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A psychological intervention based on cognitive-behavioural therapy reduces psychopathological symptoms that indirectly influence the heart rate via cortisol in hypertensive patients: Preliminary results of a pilot study

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Abstract

Objective: This study aimed at assessing the effectiveness of cognitive-behavioural therapy (CBT) integrated with psychoeducation in a group of hypertensive patients with clinically significant psychopathological symptoms.

Methods: One hundred hypertensive patients completed the Symptom Checklist-90-Revised. Of them, 17 scored above the clinical range (cut-off = 0.75) on the Global Severity Index and were included in the study. Psychological distress was assessed again after the intervention (T1) and 6 months after the end of treatment (T2). In addition, the cortisol dosage and the heart rate (HR) measurement were collected at both T0 and T2. Then, mediation analyses were carried out to calculate whether psychopathological distress might predict HR through elevated serum cortisol levels, at both T0 and T2.

Results: The psychological intervention (CBT integrated with psychoeducation) reduced most of the psychopathological symptoms (anxiety, depression, somatisations, obsessions and compulsions, hostility, interpersonal sensitivity and paranoid ideation) but not cortisol dosage and HR measurement. However, psychological distress indirectly predicted HR via cortisol at T0 but not at T2.

Conclusion: These results suggest and encourage the replicability of data in larger sample sizes and the comparison with a control group. Nevertheless, these results highlight a need for a multidimensional assessment of disorders affecting the mental and physical spheres of patients to support their overall well-being.

KEYWORDS
clinical psychology, heart rate, hypertension, psychopathology, psychotherapy

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1 | INTRODUCTION

High blood pressure is a condition characterised by elevated blood pressure in the arteries, which is determined by the amount of blood being pumped by the heart and the resistance of the arteries to the blood flow. Blood pressure measurement is expressed through two values, systolic (maximum) pressure and diastolic (minimum) pressure, which depend on whether the heart muscle contracts (systole) and relaxes (diastole) between heartbeats (Al Ghorani et al., 2022; Rosendorff et al., 2007). The latest version of the National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure defined blood pressure of more than 140/90 mm Hg as hypertension. Consistent with this assumption, about 1 billion people live with hypertension globally, and the WHO claims that this number is going to reach 1.56 billion by 2025, covering about 30% of the world's population (Sarafidis et al., 2008). The value of hypertension depends on various factors, including (1) the contraction force of the heart; (2) the systolic output, the amount of blood leaving the heart at each ventricular contraction; (3) the heart rate (HR), the number of heartbeats per minute; (4) peripheral resistances, the resistances opposed to the circulation of blood by the state of constriction of small arterial vessels (arterioles); (5) the elasticity of the aorta and the great arteries; and (6) the euvolaemia, the total volume of blood circulating in the body (Riaz et al., 2021).

Hypertension risk factors include familiarity, age, overweight and obesity, diabetes, high blood sugar and hyperlipidaemia (Hamam et al., 2020; Whelton et al., 2018). However, specific behavioural factors such as physical inactivity, tobacco use, harmful alcohol use and inadequate diet are also linked to this disease (Riaz et al., 2021).

In turn, hypertension is the most considerable modifiable risk factor for cardiovascular events, including cardiac death, coronary artery disease, heart failure, and ischaemic or haemorrhagic stroke (Rosendorff et al., 2007), and, in general, it remains the most prevalent risk factor for all the cardiovascular diseases (GBD 2017 Risk Factor Collaborators, 2018). As a consequence, understanding how to prevent hypertension and its optimal treatment is crucial to reduce cardiovascular mortality and decrease both the disease and its socio-economic burden (Lee et al., 2019).

