Weight status and mental health in Italy: Evidence from EHIS2 microdata

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Weight status and mental health in Italy: Evidence from EHIS2 microdata

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Abstract

This paper tested the association between weight status (proxied by BMI) and mental health in Italy, using EHIS2 microdata, which provide the usual information (demographic, socio-economic, etc.), and also information on weight/height, and eight mental health variables (low interest, depression, sleep disorders, tiredness, eating disorders, sense of failure, low concentration, slow moving/speaking).

The empirical results show that there is a strong positive association between weight status and all mental health variables (except of slow moving/slow speaking) with an interesting gender difference in the association between weight status and sleep disorders and eating disorders in that females suffer more than males. Moreover, the empirical results reveal that between weight status there is: a negative association with a high level of education, a high source of income and a high type of dwelling; a positive association with the marital status, a poor social network to count on in case of difficulty and a high degree of urbanization. Finally, the empirical findings sustain that a) there is a positive association between weight status and health variables (chronic anxiety and chronic diseases) and b) the association between weight status and the living area is negative when Northern italian regions are taken into account.

The positive association between weight status and new emerging types of mental health problems such as sleep disturbances and eating disturbances suggests some considerations on the higher economic costs, at individual and social level, because of these new mental health problems associated to weight status. Moreover, the negative association between weight status and a high level of education suggests that educational policies could help individuals to raise barriers against obesity and sleep/eating disturbances associated to it.

Keywords: Human capital; Weight status; Mental health; Microeconometrics.

J.E.L. : J24; I12; I1; C20.

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1. Introduction

In recent years, weight status has played a peculiar role among a person's individual characteristics. The study of the causes and consequences of obesity has interested many scholars from different disciplines, including health care, sociology, psychology, and economics (Dixon, 2010; Assari, 2014; Puhl, 2011; Cawley, 2011, 2015).

More specifically, the association between obesity (proxied by Body Mass Index (BMI)) and mental health could be of great interest to economists because related disorders can be a source of negative economic consequences as, for example, in the case of increased work absences and/or lower productivity in the workplace due to weight status (Averett, 2011; Cronin et al., 2017). The negative consequences of high BMIs in young adults could be even worse, as this age group is still in its period of human capital accumulation, and obesity has negative effects on one's education (Crosnoe and Muller, 2004; Sabia, 2007; Barone and O'Higgins, 2010; Sabia and Rees, 2015; Barone and Nese, 2016, 2019; Barone and Barra, 2018; Tefft, 2018).

The Second Wave of the European Health Interview Survey (EHIS2), in addition to the usual information (demographic, socio-economic, etc.), provides information on weight/height and mental health through eight variables: low interest, depression, sleep disorders, tiredness, eating disorders, sense of failure, low concentration, and slow moving/speaking. Sleep and eating disturbances are relatively new mental health variables when compared to the more widespread ones, that is low interest, depression, and sense of failure.

Our empirical analysis relies on microdata drawn from EHIS2 and contributes to the debate on the relevance of the weight status-mental health link mainly because prior to the collection of EHIS2 microdata there were few data to analyze this link. First, it provides new evidence on it for Italy. Second, it investigates any potential gender differences in this association. Third, it investigates on socio-economic conditions of the individuals (i.e. educational attainment, employment status, income) that are expected to be associated to health, at both physical and mental levels. Fourth, it investigates also on socio-environmental conditions of the individuals (marital status, social network, degree

of urbanization, geographical area) that are expected to be associated to health, at both physical and mental levels.

This paper is structured as follows: in section 2, we will outline the literature on the association of obesity and mental health; in section 3 we will describe the data and variables; in section 4 we will focus on the association between the study variables and will present the main empirical findings. Discussion of the results and conclusions are in the last section.

2. Previous studies: A brief review of the literature

The World Health Organization (WHO) includes in the definition of health both physical and psychological components of well being (WHO, 1946). In this view health is positively defined as an individual's fitness.

According to the economic approach to health production (Grossman, 1972; 2000) individuals simultaneously produce both physical and mental health by combining their own time to healthy activities with market goods such as nutritious foods, medical care, etc. In this view, while health capital generally declines over time, individuals can alter the rate of decline by investing in their own health capital through health-related behaviours. Overeating, for example, leads to obesity contributing to a rise in the rate of decline of health capital.

