Measure of body composition by MOC DEXA, in children and teenagers with eating disorders

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Summary. *Introduction:* Feeding has various characteristics and parameters including preferences of certain foods and eating habits, meal profile, regulation of the sense of hunger and satiety. In nutrition disorders (DCA) we find a constant alteration in the relationship between food and the individual with tendencies to hyper nutrition or as opposed to hypo nutrition. This can lead to the medium and long term compromising physical health and/or social psychic relationships. *Aim:* The aim of the study was to retrospectively examine a group of patients with DCA in order to analyze and characterize patients regarding their body composition, evaluated by MOC-DEXA, anthropometric parameters and hematochemical parameters. *Materials and methods:* The study included 28 patients (26 females and 2 males) of mean age of 13.6 years. The following parameters were analyzed for each patient: date of birth, origin, age at diagnosis, anthropometric parameters (weight, height, BMI), amenorrhea, quantification of physical activity, dose of 25(OH) vitamin D, MOC total body, left femoral muscle MOC, spine MOC and therapeutic pathway. Data was processed using excel programs and statistical analysis was performed using SPSS 15.0 for windows. *Results:* The sample examined shows that the starting age in about 50% of cases is between 13 and 14 years. The average height of patients was 156.1 cm, weight 43.8 kg and BMI of 17.8 kg/m2. Physical activity averaged 4.64 hours/week. Dosage of 25(OH) vitamin D was 25.4 ng/ml, while the therapeutic route consisted in the integration of dietary-nutritional, psychotherapeutic and pharmacological treatments. *Discussion and Conclusions:* The results of our study show that the severity of the disease correlates well with early onset. Our study shows that there are no menstruating patients with a weight below 43 kg, regardless of age and height. The weight t of 43 kg seems to be a true indicator to discriminate if there is or not amenorrhea. A further study with more patients is therefore necessary to confirm the data which, however, already well correlates with the clinical status of the patients.

Key words: MOC, eating disorders, anorexia, weight

Introdution

Feeding habits are influenced by various parameters such as attitudes, preferences, choices and food consumption, meal profile (number and composition), regulation of the sense of hunger and satiety. The term "eating disorders", refers to the type of control that patients act on feeding process (quality assessment, choice of foods, time of assumption) rather than the quantitative evaluation (energy intake, food composition protein, carbohydrate, fat, etc and total amount).

Nutrition disorders are characterized by persistent food disorder or nutritional behaviors resulting in altered consumption or absorption of food that signif-

icantly compromises physical health or psycho-social functioning (DSM-5) (1).

Although incidences of anorexia appear stable, whereas bulimia may be declining, the numbers of individuals receiving treatment have increased, but only about one-third is detected by healthcare; eating disorders are relatively common disorders that are often overlooked, although they are associated with high comorbidity and serious health consequences (2, 3).

Food Behavioral Disorders (FBDs) are therefore serious alterations to the relationship between a patient and food and constitute the "clinical core" of a severe psychic disorder resulting in a perennial "inner conflict" including the "phobia" of gaining weight, the negative feeling about food and "calories", the distortion of body image and the fear of "hunger" and its consequences (4). But eating disorders are far more than just a "food disorder". In addition to having an influence on eating behavior, they also involve other areas, such as a marked tendency to self-criticism and a distorted cognition of body weight and shape.

Weight control behaviors can cause serious alterations to the physiological functions of the body and also lead to psycho-social disturbances and FBDs are of primary importance not only in the nutritional but also in psychiatric field.

Food issues continue to be a drama for patients and their families as well as a challenge for clinicians and researchers. Many studies have dealt with this topic and not only from the clinical and psychopathological point of view, but also sociological, philosophical, and anthropological. And yet, most of the misunderstandings remain.

FBDs consequences involve many organs and apparatus (5) and in the care of these patents many figures are involved. The diagnostic evaluation program has been integrated multidisciplinary (Infantile Neuropsychiatry, Psychotherapist, Pediatrician, Endocrinologist, Psychologist, Nutritionist, Radiologist), according to the international guidelines (1) with the aim of proposing a treatment that was equally comprehensive and family-oriented.

Food behavior disorders, in particular nervous anorexia and nervous bulimia, are mental illnesses that involve serious somatic harm, with a risk of death twelve times greater than that of normal subjects of the

same age; They represent a very important socio-sanitary problem for all developed countries, and therefore also for Italy.

Nervous anorexia and DCA are the expression of a specific form of primary protein-energy malnutrition and are characterized by the severe alteration of body composition (reduction of both fatty mass and lean mass) due to a chronic decrease in energy inputs. In particular, fat mass was investigated very closely, which is the body compartment most affected by malnutrition.

