

## **The role of Metacognition in eating behavior: an exploratory study**

Maria C. Quattropani<sup>1</sup>, Vittorio Lenzo<sup>1</sup>, Cristina Faraone<sup>1</sup>,  
Giovanna Pistorino<sup>1</sup>, Ilaria Di Bella<sup>1</sup>, Massimo Mucciardi<sup>2</sup>

<sup>1</sup> Department of Cognitive Science, Education and Cultural Studies, University of Messina  
Italy

<sup>2</sup> Department of Economics, Business, Environmental Sciences and Quantitative Methods,  
Division of Mathematics and Statistics, University of Messina Italy

Email Corresponding author: [vlenzo@unime.it](mailto:vlenzo@unime.it)

### **Abstract**

In the occidental world, feeding is not only a physiological need but it may become a compulsive behavior. In fact, the tendency to instant gratification may represent a way to escape from unpleasant moods and may lead to addictive behaviors. In this process, Metacognitions, defined as internal cognitive factors that control, monitor and evaluate thinking processes, have a central role.

The aim of our study was to investigate the relationship between eating behavior, psychological needs and metacognitive processes. We evaluated 44 adults using the following instruments: Eating Disorders Inventory III (EDI-III), Metacognition Questionnaire 30 (MCQ-30) and Frontal Lobe Score.

Data analysis was performed using SPSS for Windows applying correlational analysis (Spearman's Rho). We found that negative beliefs about worry concerning uncontrollability and danger were positive correlated with general psychological maladjustment composite (0.61  $p < .01$ ). In particular negative beliefs were positive correlated with specific subscales, such as personal alienation (0.57  $p < .01$ ) and emotional dysregulation (0.51  $p < .01$ ).

Results confirmed the importance to explore metacognitive processes and to understand their role in emotional regulation, especially in overweight/obese subjects. Furthermore, we aim to examine the role of cognitive functions in eating behavior.

**Keywords:** Metacognition, Obesity, Neuropsychology, Eating Behavior

### Introduction

The relationship between people and food can be explored through the study of eating behavior. It expresses the ability to control the food intake and select feeding choices and eating habits that allow to reach or maintain ideal weight.

The *Body Mass Index* (BMI) is a value to assess how much an individual's body weight departs from what is normal or desirable for a person's height. It's obtained dividing body mass by the square of the body height and it is universally expressed in units of Kg/m<sup>2</sup>. The weight excess or deficiency may, in part, be related to body fat (adipose tissue) although other factors such as muscularity also affect BMI significantly. If BMI score is under 18.5 kg/m<sup>2</sup> there is a case of "malnutrition", eating disorders or other health problems, while people with a BMI score over 25 kg/m<sup>2</sup> and over 30 kg/m<sup>2</sup> are considered respectively "overweight" and "obese". In particular, in a range of values from 30 to 35, obesity is moderate, also called of 1st class; from 35 to 40, obesity is severe, or of 2nd class; over 40, obesity is very severe, or of 3rd class.

Obesity can be considered a social alarm in occidental world because of the dramatic consequences for health related to it, as heart disease, hypertension, diabetes, stroke and cancer (Bray et al, 1998; Aronne, 2001). This condition affects the well-being and quality of life at all ages (WHO, 2000). In Italy, there is a large number of obese people; in 2012 more than a third of the adult population (35.6 %) were overweight, while one in ten was obese (10.4 %). The proportion of overweight people increases with age. In particular, being overweight rises from 15.8 % of the 18-24 years group to 45.8 % among the 65-74 years, obesity from 2.8 % to 15.9 % for the same age groups (ISTAT, 2013). The number of obese people in the world is doubled compared to 1980; in 2014 there are approximately 1.9 billion of overweight adult people and 600 million obese (WHO, 2015).

In the Western world, because of the availability of large amounts of food, feeding is not only a physiological need but it may become a compulsive behavior. In fact, in presence of highly appetizing food, the ability to resist to overeat depends on self-control (Volkow et al., 2013) and on ability to manage negative emotions. The tendency to instant gratification may represent a way to escape from unpleasant moods and may lead to addictive behaviors, such as taking drugs or eating past the point of satiety (Spada et al., 2014).