 In the economic approach to health production, a great role is played by the socio-economic conditions of the individual, as underlined also by Fuchs (2004): better socio-economic conditions (i.e. educational attainment, employment status, income) are expected to be associated to better health, at both physical and mental levels even if there are difficulties in deriving robust scientific conclusions from these correlations or drawing policy decisions.

Before outlining the literature on the role of socio-economic conditions in the obesity–mental health link, it is worth noting that in this link *gender* has a key role. Some authors underlined that gender is expected to be positively associated to physical and mental health. Blehar and Oren (1995) show that women suffer from depression about

twice as often as men, while men seek help less than women and mask their depression with other lifestyle disorders. Costa-Font and Gil (2006) also found evidence of significant gender differences: depression and obesity in women is associated with household size and lifestyles, whilst depression in men is directly linked with the extent to which they are involved in personal interactions, their marital status, and their occupational attainment. Granberg (2011, p. 336) underlines that both longitudinal and cross-sectional research has shown that the association between obesity and depression is particularly strong among girls and that body dissatisfaction plays a role in this link.

As far as concerns socio-economic conditions, first we consider *educational attainment.* In the literature, there is evidence that educational attainment can have positive effects on health through the better health information that an individual can acquire through education (Kenkel, 1991); however, the level of educational attainment can have negative effects, as well, as highly educated individuals are relatively more exposed to higher mental health risks (Propper at al., 2005).

With respect to *employment status*, there is evidence in the literature showing that unemployed individuals could be relatively more exposed to mental health risks than employed ones (Farré et al., 2018).

Costa-Font and Gil (2006) found that *income* does not increase the likelihood of obesity and that socio-economic position plays a less important role than socio-environmental factors (especially family interactions) in explaining the obesity–depression association.

As far as concerns socio-environmental factors, we consider firstly tighter ones, such as *family interactions*; in the literature there is evidence that marriage leads to higher female obesity (Costa-Font and Gil, 2004); secondly, there are looser socio-environmental factors, such as the unemployment rate and work pressure (Ruhm, 2000), high food and restaurant prices (Chou et al., 2004), degree of urbanization, and geographical area that are expected to be associated to health, at both physical and mental levels.

From previous studies it is interesting to observe that:

a) historically, mainly depression received great attention, and that nowadays, as the EHIS2 Survey demonstrates, sleep disorders[1] and eating disorders are under analysis;

b) Costa-Font and Gil (2006) did not include an anxiety variable, but they captured it through smoking. According to Ferraro and Kelley-Moore (2003) obesity is associated with higher rates of physical disability and chronic disease, which can increase risk for depression. In the EHIS2 Survey, *chronic anxiety* and *chronic diseases* are explicitly considered as health variables and, as expected, they play a key role in the association with mental health.

c) in the EHIS2 Survey, besides marital status, there is an interesting variable (social network) revealing the role played by personal interactions in case of difficulty. This variable takes value 1 if the individual has a social network (individual could count on more than 2 people for personal problems), 0 otherwise (less than 2 people); as we will see, it will play a role in our analysis.

3. Data and Variables

The opportunity to study the association between weight status and mental health is provided by The European Health Interview Survey (EHIS)[2] microdata; in addition to the usual information (demographic, socio-economic, etc.), there are information on weight, height, and mental health variables. In the second wave of the EHIS (EHIS2), the Patient Health Questionnaire depression scale – PHQ-8 (Kroenke and Spitzer, 2002) – permits identification of individuals who presently suffer from depression. According to Kocjan and Lavtar (2016), this scale has a firm theoretical underpinning and

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[1] Quantity and quality of sleep have been recently analysed from an economic point of view by Akay at al. (2019).