The fat mass is reduced proportionally to the body mass index. Moreover, the distribution of body fat in the various anatomic sites is such that preference is maintained for the presence of visceral rather than subcutaneous. More complex are variations in lean mass, a compartment that includes tissues, organs, and apparatus with highly diversified metabolic functions and activities.

The results of our study indicate that the severity of the disease correlates significantly with early onset; The earlier the age of onset, the more serious is the compromise of weight and body composition, which results in a reduction in lean mass and bone mineral density

Aim

The aim of this study was to retrospectively analyze a group of pediatric patients affected by FBDs in order to analyze the characteristics of individual patients regarding their body composition, evaluated by the parameters obtained from the Dual Energy X-absorption (DEXA) studies and in particular their bone mass, lean and fat mass and in general the analysis of "Body Composition"; some hematochemical parameters aimed at evaluating the metabolic status of bone tissue as well as some physiological parameters and habits of daily life were evaluated as well.

Materials and methods

Retrospective study was conducted on 28 patients (26 females and 2 males), mean age of 13.6 years in the period 2010-2014 by critical analysis, evaluation of

clinical records and prior collection of informed consent.

The following parameters were evaluated by the analysis of clinic records:

- Anamnestic analysis collected by parents in order to evaluate the presence of risk factors and protective factors (hereditary and environmental) for the development and maintenance of a food disorder.
- Anthropometric measures particularly devoted to growth delay
- Electrocardiogram and cardiologic evaluation in order to evaluate the presence of bradycardia and cardiac failure.
- MOC (DEXA) in order to evaluate the bone mass reduction and body composition (bone, fat and lean mass).
- Abdominal US scan - Neuro -psychological test (assessment of the impact of nutrition on the cognitive functional processes, attentive processes, in homogenous groups matched by age)
- Psycho-diagnostic interview (diagnostic evaluation according to DSM-IV criteria)
- Nutritional assessment (malnutrition risk)
- Pediatric endocrinologist assessment in order to assess hypothalamic axis dysfunction (hypothalamic hypogonadism) and hormonal secretion change.
- Video recording of a family meal to identify management criticism and implementing strategies to override critical moments.

The following parameters were analyzed for each patient: date of birth, country of origin, age at the diagnosis, anthropometric parameters (weight, height, BMI), presence of amenorrhea, physical activity, 25(OH) Vitamin D plasmatic level, MOC Total-body (BMD at column and femoral neck, body mass, fat mass, total mass, fat%, therapeutic path (tab. 1).

DEXA protocol

The bone mineralization status was determined by the X-Ray Computed Mineral Bone Mineralometry (MOC DEXA) (6).

Computed Bone Mineralometry (MOC) with DXA (Dual X-ray Absorptiometry) technique is the examination that measures the bone mineral content (BMC) and the bone mineral density (BMD).

DEXA is a technology based on a very low dual-energy X-ray emission; by a computerized analysis of attenuation coefficient it measures both the amount and the density of mineral salts (calcium salts) contained in the examined region of skeleton (column and femoral non-dominant neck), and the amount of different tissues such us fat mass and lean mass evaluated during a total-body scan. Results are expressed both in absolute terms (gr and gr/cm^3) and in relation to a population of people matched by age, sex and ethnicity (z-scores) following indications proposed by The International Society for Clinical Densitometry – Pediatric Official Position (7).

We compared the individual parameters analyzed among themselves to evaluate the presence of correlations and differences between groups.

After exclusion of the two male patients, two groups were analyzed: patients with amenorrhea (primary and secondary) (group A) and menstrual patients (group B).

The two groups were then compared to each other in order to identify any significant differences in the parameters analyzed.

Statistical analysis was conducted on a sample of patients with eating disorders and on 2 groups (patients with amenorrhea and menstrual patients).

The data analysis has taken into account:

1) personal and clinical data of patients: age, origin, weight, height, BMI, amenorrhea, physical activity, 25 (OH) Vitamin D.
2) body composition evaluated by MOC (DEXA).

Statistic analysis

The data was then processed using computerized databases (excell, SPSS).

A descriptive statistical analysis was conducted on the sample and on the 2 groups by computing the mean ± standard deviation.

For the comparison of the medians of the three independent samples, the following actions was done for each variable:

1) Control of distribution normality with the appropriate test (Shapiro-Wilk Normality test) and homogeneity of variances by test F:

• ANOVA application,

2) If the test results in a non-normal distribution and/or uneven homogeneity, the comparison is made on the medians by the Kruskal-Wallis test.

If the Kruskal-Wallis test results significant differences between the individual groups were evaluated using the Least Significant Difference (LSD) method.

For the comparison of the averages of paired samples, the following procedure was performed for each one variable:

• Applying Student's test for paired samples,

• If distribution is not normal Wilcoxon test application.