Recently, many studies focused on neuropsychological functioning in obese subjects and the findings suggest that obesity is correlated with poor cognitive performance in children, adolescents, adults, regardless of comorbid medical conditions (Boeka & Lokken, 2008; Smith et al., 2011). In particular, some authors have hypothesized a link between obesity and deficits in executive functioning. Executive Functions (EF) are goal-directed neurocognitive processes that allow the control and management of cognition and behavior (Luria, 1966; Welsh & Pennington, 1988). In obese people, executive dysfunction is associated with the inability to control eating behaviors; in fact, people often report difficulties to control overeating, despite of a desire to successfully lose weight.

In this complex process, also metacognitive processes have a central role. Metacognition can be defined as “the aspect of information processing that monitors, interprets, evaluates and regulates the contents and processes of its organization” (Wells & Purdon, 1999). Metacognition is involved in monitoring and regulation of cognitions, emotions and behaviors (Brune, 2006). Several studies demonstrated the role of metacognition in development and maintenance of many psychopathological conditions. No study has ever examined the association between these processes and eating behavior.

The aim of our study was to investigate the relationship between eating behavior, metacognitive processes, psychological needs and executive functioning in obese, overweight and normal-weight adults.

## **Materials and methods**

### *Subjects*

Forty-four adults were included in the study, recruited in collaboration with some experts of healthy eating (dieticians and nutritionists) in Messina and

Reggio Calabria. Inclusion criteria concerned with being treated at a nutrition center in order to change current eating habits. Exclusion criteria were the presence of positive anamnesis for schizophrenia, for an eating behavior disorder or neurocognitive disorder diagnosed according to the criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013) at the time of data collection or during a six-month period before the recruiting.

Before to their participation in this study, all individuals gave written consent.

All individuals voluntarily contacted the centres except four people that decided to go to the dietician after a colleague's or a relative's suggest. None of the subjects has ever been underwent to bariatric surgery or was in treatment with weight-loss drugs. 28 subjects (64%) have never followed a diet, while 16 subjects (36%) have followed a diet but only 7 of them with success.

### *Measures*

Participants were assessed using the following instruments:

- *Sociodemographic schedule*;
- *Eating Disorders Inventory III* (EDI III, Garner, 2004; Giannini et al., 2008): self-report used to assess eating disorders as Anorexia and Bulimia. It contains 91 items organized into 12 primary scales, three "Eating Disorder Risk Scales" and nine "Psychological Scales". It's also possible to obtain six yields composites, one that is eating-disorder specific (i.e., Eating Disorder Risk) and five that are general integrative psychological constructs (i.e., Ineffectiveness, Interpersonal Problems, Affective Problems, Overcontrol, General Psychological Maladjustment).

Each yield composite is obtained by adding raw scores of some primary scales:

- Eating Disorder Risk: Drive for Thinness (DT) + Bulimia (B) + Body Dissatisfaction (BD);
- Ineffectiveness: Low Self-Esteem (LSE) + Personal Alienation (PA);
- Interpersonal Problems: Interpersonal Insecurity (II) + Interpersonal Alienation (IA);
- Affective Problems: Interoceptive Deficits (ID) + Emotional Dysregulation (ED);

- Overcontrol: Perfectionism (P) + Asceticism (A);
- General Psychological Maladjustment: total of all nine psychological scales (LSE + PA + II + IA + ID + ED + P + A + MF);
- *Frontal Lobe Score* (Ettlin et al., 2000): an instrument that consists of 17 tasks for the assessment of frontal functions and to test for potential frontal lobe damage on a behavioural dimension with a cut-off of 12 or higher. It can be divided in two subscales, cognitive (FLS\_COG) and behavioural (FLS\_NBS) ones.
- *Metacognitions Questionnaire 30* (MCQ-30, Wells, Cartwright-Hatton, 2004; Quattropani et al., 2014): a 30 items self-report instrument which measures metacognitive beliefs and processes. Items are rated on a 4-point Likert scale from 1 ('do not agree') to 4 ('completely agree'). It can be divided into five subscales: Cognitive Confidence (confidence in attention and memory); Cognitive Self-Consciousness (tendency to monitor own thoughts); Positive Beliefs about worry (positive beliefs about own perseverative thoughts); Negative Beliefs about worry concerning uncontrollability and danger (negative beliefs about own perseverative thoughts); Need to Control thoughts (need to suppress certain type of thoughts).