[2] The European Health Interview Survey (EHIS) was developed between 2003 and 2006. It consists of four modules on health status, health care use, health determinants, and socio-economic background variables. EHIS targets the population aged at least 15 years and living in private households. The four modules cover the following topics: (1) Background variables on demography and socio-economic status such as sex, age, education, labour status, etc.; (2) Health status such as self-perceived health, chronic conditions, limitations in usual activities, disease-specific morbidity, physical and sensory functional limitations, etc.; (3) Health care use such as hospitalisation, consultations, unmet needs, use of medicines, preventive actions, etc.; (4) Health determinants such as height and weight, consumption of fruits and vegetables, smoking, alcohol consumption, etc. The European Health Interview Survey is run every five years. The first wave of The European Health Interview Survey (EHIS1) was conducted between the years 2006 and 2009 without any binding legal basis. The second wave (EHIS2) took place between 2013 and 2015 in all EU Member States, Iceland, and Norway, according to the Commission Regulation 141/2013 as regards statistics based on the European Health Interview Survey (EHIS).

represents a valid measure of depression, which it is also supported in research (e.g. Kroenke et al., 2009)[3].

There are several caveats to take into account using EHIS2 microdata: EHIS2 focuses on health as negatively defined, that is as the absence of illness; information on height and weight are self-reported[4]; BMI is only one of the indicators of obesity[5]; the eight mental health variables (low interest, depression, sleep disorders, tiredness, eating disorders, sense of failure, low concentration, slow moving/speaking) and health variables (chronic diseases and chronic anxiety) are self-reported; the data are cross-sectional. For these reasons, the association between weight status and mental health is very difficult to disentangle because of methodological problems (i.e. measurements problems, omitted variable bias and reverse causality) even if recently Amin et al. (2019) found for elderly individuals that BMI has an effect on mental health presenting a model using PGS (polygenic score) as instrument for BMI. Due to the unavailability of longitudinal observations, we analyse the correlation among weight status and mental health taking into account variables inspired by previous literature (that is individual characteristics, socio-economic and socio-environmental conditions of the individual). We are interested to underline that EHIS2 provides new and useful information in the study of the association between weight status and mental health variables. Moreover, our analysis could provide useful information for a better understanding of the widespread phenomenon of obesity.

Table 1 describes the EHIS2 variables used in our empirical analysis, while Table 2 reports the main statistics divided by all samples, gender, macro area and age class.

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[3]As underlined by Kocjan and Lavtar (2016), mental health is not only the absence of mental illness (*negative health*) but also the presence of an individual's fitness (*positive health*).

[4] About the problems due to over-reporting height and under-reporting weight see Danubio et al. (2008), Krul et al. (2011).

[5] Although this is the standard measure of obesity used ubiquitously throughout the medical, sociological and economic literature, it is not without its critics. For a discussion of the issues, see, for example, Burkhauser and Cawley (2008).