The association between quantitative variables was evaluated by simple linear correlation and the calculation of the coefficient of correlation r^2.

For each correlation, statistical significance was assessed for $p < 0.05$

The statistical processing of the results was done by SPSS 15.0 per Windows, version 15.0.1 (SPSS Inc. 2006)

Results

In the present study, 28 children were recruited, including 26 females and 2 males, aged between 8 and 16 (mean age: 13.6 years, DS 1.99), with eating disorders.

The sample examined shows that the starting age of 13 to 14 years represents approximately 50% of the cases examined.

The area of origin of the patients concerned only the Lombard region territory so distributed: Milan: 14 patients, Milanese hinterland: 11 patients, other provinces: 3 patients.

The average anthropometric parameters were as follows: Height 156.51 cm (s.d. ± 9.24), Weight 43.77 Kg (s.d. ± 8.57), BMI 17.78 Kg/m² (s.d. ± 2.97)

As far as amenorrhea is concerned, excluding the 2 male patients, the breakdown of the patients was as follows: primary amenorrhea: 6 patients, secondary amenorrhoea: 12 patients, menstruating patients: 8 patients.

Average physical activity, expressed as weekly hours, was 4.64 hours (s.d. ± 4.04).

As the hematochemical parameter indicative of bone mineralization, the average dosage of Calcifediol or 25 (OH) Vitamin D was determined: 25.43 ng / ml (s.d. ± 8.13).

With regard to the therapeutic program, the following treatments have been set up, integrated according to the clinical conditions of the patients: dietary-nutritional, psychotherapeutic and pharmacological.

All the patients examined followed a therapeutic pathway associated with dietary-nutritional and psychotherapy; of these, 11 have integrated the pathway with pharmacological therapy.

Total Computer Computed Bone Mineralometry (MOC)

The analysis of body composition showed the following mean results: BMC (Bone Mineral Content): 1560.52 g (s.d. ± 340.44) Total mass: 41280.23 g (s.d. ± 10946.80) Lean Mass : 31073.57 g (s.d. ± 5465.83).

Fat Mass: 10056.20 g (s.d. ± 4157.84) Fat mass%: 23.46 (s.d. ± 7.59).

All data describing the characteristics of patients are shown in Table 1.

– Analysis of the characteristics of Group A (patients with amenorrhea)

The examined group is composed of 18 subjects aged between 8 and 16 (mean age: 13.4 years, s.d. ± 2.06).

Amenorrhea patients were further subdivided into: primary amenorrhea: 6 patients (23%), secondary amenorrhoea: 12 patients (46%)

The average anthropometric parameters were as follows: Height 155.11 cm (s.d. 9.33) Weight 40.23 Kg (s.d. ± 7.98) BMI 16.58 Kg/m² (s.d. 2.27)

The average physical activity, expressed as weekly hours, was 4.88.

As a hematochemical parameter indicative of bone mineralization, the average dosage of Calcifediol or 25 (OH) Vitamin D was determined: 27.60 ng / ml, s.d. ± 7.68.

As evidenced by the data, our sample has an average value of insufficient vitamin.