#### *Statistical analysis*

Data were organized in a SPSS version (Statistical Package for Social Sciences v. 18 software for Windows, 2009) database. Analyses were performed with descriptive and inferential statistical analysis. Then data were analysed with non-parametric test. Continuous data were expressed as mean  $\pm$  SD and significant differences between sub-groups according to sociodemographic characteristics were appraised using the Mann-Whitney non-parametric test for two independent samples. Spearman correlation coefficients were used to examine the bivariate associations among study variables. The significance levels for the correlation coefficients were  $p < 0.05$  and  $p < 0.01$ .

## **Results**

#### *Group characteristics*

The sample consisted of 44 individuals (8 males; 36 females) with mean BMI of 30.18 (SD 7.56).

Sociodemographic characteristics are detailed in Table 1.

**Table 1.** Sociodemographic Characteristics

Characteristics	
Mean age $\pm$ SD, years	42.75 $\pm$ 14.55
Gender (n, percent)	
Male	8 (18%)
Female	36 (82%)
Mean educational level $\pm$ SD, years	13 $\pm$ 3.25
Marital status – Single and Engaged (n, percent)	
Single	18 (41%)
Engaged	26 (59%)

*Group differences (Mann-Whitney U-test)*

The following tables 2 and 3 show descriptive statistics and the results of Mann-Whitney U-test for two sub-groups according to individuals' marital status.

Significant differences were found between Single and Engaged in EDI\_GPMC ( $p < .01$ ), in yield composite EDI\_IC ( $p < .01$ ), EDI\_IPC ( $p < .05$ ), EDI\_APC ( $p < .01$ ), EDI\_OC ( $p < .01$ ). According to marital status, it were found difference also in the subscale “Negative Beliefs” and “Cognitive Confidence” of the MCQ-30 test. No significant difference was found in BMI and FLS\_NBS regard to “marital status”.

**Table 2.** BMI, EDI-III and FLS mean scores

	Marital Status		Mann-Whitney test
	Single (N=18)	Engaged (N=26)	
	M (SD)	M (SD)	<i>p</i> value
<b>BMI</b>	27.40 (5.23)	32.11 (8.39)	n.s.
<b>EDI_DT</b>	13.44 (9.84)	10.88 (6.48)	n.s.
<b>EDI_B</b>	4.17 (4.00)	3.85 (4.92)	n.s.
<b>EDI_BD</b>	18.78 (10.38)	14.19 (8.88)	n.s.
<b>EDI_EDRC</b>	36.39 (19.82)	28.92 (17.74)	n.s.
<b>EDI_LSE</b>	7.56 (6.19)	3.04 (4.86)	< .01
<b>EDI_PA</b>	6.83 (5.07)	3.58 (4.45)	< .01
<b>EDI_IC</b>	14.39 (10.29)	6.62 (9.14)	< .01
<b>EDI_II</b>	10.5 (5.96)	5.62 (5.69)	< .01
<b>EDI_IA</b>	7.83 (4.66)	6.38 (5.28)	n.s.
<b>EDI_IPC</b>	18.33 (9.49)	12 (10.35)	< .05
<b>EDI_ID</b>	10.44 (7.26)	4.46 (4.87)	< .01
<b>EDI_ED</b>	6.89 (4.35)	2.31 (3.75)	< .01
<b>EDI_APC</b>	17.33 (10.46)	6.77 (7.89)	< .01
<b>EDI_P</b>	8.39 (4.54)	6.19 (4.07)	n.s.
<b>EDI_A</b>	7.72 (4.48)	4.23 (3.80)	< .01
<b>EDI_OC</b>	16.11 (6.78)	10.42 (6.87)	< .01
<b>EDI_MF</b>	16 (6.47)	9.58 (6.41)	< .01
<b>EDI_GPMC</b>	82.17 (28.15)	45.38 (33.64)	< .01
<b>FLS_NBS</b>	5.44 (4.05)	5.62 (3.4)	n.s.