Table 1: Description of the Variables

Variables (N=15733)	Symbol	Description of the variables	Mean
Low Interest	LI	Variable taking value 1 if the individual has little interest or pleasure in doing things over the last 2 weeks, 0 otherwise	2,89
Depression	DEP	Variable taking value 1 if the individual feels down, depressed or hopeless over the last 2 weeks, 0 otherwise	2,89
Sleep disorders	SD	Variable taking value 1 if the individual has trouble falling or staying asleep, or sleeping too much over the last 2 weeks, 0 otherwise	6,70
Tiredness	TR	Variable taking value 1 if the individual feels tired or has little energy over the last 2 weeks, 0 otherwise	6,32
Eating disorders	ED	Variable taking value 1 if the individual has poor appetite or overeating over the last 2 weeks, 0 otherwise	2,35
Sense of failure	SF	Variable taking value 1 if the individual feels bad about himself/herself, feels being a failure over the last 2 weeks, 0 otherwise	2,13
Low concentration	LC	Variable taking value 1 if the individual has trouble concentrating on things over the last 2 weeks, 0 otherwise	1,83
Slow moving/speaking	SM_S	Variable taking value 1 if the individual has slow moving/speaking over the last 2 weeks, 0 otherwise	1,16
Unemployment status	UN	Variable taking value 1 if the individual is unemployed, 0 otherwise	12,39
Weight status	BMI	Variable taking value 1 if the individual is overweight (obese and overweight), 0 otherwise	42,80
Education level (low)	EDU (L)	Variable taking value 1 if the individual has low level of education (none, primary education, lower secondary education), 0 otherwise	38,93
Education level (med)	EDU (M)	Variable taking value 1 if the individual has medium level of education (upper secondary, post-secondary but not tertiary education), 0 otherwise	42,82
Education level (high)	EDU (H)	Variable taking value 1 if the individual has high level of education (tertiary education), 0 otherwise	18,24
Males	ML	Variable taking value 1 if the individual is male, 0 otherwise	48,88
Females	FM	Variable taking value 1 if the individual is female, 0 otherwise	51,11
Source of income (low)	SI (L)	Variable taking value 1 if the individual has low source of income (1° tertile), 0 otherwise	37,93
Source of income (med)	SI (M)	Variable taking value 1 if the individual has medium source of income (2° tertile), 0 otherwise	18,17
Source of income (high)	SI (H)	Variable taking value 1 if the individual has high source of income, 0 oth (3° tertile) erwise	43,89
Urban area (low)	URB (L)	Variable taking value 1 if the individual lives in thinly-populated area (low degree of urbanization), 0 otherwise	30,10
Urban area (med)	URB (M)	Variable taking value 1 if the individual lives in intermediate-populated area (medium degree of urbanization), 0 otherwise	42,87
Urban area (high)	URB (H)	Variable taking value 1 if the individual lives in a densely-populated area (high degree of urbanization), 0 otherwise	27,02
Social network	SN	Variable taking value 1 if the individual has a social network (individual could count on more than 2 people for personal problems), 0 otherwise (less than 2 people)	97,5
Marital status	MS	Variable taking value 1 if the individual is married, 0 otherwise	60,18
Chronic diseases	CD	Variable taking value 1 if the individual has chronic diseases, 0 otherwise	4,02
Chronic anxiety	CAN	Variable taking value 1 if the individual has chronic anxiety, 0 otherwise	2,97
Type of dwelling (low)	TD (L)	Variable taking value 1 if the individual lives in a low type of dwelling (low), 0 otherwise	4,01
Type of dwelling (med)	TD (M)	Variable taking value 1 if the individual lives in a medium type of dwelling (medium), 0 otherwise	80,28
Type of dwelling (high)	TD (H)	Variable taking value 1 if the individual lives in a high type of dwelling (high), 0 otherwise	15,69
25-34 age class	25_34_AC	Variable taking value 1 if the individual belongs to 25-34 age class, 0 otherwise	20,08
35-44 age class	35_44_AC	Variable taking value 1 if the individual belongs to 35-44 age class, 0 otherwise	25,43
45-54 age class	45_54_AC	Variable taking value 1 if the individual belongs to 45-54 age class, 0 otherwise	29,27
55-59 age class	55_59_AC	Variable taking value 1 if the individual belongs to 55-59 age class, 0 otherwise	12,97
60-64 age class	60_64_AC	Variable taking value 1 if the individual belongs to 60-64 age class, 0 otherwise	12,22
North-West	NW	Variable taking value 1 if the individual lives in North-West region, 0 otherwise	24,14
North-East	NE	Variable taking value 1 if the individual lives in North-East region, 0 otherwise	21,01
Centre	CT	Variable taking value 1 if the individual lives in Centre region, 0 otherwise	19,80
South	ST_IS	Variable taking value 1 if the individual lives in South region, 0 otherwise	35,03

*Source***:** own elaborations on the "EHIS2" microdata for 2015 wave.

Table 2: Descriptive Statistics of Variables divided by gender, macro areas and age class (values on percentage)

