Impact of emotional intelligence on adherence to the Mediterranean diet in elementary school students. A structural equation model

Eduardo Melguizo-Ibáñez [1] , Badicu Georgian [Corresp., 2] , Filipe Manuel Clemente [3, 4, 5] , Ana Filipa Silva [3, 4] , Jose Luis Ubago-Jiménez [1] , Gabriel Gonzalez Valero [6]

[1] Department of Didactics of Musical, Plastic and Corporal Expression, Faculty of Education Sciences. University of Granada, Granada, Spain

[2] Department of Physical Education and Special Motricity, Transilvania University of Brasov, BRASOV, Romania, Romania

[3] Escola Superior Desporto e Lazer, Instituto Politécnico de Viana do Castelo, Rua Escola Industrial e Comercial de Nun'Álvares, 4900-347 Viana do Cas, Viana do Castelo, Portugal

[4] Research Center in Sports Performance, Recreation, Innovation and Technology (SPRINT), 4960-320 Melgaço, Melgaço, Portugal

[5] Instituto de Telecomunicações, Delegação da Covilhã, 1049-001 Lisboa, Lisboa, Portugal

[6] Department of Didactics of Musical, Plastic and Corporal Expression, Melilla Campus, University of Granada, Granada, Spain

Corresponding Author: Badicu Georgian
Email address: georgian.badicu@unitbv.ro

Background. Adolescence is one of the stages where a large number of physical, psychological and emotional changes occur, the latter playing a key role in adherence to a healthy dietary pattern. Taking into account the above, this research reflects the objectives of developing an explanatory model of the incidence of attention, clarity and emotional repair on adherence to the Mediterranean diet and to contrast the structural model through a multigroup analysis based on Mediterranean adherence to this dietary pattern. **Methods.** To this end, a comparative descriptive cross-sectional study has been carried out with 293 students from the third cycle of primary education. The instruments used were a sociodemographic questionnaire, the KIDMED test and the Trait Meta-Mood Scale (TMMS-24). **Results**. Students who show low adherence to the Mediterranean diet have a negative association with the repair of negative emotions. Participants who show a medium adherence to the Mediterranean diet, it is observed that they have a negative relationship with emotional clarity, while students who claim to have a high adherence to the Mediterranean diet show positive relationships with each of the constructs that make up emotional intelligence.

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[1] Department of Didactics of Musical, Plastic and Corporal Expression. Faculty of Education Sciences. University of Granada

[2] Department of Physical Education and Special Motricity, Transilvania University of Brasov, 500068 Brasov, Romania

[3] Department of Didactics of Musical, Plastic and Corporal Expression. Faculty of Education and Sport Sciences (Melilla). University of Granada

[4] Escola Superior Desporto e Lazer, Instituto Politécnico de Viana do Castelo, Rua Escola Industrial e Comercial de Nun'Álvares, 4900-347 Viana do Castelo, Portugal

[5] Research Center in Sports Performance, Recreation, Innovation and Technology (SPRINT), 4960-320 Melgaço, Portugal

[6] Instituto de Telecomunicações, Delegação da Covilhã, 1049-001 Lisboa, Portugal

Corresponding Author: Georgian Badicu
Email address: georgian.badicu@unitbv.ro

Abstract

Background. Adolescence is one of the stages where a large number of physical, psychological and emotional changes occur, the latter playing a key role in adherence to a healthy dietary pattern. Taking into account the above, this research reflects the objectives of developing an explanatory model of the incidence of attention, clarity and emotional repair on adherence to the Mediterranean diet and to contrast the structural model through a multigroup analysis based on Mediterranean adherence to this dietary pattern. **Methods.** To this end, a comparative descriptive cross-sectional study has been carried out with 293 students from the third cycle of primary education. The instruments used were a sociodemographic questionnaire, the KIDMED test and the Trait Meta-Mood Scale (TMMS-24). **Results**. Students who show low adherence to the Mediterranean diet have a negative association with the repair of negative emotions. Participants who show a medium adherence to the Mediterranean diet, it is observed that they have a negative relationship with emotional clarity, while students who claim to have a high adherence to the Mediterranean diet show positive relationships with each of the constructs that make up emotional intelligence.

