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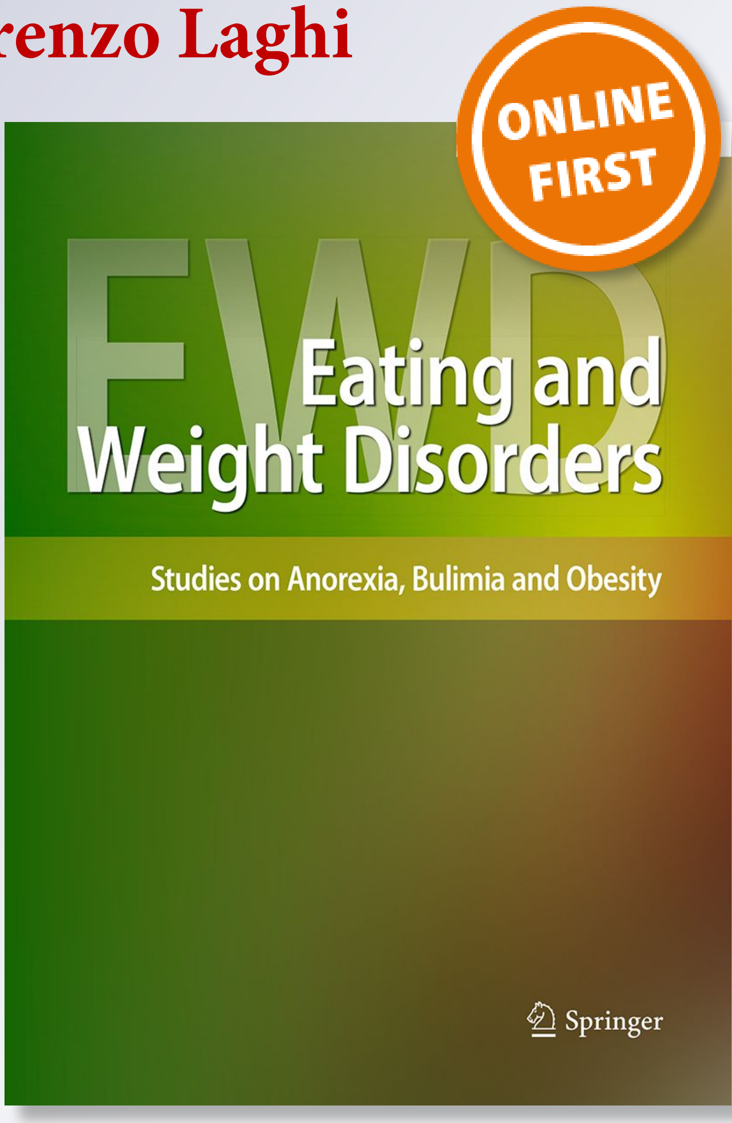

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BRIEF REPORT

Autonomic response to the Adult Attachment Projective in anorexia nervosa

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Abstract

Purpose Cardiovascular complications associated with anorexia nervosa (AN) are well recognized. Whether a wide array of studies has investigated autonomic nervous system (ANS) functioning at rest in people with AN, few is yet known on their reactivity ability during stress conditions. The aim of the current study is testing ANS reactivity to a stressful task activating attachment system among adolescents with AN.

Methods Heart rate (HR) and its variability, as derived by high-frequency-heart rate variability (HF-HRV), were continuously assessed while 13 AN patients and 12 healthy controls (HCs) responded to a set of attachment-related drawings (Adult Attachment Projective, AAP).

Results Findings showed that patients with AN displayed a stronger parasympathetic activity, as indicated by generally a lower heart rate (HR) during the entire task and a higher HF-HRV for drawings eliciting dyadic interactions compared to HCs.

Conclusion The study findings suggest a novel understanding of cardiovascular functioning in AN.

Level of evidence Level V, descriptive study.

