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Which Training Strategy is most Effective for the Treatment of Binge Eating?

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The main aim of this study was to evaluate changes in attention level in response to different physical activity strategies for patients with binge eating and investigates the most effective type of training. Binge eating symptomatology is linked to attention disorders (ADHD) and motor activity is a constituent tool for their treatment. The variability of attention was used to determine the effectiveness of the sport training treatment, the physical activity protocols have been adapted for the patients in relation to their general health and emotional state. The medical team of "Villa Guerrini-Galantara" has created an open group dedicated to physical activity. The subjects were 15 and 52± SD years old, they were sedentary and volunteer to study. Attention levels were assessed at each training session with cognitive tests adapted from "Trail Making Test" and "The d2 Test" and named "T0-T1-T2-T3", before the training session (T+EX) and after the training session (EX+T). The research lasted 18 months and on the basis of the results obtained, a statistically significant difference emerges in in attention level compared to hypothesis (0.003<0.05p) and between the different types of training, which concerns only the administration of the first motor work protocol (P1). The physical activity protocol P1 seems to be a promising tool for enhancing therapeutic interventions.

Keywords: *attention, eating disorders, physical activity*

Introduction

The references in the scientific literature and cross-sectional studies have shown how the combination of Cognitive Behavioural Therapy combined with a training program can provide assistance for the interventional treatment for patients with eating disorders diagnosis, in particular on binge eating and weight reduction (Bakland et al. 2018, Mathisen et al. 2017, Myers et al. 2017, Pendleton et al. 2002, Vancampfort et al. 2014). The basis of this longitudinal study concerns the correlation between physical activity and uncontrolled eating disorder through a direct contact between patients and sports science graduates. The aim is the investigation on the relationship between physical activity, binge eating and level of attention. The research uses the same sample in each phase and investigates the reaction of the subjects, in cognitive terms, about different types of training (Albertz et al. 2018).

Binge eating belongs to the class of eating disorders, DSM-5 classifies binge eating disorder as having a psychic pathology according to which body, food and weight are the hallmarks (He and Cai 2017). The body is intended as a mean of

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manifestation of a deep inner suffering, food constitutes the object on which one depends, both by denying it and by abusing it and weight becomes an instrument of evaluation (Loriedo et al. 2002, Dingemans et al. 2019). These elements, in psychic food pathologies, act and interfere with each other. This represents an illusory "self-care", with the underlying intent of hiding a history of trauma or abuses suffered. Obsessive thinking about food becomes an anesthetic, which has the task of filtering a profound discomfort and, at the same time, becomes the only tool to express it (Fabrizio 2019).

The DSM-5 diagnostic criteria regarding binge eating disorder provide that binge eating must occur, on average, at least once a week for 3 months and that it must meet these aspects: eat much faster than normal; eat until you feel unpleasantly full; introduce large quantities of food, even if you don't feel physically hungry; eat alone because of the embarrassment created by the quantity of food introduced; experience a feeling of self-loathing, closely matched to depression and feel guilty feeling after the episode (Dalle Grave 2013). The most evident characteristic is the excessive introduction and consumption of food, followed by anxiety, depression, stress symptoms, inattentiveness, hyperactivity and impulsivity. The symptoms of inattentiveness, hyperactivity and impulsivity are shared and associated with ADHD and mediated by negative mood. Overall, the mood is unstable and in the worst case causes the abandonment of the treatment cures (drop-out phenomenon). ADHD and uncontrolled nutrition depend on each other, thanks to compensating mechanisms that attempt to control frustration and anxiety associated with attention and organizational difficulties and that produce lower levels of awareness and dependence on internal signals of hunger and satiety (Kaisari et al. 2018).

Behavioural treatments and therapies aimed at regulating mood and attention deficits can be particularly effective in the management of both ADHD and uncontrolled eating disorder and represent a transdiagnostic approach to resilience and mental health promotion programmes. For this reason, motor activity is a valuable tool among treatment therapies, thanks to the effect of natural analgesic able to modulate anxiety and stress states, improve mood and act as an immunostimulant (Di Pietro et al. 2019, Nieman 2007).