Variables	All sample	25-34	35-44	45-54	55-59	60-64	Females	Males	Northern Regions	Southern Regions	Territorial gap (Northern region – Southern region)
	N=15733	N=3160	N=4001	N=4606	N=2042	N=1924	N=8042	N=7691	N=7105	N=8628	
Low Interest	2,9	1,6	2,3	3,1	4,5	4,1	3,2	2,6	2,6	3,1	-0,5
Depression	2,9	1,7	2,3	3,1	4,5	3,7	3,1	2,6	2,5	3,2	-0,7
Sleep disorders	6,7	3,1	4,5	7,4	10,6	11,5	8,2	5,2	7,4	6,1	1,3
Tiredness	6,3	3,6	5,5	6,7	8,7	8,9	8,0	4,6	6,5	6,2	0,3
Eating disorders	2,4	1,5	1,8	2,8	3,3	2,8	2,9	1,7	2,4	2,3	0,1
Sense of failure	2,1	1,6	2,0	2,1	3,4	2,1	2,4	1,9	2,0	2,2	-0,2
Low concentration	1,8	1,1	1,5	1,9	2,9	2,4	2,1	1,6	1,8	1,9	-0,1
Slow moving/speaking	1,2	0,7	1,0	1,2	1,8	1,4	1,2	1,1	1,1	1,2	-0,1
Unemployment status	12,4	20,7	13,7	10,2	7,9	6,2	10,3	14,6	7,6	16,4	**-8,8**
Weight status	42,8	29,0	38,3	46,3	52,5	56,0	31,9	54,2	40,5	44,7	-4,2
Education level (low)	38,9	23,7	32,8	43,6	50,0	54,0	37,2	40,8	36,5	40,9	-4,4
Education level (med)	42,8	48,9	46,9	41,5	38,2	32,4	42,8	42,9	44,0	41,5	3,5
Education level (high)	18,2	27,4	20,3	15,0	11,8	13,6	20,0	16,4	19,1	17,5	1,6
Males	48,9	50,6	48,6	48,5	48,3	48,1	-	-	49,1	48,7	0,4
Females	51,1	49,4	51,4	51,5	51,7	51,9	-	-	50,9	51,3	-0,4
Source of income (low)	37,9	41,2	38,6	38,4	36.4	31,2	36,3	39,4	25,9	47,7	**-21,8**
Source of income (med)	18,1	18,0	18,8	19,5	16,0	15,9	17,6	18,6	18,7	17,7	1
Source of income (high)	43,8	40,6	42,4	42,0	47,4	52,8	46,0	41,8	55,2	34,5	**20,7**
Urban area (low)	30,1	30,4	29,6	29,1	31,3	31,7	31,1	29,1	29,4	30,7	-1,3
Urban area (med)	42,9	41,9	43,2	43,9	41,1	43,3	42,5	43,2	47,5	39,0	**8,5**
Urban area (high)	27,0	27,7	27,2	27,0	27,6	25,0	26,4	27,7	23,1	30,3	**-7,2**
Social network	97,5	97,7	97,9	97,3	97,1	97,1	97,6	97,4	98,3	96,8	1,5
Marital status	60,1	28,8	60,2	69,9	72,9	74,7	57,8	62,4	58,0	61,9	-3,2
Chronic diseases	4,0	1,3	2,9	4,5	6,6	7,0	4,9	3,1	3,9	4,2	-0,3
Chronic anxiety	3,0	1,0	2,0	3,2	5,3	4,9	3,7	2,2	2,5	3,4	-0,9
Type of dwelling (low)	4,0	4,2	3,5	4,1	4,2	4,3	3,7	4,3	3,4	4,5	-0,11
Type of dwelling (medium)	80,3	82,0	81,8	79,8	79,3	76,7	80,5	80,1	79,0	81,3	-2,3
Type of dwelling (high)	15,7	13,8	14,7	16,2	16,5	19,0	15,8	15,6	17,6	14,2	3,4

Source: own elaborations on the "EHIS2" microdata for 2015 wave; Northern regions: North-West (NW) + Northern East (NE); Southern regions: Centre (CT) + South + Islands (ST_IS).

For the sake of clarity and brevity, we only illustrate the statistics that consider the entire sample of individuals between 25–64 years (see Table 2, column 1). The statistics confirm that a low percentage of individuals (ranging from 1% to 6%) has mental health problems, and a low percentage (13%) declares to be unemployed. It is interesting to note that about 43% of individuals are overweight and experience obesity problems. Only 18% attained a high level of education, while 43% have a high family income. Most of individuals (43%) live in medium level of urbanization areas, while a very high

percentage of individuals (97.5%) declare that they have been helped by multiple persons (more than 2) with their personal problems, thus establishing very strong social networks. Finally, more than half of individuals assert to be married (60%), a very low percentage claim chronic anxiety and chronic disease problems (ranging from 3% to 4%), while the majority (80%) lives in medium-type dwellings.