Table 1. Data base patients

sex	age years	residence	Exercise h/week	Early onset of the disorder	amenorrhea	Weight kg	Height cm	BMI	25(OH) Vit D ng/mL	BMC	Lean mass g	Fat mass g	Totas mass g	Fat %	Zscore femoral neck	Zscore vertebral column	Therapeutic route
m	21,5	Milan	6	15	N/A	61,4	158	24,6	22,9	2296	46179	14548	63023	23,1	>-2	<-2	D+P
f	18,7	Milan	10	16	NO	56,7	166,5	20,6	27,35	2056	35580	15086	52520	29,9	>-2	<-2	F+P+D
f	17,1	Milan	8	15	2a	51,2	165	18,8	25,7	1777	33288	11450	46520	25,6	>-2	>-2	D+P
f	18,5	Lodi	6	15	2a	51,2	173,5	17	36,09	2131	34984	9616	46700	21,6	>-2	>-2	F+P+D
f	15,0	Lecco	7	13	NO	51,1	157	17,3	17,43	1599	31817	14046	47460	30,6	>-2	>-2	D+P
f	19,0	Milan	0	15	2a	51	162,5	19,31	39,9	1516	35626	16383	50825	26,9	>-2	>-2	D+P
f	18,1	Rozzano	11	16	2a	50,6	153,5	21,44	29,92	1596	36796	8405	48800	18,6	>-2	>-2	D+P
f	18,0	Milan	2	16	NO	50,3	163	18,98	25,22	1730	30938	13175	45840	29,9	>-2	>-2	D+P
f	20,1	Milan	8	13	NO	50,3	155,5	22,3	4	1941,53	34719,7	14785,6	51446,7	28,7	>-2	>-2	F+P+D
f	16,1	Milan	0	14	NO	49,2	165	18,08	13,51	1474	29502	14689	45660	33,20	>-2	>-2	D+P
f	20,8	Milan	0	16	NO	47,6	165,5	16,9	22,3	1861	36020	9531	47413	20,10	>-2	>-2	F+P+D
f	16,9	Pavia	0	14	NO	47,2	159,5	18,58	27,4	1493	30474	11402	43300	27,20	>-2	>-2	D+P
f	19,5	Settimo Mil.	10	15	2a	44,9	150	19,9	24,6	1238	30011	12823	44070	29,90	>-2	<-2	F+P+D
f	13,2	Milan	3	10	NO	44,5	136	24	27,3	1046	21277	18641	40970	46,70	>-2	<-2	D+P
m	22,5	Rho	6	15	N/A	43,2	164,5	16	27,8	1697	35625	5069	42390	12,00	>-2	<-2	D+P
f	17,4	Rozzano	0	14	2a	43	161	16,5	33,75	1838	30892	5579	38000	15,30	>-2	>-2	F+P+D
f	15,7	Milan	10	13	1a	43	159	17	28,9	1305	30471	7432	39210	19,60	>-2	>-2	D+P
f	15,9	Abbiategrasso	10	14	2a	42,2	166	15,34	24,43	1705	31959	5071	38740	13,70	>-2	>-2	F+P+D
f	16,0	Milan	10	13	2a	41,5	152,5	18	36,59	1478	29993	6202	37670	17,10	>-2	>-2	F+P+D
f	19,1	Paullo	7	14	1a	40,6	153	17,35	19,6						>-2	>-2	
f	19,7	Casorezzo	0	13	2a	39	162	15	30,8	1497	29164	8421	3982	21,50	>-2	>-2	D+P
f	15,6	Milan	6	14	1a	37,7	154,5	15,6	21,84	1211	24850	8304	34370	25,00	>-2	>-2	F+P+D
f	19,5	Milan	0	14	2a	37	152	16,01	33,2	1250	26602	6940	34530	20,10	>-2	>-2	F+P+D
f	20,4	Milan	1	15	2a	35,8	156,5	14,6	12,46	1499	32176	8406	42080	20,70	>-2	>-2	F+P+D
f	16,5	Calvignasco	0	13	2a	33	150	14,7	31,09	1296	24561	4533	30390	15,60	>-2	>-2	D+P
f	14,4	Pieve Eman.	1	8	1a	29,2	136	15,8	19,9	914	22021	7264	30199	24,10	>-2	>-2	P+D
f	13,3	Rozzano	2	9	1a	27	140	13,7	14,9						>-2	>-2	D+P
f	18,0	Rozzano	6	12	1a	26,4	145	12,5	33,2	1129	22387	3660	27177	13,50	>-2	>-2	F+P+D
Average	17,7295		4,642857	13,52		43,7786	156,52	17,71	25,43142857	1577,76	31421,04	10312,1	41844,37	23,868			
s.d.	2,38758		4,047993	1,997352745		8,5709	9,2441	2,942	8,135836461	335,674	5277,342595	4029,27	10779,9	7,4676926			

The Total Body Computed Bone Mineralometry (MOC) for Body Composition Analysis showed the following average results:

BMC (Bone Mineral Content): 1461.27 g (ds ± 304.69) Total Mass: 37078.94 g (ds ± 11224.32) Lean Mass : 29736.31 g (ds ± 4560.22) Fat Weight: 8155.57 g (ds ± 3253.50) Fat Grass%: 20.55 Ds ± 4.85).

- Analysis of Group B characteristics (menstruating patients)

The examined group is composed of 8 subjects aged between 10 and 16 years (mean age: 14 years). The average anthropometric parameters were as follows: Height 158.5 cm (s.d. ± 9.95) Weight 49.61 Kg (s.d. ± 3.57) BMI 19.59 Kg/m² (s.d. ± 2.50).

Average physical activity, expressed as weekly hours, was 3.75.

The average plasmatic level of Calcifediol or 25 (OH) Vitamin D was : 20.56 ng / ml (s.d. ± 8.42).

The Total Body Computed Bone Mineralometry for body composition analysis showed the following average results: BMC (Bone Mineral Content): 1650.06 g (ds ± 321.55) Total Mass: 46826.21 g (ds ± 3846.63) Lean Mass : 31290.96 g (ds ± 4736.85)

Fat Mass: 13919.45 g (s.d. ± 2703.50) 30.78% (s.d. ± 7.48).