Additionally, psychological comorbidities have been associated with worse cardiovascular outcomes (Nicholson et al., 2006; Özpelit et al., 2015; Roest et al., 2010). Data from the 2005 National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey showed that up to 32.5% of outpatients presenting for anxiety treatment had unrecognised elevated blood pressure measurements, in comparison with 24.6% of all outpatient visits (Player et al., 2008). Subsequent studies found that anxiety related to chronic stress modulated a sympathetic firing pattern that activated the sympathetic nervous system and the hypothalamic–pituitary–adrenal (HPA) axis in patients with metabolic syndrome, resulting in increased blood pressure (Lambert et al., 2010). As a consequence, patients with chronic medical conditions such as hypertension may develop negative emotions leading to anxiety, stress and depression. This somatopsychic aspect may lead to a lower likelihood of complying with medical prescriptions (i.e., medication intake and adherence to lifestyle modifications; Kretchy et al., 2014). The connection between hypertension and mental health is complex, and it can lead to treatment-resistant hypertension, non-compliance with medications and worse outcomes (Hamam et al., 2020). In summary, all of these psychological conditions can have somatic repercussions including, by way of illustration, tachycardia and increased HR. More specifically, it has repeatedly been documented that certain psychological conditions (i.e. anxiety, depression, obsessions, eating disorders and stress-related syndromes) can alter the psychophysical balance (De Vincenzo et al., 2022; Pruneti & Boem, 1995; Pruneti & Guidotti, 2022; Pruneti et al., 2002, 2010, 2022). Psychologically stressful situations can overload the autonomic balance evidenced by increased HR, heart rate variability (HRV), sweating (or electrodermal activity, EDA) and respiratory rate (Chrousos & Gold, 1992; Jarczok et al., 2013; Lin et al., 2011).

These studies were useful in our decision to focus our research on the proposal of a psychological intervention for hypertensive patients with clinically significant psychopathological symptoms. Although most of the studies conducted highlighted the need to foster adherence to medical prescriptions and the growth of the concept of self-care (Di et al., 2020; Drevenhorn et al., 2015; Hedegaard et al., 2015; Nolan et al., 2018), this goal was achieved only a few times (Drevenhorn et al., 2015; Ionov et al., 2021; Nolan et al., 2018; Oseni et al., 2022). The few studies in the literature that have investigated the effectiveness of psychological interventions in the cardiology setting involved only infarcted patients. To illustrate, one of the earliest randomised clinical trials reported by the Writing Committee For The ENRICHD Investigators (Berkman et al., 2003) found that integrated intervention (individualised sessions of

Implications for practice and policy

- To our knowledge, this is the first study in the literature that considered psychological distress as a modifiable risk factor for hypertension. It is believed that psychological interventions can be useful for the patient's health, both physical and mental. Ascertaining a relationship between mental health and physical well-being could further validate the need to offer assessment and psychological services in hospital wards.
- From a multidimensional perspective, the intervention offered by psychologists should be added to the other programmes proposed by nurses, pharmacists and physicians. A multidisciplinary intervention could enhance the effects of each of these treatments and offer patients the greatest number of effective interventions currently available.
- In any case, being able to contribute to the improvement of psychological health and lifestyle appears to be beneficial for the patient and the community, and for the National Health System in terms of economic savings.

cognitive-behavioural therapy [CBT] and traditional medical treatment) had greater efficacy in improving depression and social isolation. Similar results were later confirmed by Gullikkson et al. (2011) who, additionally, underlined that a series of 20 two-hour group sessions of CBT were effective in promoting better stress management and reduced recurrences of acute cardiovascular disease (up to 41% of the decrease in recurrences of fatal and nonfatal cardiovascular events). Another randomised controlled trial (O'Neil & Sanderson, 2011) further supported the evidence of a group-based CBT programme and described the effects on psychological well-being of CBT over time (the decrease in risk of relapse persisted 91 months after the end of the treatment).