The research was carried out at the outpatient center dedicated to the treatment of eating disorders in the structure of "Villa Guerrini-Galantara". Each patient underwent the outpatient course of his reception in the clinic, the first, second and third specialist visits to end with group therapies (Palavras et al. 2017, Treasure et al. 2003). The fundamental idea at the base of the treatment process was to manipulate different types of training in order to avoid the possible effects of the disease, in a long-term perspective, often represented by a low self-esteem, low level motivation and poor concentration (Brewin et al. 2016). All patients performed one session per week. The research premise was based on the monitoring of ADHD levels characteristic of the binge eating disorder (Cortese et al. 2007, Seymour et al. 2015), through the administration of 4 tests concerning cognitive skills and the prescription, concurrently, of four different types of physical activity protocols, in order to evaluate the degree of attention in the individual subjects before and after the execution of training sessions (Brunault et

al. 2019). The research purpose expanded not only to the role that sport activity can play in relation to the attention level, but also to promote: regular physical activity; better ability to regulate emotions; relational skills of self-esteem and self-efficacy; a reduction in dysfunctional behaviour related to food; the acquisition of adequate feeding behaviour; an improvement in the relationship with the body image (Schlegel et al. 2015, Bratland-Sanda et al. 2012, Ruggieri et al. 2006).

Methodology

Patients and Study Design

The research lasted 18 months, the experimental group was 15 participants (12 were female, 3 were male), their mean age was 52. The experimental group (15 subjects) completed the research until the eighteenth month, the remaining part of the group (6 subjects) was excluded from the trial because it abandoned both the research and the therapeutic path of the outpatient center.

The subjects were selected by Galantara medical center team according to specific inclusion criteria: general medical history (subjects characteristics able to attend the group lessons, that the psychological conditions would have allowed, decided by the psychiatrist responsible for the structure), weight monitoring (by the dietician), medical certificate of sport fitness (it guarantees sports fitness and it is issued by a sports medicine specialist or general medical doctor) and binge eating diagnosis (by the psychiatrist responsible for the structure) (Ruocco 2017, Ministero della Salute 2013). The subjects were informed of the project and voluntarily joined by signing the informed consent.

The psychiatrist responsible for the structure has selected all the patients (with the inclusion criteria) who would join the project voluntarily and with an age of 18 and excluded minors deemed not yet suitable by the same to participate in the research. The participants must have experienced at least one year of group outpatient therapy and individual sessions before being admitted to the group dedicated to physical activity. They were mainly obese and suffer from various pathologies that add up to the eating disorder, furthermore they can be identified as extremely sedentary subjects with a rejection of physical activity, generally they did not take psychotropic drugs during the research (Gerlach et al. 2016).

Before participating in the research project the subjects carried out individual and group psychotherapy sessions. During the research the participants continued to carry out the psychotherapy sessions up to 12 months from the beginning of the research, continuing for the remaining 6 months to attend only the exercise lessons. The medical team considered the creation of a control group was not necessary in order to not exclude any patient from exercises practicing and to prevent the creation of complications among the participants in the psychotherapy groups already set up. In fact, subjects suffering from eating disorders see the body as an unknown object or an enemy, something not belonging to them. Therefore, the prescription of exercise has been calibrated to give space to a traumatized body to recover and to understand itself, without reducing the practice to a desperate

pursuit of weight loss, but to an essential activity, necessary both to the mental state and to the physical health (Davis et al. 1997, Selby et al. 2015).

Experimental Procedures

The selected patients were subjected to 4 tests (T0, T1, T2, T3). The tests investigate aspects of attention, visuo-motor and visuo-conceptual tracking and have been modified and combined with different motor protocols in order not to accustom the subject to compilation and to produce less subjective results possible in a long-term research period. The authors created and adapted the tests from internationally cognitive instrument used to assess both selective and sustained attention in a variety of clinical settings named "The d2 Test" and "Trail Making Test" (Bates and Lemay 2004, Casagrande et al. 2000, Bowie and Harvey 2006).

"Trail Making Test" or "TMT" is one of the most frequently used neuropsychological tests due to its ease of administration and sensitivity in detecting brain damage, it can be administered to people with attentional deficits from 15 years to over 70 (Amodio et al. 2002). Patients with emotional disorders tend to have a worse performance than emotionally stable people (Gass and Daniel 1990). In the TMT depression has the effect of slowing down the performance that interacts with the typical aging slow down, so much so that depressed elderly patients require more time to complete the testing of emotionally stable or depressed younger elderly subjects. "The d2-R" is the updated version of the test currently most used in Europe and the USA for the measurement of concentration skills, attention and speed of information processing. Specifically, it is a concentrated attention test, defined as the ability to maintain concentration during the selection of relevant stimuli or during a task that requires selective attention (Krumm et al. 2008). It applies in all those areas where it is important to detect the operation and integration of attention, concentration and speed (Steinborn et al. 2017). The tests, used and adapted, contain the following characteristics:

