eating patterns[34,38]. First, the 45 items in the food frequency questionnaire were grouped into 19 food groups (Supplementary Table). A factor analysis was conducted to assess the main dietary patterns. The patterns were rotated by orthogonal transformation (varimax rotation) to retain uncorrelated factors and improve factor interpretation. The factors to be extracted were those with an eigenvalue over 1, and the factors to be retained were confirmed using the screen plot. The screen plot consists of plotting the extracted factors against their eigenvalues to identify distinct inflexion points in the slope of the plot. To determine where the inflexion point appears, a straight line is drawn through the lower eigenvalues. The point where the factors curve above the line identifies the number of factors to be extracted. In the analysis, seven factors showed an eigenvalue over 1 and the factors were reduced to three factors by means of the screen plot (figure 2). As a result, three independent factors (or dietary patterns) were identified. The factor loading matrix was used to extract the factor loading for

each food group of these three factors. The food groups with a factor load of 0.30 or more were considered as major contributors to the dietary patterns. If any food group showed a factor loading set at 0.30 or greater in two patterns, the higher factor loading would be selected. The dietary patterns were labelled according to the factor loading (table 2). These variables were calculated as linear combinations of the standardized intake of the nineteen food groups weighted by their factor score coefficients. These coefficients were generated automatically by the statistical software. By means of this method, all adolescents received a score for the three dietary patterns measured on the z-score scale. The score indicated adherence to those dietary patterns. The dietary pattern scores were categorized into tertiles. Tertile 1 was low adherence (the lowest score), tertile 2 was medium adherence and tertile 3 was high adherence (the highest score) to each dietary pattern.

RESULTS

Description of Participants

Of the 165 participants, 64.24% were girls and 35.76% were boys. Among the girls, 40.57% were in the group without emotional symptoms and 59.43% presented some emotional symptoms. Likewise, 37.29% of the boys were in the group without emotional symptoms and 62.71% presented some emotional symptoms. There were no significant differences by gender (p=.744).

Table 1 presents the socioeconomic, anthropometric, lifestyle, and psychological characteristics of the study participants in relation to the presence of emotional symptoms. No significant differences were observed in socioeconomic and anthropometric variables for either girls or boys. However, an independent-samples t-test indicated that girls with emotional symptoms showed higher eating disorder symptom scores than those in the group without emotional symptoms (p=.004). In relation to lifestyle, the comparative analyses generated by independent-samples t-test showed that the MD score (p=.042) and physical activity (p=.028) score were significantly lower in girls with emotional

symptoms than in the group without emotional symptoms. In contrast to the girls, the MD score was not significantly different between boys with or without emotional symptoms.

Dietary Patterns

The three dietary patterns were identified by principal components analysis (table 2), which explained 37.89% of the total variance. For each of the three dietary patterns, the food groups with a factor loading set at 0.3 or greater were considered important contributors to each pattern. The first dietary pattern was labeled "sweet and fatty food (SFF) pattern". This pattern is characterized by a high consumption of sweets (0.751), soft drinks (0.675), sweet dairy products (0.627), baked goods and chocolates (0.623) and savory snacks (0.577). The second dietary pattern was labeled as a typical "western pattern" because it is characterized by high consumption of meat and cold meat (0.332), starchy foods (0.790) and potatoes (0.724). The third dietary pattern was identified as a "healthy pattern" since it includes fruit (0.543), beans (0.773), vegetables (0.507), fish and seafood (0.381). In addition, the healthy dietary pattern showed a significant moderate correlation with MD adherence (Pearson's r=.302, p=.002).

A chi-square test of independence was performed to examine the association between emotional symptoms and adherence to each dietary pattern (categorized in tertiles) (table 3). Approximately 39.68% of girls with emotional symptoms had a significantly high adherence to the sweet and fatty pattern, in contrast to 18.60% of girls without emotional symptoms (p=.048). However, there were no significant differences in the western and healthy pattern. No significant differences were found among boys.

Multivariable analyses to predict the effect of emotional symptoms on the SFF pattern were conducted using adjusted logistic regression (table 4). The results suggest that the group of girls with emotional symptoms was four times more likely to have an SFF pattern (OR: 4.79, 95%CI (1.55-15.10,)) than the group without emotional symptoms. Additionally, age (OR: 2.31, 95%CI

(1.26-2.42)) and SES (OR: 0.16, 95%CI (0.03-0.78)) were associated with high adherence to an SFF pattern. In boys, high physical activity was inversely related to adherence to the SFF pattern (OR: 0.65, 95%CI (0.45-0.94)).