*Notes:* BMI= Body Mass Index; EDI\_DT = Drive for Thinness; EDI\_B = Bulimia; EDI\_BD = Body Dissatisfaction; EDI\_EDRC = Eating Disorder Risk; EDI\_LSE = Low Self-Esteem; EDI\_PA = Personal Alienation; EDI\_IC = Ineffectiveness; EDI\_II = Interpersonal Insecurity; EDI\_IA = Interpersonal Alienation; EDI\_IPC = Interpersonal Problems; EDI\_ID = Interoceptive Deficits; EDI\_ED = Emotional Dysregulation; EDI\_APC = Affective Problems; EDI\_P = Perfectionism; EDI\_A = Asceticism; EDI\_OC = Overcontrol; EDI\_MF =Maturity Fears; EDI\_GPMC = General Psychological Maladjustment; FLS\_NBS= Frontal Lobe Score- Neurobehavioural Scale.

**Table 3.** MCQ-30 mean scores

	Marital Status		Mann-Whitney test
	Single (N=18)	Engaged (N=26)	
	M (SD)	M (SD)	<i>p</i> value
MCQ_PB	11.83 (4.72)	9.46 (3.17)	n.s.
MCQ_NB	13.39 (4.75)	10.46 (3.43)	< .05
MCQ_CC	12.39 (3.99)	9.96 (3.75)	< .05
MCQ_NC	12.28 (3.79)	11 (2.94)	n.s.
MCQ_CSC	16.89 (2.68)	17.73 (2.74)	n.s.
MCQ_TOT	66.78 (12.98)	58.62 (8.92)	n.s.

Notes: MCQ\_PB = Positive beliefs; MCQ\_NB = Negative beliefs; MCQ\_CC = Cognitive Confidence; MCQ\_NC = Control Thoughts; MCQ\_CS = Cognitive Self-Consciousness; MCQ\_TOT= Total score.

Tables 4 and 5 below show descriptive statistics and the results of Mann-Whitney *U*-test for two sub-groups according to individuals' educational level.

Significant differences were found between people with Low educational level and people with Medium/High educational level in BMI ( $p < .01$ ), FLS\_NBS ( $p < .05$ ), EDI\_GPMC ( $p < .05$ ) and EDI\_APC ( $p < .05$ ). No significant difference was found in MCQ-30 regard to "Educational Level".

**Table 4.** BMI, EDI-III and FLS mean scores

	Educational Level		Mann-Whitney test
	Low (N=9)	Medium/High (N=35)	
	M (SD)	M (SD)	<i>p</i> value
BMI	35.16 (4.41)	28.9 (7.72)	< .01
EDI_DT	13.3 (7.42)	11.57 (8.23)	n.s.
EDI_B	2.89 (2.57)	4.26 (4.89)	n.s.
EDI_BD	16.44 (10.26)	15.97 (9.68)	n.s.
EDI_EDRC	32.67 (17.93)	31.8 (19.22)	n.s.
EDI_LSE	1.78 (1.92)	5.69 (6.23)	n.s.
EDI_PA	3.67 (2.69)	5.23 (5.34)	n.s.



<b>EDI_IC</b>	5.44 (3.78)	10.91 (11.12)	n.s.
<b>EDI_II</b>	4.89 (5.88)	8.31 (6.20)	n.s.
<b>EDI_IA</b>	6.11 (5.25)	7.2 (5.02)	n.s.
<b>EDI_IPC</b>	11 (10.92)	15.51 (10.20)	n.s.
<b>EDI_ID</b>	3.22 (2.54)	7.86 (7.00)	n.s.
<b>EDI_ED</b>	2.11 (3.22)	4.71 (4.74)	n.s.
<b>EDI_APC</b>	5.33 (5.24)	12.57 (10.86)	< .05
<b>EDI_P</b>	5.78 (3.53)	7.43 (4.53)	n.s.
<b>EDI_A</b>	4.22 (2.54)	6.03 (4.72)	n.s.
<b>EDI_OC</b>	10 (4.61)	13.46 (7.76)	n.s.
<b>EDI_MF</b>	12.33 (6.18)	12.17 (7.47)	n.s.
<b>EDI_GPMC</b>	44.11 (27.13)	64.63 (37.28)	< .05
<b>FLS_NBS</b>	7.78 (2.91)	4.97 (3.61)	< .05