- Test T0 "Reading test" (associated with P1): the subject must find the errors present in the text, the maximum score is 30 errors, in a time equal to 3 and a half minutes.
- Test T1 "Dots" (associated with P2): the subject must connect dots to compose a figure representing an animal in the shortest time possible time.
- Test T2 "Finds the 20 differences" (associated with P3): it includes a facade in which there are two apparently identical images, however one contains 20 differences with compared to the other. The subject has to find as much differences as possible in a time defined by 3 and a half minutes.
- Test T3 "Compose the words" (associated with P4): The test comprises a set of letters inserted inside square composed of four lines and four columns. The composition of words is considered valid in all direction unless the same letter is not repeated in the same word. The letter to compose a word must be close to each other in order to draw an

imaginary line that crosses the same, all words are considered valid except proper names of people, things and places. The subject must perform the test by composing as many words as possible, according to the rules previously described in a time equal to 4 minutes.

Each test was submitted manually to patients before (T+ EX) and after the training session (EX+T). T0-T1-T2-T3 (EX+T) and T0-T1-T2-T3 (T+EX) were administered separately and therefore alternated weekly to have the same amount of data for both. The training lesson had a frequency of one session per week lasting one hour and a half. T0-T1-T2-T3 tests have been combined with P1-P2-P3-P4 protocols according to the achievement of the objectives of the motor protocols in a gradual manner, the subjects in question started from an absolutely sedentary lifestyle and it was necessary to achieve the objectives for all the protocols before proceeding to the next. The frequency, duration and type of the training protocols depended on the reaction of the subjects in their pathological and psychophysical individuality, the progresses achieved and the emotional state of the individual (Borino 2013, Zana 2014, Salvo et al. 2018).

- Protocol P1: breath learn as a form of relaxation and proprioception, distinguishing diaphragmatic or abdominal respiration from costal or thoracic (Cavaleri 2013, Cesarani and Alpini 1999, Giardini 2007); learn to diversify the stimuli from the various body districts, acquire the perception of the various body districts in space and time both in static and dynamic conditions; performing exercises aimed at muscle stretch, to flexibility and posture at low training intensity (Paillard 1992).
- Protocol P2: coordination improvement and decrease of muscle tension and fatigue by performing exercises deriving from Yoga and Pilates practice (Kendall et al. 2005, El Ghoch et al. 2013, Loudes 1980).
- Protocol P3: functional training preceded by the teaching of the proposed exercises; introduce cardiorespiratory exercises; perform complex exercises that involved multiarticular mobilization respecting the rhythm and breathing; recommend activities also in playful form as well with the inclusion of group games, of the basics of athletics, and volleyball (Barber et al. 2018, Bektaş 2019).
- Protocol P4: increase in strength, hypertrophy and muscular endurance through circuit training without overloads, in multiple series, high repetitions and with short breaks between medium intensity exercises (Carraro et al. 1998, Dingemans et al. 2017).

Statistical Method

The data were transcribed and collected manually in a database created with Microsoft Excel at the end of each training session. The Wilcoxon test (Divine et al. 2013) was conducted to examine the differences caused by the treatment in each study subject in the parameters of (EX +T) and (T+EX) in the domains of the T0, T1, T2, T3 tests. It was assessed between the beginning of the training session

and the final phase to analyze the trend of attention variables before and after the training session, Tables 1–5. In any analyses, P<0.05 was considered statistically significant. The probability value for trends has been set at a level of P <0.05.

Table 1. (a) *Ranks T0*

		N	Average rank	Sum of ranks
T0 (T+EX) - T0 (EX+T)	negative ranks	9[a]	5.89	53.00
	positive ranks	1[b]	2.00	2.00
	correlations	2[c]		
	total	12		

a.T0 (T+EX) < T0 (EX+T); b.T0 (T+EX) > T0 (EX+T); c.T0 (T+EX) = T0 (EX+T).Calculation, for each entity of the change, in the variable attention levels of T0 test data and rank all differences in relation to their absolute value. Sum of the ranks T0, in order to obtain the statistical test W.

Table 1. (b) *Test[a] Statistics T0*

	T0 (T+EX) - T0 (EX+T)
Z	-2.608[b]
Sign. asymptotic (two-tailed)	0.009
Sign. exact (two-tailed)	0.008
Sign. exact (one-tailed)	0.004
Point probability	0.003

a.Wilcoxon sign rank test; b. Based on positive ranks. Comparison with the value of W obtained with the distribution of the possible values of W and compared to the hypothesis P<0.05.