34   **Keywords** Emotional Intelligence, Mediterranean Diet, Teenagers, Elementary Education

35   **Introduction**

36   Currently, modernisation and cultural changes in Western societies are bringing

37   sociological changes that have a negative impact on physical and psychological development in

38   adolescence (Joensuu et al., 2021; Beghin et al., 2019). This stage of human development occurs

39   between childhood and adulthood, playing a key role not only because of the physical changes that

40   occur, but also because of the psychological and social changes that it entails (Corder et al., 2019).

41   This phase, being a period of so many changes, increases the vulnerability of subjects to the

42   acquisition of harmful lifestyle habits, making them a risk group (Bornhost et al., 2020).

43   Studies point to the progressive abandonment of a dietary pattern in adolescence, as young

44   people begin to have greater control over their dietary pattern and a greater shift towards Western

45   diets based on calorie imbalance (Appannah et al., 2021; Appannah et al., 2020) leading to a

46   progressive deterioration of optimal adherence to the Mediterranean diet (Wilson et al., 2020).

47   This dietary pattern is characterised by the intake of a wide variety of foods including whole grains,

48   olive oil, bread, dairy products, fruits, vegetables and nuts (Martínez-González et al., 2019). At the

49   same time, Muros et al. (2017) point out that positive adherence to the Mediterranean diet brings

50   numerous health benefits such as reduced waist circumference, increased life expectancy and

51   adequate body fat percentage, reduced likelihood of cardiovascular and neurodegenerative

52   diseases (Ubago-Jiménez et al., 2020) and benefits in emotional control (Ferrer-Cascales et al.,

53   2019).

54   Emotional competence is a fundamental element in the day-to-day development of

55   students, as it equips them with the necessary skills to cope with various negative situations

56   emotionally, as well as to promote psychological well-being (Puertas-Molero et al., 2020). Being

57   emotionally competent brings benefits such as improved concentration, control over stressful

58   situations and improved personal self-motivation (Castro-Sáchez et al., 2018). This is why

59   emotional intelligence is conceived as a construct that constitutes the psychological development

60   of emotions (Puertas-Molero et al., 2020), being composed of attention to these states, clarity of

61   understanding and repair in the face of negative emotions (Mayer et al., 1999), these constructs

62   playing a key role in academic success and mental, social and educational well-being (Puertas-

63   Molero et al., 2020).

64   Numerous studies have attempted to explain the incidence of the emotional environment
65   on adherence to an active and healthy lifestyle. In this case, the research conducted by Melguizo-
66   Ibáñez et al. (2020) found that adolescents who show better emotional control show better
67   adherence to the Mediterranean diet, affirming Toet et al. (2022) the presence of emotional eaters,
68   who, when faced with negative emotions or negative disruptive states, tend to carry out a process
69   of overeating, characterized by the intake of unhealthy foods such as pastries and an increase in
70   alcoholic beverages (Chang et al., 2021), with adolescents being a population at risk due to the
71   numerous emotional changes that occur during this stage (Melguizo-Ibáñez et al., 2021).

72   Therefore, focusing attention on the above, the present study reflects the objectives of (a)
73   developing an explanatory model of the impact of attention, clarity and emotional repair on
74   adherence to the Mediterranean diet and (b) contrasting the structural model by means of a multi-
75   group analysis in terms of Mediterranean adherence to this dietary pattern.

76   Finally, the following research hypothesis is proposed:

77   • Participants who show high adherence to the Mediterranean diet will obtain better
78   associations between said dietary pattern and the tridimensional construct that composes
79   emotional intelligence than those who show low or medium adherence.

80   Then, in light of the literature reviewed and the different relationships expected between
81   variables, an exploratory model of adherence to Mediterranean diet in children will be explored
82   (Figure 1)

83   **Materials & Methods**

84   *Design and Participants*

85   The present study reflects a non-experimental design (ex post facto), descriptive and cross-
86   sectional. The sample consisted of schoolchildren in the third cycle of primary education in the
87   province of Granada, whose ages ranged between 11 and 12 years (11.47±0.32). Likewise,
88   convenience sampling was used, inviting those young people who met the requirements of the
89   present study to collaborate. In this case, the inclusion criteria were the following: being in the
90   third cycle of primary education (fifth and sixth grade), being an exclusion criterion not to be in
91   this educational stage. The sample consisted of a total of 293 students, of whom 147 were male
92   (50.2%) and 146 female (49.8%).