Keywords Anorexia nervosa · Attachment · Heart rate · Heart rate variability · Adolescents

Introduction

Anorexia nervosa (AN) has been estimated to have the highest mortality rate of any psychiatric disorder [1] because of cardiovascular complications due to malnutrition, starvation, and the progressive loss of weight [2]. Cardiac abnormalities in AN are widely recognized among scientific community and a recent meta-analysis [3] has systematized this knowledge, revealing that bradycardia and QT interval prolongation constitute the main complications. Nowadays, a growing research attention is being paid to the autonomic function in patients with AN through the lens of Porges' polyvagal theory [4]. Porges emphasizes the existence of two different branches of parasympathetic nervous system (PNS), which mirrors the phylogenetic history of human development. Ventral vagal branch is myelinated, and its activation occurs when environmental cues are perceived as safe. Consequently, vagal brake is applied, and social engagement is promoted. Dorsal vagal branch is involved in facing with an intolerable shock. Behaviors as dissociation, shut down, or freezing reflect the activation of dorsal vagal branch. Threatening stimuli lead the activation of parasympathetic nervous system (PNS), which causes the inhibition of vagal tone and the engagement of behaviors finalized to survival (flight/fight). According to Friedman and Thayer [5], the hallmarks of vagal tone are the number of heart beats per minute, named heart rate (HR), and the short-term fluctuation of HR induced by parasympathetic part, labelled high-frequency-heart rate variability (HF-HRV).

Despite the lack of a large consensus among researchers, the majority of studies [6] have ascertained the impairments

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of autonomic nervous system (ANS) in AN, suggesting a dominance by parasympathetic nervous system (PNS) and a decreased modulation of sympathetic nervous system (SNS) under resting conditions. However, different response patterns have been observed when patients with AN are involved in physical or emotional tasks. Recently, Billeci and colleagues [7] demonstrated that during light physical activity, the trend of psychophysiological indices suggested a sympathetic activation among AN group; the opposite trend was observed for controls. Conversely, a meta-analysis [8] documented that the engagement in stress social tasks is associated with a lower HR and a reduced activity of SNS in patients with eating disorders compared to controls. More specifically on AN, Het and colleagues [9] demonstrated that patients with AN, compared to healthy controls (HCs), display a higher parasympathetic activity, as derived by lower HR and higher HF-HRV. This result confirms the tendency towards emotion over-regulation by anorexic patients.

It must be said that reactivity in AN has been investigated through traditional stress tests with the Tries Social Stress Test being the most used [10]. In the current study, we were interested in testing the cardiovascular reactivity to a stressful task activating attachment system in AN. Indeed, the attachment system is a motivational system interacting with ANS and is activated primarily in emotionally evocative situations that pose threats or elicit distress [11, 12]. As a consequence, and according to Diamond [13], deficits in attachment cause an ineffective emotion regulation, which influences hypothalamic–pituitary–adrenal (HPA) axis and ANS functioning. More recently, it has been demonstrated the influence of attachment on both HPA axis reactivity to stressors and basal HPA axis activity in AN as well as in other eating disorders [8, 14].

Attachment in adults is manly investigated through the instruments based on autobiographical narrative, first the Ault Attachment Interview [15], that require a long administration time. The Adult Attachment Projective (AAP) which has demonstrated an optimal convergent validity and reliability with the AAI allows assessing attachment style, the concept of agency of the self, and defensive processes (e.g., deactivation and segregated system) in line with Bowlby's conceptualization, overcoming problems of a long administration [16]. Past studies with the AAP [17–19] documented that patients with AN fail in adopting organized and coherent strategies to cope with attachment themes, such as separation, exploration, and closeness, preferring to maintain an avoidant and detached position or engaging in a confused and chaotic view. Unresolved and dismissing attachment patterns both appear predominant in eating disorder, especially for patients with AN. As documented in a review paper of Tasca and Balfour [20], attachment avoidance is manly observed in people with AN, who tend to down-play emotions. As a whole, these issues clearly suggest that the activation of attachment system constitutes for people with AN a very stressful event.

The aim of the present study was to verify differences in PNS stress responses between patients with AN and HCs. Armed with the understanding of the literature research, we expected to find a lower HR and a higher HF-HRV in patients with AN compared to HCs at both resting and during the stress task.