In the sample considered as a whole a correlation has been found between age of onset and BMI(r2: 0,45), age of onset and BMI (r2: 0,23) and age of onset and lean mass (r2: 0,56); on the other hand early onset and fat mass exercise and weight, exercise and lean mass, exercise and fat mass, exercise and total mass, exercise and BMI, exercise and Vitamin D, exercise and fat%, BMI and vitamin D were not significantly related.

When analyzing the two groups (amenorrhea and menstruated) amenorrhea patients showed a statistically lower weight (p = 0.021), lower BMI values: 16.58 versus 19.59 (p = 0.034), lower fat mass: 8.155 g versus 13.919 g (p = 0.008), lower fat per cent: 20.55% versus 30.78% (p = 0.004) and lower total mass: 37078.94 g versus 46826.21 (p = 0.023)

In our study we found a cut-off of weight corresponding to 43 Kg below which all patients had amenorrhea and above none did

Summary of results are shown in Table 2.

Discussion

The analysis of the general population showed a prevalence from the city, according to well kown ink between anorexia and social behavior in developed countries. In recent decades, in our society, there have been changes both at an economic and cultural level, there has been a considerable push for consumption and a lifestyle characterized by cult of body and physical beauty has been established. The cult for the perfect physicist then found in the mass media the main instrument of affirmation and television programs the place of a continuous chirping of the thinness indicated as a model of perfection. Anorexia is a disease that prevails in high-grade developed countries and high-grade social classes, almost exclusively in the female sex, although current research shows a widening of this pathology also among middle classes and workers classes (8); moreover in developing countries exposition to western culture cause an increase in the prevalence of the disease (9)

Self-Reported (by the Patient and family) physical activity, (mean 4.64 hours/week) is in agreement to Literature data.

Excessive and compulsive exercise (at least five times a week for one hour without stopping) and is a clinical feature common inn about 50% of patients with eating disorders and its prevalence is particularly high in those with Anorexia Nervosa. In most cases it is used to control or modify body weight and shape and to burn calories, but in a subgroup of patients also to modulate emotions. These patients show higher levels of dietary restriction, worries about weight and body shape, lower IMC and younger ages. Interestingly in our Patients physical activity is not related to body composition modification (as expecting in normal population) suggesting that our patient used this activity for psychological reasons rather than to directly control their weight; moreover it should be remembered that recording the total amount of physical activity is a relatively subjective data not controllable by operators

The level of vitamin D was insufficient in the sample considered as a whole. This data confirms the

Table 2. Comparison patients amenorrhea no /amenorrhea yes

residence	age years	Exercise h/week	Early onset of the disorder	amenorrhea	Weight kg	Height cm	BMI	25(OH) Vit D ng/mL	BMC	Lean mass g	Fat mass g	Totas mass g	Fat %	Zscore femoral neck	Zscore vertebral column	Therapeutic route
Milan	18	10	16	NO	56,7	166,5	20,6	27,35	2056	35580	15086	52520	29,9	>-2	>-2	F+P+D
Lecco	14	7	13	NO	51,1	157	17,3	17,43	1599	31817	14046	47460	30,6	>-2	>-2	D+P
Milan	17	2	16	NO	50,3	163	18,98	25,22	1730	30938	13175	45840	29,9	>-2	>-2	D+P
Milan	19	8	13	NO	50,3	155,5	22,3	4	1941,53	34719,7	14786	51446,7	28,7	>-2	>-2	F+P+D
Milan	15	0	14	NO	49,2	165	18,08	13,51	1474	29502	14689	45660	33,2	>-2	>-2	D+P
Milan	20	0	16	NO	47,6	165,5	16,9	22,3	1861	36020	9531	47413	20,1	>-2	>-2	F+P+D
Pavia	16	0	14	NO	47,2	159,5	18,58	27,4	1493	30474	11402	43300	27,2	>-2	>-2	D+P
Milan	12	3	10	NO	44,5	136	24	27,3	1046	21277	18641	40970	46,7	>-2	<-2	D+P
Rozzano	16	0	14	2a	43	161	16,5	33,75	1838	30892	5579	38000	15,3	>-2	>-2	F+P+D
Milan	15	10	13	1a	43	159	17	28,9	1305	30471	7432	39210	19,6	>-2	>-2	F+P+D
Abbiategrasso	15	10	14	2a	42,2	166	15,34	24,43	1705	31959	5071	38740	13,7	>-2	>-2	F+P+D
Milan	15	10	13	2a	41,5	152,5	18	36,59	1478	29993	6202	37670	17,1	>-2	>-2	F+P+D
Paullo	18	7	14	1a	40,6	153	17,35	19,6						>-2	>-2	
Casorezzo	19	0	13	2a	39	162	15	30,8	1497,29	29163,6	8421	3982,1	21,5	>-2	>-2	D+P
Milan	15	6	14	1a	37,7	154,5	15,6	21,84	1211	24850	8304	34370	25	>-2	>-2	F+P+D
Milan	19	0	14	2a	37	152	16,01	33,2	1250	26602	6940	34530	20,1	>-2	>-2	F+P+D
Milan	19	1	15	2a	35,8	156,5	14,6	12,46	1499	32176	8406	42080	20,7	>-2	>-2	F+P+D
Calvignasco	16	0	13	2a	33	150	14,7	31,09	1296	24561	4533	30390	15,6	>-2	>-2	D+P
Pieve Eman.	13	1	8	1a	29,2	136	15,8	19,9	913,65	22021,3	7264	30199,2	24,1	>-2	>-2	P+D
Rozzano	12	2	9	1a	27	140	13,7	14,9						>-2	>-2	D+P
Rozzano	17	6	12	1a	26,4	145	12,5	33,2	1129,45	22387	3660	27176,8	13,5	>-2	>-2	F+P+D