93   *Variables and Instruments*

94   Sociodemographic questionnaire which was designed to collect variables such as sex (male

95 and female) and age.

96   *Kidmed questionnaire* developed by Serrá-Majem et al. (2004). This instrument is made

97 up of a total of 16 items, which are answered positively or negatively. Items 5, 11, 13 and 15 have

98 a negative character and if answered positively they are valued with -1 point. The values of

99 adherence to the Mediterranean diet are as follows: optimal diet ($\geq$8 points), needs improvement

100 (2-7 points) and low diet quality ($\leq$ 1 point). For the present study, Cronbach's alpha obtained a

101 score of $\alpha=0.889$.

102   *Trait Meta-Mood Scale (TMMS-24)* developed by Salovey et al. (1995), but for the present

103 research, the version adapted to Spanish by Fernández-Berrocal et al. (2004) has been used. This

104 questionnaire assesses emotional intelligence as a trifactorial construct, where emotional attention,

105 emotional clarity and emotional repair are assessed through a summative measure. In the present

106 study, emotional attention obtained an $\alpha=0.843$, emotional clarity an $\alpha=0.842$ and finally,

107 emotional repair an $\alpha=0.814$.

108

109   *Procedure*

110   The procedure has been similar to that developed in other studies (Melguizo-Ibáñez et al.,

111 2022). The first step was to carry out a bibliographical search of the current problem in order to

112 find out the state of the art. Subsequently, the Department of Didactics of Musical, Plastic and

113 Corporal Expression of the University of Granada contacted various educational centres by

114 telematic means, informing them of the purpose of the study, and once a favourable response was

115 obtained, an email was sent to the students' legal guardians, informing them that the data would be

116 treated anonymously and exclusively for scientific purposes. Once written consent had been

117 obtained from the legal guardians for their children to participate in the research, a Google Form

118 was sent to the different schools, where the participants responded to the instruments described

119 above. Because the investigators were unable to access the various schools due to the COVID-19

120 pandemic, teachers at the various schools were instructed to resolve any questions that arose. This

121 research followed the ethical principles established in the Declaration of Helsinki and was

122 approved and supervised by an ethics committee of the University of Granada (1230/CEIH/2020).

123 To ensure that participants did not respond randomly to the questions, two questionnaires were

124   duplicated in order to ensure that they were not randomly answered, however, a total of 25

125   questionnaires had to be eliminated due to inadequate completion.

126   *Data Analysis*

127   The IBM SPSS Statics 25.0 statistical programme (IBM Corp, Armonk, NY, USA) was used to

128   analyse the data, where an analysis of frequencies and means was carried out, using Cronbach's

129   Alpha to determine the internal consistency of the instruments, establishing the reliability index at

130   95%. To study the normality of the sample, the Kolmogorov-Smirnov purity test was used,

131   obtaining normal normality.

132   For the elaboration of the structural equation models, the IBM SPSS Amos 26.0 program

133   (IBM Corp., Amonk, NY, USA) was used to establish the relationships between the variables that

134   make up the theoretical model (Figure 1). A general model was developed for the total sample and

135   subsequently a model was presented according to the degree of adherence to the Mediterranean

136   diet (low, medium and high). Likewise, each model is made up of three exogenous variables (EA,

137   EC, ER) and one endogenous variable (MDA). In the case of the latter variable, a causal

138   explanation has been made taking into account the observed associations between the indicators

139   and the reliability of measurement, so that the measurement error of the observed variables has

140   been included in the model. Likewise, the unidirectional arrows represent lines of influence

141   between the latent variables and are interpreted from regression weights. A significance level of

142   0.05 was established using Pearson's Chi-Square test.

143   In this case, adherence to the Mediterranean diet acts as an endogenous variable, which is

144   affected by the three-factor construct of emotional intelligence (attention, clarity and repair).