Methods

Participants

Thirty adolescents who were admitted in a day-hospital setting to child and adolescence clinical service specialized in the evaluation and treatment of Eating Disorders (Bambino Gesù Pediatric Hospital in Rome) were evaluated from May 2017 to November 2017. Among them, 13 (BMI: 16.28 ± 1.49 kg/m^2) were effectively enrolled in the study in accordance with inclusion criteria: (a) female gender, (b) restrictive-type AN diagnosis according to DSM 5 criteria [21], (c) age comprised between 13 and 17 years, (d) absence of severe physical condition, (e) no psychoactive substance use or medication that may impact on autonomic functioning, and (f) willingness to participate in the study and to express oral consent (parents' written consent was also required). All patients were assessed before entering a specific treatment program. They filled out the Eating Disorder Inventory 3 (EDI) [22] and the Eating Attitude Test (EAT-26) [23]. Medical parameters, psychiatric interview, and nutritional interview completed the assessment phase (for details, see 24). Only three patients with AN had comorbidity diagnoses: major depressive disorder ($n = 2$) and generalized anxiety disorder ($n = 1$). Patients diagnosed with intellectual disabilities, pervasive developmental disorders, schizophrenia spectrum disorders, or associated neurological conditions were not included.

Twelve healthy female adolescents (BMI: 20.07 ± 1.23 kg/m^2) matched for age (AN: 15.00 ± 0.91 years; HC: 15.33 ± 1.37 years; $t_{23} = 0.721$, $p > 0.05$) were recruited by a local advertisement and constituted the control group. They had no lifetime history of any eating and/or other psychiatric disorders. All participants were high school students. Written informed consent was obtained from the parents of all participants.

Experimental procedure

The study protocol consisted of a laboratory session. The participants were invited to seat and were instrumented for cardiovascular monitoring. The laboratory protocol began with an initial 5-min baseline period, followed by the experimental task. The session ended with a 5-min recovery period. The full procedure lasted about 30-35 min. All the participants refrain from alcohol, caffeine, medication, and heavy exercise for 2 h preceding the laboratory session. Specifically, all patients were tested before entering in specific treatment programs (e.g., medication or psychotherapy). This study was reviewed and approved by the Ethics Commission of the Department of Social and Developmental Psychology, Sapienza University of Rome. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Measures and psychophysiological assessment

To screen HC adolescents for eating and other psychiatric disorders, the Italian version of the Eating Disorder Inventory 3 [22] and the Symptoms Checklist-90-Revised [25] were administered. Attachment was assessed through the Adult Attachment Projective [16], a method of assessing attachment based on the analysis of responses to a set of attachment-related drawings. The individual is asked to make up a story for each picture. Three scenes depict potential attachment dyads; other scenes depict individuals as alone. Dyadic scenes allow analyzing the quality of dyadic synchrony, where secure individuals describe a mutual enjoyment relationship between the two characters of the table. The AAP allows distinguishing the four adult attachment patterns: Free organized patterns (secure-F; dismissing-Ds, and preoccupied-E) and one disorganized, labelled unresolved-U. For a broader examination, see George and West [16]. Inter-rater agreement between two independent judges trained and certified by Carol George was established on the basis of 75% of the interviews. For the current study, the agreement for secure vs. insecure classifications was 94.7% (kappa = 0.83), whereas that for the four major attachment groups was 84.2% (kappa = 0.77).

HR was continuously recorded (Bodyguard 2, Firstbeat) for the entire laboratory session. Following suggestions provided by Nunam, Sandercock and Brodie [26] on normative data for short-term measures of HRV, artifacts were checked and removed through Kubios HRV software [27]. HR and HF-HRV (milliseconds squared) were then obtained.

Statistical analyses

Data analyses were performed with SPSS (IBM). Because of the small sample size, non-parametric statistical analyses were used. Chi-square was performed to verify whether the distribution dealing with attachment patterns was different for the two groups. Friedman test followed by post hoc analysis with Wilcoxon signed-rank test was applied to verify change in HR and HF-HRV during baseline, task and recovery for the AN group and controls, respectively. The Mann–Whitney test was used to investigate the differences between the 2 groups on HR and HF-HRV at baseline, during attachment activation, and at recovery period.