Besides these results, to our knowledge, there are no studies in the literature in which CBT aimed at treating mental disorders is integrated into psychoeducational sessions specifically structured for cardiological patients. For this reason, a psychological intervention composed of CBT sessions and psychoeducation was implemented. Since psychological symptoms are considered risk factors for hypertension (Hamam et al., 2020; Nicholson et al., 2006; Özpelit et al., 2015; Riaz et al., 2021; Roest et al., 2010), the first specific aim was the reduction in symptoms of psychological suffering. In addition, it was hypothesised that a psychological intervention might improve some clinical-medical parameters, such as serum cortisol level and HR. Bearing in mind that HR is one of the factors that can influence blood pressure, it was decided to investigate a possible direct or indirect effect of psychological distress on the HR parameter. This study hypothesised that psychopathological symptoms may modulate HR through the increase in cortisol.

2 | MATERIALS AND METHODS

2.1 | Participants and procedure

In this quasi-experimental study, one hundred hypertensive patients aged between 20 and 81 years with no history of neurological and psychiatric diseases and not receiving psychopharmacological treatment completed the Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994; Prunas et al., 2012) after providing informed consent. These patients accessed the Cardiological Rehabilitation Service of the San Cesario Hospital of Lecce (Italy) during a day-hospital or day-service. Participants were referred by their general practitioner, other departments of the Vito Fazzi Hospital or directly with a personal booking. A PhD student of clinical psychology collected the participants' data. Since the cut-off (=0.75) of the Global Severity Index (GSI) on the SCL-90-R has been attested to accurately discriminate individuals with a mental disorder from those who do not (Schmitz et al., 1999), participants who scored above this clinical range were included in the study. At the time of recruitment, all the patients were on medication to control their blood pressure through pharmacology.

The demographic characteristics of the 17 patients selected are shown in Table 1.

TABLE 1 Demographic and disease-related characteristics of the sample ($N = 17$).

Age, mean (*SD*)	52.88 (13.78)
Gender, *N* (%)	
Male	8 (47.1%)
Female	9 (52.9%)
Marital status, *N* (%)	
Single	1 (5.9%)
Married/cohabitant	14 (82.4%)
Separated/divorced	1 (5.9%)
Widowed	1 (5.9%)
Education level, *N* (%)	
Middle school graduation	9 (52.9%)
High school graduation	6 (35.3%)
University/postuniversity degree	2 (11.8%)
Current occupation, *N* (%)	
Student	1 (5.9%)
Employed	12 (70.6%)
Unemployed/retired	4 (23.6%)

2.2 | Measures

Participants underwent a psychological assessment procedure through the administration of the SCL-90-R (Derogatis, 1994; Prunas et al., 2012), which was used to investigate the presence of somatic complaints (SOM), obsessive and compulsive behaviours (O-C), interpersonal sensitivity (I-S), depression (DEP), anxiety (ANX), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR) and psychoticism (PSY) (cut-off = 0.75; Schmitz et al., 1999). The SCL-90-R also provides the Global Severity Index (GSI), which represents the intensity of the level/depth of the distress and whose cut-off has been attested to accurately discriminate individuals who have a full-blown mental disorder from those who do not (Greco et al., 2009; Schmitz et al., 1999). The corresponding Cronbach's alpha value for a general scale, including all of the items, was 0.96. The psychometric test (SCL-90-R) used as the outcome measure was administered before (T0) and after the psychological intervention (T1), as well as 6 months after the end of the intervention (follow-up, T2).

As secondary outcome measures, serum cortisol level and HR were measured.

The *Cortisol Blood Test* was made to measure the level of cortisol, a steroid hormone released by the adrenal glands. A blood sample was necessary to execute this test. Because cortisol levels vary throughout the day, the test was performed in the morning (at 7 a.m.).

The measurement of HR was obtained at the time of blood pressure control. The physician who performed the medical examination measured this using an automatic electronic arm pressure gauge (sphygmomanometer), which allowed them to obtain the measurement of blood pressure and pulse rate. Only the HR measure was taken into consideration since all patients were under pharmacological control for hypertension.

Considering that biological parameters change more slowly over time, these indices were assessed only before the intervention, at baseline (T0) and 6 months after the end of the intervention (T2).