145   Finally, the fit of the model was evaluated after estimating the different parameters of the

146   model. According to the criteria established by McDonald and Marsh (1990) and Bentler (1990),

147   the goodness of fit must be assessed on the Chi-Square fit, whose values associated with p and not

148   significant indicate a good fit of the model. In this case, the comparative fit index (CFI; values

149   above 0.95 indicate a good model fit), the goodness-of-fit index (GFI; values above 0.90 indicate

150   an acceptable fit), the incremental reliability index (IFI; values above 0.90 indicate an acceptable

151   fit) and the root mean square approximation (RMSEA; values below 0.1 indicate an acceptable

152   model fit).

153

154   ***FIGURE 1***

155 **Results**

156   Table 1 shows the sociodemographic characteristics of each model developed. In this case

157 it is observed that the total sample is made up of 147 boys and 146 girls. It should also be noted

158 that 93 participants showed an optimal adherence to the Mediterranean diet, 166 showed an

159 average adherence and 34 showed a low adherence to this dietary pattern.

160   ***TABLE 1***

161   The model develop for low adherence showed a good fit for each of the indices. Chi-Square

162 showed a significant p-value (X^2= 77.699; df=16; pl=0.000). In this case, such data cannot be

163 interpreted in an independent way due to the sample size and susceptibility of the sample, therefore

164 other standardized fit indices have been used (Tenenbaum and Eklund, 2007). The comparative fit

165 index (CFI) obtained a value of 0.949, the normalized fit index (NFI) showed a value of 0.925, the

166 incremental fit index (IFI) obtained a score of 0.958 and the Tucker Lewis index (TLI) evidenced

167 a value of 0.953. Finally RMSEA obtained a value below 0.1, namely 0.052.

168   ***FIGURE 2***

169

170   ***TABLE 2***

171

172

173   Figure 2 and Table 2 show a positive relationship between low adherence to the

174 Mediterranean diet (MDA) and emotional attention (EA) (r=0.058), occurring exactly the same

175 with emotional clarity (EC) (r=0.074). On the contrary, a negative relationship was observed with

176 emotional repair (ER) (r=-0.144). Continuing with the variables that make up emotional

177 intelligence, for emotional attention (EA), positive relationships are observed with emotional

178 clarity (EC) (r=0.215) and emotional repair (ER) (r=0.377). Positive relationships were also

179 observed between emotional clarity (EC) and emotional repair (ER) (r=0.432).

180   The proposed model for average adherence to a healthy dietary pattern obtained good

181 scores for the different indices that evaluate the fit of the model. The Chi-square showed a

182 significant p-value (X^2= 75.653; df=16; pl=0.000). Likewise, the comparative fit index obtained a

183 score of 0.959, the normalized fit analysis (NFI) showed a score of 0.952, these being excellent

184 values. In addition, the incremental fit index (IFI) was 0.945 and the Tucker-Lewis index (TLI)

185 obtained a value of 0.944. Finally, the root mean square error of approximation analysis (RMSEA)

186 obtained a score of 0.050.

187   ***FIGURE 3***

188

189   ***TABLE 3***

190

191   Table 3 and Figure 3, evidence a positive relationship between adherence to the
192 Mediterranean diet (MDA) and emotional attention (EA) (r=0.059), the same pattern being
193 observed with emotional repair (ER) (r=0.158). In contrast, a negative relationship was shown
194 between emotional clarity (EC) and adherence to a healthy dietary pattern (MDA) (r=-0.101).
195 Continuing with the relationships found between the different emotional constructs, positive
196 relationships are shown between emotional clarity (EC) and emotional attention (EA) (p<0.001;
197 r=0.431). A positive relationship was also observed between emotional clarity (EC) and emotional
198 repair (ER) (p<0.001; r=0.556). Finally, a positive relationship was obtained between attention to
199 feelings (EA) and emotional repair (ER) (p<0.001; r=0.448).

200   Finally, focusing on the model developed for students showing high adherence to the
201 Mediterranean diet, it showed good scores for each of the indices. Chi-Square showed a significant
202 p-value ($X^2 = $ 74.345; df=16; pl=0.000). The comparative fit index (CFI) analysis obtained a value
203 of 0.959, which represents an excellent score. The normalised fit index (NFI) analysis obtained a
204 value of 0.952, the incremental fit index (IFI) was 0.9945 and the Tucker-Lewis index (TLI)
205 obtained a value of 0.944, all of which were excellent. In addition, the root mean square error of
206 approximation analysis (RMSEA) also obtained a value of 0.051.