*Notes:* BMI= Body Mass Index; EDI\_DT = Drive for Thinness; EDI\_B = Bulimia; EDI\_BD = Body Dissatisfaction; EDI\_EDRC = Eating Disorder Risk; EDI\_LSE = Low Self-Esteem; EDI\_PA = Personal Alienation; EDI\_IC = Ineffectiveness; EDI\_II = Interpersonal Insecurity; EDI\_IA = Interpersonal Alienation; EDI\_IPC = Interpersonal Problems; EDI\_ID = Interoceptive Deficits; EDI\_ED = Emotional Dysregulation; EDI\_APC = Affective Problems; EDI\_P = Perfectionism; EDI\_A = Asceticism; EDI\_OC = Overcontrol; EDI\_MF =Maturity Fears; EDI\_GPMC = General Psychological Maladjustment; FLS\_NBS= Frontal Lobe Score- Neurobehavioural Scale.

**Table 5.** MCQ-30 mean scores

	Educational Level		Mann-Whitney test
	Low (N=9)	Medium/High (N=35)	
	M (SD)	M (SD)	<i>p</i> value
<b>MCQ_PB</b>	9.22 (2.68)	10.74 (4.25)	n.s.
<b>MCQ_NB</b>	10.56 (2.79)	11.94 (4.52)	n.s.
<b>MCQ_CC</b>	10.78 (2.28)	11 (4.35)	n.s.
<b>MCQ_NC</b>	9.67 (2.55)	12 (3.37)	n.s.
<b>MCQ_CSC</b>	17.11 (2.15)	17.46 (2.86)	n.s.
<b>MCQ_TOT</b>	57.33 (6.58)	63.14 (12.10)	n.s.

*Notes:* MCQ\_PB = Positive beliefs; MCQ\_NB = Negative beliefs; MCQ\_CC = Cognitive Confidence; MCQ\_NC = Control Thoughts; MCQ\_CS = Cognitive Self-Consciousness; MCQ\_TOT= Total score.

*Correlational analysis (Rhos)*

As it can be seen in Table 6 below, there were not significant coefficients correlation between Metacognition and BMI. Otherwise, the results of correlational analysis show significant associations between MCQ-30 and EDI-III.

A highly positive correlation was found between the EDI integrative psychological construct of “General Psychological Maladjustment” (EDI\_GPMC) and the total score of MCQ-30 (MCQ\_TOT  $r = 0.70$ ;  $p < .01$ ). Specifically, there was a positive correlation between EDI\_GPMC and the MCQ-30 subscales “Negative Beliefs about worry concerning uncontrollability and danger” (MCQ\_NB  $r = 0.61$ ;  $p < .01$ ) and “Need to Control thoughts” (MCQ\_NC  $r = 0.53$ ;  $p < .01$ ).

Moreover, the EDI psychological construct of “Overcontrol” (EDI\_OC) was significantly correlated with MCQ total score (MCQ\_TOT  $r = 0.60$ ;  $p < .01$ ), especially with the subscale “Need to Control thoughts” (MCQ\_NC  $r = 0.50$ ;  $p < .01$ ). In particular, the primary scale “Asceticism” (EDI\_A) was significantly correlated with the “Negative Beliefs” (MCQ\_NB  $r = 0.55$ ;  $p < .01$ ) and with the “Need to Control thoughts” (MCQ\_NC  $r = 0.51$ ;  $p < .01$ ) subscales.