DISCUSSION

This longitudinal school-based study assessed how emotional symptoms may be associated with dietary patterns during a 3-year-follow-up in Spanish Mediterranean adolescents. As far as we know, this is the first such study carried out in southern European countries. The study suggests that, mainly in girls, emotional symptoms in early adolescence could be associated with unhealthy lifestyle behaviors in terms of dietary patterns and sedentary behavior, and this relationship could be different between genders. Girls with emotional symptoms during early adolescence showed a low MD adherence and presented a high adherence to unhealthy dietary patterns that are rich in sweet and fatty foods and low levels of physical activity; however, no association was observed in boys.

This study identified three habitual dietary patterns in adolescents by means of a sophisticated statistical analysis similar to those used in other studies[34,36]. In addition, a quick test was used to obtain descriptive information on lifestyle, diet quality related to MD and the level of physical activity. The findings showed that girls suffering from emotional symptoms had low adherence to the MD and acquired a dietary pattern rich in sweet and fatty food. Indeed, almost 40% of girls with emotional symptoms present a high adherence to an SFF pattern, and the relation remained significant when the regression model was adjusted for potential confounding factors.

These findings are consistent with the literature on the relation between stress and food choices. Several authors have shown a moderate association between high stress levels and higher sweet

273 food intake[6,8,39]. In terms of emotional symptoms, a recent population-based study of young
274 university students in the United Kingdom showed that depressive symptom scores were associated
275 with a high consumption of unhealthy foods (sweets, cookies, snacks, fast food) and a low
276 consumption of healthy foods (fresh fruits, salad, cooked vegetables)[13]. Moreover, depression was
277 associated with poor diet quality in Australian adolescents[14]. Elsewhere, in other school-based
278 adolescent samples, the consumption of snacks, sweets and fast food was not associated with
279 emotional symptoms[9,10,40]. It is possible that the emotional symptoms were related to eating
280 disorders, which occur more often during adolescence and can lead a decline in food consumption[35].
281 Although the results showed that girls with emotional symptoms scored higher for the eating
282 disorder symptoms questionnaire, the relationship between emotional symptoms and sweet and fatty
283 dietary patterns remains significant. Therefore this relationship could be caused by a stress
284 mechanism regardless of the presence of eating disorders. It was therefore proposed that stress
285 would stimulate appetite and that it would increase the preference for sweet food[41]. These palatable
286 foods may be used for emotional relief and be a form of maladaptive emotional regulation because
287 they may reduce the stress response via the hypothalamic-pituitary-adrenal axis and increase
288 serotonin availability[3]. This stress mechanism occurs independently of the eating disorder, although
289 eating disorders could be associated or appear as a consequence. Over time, the pattern rich in
290 palatable food may develop into the individual's usual way of coping with emotional symptoms[3]
291 and become a habitual dietary pattern in the future. Such increases of sweet and fatty food
292 consumption would be expected to lead to excessive weight and fat gain. Furthermore, according to
293 several authors, a bidirectional relationship could exist because dietary patterns with lower
294 consumption of fish, olive oil, nuts and vegetables have also been associated with an increase in
295 mental disorders[42,43].
296

297 In contrast to girls, no differences related to dietary patterns were found between adolescent boys
298 with or without emotional symptoms. Indeed, laboratory studies in adults observed that men tend to
299 choose meal-related food during negative feeling[44]. This may partly explain the differences in food
300 preferences between girls and boys with emotional symptoms. The differences between genders and
301 the mechanisms involved are not sufficiently clear and more research is needed. In addition, the
302 present results should be interpreted with caution due to the small size of the sample.
303
304 The results also showed that emotional symptoms are associated with reduced physical activity in a
305 manner that is especially significant in adolescent girls. Adolescents with emotional symptoms may
306 show more apathy, have less interest in doing exercise and spend more time on sedentary activities
307 such playing video games, surfing the internet and watching television[45]. The results did not support
308 this relationship in boys. This study only shows that boys engage in more physical activity and
309 adhere less to sweet and fatty dietary patterns. It is possible that boys tend to do more physical
310 exercise than girls and, as a result, boys may be more concerned with a healthy diet[46].
311
312 In addition, the results also found that age and SES were associated with an SFF pattern. As is
313 generally known, food consumption and eating patterns change with the age, especially from
314 childhood to adolescence[47]. While the eating habits of children are determined by parental influence
315 and home availability, adolescents usually acquire new eating habits characterized by snacks, fast
316 food and out-of-home patterns[34,47]. Similarly, the results of this study showed that an increase in age
317 was associated with an SFF pattern. It was found that high SES was a protective factor for high
318 adherence to an SFF pattern, as has also been concluded by other authors[32,33], who have suggested
319 that families with higher SES may have a better knowledge of healthy dietary habits and more
320 money to buy healthy food[33].
321