207   ***FIGURE 4***

208

209   ***TABLE 4***

210

211   Looking at the results shown in figure 4 and table 4, there is a positive relationship between
212 high adherence to the Mediterranean diet (MDA) and emotional attention (EA) (r=0.049),
213 emotional clarity (EC) (r=0.186) and emotional repair (r=0.015). Likewise, among the emotional
214 constructs, positive relationships were obtained between 'emotional clarity (EC) and emotional
215 attention (EC) (p<0.001; r=0.391) and emotional repair (ER) (p<0.001; r=0.607), with another
216 positive relationship between emotional attention (EC) and emotional repair (ER) (r=0.340).

217 **Discussions**

218   The present study reflects the influence of emotions on adherence to a healthy dietary
219   pattern, in this case to the Mediterranean diet in adolescent students in the third cycle of primary
220   education. In this case the platen research hypothesis is fulfilled, as the model equations reveal
221   that having a low adherence to the Mediterranean diet reports worse associations between the
222   emotional and dietary domains. The results obtained respond to the proposed objectives, which is
223   why this discussion aims to compare the results obtained in this study with those obtained in other
224   similar studies.

225   Students who show low adherence to the Mediterranean diet, a negative relationship is
226   observed between emotional repair and positive adherence to a healthy dietary pattern. Results
227   very similar to those obtained in the present research were concluded by Herren et al. (2021) and
228   Melguizo-Ibáñez et al. (2022), where Trigueros et al. (2020) affirm the existence of a process of
229   emotional eating. In this case, this process consists of overeating unhealthy foods, such as pastries
230   and sweets in times of stress or anxiety or negative emotions. In this case, research by Linswiller
231   et al. (1989) states that people who mismanage their emotions tend to experience states such as
232   anxiety and stress, leading to a process of overeating. This may also be due to the fact that students
233   may have received little emotional training, and are able to overcome such states through the
234   process described above (Sabingoz and Dogan, 2019).

235   Continuing with the model developed for participants showing a medium adherence to the
236   Mediterranean diet, a negative relationship with emotional clarity is denoted. Very distant results
237   were obtained by Marchena et al. (2020), where Melguizo-Ibáñez et al. (2021) affirming that
238   emotional clarity plays a key role in knowing the different emotional states that are experienced
239   and whether they are beneficial or detrimental. Likewise, emotional clarity plays a key role with
240   emotion repair as students need to understand whether a certain state makes them feel good or bad
241   and thus recover from it if it harms them without engaging in excessive intake of unhealthy foods
242   (Trigueros et al., 2020).

243   For the model developed for students who show a high adherence to the Mediterranean
244   diet, it is observed that there is a positive relationship with the three constructs that comprise
245   emotional intelligence. Very similar results were obtained by Marchena et al. (2020) where they
246   state that a healthy diet brings benefits on different personal dimensions, among which emotional
247   intelligence stands out (Ubago-Jiménez et al. 2020).

248   Such behavior can be explained by the fact that an optimal adherence to the Mediterranean
249   diet brings benefits on the physical and emotional self-concept, generating positive and satisfactory
250   emotions in the physical and mental image of individuals. (Zurita-Ortega et al., 2018; Melguizo-
251   Ibáñez et al., 2022).

252   Regarding the implications that this research offers in the field of health, it is the presence
253   and importance of emotions when it comes to adherence to a healthy dietary pattern. Likewise, the
254   presence of negative emotions together with disruptive emotional states can originate a process of
255   emotional overeating, resulting in a process that is detrimental to the physical and mental health
256   of individuals. Several practical applications of this research can be extrapolated to the educational
257   field, through an intervention program focused on emotional control and its impact on an active
258   and healthy lifestyle (Ubago-Jiménez et al., 2020; Melguizo-Ibáñez et al., 2022).