The EDI psychological construct of “Affective problem” (EDI\_PA) was related to MCQ (MCQ\_TOT  $r = 0.59$ ;  $p < .01$ ). Specifically, the “Emotional Dysregulation” subscale (EDI\_ED) was positive correlated with “Negative Beliefs” (MCQ\_NB  $r = 0.51$ ;  $p < .01$ ) and “Cognitive Confidence” (MCQ\_CC  $r = 0.47$ ;  $p < .01$ ); the “Interoceptive Deficits” subscale (EDI\_ID) was positive correlated with “Negative Beliefs” (MCQ\_NB  $r = 0.49$ ;  $p < .01$ ) and with “Need to Control thoughts” (MCQ\_NC  $r = 0.55$ ;  $p < .01$ ).

The psychological construct “Interpersonal Problems” (EDI\_IPC) was also in correlation with Metacognition (MCQ\_TOT  $r = 0.39$ ;  $p < .01$ ), such as the “Maturity Fears” scale (EDI\_MF).

Furthermore, a positive correlation was found between the construct “Ineffectiveness” (EDI\_IC) and “Negative Beliefs” ( $r = 0.53$ ;  $p < .01$ ); in particular MCQ\_NB was related to the “Personal Alienation” primary scales (EDI\_PA  $r = 0.57$ ;  $p < .01$ ) and “Low Self Esteem” (EDI\_LSE  $r = 0.46$ ;  $p < .01$ ).

There were not significant coefficients correlation between EDI yield composite of “Eating Disorder Risk” (EDI\_EDRC) and MCQ-30.

**Table 6.** Correlational analysis between MCQ-30 and BMI, and EDI-III, and FLS.

	MCQ_PB	MCQ_NB	MCQ_CC	MCQ_NC	MCQ_CS	MCQ_TOT
<b>BMI</b>	-0.22	-0.22	-0.10	-0.06	0.03	-0.28
<b>EDI_DT</b>	0.04	0.23	-0.06	0.29	0.12	0.24
<b>EDI_B</b>	0.14	0.22	-0.02	0.29	0.16	0.22
<b>EDI_BD</b>	-0.13	0.11	0.12	0.08	0.07	0.05
<b>EDI_EDRC</b>	0.02	0.20	-0.01	0.24	0.11	0.18
<b>EDI_LSE</b>	<b>0.34(*)</b>	<b>0.46(**)</b>	<b>0.41(**)</b>	0.27	-0.10	<b>0.49(**)</b>
<b>EDI_PA</b>	<b>0.34(*)</b>	<b>0.57(**)</b>	<b>0.34(*)</b>	0.27	-0.13	<b>0.45(**)</b>
<b>EDI_IC</b>	<b>0.34(*)</b>	<b>0.53(**)</b>	<b>0.40(**)</b>	0.27	-0.14	<b>0.47(**)</b>
<b>EDI_II</b>	0.17	0.29	0.25	0.26	-0.24	<b>0.32(**)</b>
<b>EDI_IA</b>	0.10	0.27	<b>0.32(*)</b>	0.20	-0.04	<b>0.39(**)</b>
<b>EDI_IPC</b>	0.16	<b>0.33(*)</b>	0.29	0.25	-0.16	<b>0.39(**)</b>
<b>EDI_ID</b>	<b>0.46(**)</b>	<b>0.49(**)</b>	0.22	<b>0.55(**)</b>	0.00	<b>0.59(**)</b>
<b>EDI_ED</b>	<b>0.36(*)</b>	<b>0.51(**)</b>	<b>0.47(**)</b>	<b>0.38(*)</b>	<b>-0.30(*)</b>	<b>0.50(*)</b>
<b>EDI_APC</b>	<b>0.46(**)</b>	<b>0.54(**)</b>	<b>0.34(*)</b>	<b>0.51(**)</b>	-0.15	<b>0.59(**)</b>
<b>EDI_P</b>	<b>0.30(*)</b>	0.20	0.05	0.28	0.22	<b>0.38(**)</b>
<b>EDI_A</b>	<b>0.41(**)</b>	<b>0.55(**)</b>	0.20	<b>0.51(**)</b>	0.11	<b>0.57(**)</b>
<b>EDI_OC</b>	<b>0.46(**)</b>	<b>0.42(**)</b>	0.16	<b>0.50(**)</b>	0.21	<b>0.60(**)</b>
<b>EDI_MF</b>	<b>0.49(**)</b>	<b>0.50(**)</b>	0.21	<b>0.43(**)</b>	-0.01	<b>0.57(**)</b>
<b>EDI_GPMC</b>	<b>0.45(**)</b>	<b>0.61(**)</b>	<b>0.37(*)</b>	<b>0.53(**)</b>	0.00	<b>0.70(**)</b>
<b>FLS_DISC</b>	0.13	-0.07	-0.24	-0.07	-0.21	-0.17