Strengths and limitations

The present study has several strengths and limitations. The first strong point is the longitudinal design of the study and the fact that the sample was provided from a school-based population of both genders. Moreover, estimating dietary pattern using principal component analysis also enables us to identify the diet that adolescents usually follow because this method provides a behavioral description of food intake and eating patterns[38]. Little use has been made of this method to study dietary pattern in relation to emotional disorders in children or adolescents. Moreover, additional analysis showed that a healthy dietary pattern was correlated to MD adherence; therefore, an MD test could be a quick screening tool to assess whether the diet of children in this region follow a nutritionally adequate diet as was indicated by other studies[26,48]. Nonetheless, this study also has certain limitations. One limitation is the follow-up rate and the small sample size. The preferred sample size in the group of girls for observing differences in the main variable (i.e. adherence to the SFF pattern) would be 39 subjects in group without emotional symptoms and 73 subjects in emotional symptoms group, given that the proportion of high adherence to an SFF pattern in the group without emotional symptoms is 0.189 and in the emotional symptoms group is 0.397, if, of course, we accept an alpha risk of 0.05 and beta risk less than 0.2, with a unilateral contrast and use the ARCSINUS approach. Therefore the results should be interpreted with caution and need to be confirmed by more studies. Another limitation is that the variables of dietary intake, physical activity and eating disorder were only assessed in the third phase. Therefore, it was not possible to examine changes to dietary patterns over the course of the study or whether dietary intake may have a potential role in predicting mental health problems in children.

IMPLICATIONS FOR RESEARCH AND PRACTICE

In summary, this study contribute to the literature on adolescents because it assessed habitual dietary patterns and physical activity in relation to emotional symptoms during early adolescence; both of

these factors are associated with the future development of weight gain and obesity. It is crucial to develop and establish healthy dietary habits during adolescence because good nutrition is essential for growth and development and has both short and long-term health benefits. Furthermore, given the increase in anxiety and depression in adolescence, any assessment of emotional symptoms should also bear in mind dietary intake and factors related to food choices. This study, combined with recent evidence,[16] suggests that interventions aimed at dealing with negative emotion and stress would be helpful in preventing unhealthy eating behaviors in childhood. In order to decrease weight gain and overweight among adolescents, it is vital to evaluate the effect of emotional symptoms on lifestyle so that appropriate interventions can be developed.

In conclusion, girls with emotional symptoms during early adolescence present a higher adherence to a dietary pattern rich in sweet and fat foods, low MD adherence and engage in low levels of physical activity. No differences were found among adolescent boys. This suggests that unhealthy eating as a means of dealing with emotional symptoms could develop into a habitual lifestyle pattern and may lead to weight gain and obesity in the future. These findings may contribute to obesity and obesity-related disease prevention programs because they also highlight that adequately managing negative emotions could improve eating habits. More prospective research is needed to confirm these results.

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CAPTIONS

Figure 1. Description of sample and design of study and main variables

Figure 2. Screen plot of eigenvalues plotted against their factors to identify the number of factors to be extracted

Table 1. Description of the main socioeconomic, anthropometric, psychological and lifestyle characteristics of the sample in relation to emotional symptoms in Mediterranean Spanish adolescents (n=165)