Table 2. (a) *Ranks T1*

		N	Average rank	Sum of ranks
T1 (T+EX) – T1 (EX+T)	negative ranks	4[a]	3.38	13.50
	positive ranks	1[b]	1.50	1.50
	correlations	1[c]		
	Total	6		

a. T1 (T+EX) < T1 (EX+T); b. T1 (T+EX) > T1 (EX+T); c. T1 (T+EX) = T1 (EX+T). Calculation, for each entity of the change, in the variable attention levels of T1 test data and rank all differences in relation to their absolute value. Sum of the ranks T1, in order to obtain the statistical test W.

Table 2. (b) *Test[a] Statistics T1*

	T1 (T+EX) -T1 (EX+T)
Z	-1.633[b]
Sign. asymptotic (two-tailed)	0.102
Sign. exact (two-tailed)	0.188
Sign. exact (one-tailed)	0.094
Point probability	0.063

a.Wilcoxon sign rank test; b. Based on positive ranks. Comparison with the value of W obtained with the distribution of the possible values of W and compared to the hypothesis P<0.05.

Table 3. (a) *Ranks T2*

		N	Average rank	Sum of ranks
T2 (T+EX) - T2 (EX+T)	negative ranks	7[a]	4.07	28.50
	Positive ranks	1[b]	7.50	7.50
	correlations	2[c]		
	total	10		

a. T2 (T+EX) < T2 (EX+T); b. T2 (T+EX) > T2 (EX+T); c. T2 (T+EX) = T2 (EX+T). Calculation, for each entity of the change, in the variable attention levels of T2 test data and rank all differences in relation to their absolute value. Sum of the ranks, T0 in order to obtain the statistical test W.

Table 3. (b) *Test[a] Statistics T2*

	T2 (T+EX) - T2 (EX+T)
Z	-1.474[b]
Sign. Asymptotic (two-tailed)	0.141
Sign. Exact (two-tailed)	0.164
Sign. Exact (one-tailed)	0.082
Point probability	0.016

a. Wilcoxon sign rank test; b. Based on positive ranks. Comparison with the value of W obtained with the distribution of the possible values of W and compared to the hypothesis P<0.05.

Table 4. (a) *Ranks T3*

		N	Average rank	Sum of ranks
T3 (T+EX) - T3 (EX+T)	negative ranks	2[a]	4.50	9.00
	positive ranks	4[b]	3.00	12.00
	correlations	0[c]		
	total	6		

a. T3 (T+EX) < T3 (EX+T); b. T3 (T+EX) > T3 (EX+T); c. T3 (T+EX) = T3 (EX+T). Calculation, for each entity of the change, in the variable attention levels of T3 test data and rank all differences in relation to their absolute value. Sum of the ranks T3, in order to obtain the statistical test W.

Table 4. (b) *Test[a] Statistics T3*

	T3 (T+EX) - T3 (EX+T)
Z	-0.314[b]
Sign. Asymptotic (two-tailed)	0.753
Sign. Exact (two-tailed)	0.844
Sign. Exact (one-tailed)	0.422
Point probability	0.078

a. Wilcoxon sign rank test; b. Based on positive ranks. Comparison with the value of W obtained with the distribution of the possible values of W and compared to the hypothesis P<0.05.

Table 5. (a) *Ranks TO (EX+T) and T1, T2, T3 (T+EX)*

		N	Average rank	Sum of ranks
T0 (T+EX) – T0 (EX+T)	negative ranks	9[a]	5.89	53.00
	positive ranks	1[b]	2.00	2.00
	correlations	2[c]		
	total	12		
T1 (EX-T) – T0 (EX+T)	negative ranks	6[d]	3.50	21.00
	positive ranks	0[e]	0.00	0.00
	correlations	0[f]		
	total	6		
T2 (EX-T) – T0 (EX+T)	negative ranks	7[g]	4.00	28.00
	positive ranks	0[h]	0.00	0.00
	correlations	0[i]		
	total	7		
T3 (EX-T) – T0 (EX+T)	negative ranks	4[j]	2.50	10.00
	positive ranks	0[k]	0.00	0.00
	correlations	0[l]		
	total	4		

a.T0 (T+EX) < T0 (EX+T); b. T0 (T+EX) > T0 (EX+T); c. T0 (T+EX) = T0 (EX+T); d. T1 (T+EX) < T0 (EX+T); e. T1 (T+EX) > T0 (EX+T); f. T1 (T+EX) = T0 (EX+T); g. T2 (T+EX) < T0 (EX+T); h. T2 (T+EX) > T0 (EX+T); i. T2 (T+EX) = T0 (EX+T); j. T3 (T+EX) < T0 (EX+T); k.T3 (T+EX) > T0 (EX+T); l. T3 (T+EX) = T0 (EX+T). Calculation, for each entity of the change, in the variable attention levels of T0 (EX+T) and T1-T2-T3 (T+EX) test data and rank all differences in relation to their absolute value. Sum of the ranks T0 (EX+T) and T1-T2-T3 (T+EX), in order to obtain the statistical test W.