259

260   **Limitations and future prospects**

261   The present study reflects a series of limitations, which are described below. The first one
262   is that since this is a cross-sectional study, it is only possible to establish the causal relationships
263   of the variables at that time. In addition, the sample is made up of students from a very specific
264   geographic area, so that it is not possible to establish generalizations in a wider area of the national
265   geography. Likewise, the study is exploratory in nature, requiring a future intervention to better
266   study the relationships.

267   Focusing attention on future perspectives, it has been proposed to develop a longitudinal
268   intervention program, where, through emotional education, the effects of these states on food
269   intake can be studied.

270

271   **Conclusions**

272   The present study shows that attention, clarity and emotional repair influence positive
273   adherence to a healthy pattern. Based on the different models of equations developed, it is observed
274   that students who show low adherence to the Mediterranean diet have a negative association with
275   the repair of negative emotions. Likewise, continuing with those participants who show a medium
276   adherence to the Mediterranean diet, it is observed that they have a negative relationship with
277   emotional clarity, while students who claim to have a high adherence to the Mediterranean diet
278   show positive relationships with each of the constructs that make up emotional intelligence.

279 Finally, the data from the present research affirm that positive adherence to a healthy dietary
280 pattern results in better understanding, clarity and repair of emotions.

281

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283 G.G.V.; formal analysis, J.L.U.J.; investigation, E.M.I.; resources, G.B.; data curation, J.L.U.J. and G.G.V.; writing—original draft
284 preparation, E.M.I., F.M.C. and G.G.V; writing—review and editing, G.G.V. A.F.S. and G.B.; visualization, A.F.S. and F.M.C.;
285 supervision, G.G.V; project administration, E.M.I.; funding acquisition, G.B. All authors have read and agreed to the published
286 version of the manuscript.

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289 **Human Ethics:** This research followed the ethical principles established in the Declaration of Helsinki and was approved and
290 supervised by an ethics committee of the University of Granada (1230/CEIH/2020).

291
292 **Data Availability:** The raw measurements are available in the Supplementary File.

293

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Figure 1

Figure 1 Proposed theoretical model

Note: Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA).
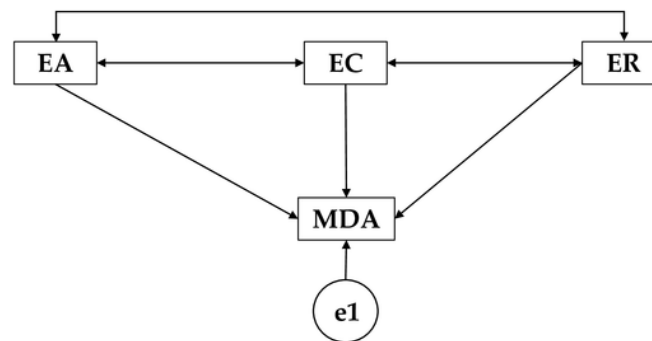
Figure 2

Figure 2 Theoretical model proposed for low adherence to the Mediterranean diet

Note: Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA).
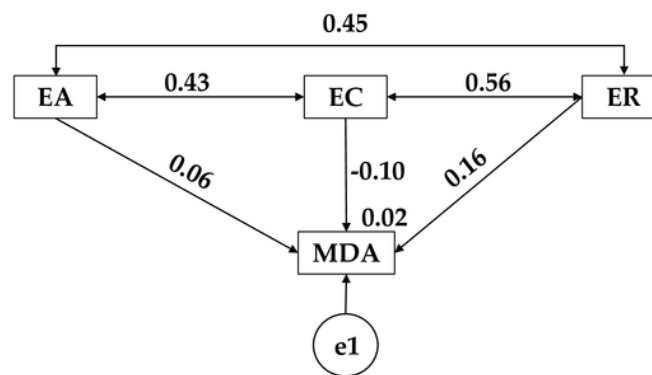
Figure 3

Figure 3 Theoretical model proposed for medium adherence to the Mediterranean diet

Note: Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA).
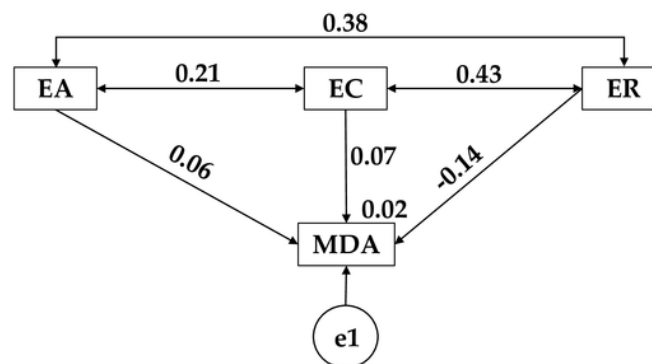
Figure 4