2.3 | Psychological intervention

An integrated psychological intervention, including a psychoeducational programme specifically designed for patients with cardiovascular disorders (Linee guida ANMCO-SIC-GIVFRC sulla riabilitazione cardiologica, 1999) and CBT psychotherapy (Bara, 2005; Kirk et al., 2016; Perdighe & Mancini, 2008), was proposed to the patients.

Psychoeducational interventions provide access to a series of information about the nature and management of one's disorder by building a welcoming, non-judgemental atmosphere open to communication and reflection. Psychoeducation was specifically designed for hypertensive patients and was aimed at helping the person to (1) obtain from his/her care team (doctors, psychologists and nurses) and assimilate information on the main behavioural risk factors associated with hypertension (i.e., nutrition, physical activity, alcohol consumption, smoking, and anxiety and depression); (2) promote better adherence to medical recommendations and the self-management of the medical therapies; and (3) support lifestyle changes (in case of risk behaviours for physical health and, specifically, hypertension; i.e., inadequate stress management) and increase the level of self-efficacy in the management of the disease.

After four psychoeducational sessions, the patients also participated in a psychotherapeutic treatment with a cognitive-behavioural orientation (Bara, 2005; Kirk et al., 2016; Perdighe & Mancini, 2008). The recommended therapy cycle is 12–30 sessions of 45 min each, with a frequency of once a week. The CBT treatment was aimed at modifying specific dysfunctional cognitive-emotional patterns (cognitive-emotional structures of meaning, operational models, etc.) that the person had developed and that, along with biological predispositions, determined the level of suffering. The goals of the treatment were agreed upon with each individual during the engagement and initiation of the relationship with them. In a nutshell, consistent with the CBT approach, work was carried out on (1) the analysis of dysfunctional operational patterns of meaning; (2) the enhancement of the ability to process internal and external experiences and of self-monitoring; (3) the recognition of emotions and their connection with irrational thoughts; (4) the development of decentreing and differentiation of self; (5) the recognition of cognitive errors; (6) the enhancement of self-efficacy and behavioural autonomies; (7) the modulation of emotional experiences of the most intense degree; and (8) exposure to feared situations.

2.4 | Statistical analysis

Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics (Version 28.0.1.0). Descriptive statistics of the scores obtained on the SCL-90-R were performed with the calculation of the mean (*M*) and standard deviation (*SD*). To implement parametric statistical analyses, tests for Skewness, Kurtosis and Kolmogorov–Smirnov were used to assess the normality of distribution. Furthermore, in a multicollinearity test, no extreme coefficient values ≥0.8 were found among the independent variables, indicating a low risk of multicollinearity. All independent variables had variance inflation factors ≤10 and tolerance ≥0.1, indicating the absence of multicollinearity. Since all the assumptions for the conduction of parametric statistics have been respected, the following analyses were computed: (1) a Pearson's correlation analysis was conducted to examine the association between the psychopathological scales of the SCL-90-R and the medical indexes (i.e., cortisol and HR); (2) a repeated measures ANOVA on every scale of the SCL-90-R was calculated to assess the change over time in psychological suffering; (2) two paired sample *t*-tests were carried out to assess the differences between pre-intervention (T0) and follow-up (T2) scores on cortisol dosage and HR measurement; and (3) lastly, two serial mediation analyses using the PROCESS macro for SPSS v22 (Hayes, 2017) were implemented, considering mental suffering (SCL-90-R GSI) as the independent variable, cortisol as serial mediator and HR as the dependent variable for both the measurements (T0 and T2).

3 | RESULTS

Considering the large standardised Cohen's effect size ($d=0.35$), a type I error of 5% ($\alpha=0.05$) and a type II error of 5% ($\beta=0.05$; power = 95%), and an a priori power calculation using GPower 3.1 (Faul et al., 2009), revealed that 23 participants were required. Although fewer than 23 subjects were recruited for the actual research, a post hoc power analysis documented that a sufficient power of 0.86 was achieved with the current sample size of 17 for the conduction of the repeated measures ANOVA. Considering the calculation of the sample size for the conduct of serial mediation analyses, it was calculated that a sufficient power of 0.84 was achieved (Cohen's effect size [$d=0.5$], type I error of 15% [$\alpha=0.15$] and type II error of 15% [$\beta=0.15$; power = 85%]).