Table 5. (b) *Test[a] Statistics TO (EX+T) and T1, T2, T3 (T+EX)*

	T0 (T+EX) - T0 (EX+T)	T1 (T+EX)- T0 (EX+T)	T2 (T+EX) - T0 (EX+T)	T3 (T+EX) - T0 (EX+T)
Z	-2.608[b]	-2.201[b]	-2.366[b]	-1.826[b]
Sign. Asymptotic (two-tailed)	0.009	0.028	0.018	0.068
Sign. Exact (two-tailed)	0.008	0.031	0.016	0.125
Sign. Exact (one-tailed)	0.004	0.016	0.008	0.063
Point probability	0.003	0.016	0.008	0.063

a. Wilcoxon sign rank test; b. Based on positive ranks. Comparison with the value of W obtained with the distribution of the possible values of W and compared to the hypothesis P<0.05.

Results

A total of 97 tests were performed at the end of the training session (EX +T) and 105 tests before the training session (T+EX). Patients received no special recommendations to avoid compromising results. The averages of the results of 4 different types of cognitive tests were reported (T0, T1, T2, T3). In table 6, extrapolated from the database created on Excel, the averages of the results were reported for each individual subject which have been identified with "n.1-15" to guarantee their privacy, divided by test, (T0, T1, T2, T3) according to the time of the execution: before training (EX+T) after training (T+EX). Absences have been

transcribed with a "-" symbol. Only the test averages belonging to T2 have been converted to decimals. Figures 1–4 show in graph the comparison of the results reported in Table 6, the graph belonging to Figure 5 shows the trend of the subjects who have participated at least three training sessions. Tables 7 show the results produced by the Wilcoxon test for each type of test. Tables 8 show the Wilcoxon test results in relation to T0 (T+EX) and T1, T2, T3 (EX+T).

Table 6. *Differences in Average Cognitive Tests*

Subjects	T0 (EX+T±T+EX)	T1 (EX+T±T+EX)	T2 (EX+T±T+EX)	T3 (EX+T±T+EX)
n.1	12±13.5	-	-	-
n.2	22.5±19.3	-	-	-
n.3	24.2±19	-	-	-
n.4	19.3±16.5	0.09±0.07	13.5±12	10±7
n.5	21±17	-	-	-
n.6	9.5±8	-	-	-
n.7	20.7±20.7	0.06±0.07	13.2±12	5.3±7
n.8	19±17	0.08±0.06	14.6±13.25	10±13.3
n.9	18.3±11	0.15±0.07	15±13.5	-
n.10	16±16	0.08±0.08	10.3±10	-
n.11	18.5±17	-	13±15	-
n.12	-	-	18±18	-
n.13	20±16.8	0.12±0.11	11.25±11.25	6±4
n.14	-	-	11±9	9.5±10.5
n.15	-	-	14±13	10.5±12

T0 (EX+T±T+EX) - first attention test (average of the administration test before the training session and after the training session); T1 (EX +T ±T+ EX) - second attention test (average of the test administration before the training session and after the training session); T2 (EX+T±T+EX) - third attentional test (average of the test administration before the training session and after the training session); T3 (EX+T±T+EX) - fourth attentional test (average of the test administration before the training session and after the training session); Abbreviations: T0 = first cognitive test; T1 = second cognitive test; T2 = first cognitive test; T3 = first cognitive test; EX+T = cognitive test done before physical activity T+EX =cognitive test done after physical activity.

Table 7. *Results of Wilcoxon Signed Rank Test*

Variable	n	Point Probability
T0 (T+EX) -T0 (EX+T)	12	<0.003*
T1 (T+EX) -T1 (EX+T)	6	0.063
T2 (T+EX) -T2 (EX+T)	10	0.016
T3 (T+EX) -T3 (EX+T)	6	0.078

*0.003 <0.05p; Abbreviations: T0 = first cognitive test; T1 = second cognitive test; T2 = first cognitive test; T3 = first cognitive test; (T+EX) = cognitive test done before physical activity (EX+T) = cognitive test done after physical activity.