The last column describes, for each variable, the territorial gap between Northern and Southern Italian regions; in the South there is a higher rate of individuals unemployed, obese, low educated, low income, married, living in an highly urbanized area and in a low/medium type of dwellings while in the North there is a higher rate of individuals with sleep disorders, with medium/high education, high income, living in a moderately urbanized area, and a higher social network.

4. Empirical Evidence: The nexus between weight status and mental health

As previously stated, our aim is to analyse the association between weight status and mental health.

Obese individuals differ from normal weight individuals in regards to their eating behaviour and sleep patterns and, as expected, we found a strong positive association between them, as reported in Table 3 (p.16). In other words, obesity problems are associated to sleep disorders and eating disorders. In the medical literature several papers investigate and find the link between obesity and sleep disorders (Danisi et al., 2019; Muscogiuri et al., 2019; Otsuka et al., 2019).

Moreover, we found also a strong positive association between weight status and the other mental health variables[6] (low interest, depression, tiredness, sense of failure, low concentration), except of slow moving/slow speaking. In the medical literature, Chu et al. (2019) show that obesity, besides physical consequences, has negative psychological

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[6] The eight mental health variables in EHIS2 are: (1) Little interest or pleasure in doing things over the last two weeks (low interest); (2) Feeling down, depressed, or hopeless over the last two weeks (depression); (3) Having trouble falling or staying asleep, or sleeping too much over the last two weeks (sleep disorders); (4) Feeling tired or having little energy over the last two weeks (tiredness); (5) Having poor appetire or overeating over the last two weeks (eating disorders); (6) Feeling bad about yourself, feeling like a failure over the last two weeks (sense of failure); (7) Having trouble concentrating on things, such as reading the newspaper or watching television, over the last two weeks (low concentration); (8) Noticeably moving or speaking very slowly, or being noticeably fidgety or restless, over the last two weeks (slow moving/speaking).

effects, including also depression, low self-esteem, stress and eating disorders, which are correlated with age and gender.

There is a positive association between weight status and education when the level of education is low while a negative one when the level is high. Higher education could have negative effects on weight status through better health information that an individual can acquire through education (Kenkel, 1991), but also through the higher income that education can ensure; in this case, for example, the individual can afford more expensive high-quality food. This result seems to confirm the protective role that education can have against obesity.

Gender plays a role because females have more mental health problems than males, as reported in most of the literature (Blehar and Oren, 1995; Costa-Font and Gil, 2006; Granberg, 2011).

The association between weight status and the source of income is positive for low source of income and negative for intermediate and high source of income. As said before, this result could be due to the role played by education.

The association between weight status and the degree of urbanization of the area where the individual lives is negative for low and intermediate degrees of urbanization, positive for high degree of urbanization. Usually urban environment encourages people to eat unhealthy (i.e. the growing availability of fast-food restaurants, Chou et al., 2004; Rashad et al., 2005) and not to do enough exercise (i.e. using cars, lifts, etc.)

There is a positive association between weight status and two socio-environmental variables: being married and having a poor social network to count on in case of difficulty. Costa-Font and Gil (2004) found that marriage leads to higher female obesity. The social network is an interesting variable because it reveals the role played by personal interactions in case of difficulty.

Moreover, weight status, as expected, is positively associated to health variables[7] (chronic diseases and chronic anxiety); there could be pathways through which obesity may increase risk for mental health: the higher rate of physical disability (chronic disease) and chronic anxiety.

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[7] It is worth recalling that Costa-Font and Gil (2006) did not have "anxiety" as variable but captured it through smoking.

The association between the weight status of the individuals and the type of dwelling (proxy of wealth of individuals) is negative in the case of high type of dwelling: in luxurious homes live individuals with lower weight status. This result is analogous to that associated to high education and high income.

Finally, considering looser socio-environmental variables, for the individuals it emerges a negative association between weight status and the living area (the North, that is North-West and North-East). This could be due to the better characteristics of the Northern regions of Italy compared to the Southern ones: a higher rate of individuals with medium/high education, high income, with a stronger social network and living in a moderately urbanized area.