Figure 4 Theoretical model proposed for high adherence to the Mediterranean diet

Note: Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA).
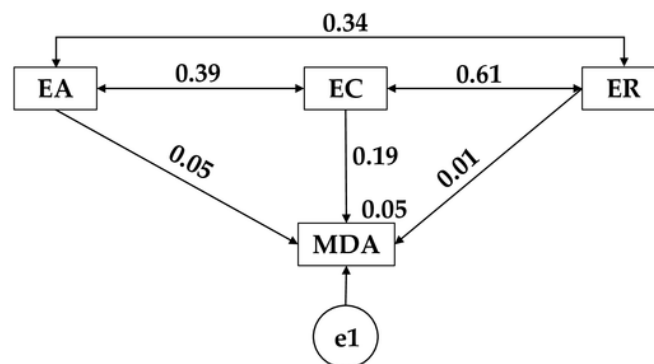
Table 1 Sociodemographic characteristics of the different proposed models

	Mediterranean Diet Adherence			Total
	High Adherence	**Medium Adherence**	**Low Adherence**	
Male	51 (54.8%)	76 (45.8%)	20 (58.8%)	147 (50.2%)
Female	42 (45.2%)	90 (54.2%)	14 (41.2%)	146 (49.8%)
Total	93 (100.0%)	166 (100.0%)	34 (100.0%)	293 (100.0%)

Table 2 Structural model for low adherence to Mediterranean diet

Note 1: Regression weights (R.W); Standardized regression weights (S.R.W); Estimation error (S.E); Critical ratio (C.R). **Note 2:** Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA). **Note 3**: *** p < 0.001

Associations between variables	R.W.				S.R.W.
	Estimates	S.E.	C.R.	p	Estimates
MDA←EA	0.008	0.025	0.313	0.754	0.058
MDA←EC	0.011	0.029	0.386	0.700	0.074
MDA ←ER	-0.019	0.027	-0.711	***	-0.144
EC←→EA	0.105	0.087	1.205	0.228	0.215
EC←→ER	0.210	0.092	2.278	0.023	0.432
EA←→ER	0.205	0.101	2.024	0.043	0.377

Table 3 Structural model for medium adherence to the Mediterranean diet.

Note 1: Regression weights (R.W); Standardized regression weights (S.R.W); Estimation error (S.E); Critical ratio (C.R). **Note 2:** Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA). **Note 3**: *** $p < 0.001$

Associations between variables	R.W.				S.R.W.
	Estimates	S.E.	C.R.	*p*	Estimates
MDA←EA	0.005	0.007	0.667	0.505	0.059
MDA←EC	-0.010	0.010	-1.051	0.293	-0.101
MDA←ER	0.015	0.009	1.638	0.101	0.158
EC←→EA	0.285	0.056	5.071	***	0.431
EC ←→ER	0.299	0.048	5.071	***	0.556
EA ←→ER	0.302	0.058	5.240	***	0.448

Table 4 Structural Model for High Adherence to the Mediterranean Diet

Note 1: Regression weights (R.W); Standardized regression weights (S.R.W); Estimation error (S.E); Critical ratio (C.R). **Note 2:** Emotional Attention (EA); Emotional Clarity (EC); Emotional Repair (ER); Mediterranean Diet Adherence (MDA). **Note 3**: *** p < 0.001

Associations between variables	R.W.				S.R.W.
	Estimates	S.E.	C.R.	p	Estimates
MDA←EA	0.005	0.011	0.436	0.663	0.049
MDA←EC	0.020	0.014	1.405	0.160	0.186
MDA←ER	0.002	0.016	0.113	0.910	0.015
EC←→EA	0.268	0.077	3.491	***	0.391
EC ←→ER	0.323	0.065	4.980	***	0.607
EA ←→ER	0.198	0.064	3.084	0.002	0.340