Table 8. *Results of Wilcoxon Signed Rank Test T0 (T+EX) Correlated to T1-T3 (EX+T)*

Variable	n	Point Probability
T0 (T+EX) -T0 (EX+T)	12	*<0.003**
T1 (T+EX) -T0 (EX+T)	6	*<0.016***
T2 (T+EX) -T0 (EX+T)	7	*<0.008****
T3 (T+EX) -T0 (EX+T)	4	0.063

*(0.003<0.05p); **(0.016<0.05p); ***(0.008<0.05p). Each comparison is based on a different number of subjects.

Figure 1. *Trend of Attention Variables before (T+EX) and after (EX+T) the Training Session T0*

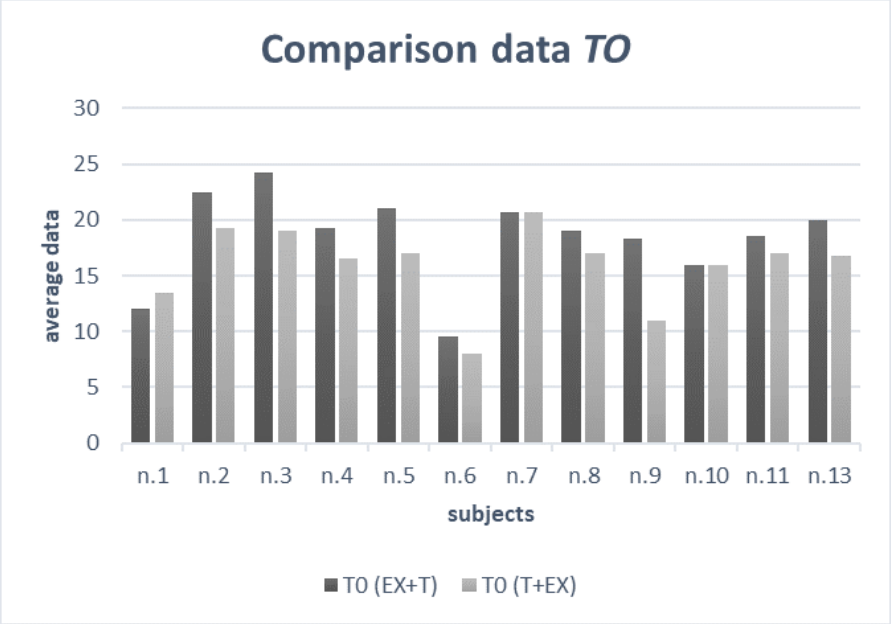


Figure 2. *Trend of Attention Variables before (T+EX) and after (EX+T) the Training Session T1*

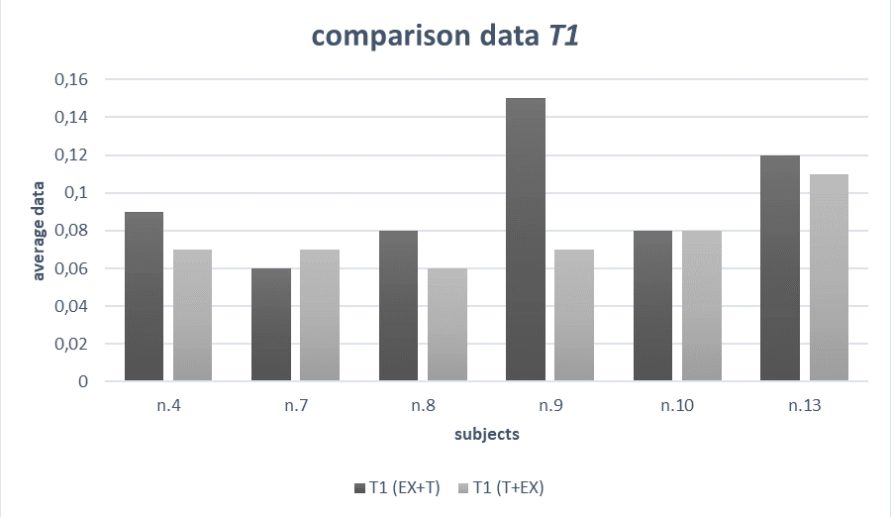


Figure 3. *Trend of Attention Variables before (T+EX) and after (EX+T) the Training Session T2*