5. Discussion of the results and Conclusions

This paper tested the association between weight status (proxied by BMI) and mental health in Italy, using EHIS2 microdata, which provide the usual information (demographic, socio-economic, etc.), and also information on weight/height, and eight mental health variables (low interest, depression, sleep disorders, tiredness, eating disorders, sense of failure, low concentration, slow moving/speaking).

The empirical results show that there is a strong positive association between weight status and all mental health variables (except of slow moving/slow speaking) with an interesting gender difference in the association between weight status and sleep disorders and eating disorders in that females suffer more than males. Moreover, the empirical results reveal that between weight status there is: a negative association with a high level of education, a high source of income and a high type of dwelling, proxy of the individual's wealth; a positive association with socio-environmental variables: marital status, the poor social network to count on in case of difficulty and a high degree of urbanization, proxy of obesogenic environment

Finally, the empirical findings sustain that a) there is a positive association between weight status and health variables (chronic anxiety and chronic diseases) and b) the association between weight status and the living area is negative when Northern italian regions are taken into account.

The positive association between weight status and new emerging types of mental health problems such as sleep disturbances and eating disturbances suggests some considerations on the higher economic costs, at individual and social level, because of these new mental health problems associated to weight status. Moreover, the negative association between weight status and a high level of education suggests that educational policies could help individuals to raise barriers against obesity and sleep/eating disturbances associated to it.