	age years	Exercise h/week	Early onset of the disorder	amenorrhea	Weight kg	Height cm	BMI	25(OH) Vit D ng/mL	BMC	Lean mass g	Fat mass g	Totas mass g	Fat %
t test		0,862106	0,19854181		2,22E-05	0,187954	0,000174	0,135812	0,055709	0,086142813	1,0156E-06	0,001762381	0,000283
Average no amenorrhea	16,375	3,75	14		49,6125	158,5	19,5925	20,56375	1650,066	31290,9625	13919,45	46826,2125	30,7875
Average yes amenorrhea	16,07692308	4,076923	12,76923077		36,56923	152,8846	15,54615	26,20462	1374,763	27734,17273	6528,38182	32395,28182	18,74545
s.d. no amenorrhea	2,669269563	4,026697	2,070196678		3,577085	9,957051	2,506128	8,424398	321,5562	4736,853034	2703,50473	3846,634765	7,484162
s.d. yes amenorrhea	2,253202849	4,192484	2,047512562		5,950964	8,643769	1,506113	7,83787	262,8705	3782,659357	1647,13501	10447,80855	3,990079
median no amenorrhea	16,5	2,5	14		49,75	161,25	18,78	23,76	1664,5	31377,5	14367,5	46626,5	29,9
median yes amenorrhea	16	2	13		37,7	153	15,6	28,9	1305	29163,6	6940	34530	19,6

poor nutritional status that affects bone metabolism resulting in osteopenia and osteoporosis, which are the most common complications in eating disorders. Moreover Vitamin D represents an important element to be added after starvation in recovering patients: a strong relation between Vitamin D levels and bone mass recovery has been demonstrated (10).

As shown in the Figures 1, 2, 3 a statistically significant correlation was found among the age of onset and weight, lean mass and bone mineral density but no correlation was found with fat mass; this means that the earliest is the onset, the greater the implications on weight and body composition, suggesting that the first areas to be affected are lean mass and bone tissue.

We know that weight loss involves lean mass loss resulting in decomposition and demineralization and fat loss with subsequent slimming and emasculation. Remember that the bone is part of the lean mass and is the first representative of the same, followed by the muscle.

FFM (Fat Free Mass, Lean Mass) and FM (Fat Mass) represent the percentages of lean mass and fat mass relative to the total weight of the subject; Under normal conditions the FM should not exceed 25% of the body weight, so the FFM should account for at least 75% of the total weight; moreover the % Fat was

about 30% (mean) and 11 out of 30 patients had a % fat above 25%-.

The relationship between FFM and FM is not only important for maintaining the basal metabolism level but is closely related to overall body hydration and its distribution.

Loss of lean mass and increased fat mass lead to a decrease in overall body hydration, and are related to the alteration of circadian rhythm of cortisol that, by altering glucid metabolism, leads to protein (muscular) degradation for production of amino acids useful for the synthesis of sugars (auto cannibalism of lean mass), and promotes the synthesis of adipose tissue; Lean mass loss is also associated with hormonal deficiencies (in particular growth hormone deficiency).

As for bone mineral density, we must point out that the period of maximum bone mass acquisition ranges from 11 to 18 years: during this period of rapid growth a boy or girl accumulates about 50% of their adult bone mass. The bone mass that reaches 20 years is about 90% of the maximum value that will be reached later. The remaining 10% is between 20 and 30 years, where, of course, the rate of mineral accumulation is much less intense.