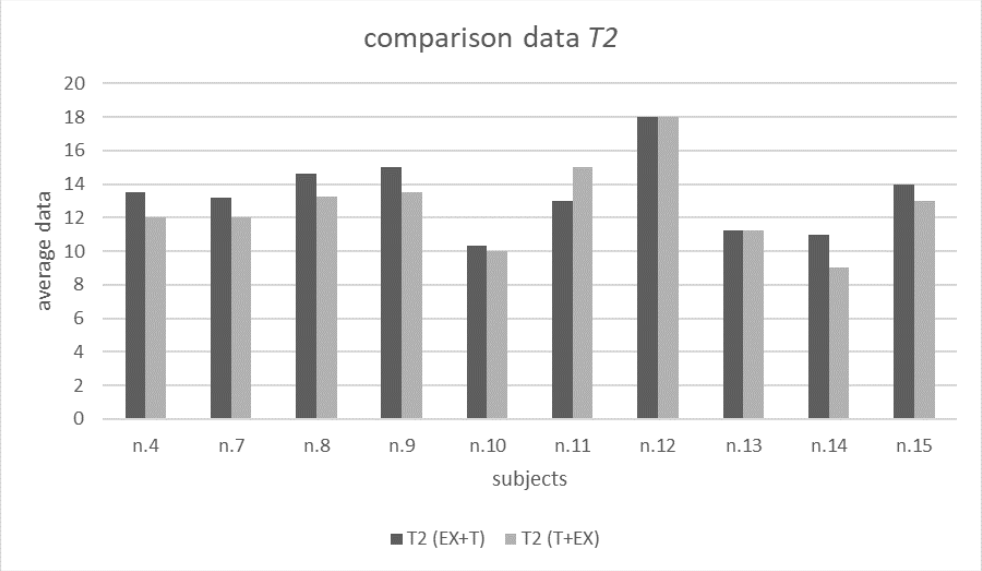


Figure 4. *Trend of Attention Variables before (T+EX) and after (EX+T) the Training Session T3*

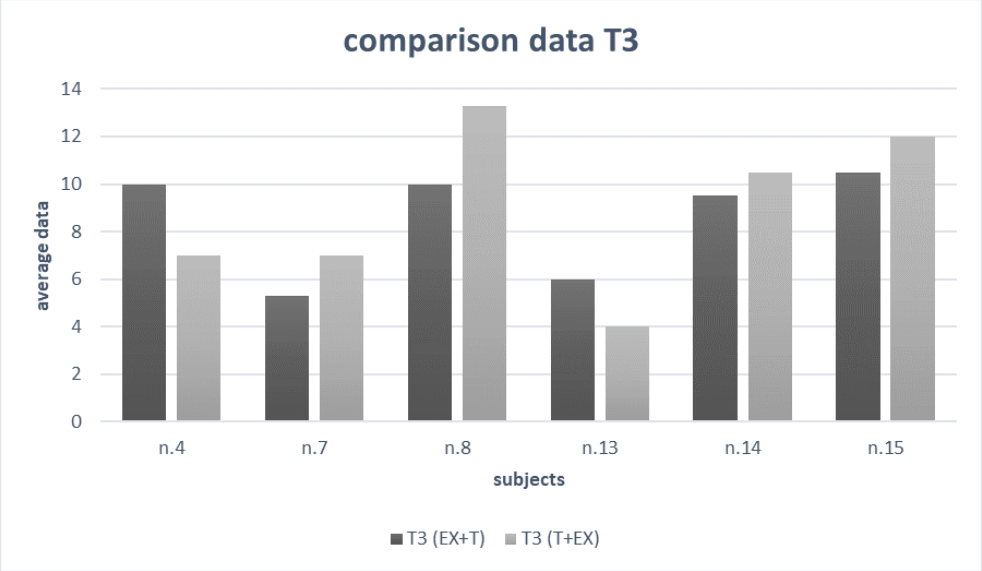
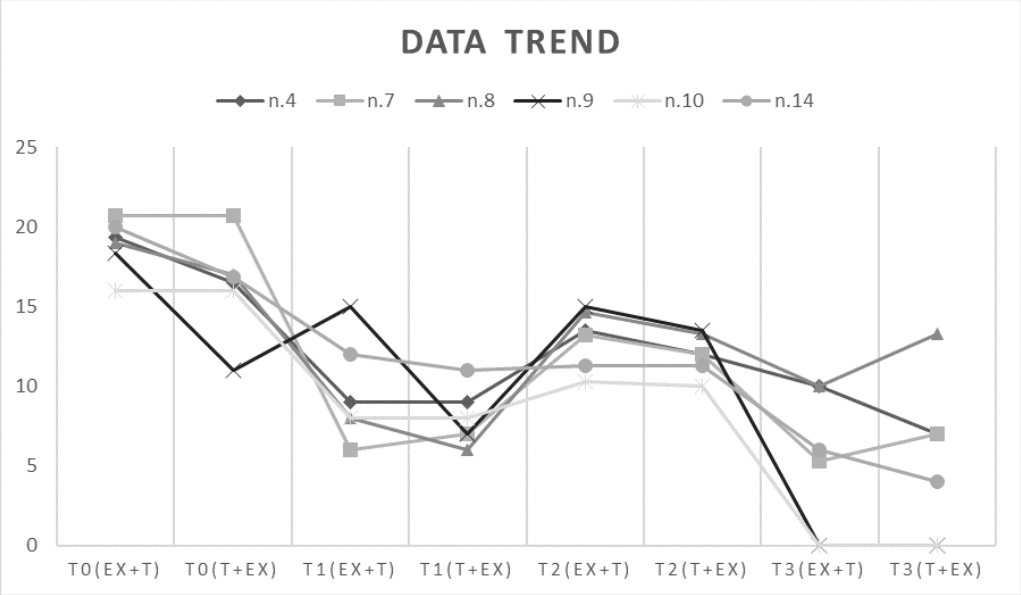