	Girls			Boys		
	Without emotional symptoms n=43	Emotional symptoms n=63	p	Without emotional symptoms n=22	Emotional symptoms n=37	p
	Mean (SD) or %	Mean (SD) or %		Mean (SD) or %	Mean (SD) or %	
Age (years)	13.44 (0.85)	13.62 (0.94)	.325	13.23 (0.75)	13.35 (1.06)	.602
Socioeconomic level (%)						
Low	39.5	28.9		27.3	18.9	
Medium	39.5	54.0	.333	45.5	45.9	.704
High	20.9	17.5		27.3	35.1	
Weight (kg)	51.76 (9.79)	52.25 (8.83)	.790	51.85 (10.16)	49.41 (8.39)	.324
Height (m)	1.60 (0.07)	1.60 (0.06)	.836	1.64 (0.08)	1.60 (0.80)	.100
BMI (kg/m^2)	20.10 (3.49)	20.14 (2.63)	.944	18.94 (2.59)	19.03 (2.83)	.901
zBMI (score)	-0.08 (1.01)	-0.97 (0.75)	.941	-0.25 (0.71)	-0.25 (0.82)	.980
Eating disorder symptoms (score)	11.37 (10.08)	18.03 (13.09)	**.004**	10.95 (6.24)	11.94 (8.48)	.636
Physical activity Test (score)	5.86 (1.94)	4.97 (2.05)	**.028**	6.48 (2.20)	6.19 (2.35)	.650
Mediterranean Diet (score)	6.19 (1.67)	5.41 (2.19)	**.042**	5.45 (2.65)	5.95 (2.14)	.440

SD, Standard Deviation. zBMI, BMI z-score.
Levels of statistical significance are $p<.05$ assessed using the chi-square test for the percentage and the t test for mean comparisons.

Table 2. Factor loading matrix for the three dietary patterns derived from principal component analysis in Mediterranean Spanish adolescents (n=165)

	Factor loading		
	Sweet and Fatty Food Pattern	Western Pattern	Healthy Pattern
Sweets	**0.751**	0.161	-0.082
Soft drinks	**0.675**	-0.148	0.192
Sweet dairy products	**0.627**	-0.232	-0.108
Baked goods and chocolates	**0.623**	0.155	0.250
Savoury Snacks	**0.577**	0.332	0.086
Meat and cold meat	0.094	**0.790**	-0.196
Starchy	0.044	**0.724**	0.240
Potatoes	0.037	**0.344**	0.291
Fruit	0.152	0.399	**0.543**
Beans	0.253	-0.046	**0.773**
Vegetables	-0.185	0.069	**0.507**
Fish and seafood	-0.086	0.066	**0.381**
Dairy products	0.029	0.154	0.197
Eggs	0.064	-0.025	0.036
Breakfast cereals and biscuits	0.089	0.061	-0.109
Nuts	0.139	-0.010	-0.053
Pre-cooked meals	0.129	-0.039	-0.075
%variance	18.03	11. 23	8.63

Food groups with a factor loading of > 0.3 are retained for each pattern and are highlighted in bold. If any food group showed a factor loading set at 0.3 or greater in two patterns, the higher factor loading would be selected.

Table 3. Association between emotional symptoms and the three main dietary patterns identified in Mediterranean Spanish adolescents (n=165)

		Girls			Boys		
		Without emotional symptoms n=43	Emotional symptoms n=63	p	Without emotional symptoms n=22	Emotional symptoms n=37	p
Sweet and Fatty Food Pattern	Low adherence (%)	48.84	30.15	**.048**	31.82	21.62	.653
	Medium adherence (%)	32.56	30.15		31.82	40.54	
	High adherence (%)	18.60	39.68		36.36	37.84	
Western Pattern	Low adherence (%)	32.56	34.92	.940	31.82	32.43	.947
	Medium adherence (%)	32.56	33.33		31.82	35.14	
	High adherence (%)	34.88	31.75		36.36	32.43	
Healthy Pattern	Low adherence (%)	27.91	36.50	.646	31.82	35.13	.516
	Medium adherence (%)	34.88	31.75		27.27	37.84	
	High adherence (%)	37.21	31.75		40.91	27.03	

Level of statistical significance is $p<.05$ assessed using the chi-square test

Table 4. Relationship between emotional symptoms and the risk of a high sweet and fatty food pattern in Mediterranean Spanish adolescents (n=165)