Reaching a normal bone mass peak during the adolescence and the young adulthood is of crucial important mainly for developing of some age-related
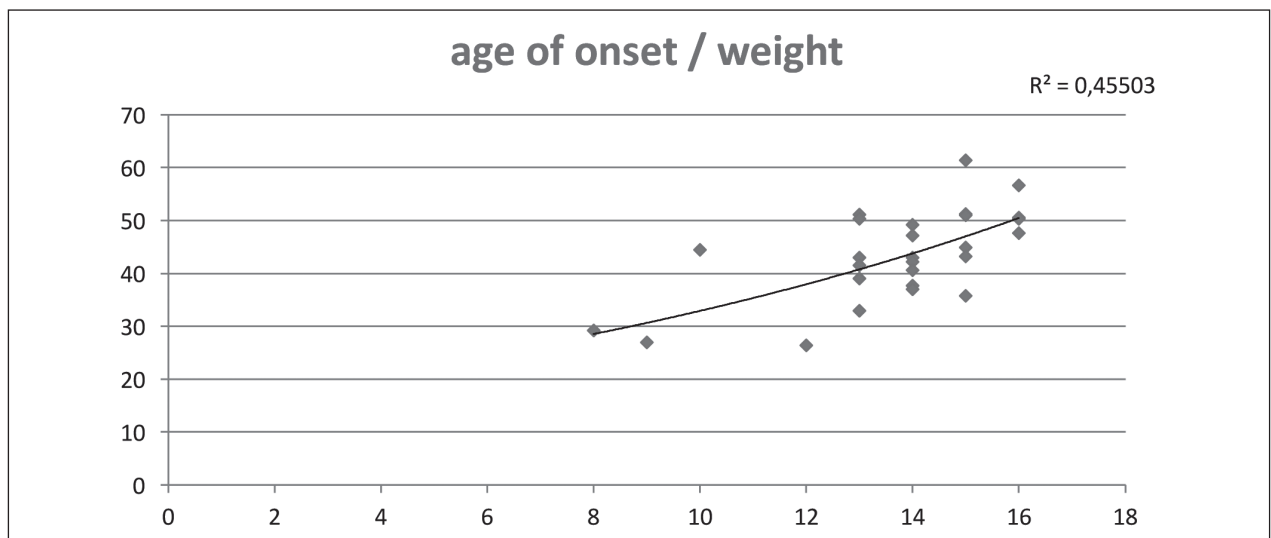

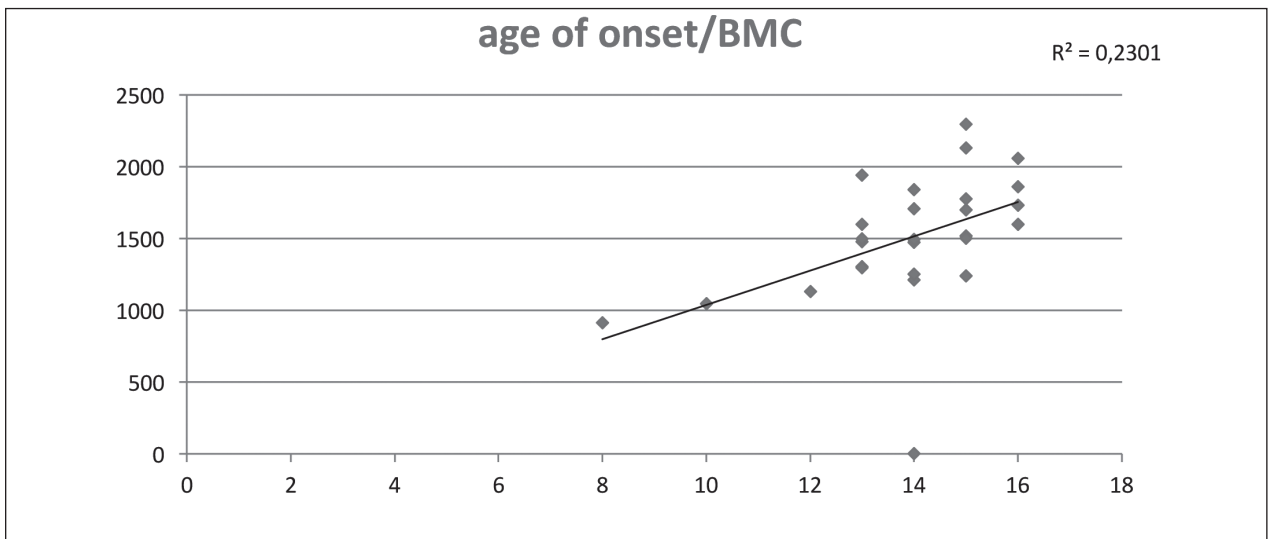**Figure 1.** Correlation age of onset/weight
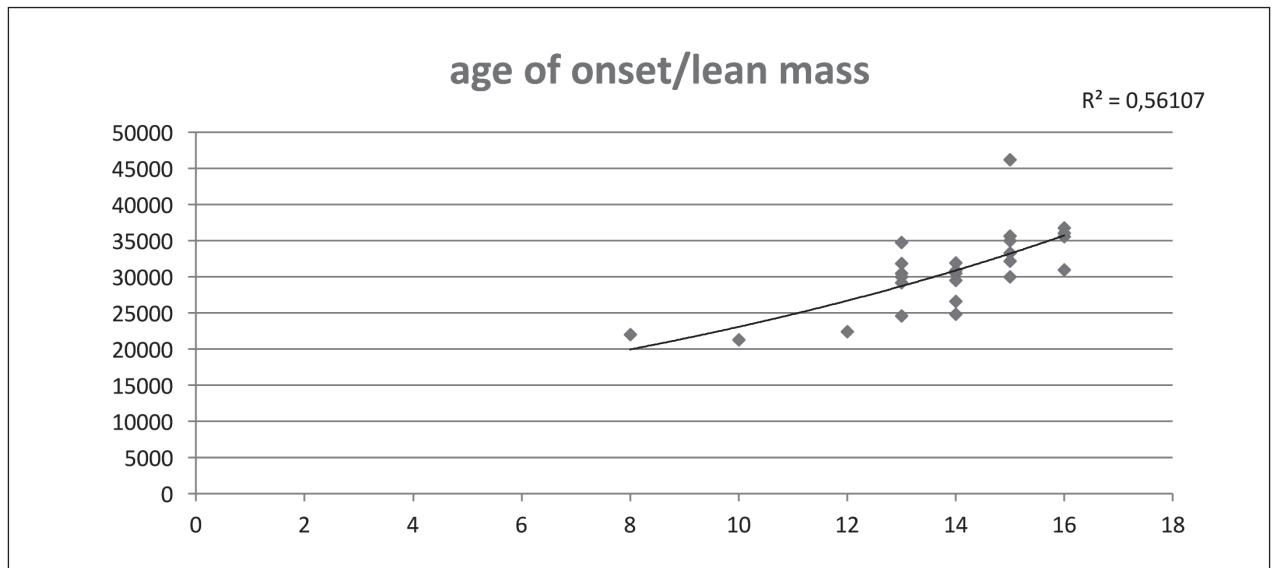
Figure 2. Correlation age of onset/BMC