Figure 5. *Trend of the Subjects who have Participated at Least Three Training Sessions before (T+EX) and after (EX+T) T0-T1-T2-T3*



Discussion

The cognitive skills and attention improve through the performance of motor activities which may however not indicate a psychophysical condition necessarily positive to the different types of training. In the present study, low intensity training aimed at improving breathing and motor control is associated with excellent cognitive response and increased attention span (Colcombe and Kramer 2003).

The results divided by the 4 modules (T0, T1, T2, T3) have shown that the attention index, calculated by the variables (EX+T) and (T+EX), obtained through their combination with 4 different types of work protocols (P1, P2, P3, P4), change significantly depending on the type of training. The results of the T0 tests administered before (EX+T) and after the training session (T+EX) show that a statistically significant difference emerges (Table 6) (*0.003 <0.05p) which identifies the training of the P1 protocol positively relevant to the increase cognitive abilities, even if it contains, in the final phase, a data break-even (Figure 1) of the results between T0 (EX+T) and T0 (T+EX) interpreted as an indicator of habit with respect to the specific type of test.

The results of tests T1, T2, T3 do not reveal a statistically significant difference between the variables (EX+T) and (T+EX). Taking into consideration the comparison which is based on a different number of subjects of T0 (T+EX) with T1 (EX+T), T2 (EX+T), T3 (EX+T) we can affirm that, among the 4 cases who participated at least four sessions, there was no statistically significant difference between T0 (T + EX) and T3 (EX + T). Differences emerge instead between T0 (T + EX) and T0 (EX + T), between T0 (T + EX) and T1 (EX + T) and between T0 (T + EX) and T2 (EX + T) which demonstrate an increase in

long-term cognitive activity produced by the constant execution of motor activity (Table 3) *(0.003<0.05p) **(0.016<0.05p) ***(0,008<0,05p) (Figure 5). The heterogenic response to training has been linked to differences in the regulation of psychological factors, regarding the state of therapies, age, genetic and pathological factors (Hillman et al. 2006).

In our research, an increase in cognitive activity and attention span depending on the type of motor protocol occurred mainly during the sessions of the first working protocol used P1 and in the long term. On the contrary, the stasis in cognitive activity and the threshold of attention were more likely to be found in the exercise protocols that required greater muscle effort, therefore we suggest that the withdrawal from lessons of some group members and the fluctuating psychological conditions, regarding the performance for this specific disorder, have influenced the motivation and therefore the result produced by the motor activity of protocols P2, P3, P4. A more uniform assessment could be given using different tests to reach results less receptive to emotional states, ultimately making the data more objective with a larger sample number. The training sessions were carried out in a classroom equipped by the outpatient center and therefore in the absence of specific tools for motor activity, which certainly have contributed to make the lesson place welcoming but on the contrary, it has been not allow a more complete management of the exercise planning. The professional relationship with the subjects has been not always easy to manage the teaching in the various lessons, because of waivers or their sudden mood swings that have generated a customary number of drop-outs of motor practice (Linardon et al. Smith et al. 2018, Yager et al. 2014).

Conclusions

Despite the drop-out phenomenon by patients and their intermittent presence at the lessons, it can be stated that a long-term physical activity has a positive effect on the attention levels of patients with binge eating (Kramer et al. 1999) and the working protocol P1 is, for these patients, the therapy with greater quantitative and qualitative feedback. We believe motor activity could play a concrete role in the future as a constitutive tool in the treatment of binge eating through the creation of motor intervention protocols guaranteed in their effectiveness.

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