Results

Attachment classification

No patients with AN held secure attachment representation, displaying a dismissing ($n = 5$), preoccupied ($n = 4$) or unresolved style ($n = 4$). Among HCs, half of them ($n = 6$) had a secure attachment status, whereas 3 classified as unresolved and 3 displayed a dismissing pattern. Because some categories had frequencies < 5, we were not able to use Chi-square to evaluate significant differences between the two groups.

Physiological responses to attachment assessment

As yielded by Friedman test, HR changed during the different phases of the study in both groups [for patients with AN, $\chi^2(2) = 14.923$, $p < 0.01$; for HCs, $\chi^2(2) = 10.500$, $p < 0.01$]. Specifically, the same trend was observed for the groups, in which HR significantly increased at task compared to baseline (for the AN group, $Z = -3.180$, $p < 0.001$; for the control group, $Z = -2.667$, $p < 0.01$) and later significantly decreased during the recovery (for the AN group, $Z = -2.970$, $p < 0.01$; for the control group, $Z = -2.667$, $p < 0.01$). As regards HF-HRV, a phase effect has been observed in both groups (for patients with AN, $\chi^2(2) = 8.769$, $p < 0.05$; for HCs, $\chi^2(2) = 10.500$, $p < 0.01$). However, post hoc analysis revealed a different trend for the groups. Among patients with AN, HF-HRV significantly decreased at task compared to baseline, $Z = -2.132$, $p < 0.05$, but during recovery, it increased compared to task but not in a statistically significant way, $Z = -0.874$, $p = 0.38$. Conversely, lower levels of HF-HRV during recovery were observed compared to baseline, $Z = -2.201$, $p < 0.05$. Among controls, HF-HRV at task significantly decreased compared to baseline, $Z = -2.776$, $p < 0.01$, and later significantly increased during recovery, $Z = -2.776$, $p < 0.01$.

A series of the Mann–Whitney tests revealed that HCs displayed higher mean values of HR at baseline, during attachment system activation—both considering the entire task and each scene (except for Bed scene where the same trend was also observed in both groups)—and at recovery compared to AN patients. The two groups did not differ in HF-HRV, except for two of the three dyadic scenes, with AN patients displaying higher mean values than HCs (Table 1).

Table 1 Descriptive statistics and significant effects in autonomic response at baseline, during the AAP, and at recovery

Autonomic response	HC $n = 12$	AN $n = 13$	U	p
Baseline period				
HR	77.14 (11.84)	62.35 (10.77)	29.000	0.008
HF-HRV	1363.90 (895.60)	1132.71 (936.30)	66.000	0.514
AAP				
Window scene				
HR	88.51 (13.45)	71.89 (14.15)	35.000	0.019
HF-HRV	557.41 (550.26)	707.76 (462.60)	58.000	0.277
Departure scene				
HR	87.52 (12.40)	71.25 (13.58)	32.000	0.012
HF-HRV	350.55 (282.92)	872.17 (532.48)	18.000	0.001
Bench scene				
HR	86.73 (13.46)	71.34 (13.22)	34.000	0.017
HF-HRV	356.57 (166.38)	585.01 (436.01)	60.000	0.328
Bed scene				
HR	85.96 (14.46)	71.76 (13.64)	43.000	0.057
HF-HRV	278.88 (178.57)	495.50 (317.02)	40.000	0.039
Ambulance scene				
HR	85.48 (12.99)	70.48 (11.73)	35.000	0.019
HF-HRV	502.21 (363.96)	576.73 (437.23)	74.000	0.828
Cemetery scene				
HR	85.22 (13.35)	70.60 (12.57)	35.000	0.019
HF-HRV	665.85 (626.43)	502.60 (310.12)	76.000	0.913
Corner scene				
HR	85.52 (12.44)	69.28 (12.17)	30.000	0.009
HF-HRV	311.08 (85.55)	803.86 (597.66)	45.000	0.073
Entire task				
HR	86.30 (13.10)	70.48 (12.97)	32.000	0.012
HF-HRV	308.22 (149.52)	486.77 (415.25)	7.000	0.967
Recovery				
HR	77.60 (12.56)	63.43 (11.27)	32.000	0.012
HF-HRV	1291.01 (790.88)	709.68 (537.72)	66.000	0.514