Figure 3. Correlation age of onset/lean mass

pathologies such as osteoporosis which diagnosis and onset is related to the bone mass at peak (11).

Another parameter being analyzed is amenorrhea, which led us to subdivide our patient into two groups:

Group A: patients with primary and secondary amenorrhea

Group B: menstruating patients

Amenorrhea observed in patients with eating

disorders is termed "functional hypothalamic amenorrhea" and is characterized by:

1) reduced LH levels with reduced LH pulsation frequency;
2) elevation of cortisol levels, indicating hyperactivity of the hypothalamic-pituitary-adrenal system;
3) reduction of circulating levels of thyroid hormones with unchanged levels of TSH, indicat-

ing a lower thyroid axis reset to reduce energy consumption;

4) a reduction in the levels of insulin and glycemia and free IGF-1 as a result of the growth of IGF-1 binding proteins;

5) reduced leptin levels resulting from low fat content;

6) prolonged night-time production of melatonin, an epidemic of amenorrhea and thinness, but it is possible to alter some of the endocrine parameters.

Our patients with amenorrhea seems to have a most serious disease with respect to patients who didn't because they show a significantly lower body composition parameters and seems to show a discrete level (about 42 kg) of body weight as a "trigger" of this physiologic process: under this weight nobody had their period while all above this weight level did.

Although in the literature is know the role of body weight in defining the gravity of disease (12), and the possibility of recovery (13), to our knowledge this is the first evidence of a body weight cut-off for onset of amenorrhea

From literature, it has been found that women with anorexia with amenorrhea have a more severe bone remodeling than menopausal women. Also, from the available literature, it emerged that the recovery of the menstrual cycle in patients with anorexia occurred at an increase in percentile BMI (14).

In consideration of the relatively low number of observations, these findings deserve further confirmation in a wider sample and also considering the follow-up of these patients

Conclusion

Nervous anorexia is a systemic disease involving not only quantity but also quality of body composition; gravity of the disease is linked to age of onset but not to level of exercise in the contest of malnutrition/disnutrition marked by low Vitamin D levels; moreover patients presenting with amenorrhea tend to have a more serious disease, lower body composition indexes and in our patients we were able to identify a level of body weight acting as a switch on/off mechanism.

Due to intrinsic limitations of this study (relativity low number of patient, lacking of follow-up) further investigations are needed in order to confirm these findings.

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