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	LI	DEP	SD	TR	ED	SF	LC	SM_S	UN	BMI	EDU (L)	EDU (M)	EDU (H)	ML	SI (L)	SI (M)	SI (H)	URB (L)	URB (M)	URB (H)	SN	MS	CD	CAN	TD (L)	TD (M)	TD (H)	NO
LI	1																											
DEP	0.5672***	1																										
SD	0.3157***	0.3514***	1																									
TR	0.4203***	0.4257***	0.4346***	1																								
ED	0.3297***	0.3536	0.3012	0.3537	1																							
SF	0.4318***	0.5245***	0.2982***	0.3569***	0.3304***	1																						
LC	0.4353***	0.4207***	0.2878***	0.3692***	0.2939***	0.4698***	1																					
SM_S	0.3875***	0.3803***	0.2358***	0.3133***	0.2743***	0.4029***	0.5015 ***	1																				
UN	0.0359***	0.0512***	0.0038	0.0017	0.0145*	0.0572***	-0.0002	0.0015	1																			
BMI	0.0164**	0.0283***	0.0302***	0.0340***	0.0285***	0.0245***	0.0192**	0.0107	-0.0116	1																		
EDU (L)	0.0474***	0.0605***	0.0473***	0.0328***	0.0247***	0.0386***	0.0453 ***	0.0406***	0.0497***	0.1351***	1																	
EDU (M)	-0.0192**	-0.0244***	-0.0177**	-0.0089	-0.0097	-0.0155*	-0.0149*	-0.0198**	-0.0257**	-0.0446***	-0.6910***	1																
EDU (H)	-0.0353***	-0.0452***	-0.0371***	-0.0300***	-0.0188***	-0.0290***	-0.0382***	-0.0260**	-0.0298**	-0.1134***	-0.3772***	-0.4088***	1															
ML	-0.0178**	-0.0143*	-0.0603***	-0.0697***	-0.0390***	-0.0156*	-0.0202**	-0.0070	0.0651***	0.2249***	0.0366***	0.0012	-0.0477***	1														
SI (L)	0.0136	-0.0045	0.0233**	-0.0007	-0.0002	-0.0038	-0.0086	-0.0038	-0.0706***	0.1460***	0.0226**	-0.0107	-0.0148*	0.4084***	1													
SI (M)	-0.0260**	-0.0114	0.0224**	0.0231**	0.0085	-0.0083	-0.0000	-0.0125	-0.1050***	-0.0528***	0.0627***	-0.0193**	-0.0545***	-0.4995***	-0.6164***	1												
SI (H)	0.0005	0.0072	0.0016	0.0136*	0.0021	0.0099	-0.0021	-0.0053	0.0030	-0.0403***	-0.0178**	0.0051	0.0159**	-0.0652***	-0.1708***	-0.1133***	1											
URB (L)	0.0284***	0.0244**	0.0034	0.0156*	0.0105	0.0226**	0.0137*	0.0075	0.0063	-0.0247**	-0.0867***	-0.0076	0.1191***	-0.0219**	0.0180**	-0.0345***	-0.0139*	1										
URB (M)	-0.0218*	-0.0215**	-0.0179**	-0.0221**	-0.0187**	-0.0077	-0.0125	-0.0024	-0.0191**	-0.0057	0.0123	0.0158**	-0.0357***	0.0074	-0.0022	0.0126	0.0237**	-0.5685***	1									
URB (H)	-0.0050	-0.0012	0.0165**	0.0085	0.0100	-0.0148*	-0.0003	-0.0051	0.0148*	0.0318***	0.0758***	-0.0098	-0.0833***	0.0144*	-0.0161**	0.0216**	-0.0120	-0.3994***	-0.5272***									
SN	-0.0483***	-0.0510***	-0.0162**	-0.0243**	-0.0212**	-0.0390***	-0.0301***	-0.0134*	-0.0257**	-0.0296**	-0.0337***	0.0104	0.0292***	-0.0051	-0.0344***	0.0211**	0.0094	-0.0123	0.0110	0.0004	1							
MS	0.0020	-0.0049	0.0519***	0.0159**	-0.0048	-0.0078	0.0055	0.0161**	-0.0868***	0.0662***	0.1029***	-0.0491***	-0.0670***	0.0255**	0.0846***	-0.0007	-0.0342***	-0.0092	0.0198**	-0.0125	-0.0017	1						
CD	0.3375***	0.4463***	0.3035***	0.3307***	0.2427***	0.3525***	0.3006 ***	0.2602***	0.0438***	0.0369***	0.0709***	-0.0299***	-0.0513***	-0.0441***	-0.0041	0.0159**	-0.0060	0.0189**	-0.0051	-0.0139*	0.0321***	0.0247**	1					
CAN	0.2968***	0.3481***	0.2735***	0.2798***	0.2020***	0.2982***	0.2853***	0.2268***	0.0066	0.0321***	0.0538***	-0.0248**	-0.0361***	-0.0437***	-0.0086	0.0164**	0.0040	0.0203**	-0.0152*	-0.0041	0.0326***	0.0117	0.5198***	1				
TD (L)	0.0026	0.0185**	0.0092	-0.0021	0.0212**	0.0159*	0.0043	0.0028	0.0244**	0.0277***	0.0613***	-0.0335***	-0.0345 ***	0.0153*	-0.0213**	-0.0144*	-0.0079	-0.0685***	-0.0147*	0.0871***	0.0138*	0.0031	0.0127	0.0156*	1			
TD (M)	0.0136*	0.0086	0.0084	0.0095	0.0027	0.0033	0.0047	0.0005	0.0385***	0.0223**	0.0778***	-0.0136***	-0.0808***	-0.0042	0.0275***	-0.0192**	0.0153*	0.0890***	-0.0231**	-0.0662***	0.0153*	-0.0212**	0.0131	0.0076	-0.4126***	1		
TD (H)	-0.0162**	-0.0193**	-0.0141*	-0.0092	-0.0142*	-0.0121	-0.0075	-0.0020	-0.0552***	-0.0392***	-0.1182***	0.0330***	0.1070***	-0.0037	-0.0186**	0.0288***	-0.0124	-0.0604***	0.0332***	0.0254**	-0.0241**	0.0215**	-0.0210**	-0.0166*	-0.0882***	-0.8710***	1	
NO	-0.0158**	-0.0224**	0.0263**	0.0045	0.0007	-0.0082	-0.0024	-0.0050	-0.1324***	-0.0421***	-0.0447***	0.0285***	0.0198**	0.0035	0.0420***	-0.0104	0.0741***	-0.0141*	0.0857***	-0.0809***	-0.0457***	0.0737***	-0.0073	-0.0243**	-0.0286***	-0.0284***	0.0465***	1

Notes: see Table 1 for more details about the description of the variables; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Correlation matrix for study variables (EHIS2).