Notes: MCQ\_PB = Positive beliefs; MCQ\_NB = Negative beliefs; MCQ\_CC = Cognitive Confidence;

MCQ\_NC = Control Thoughts; MCQ\_CS = Cognitive Self-Consciousness; BMI = Body Mass Index; EDI\_DT = Drive for Thinness; EDI\_B = Bulimia; EDI\_BD = Body Dissatisfaction; EDI\_EDRC = Eating Disorder Risk; EDI\_LSE = Low Self-Esteem; EDI\_PA = Personal Alienation; EDI\_IC = Ineffectiveness; EDI\_II = Interpersonal Insecurity; EDI\_IA = Interpersonal Alienation; EDI\_IPC = Interpersonal Problems; EDI\_ID = Interoceptive Deficits; EDI\_ED = Emotional Dysregulation; EDI\_APC = Affective Problems; EDI\_P = Perfectionism; EDI\_A = Asceticism; EDI\_OC = Overcontrol; EDI\_MF = Maturity Fears; EDI\_GPMC = General Psychological Maladjustment;

FLS\_DISC = Frontal Lobe Score Subscale "Language".

\* $p < .05$ ; \*\* $p < .01$ .

## Discussion

The current study aimed to explore the association between metacognitions, executive functioning, psychological needs and eating behavior.

The results from an increasing number of studies have suggested a link between obesity and poor cognitive performance and deficits in executive functioning (Sorensen, Sonne-Holm, Christensen, & Kreiner, 1982), while few studies have examined metacognitions in obese subjects (Hartley, 2013).

The absence of studies that examined the relationship between metacognitive beliefs, executive functions and BMI (Body Mass Index) took us to explore these aspects.

Results of Mann-Whitney test showed the difference of two sub-groups according to marital status and educational level. In all yield composite of EDI-III, except EDRC, was found a higher expression of psychological needs in singles than in engaged subjects. Regarding the educational level was found a higher BMI in subjects with a low education such as broadly reported in literature. This difference may be due to a metacognitive and executive functioning slightly compromise among people with a low educational level, as it is confirmed by higher scores in FLS\_NBS. This condition could not only have affected academic performances and success, but it may play a central role in eating behavior, reducing control in food intake. Future studies could explore our hypothesis.

Furthermore we hypothesized that metacognition could be associated with psychological features related to eating habits. Preliminary results confirmed our hypotheses.

Specifically, the study revealed positive and significant correlations between the negative beliefs about worry concerning uncontrollability and danger, the need to control certain type of thoughts and general psychological maladjustment. Especially affective problems, measured through EDI-III, were linked to metacognitive beliefs. So, we demonstrated that among subjects without any psychiatric disorder and without any specific eating disorder diagnosis (DSM-5; APA, 2013) metacognition plays a key-role in psychological adjustment.

Previous studies focussed on the association between dysfunctional metacognitive processes and eating disorders such as anorexia nervosa (Cooper, Grocutt, Deepak & Bailey, 2007), bulimia (Sassaroli et al., 2007) or binge-eating disorder (Hartley, 2013). We found that also in a non-

clinical sample metacognition was related to expression of affective and interpersonal problems. Indeed, no correlation was found between BMI and metacognition.

The results should be interpreted in the context of several limitations, including a relatively small sample size and the use of a non-parametric statistics for the analysis. Furthermore, it would have been necessary to use a more sensitive instrument to measure executive functioning and its underlying components to notice a significant correlation between EF and metacognition in people with bad eating habits.

Our research represents a preliminary study, so further studies focussing on metacognition, executive functions and obesity are needed to understand their complex relationship. Specifically, it would be necessary to conduct longitudinal and interdisciplinary studies.

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