		OR	(95%CI)	p	
Boys					
Emotional symptoms		1.34	(0.32-5.60)	.392	
Eating disorder symptoms (score)		.95	(0.85-1.06)	.683	
Age (years)		.55	(0.23-1.34)	.195	
Socioeconomic level					R^2 *Nagelkerke**100=45.4
	Low	1	1		$\chi^2_{8.59}$=23.56
	Medium	0.64	(0.09-4.63)	.662	*p*=**.003**
	High	0.44	(0.49-4.02)	.470	
zBMI (score)		0.77	(0.25-2.37)	.661	
Energy intake (kcal)		1.00	(1.00-1.00)	**.005**	
Physical activity (score)		0.65	(0.45-0.94)	**.022**	
Girls					
Emotional symptoms		4.79	(1.55-15.10)	**.007**	
Eating disorder symptoms (score)		0.99	(0.95-1.03)	.767	
Age (years)		2.31	(1.26-4.24)	**.007**	
Socioeconomic level					R^2 *Nagelkerke**100=31.1
	Low	1	1		$\chi^2_{8.106}$ =25.88
	Medium	0.31	(0.09-1.04)	.059	*p*=**.001**
	High	0.16	(0.03-0.78)	**.024**	
zBMI (score)		0.89	(0.49-1.63)	.727	
Energy intake (kcal)		1.00	(1.00-1.00)	**.011**	
Physical activity (score)		1.14	(0.88-1.48)	.300	

zBMI, BMI z-score. OR, Odds Ratio. 95% CI, 95% Confidence Interval. Level of statistical significance is p<.05. Results for ORs are from logistic regression models adjusted for eating disorder symptoms, age, socioeconomic level, BMI, energy intake, and physical activity.

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505 Supplementary table

Table. Food groups included in the factor analysis.

Food Groups	Food included
Dairy products	Milk, yogurt, cheese
Sweet dairy products	Crème caramel, custard, pudding, chocolate dairy desserts, ice-cream
Breakfast cereals and biscuits	Breakfast cereals and standard biscuits
Baked goods and chocolates	croissants, donut, sweet bun, cream and chocolate cake, biscuits with chocolate-flavoured filling, chocolate bars
Sweets	candies, sugar, honey
Starchy	wheat, rice, pasta, bread
Beans	lentils chickpea, various types of beans
Potatoes	baked, boiled or fried potatoes
Vegetables	leafy green vegetables (lettuce, chard, spinach) cruciferous vegetables (cabbage, Brussels sprouts, broccoli, cauliflower, coleslaw), yellow and red vegetables (carrots, pumpkins, capsicum), other vegetables (cucumber, tomato, beetroot, mushroom, celery, turnip, swede, onion, mixed vegetables, green beans)
Fruits	Citrus fruit (oranges, mandarin, kiwis) other fruits (apple, banana, berries, strawberries, melon, water melon, peach, plum nectarine, apricot, grapes, pineapple) canned fruit, juices.
Nuts	Almond, nut, raisins, currants, hazelnuts, peanuts, pistachios
Meat and cold meat	Lamb, beef, pork, chicken, turkey, offal, minced meat, boiled ham, Parma ham
Fish and seafood	blue fish (salmon, tuna, sardines) white fish (hake, sole, grouper) seafood
Eggs	eggs
Pre-cooked meals	pizza, croquette, hamburgers,
Savory snacks	chips, salad biscuits and snacks
Soft-drinks	Carbonated and/or sweet drinks (Coca-Cola, Fanta,..)