Discussion

The object of the present study was to investigate the cardiovascular reactivity in AN patients. Past research has already attempted to address this issue through traditional measures of stress [8]. The novel aspect of this study is constituted by the use of a test stressing attachment system. The high percentage of dismissing attachment status among patients with AN compared to HCs confirms that these patients try to cope with stress induced by attachment system activation through the attempt to shift their attention and to move from attachment need and emotions [16].

Compared to HCs, patients with AN displayed a stronger parasympathetic activity, as indicated by generally lower HR mean values during the entire laboratory session This finding is congruent with research dealing with the cardiovascular impairments, first bradycardia, and the high mortality risk among patients with AN. The parasympathetic/sympathetic imbalance with parasympathetic dominance is hypothesized by researchers to be an adaptation to deal with rigid diet, starvation, and malnutrition that characterize patients with AN [6].

Interestingly, patients with AN showed a delayed cardiovascular recovery, as indexed by HF-HRV, compared to controls. Specifically, among AN group, no significant difference in HF-HRV has been observed at task and during recovery period. Conversely, among controls HF-HRV decreased during the task to return to similar basal values during the recovery. Moreover, higher HF-HRV mean values were found in patients with AN compared to HCs only on two dyadic drawings, namely Departure and Bed scenes. Departure scene—in which an adult man and woman stand facing each other with suitcases positioned nearby—introduces a separation theme, whereas

Bed scene—whereby a child and woman sit facing each other at opposite ends of the child's bed—evokes the need to maintain proximity to an attachment figure. As it has been found by previous studies [19], AN patients fail in the describing the dyadic scenes in terms of mutual enjoyment relationship or an attachment activation and care. Perhaps, emotions recalled by interpersonal relation stimuli may be more scarcely regulated than emotions related to solitude, confirming the dismissing attitude of AN patients. Moreover, it is well documented an abnormal cognitive-emotional processing of interpersonal stress stimuli in people with eating disorders [8]. Altered stress responses have been also observed in patients with bulimia nervosa, showing a higher vagal activity and lower low frequencies than controls [28]. At the same way, patients with a diagnosis of major depression disorder show atypical or dysregulated HRV responses to both social and cognitive tasks, as indexed by HF-HRV when compared to healthy controls [29].

We know that our study is far from providing a deep understanding of psychophisiological mechanisms underpinning AN in adolescence. The low number of the participants represents the main delimitation of the current study which does not allow us to completely speculate on cardiovascular reactivity of patients with AN nor to get exhaustive conclusions. Nevertheless, emotional response to the AAP should deserve a specific focus in AN, going beyond the vagal reactivity. Our results dealing with autonomic function when attachment is activated are preliminary, and thus, more caution is required in the finding interpretation. As a whole, attachment appears to constitute a promising framework to shed light on cardiac impairments in AN. Future studies combining a psychophysiological perspective and a clinical perspective are needed to ascertain this issue and contribute to the development of new intervention programs. Moreover, comorbidity with other disorders, first depression and anxiety, in AN represents another important aspect because of their impact on cardiovascular functioning. In this study, the effects of comorbidity on the relation between attachment and vagal tone were not considered. Importantly, autonomic function is also influenced by the duration and the severity of symptoms in patients with AN. Thus, future research may test whether and how the link between attachment and vagal tone changes in the presence of different conditions or phases of recovery (e.g., onset of symptoms and relapse).

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval from the Research Ethics Board of the Department of Social and Developmental Psychology, Sapienza University of Rome was obtained before data were collected for the current study.

Informed consent The participants were underage (below 18 years). For this reason, written informed consents were obtained by their parents.

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