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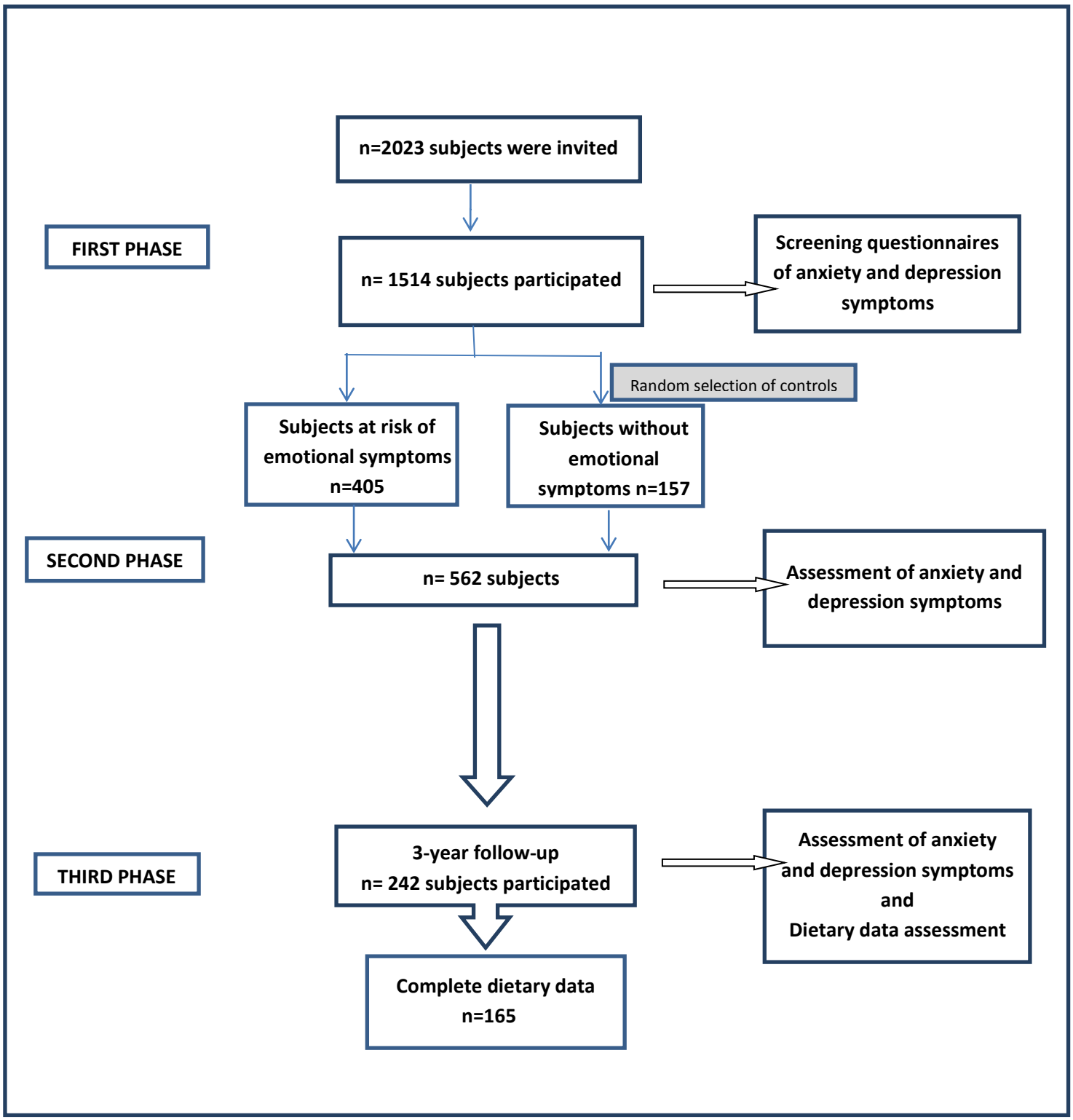
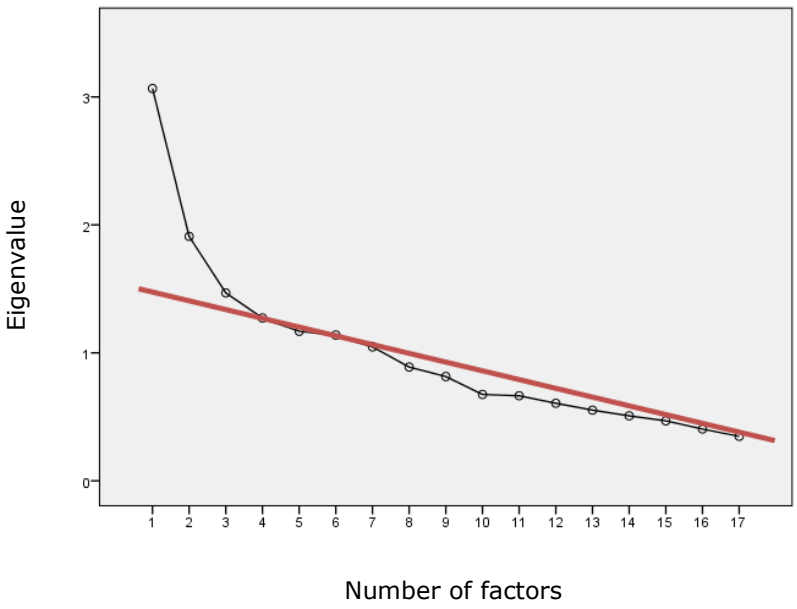

n=2023 subjects were invited
FIRST PHASE
n= 1514 subjects participated
Screening questionnaires of anxiety and depression symptoms
Random selection of controls
Subjects at risk of emotional symptoms n=405
Subjects without emotional symptoms n=157
SECOND PHASE
n= 562 subjects
Assessment of anxiety and depression symptoms
THIRD PHASE
3-year follow-up
n= 242 subjects participated
Assessment of anxiety and depression symptoms and Dietary data assessment
Complete dietary data
n=165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