Some scores on the clinical scales of the SCL-90-R are noteworthy at a descriptive level. Psychopathological symptoms attributable to anxious activation with somatisations, alteration of mood (in terms of both feeling depressed and being easily irritated), obsessions and compulsions, as well as interpersonal sensitivity characterised by slight paranoid ideation were observed at T0 (Table 2). All of these psychopathological symptoms (excluding hostility) correlated with each other. Nevertheless, as to the relationships between the clinical-medical variables, a positive and significant association between cortisol and HR was described.

Concerning the effects of the intervention, CBT psychotherapy was effective in reducing all of the psychological symptoms reported by patients and investigated through the SCL-90-R (Table 3), except for phobic anxiety and psychoticism. On top of this, these results were maintained for up to 6 months, as observed during the

TABLE 2 Relationships between variables in the whole sample.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1 Cortisol	17.8	5	1											
2 Heart rate	71.7	11.2	0.57*											
3 Body mass index	27.4	4.7	–	–										
4 SCL-90-R SOM	1.62	0.83	–	–	–									
5 SCL-90-R O-C	1.48	0.77	–	–	–	0.59**								
6 SCL-90-R I-S	0.80	0.61	–	–	–	0.84**	0.78**							
7 SCL-90-R DEP	1.53	0.79	–	–	–	0.85**	0.65**	0.79**						
8 SCL-90-R ANX	1.32	0.71	–	–	–	0.82**	0.70**	0.78**	0.76**					
9 SCL-90-R HOS	0.81	0.44	–	–	–	–	–	–	–	–				
10 SCL-90-R PHOB	0.62	0.84	–	–	–	0.63**	0.79**	0.65**	–	0.77**	–			
11 SCL-90-R PAR	1.18	0.78	–	–	–	0.78**	0.50*	0.77**	0.74**	0.70**	–	0.42*		
12 SCL-90-R PSY	0.65	0.58	–	–	–	0.80**	0.81**	0.85**	0.73**	0.87**	–	0.80**	0.65**	
13 SCL-90-R GSI	1.19	0.60	–	–	–	0.91**	0.83**	0.91**	0.88**	0.93**	–	0.76**	0.80**	0.91**

Abbreviations: ANX, anxiety; DEP, depression; GSI, Global Severity Index; HOS, hostility; I-S, interpersonal sensitivity; O-C, obsessive-compulsive; PAR, paranoid ideation; PHOB, phobic anxiety; PSY, psychoticism; SCL-90-R, Symptom Checklist-90-Revised; SOM, somatisation.

*$p<0.05$, **$p<0.01$.

follow-up measurement. However, somatisations and obsessive-compulsive behaviours still required clinical attention at T2.

In contrast, the effect of psychotherapy on the clinical medical variables was not observed (Table 4).

Another aim of this study was to verify whether psychopathological symptoms and cortisol might have an effect on HR at T0 and T2. For this purpose, a serial mediation analysis was implemented considering mental suffering (SCL-90-R GSI) as the independent variable, cortisol as the serial mediator and HR as the dependent variable, at both T0 and T2.

Figure 1 shows the direct effects between the variables at T0 included in the present serial mediation model. Although no direct effect between GSI and HR emerged, the mediation analysis showed that mental distress (SCL-90-R GSI) can indirectly influence HR. More specifically, the GSI predicted HR via cortisol ($\beta = 2.21$; $SE = 8.12$; $p = <0.05$), revealing that patients with higher levels of distress are more likely to report higher levels of HR through the modulation of cortisol serum levels.

The same results were not confirmed at T2. Figure 2 shows the direct effects between the variables at T2, included in the serial mediation model. Neither direct nor indirect relationships between psychological suffering, serum cortisol levels and heart rate were significant.

4 | DISCUSSION

Our study aimed to assess the impact of CBT psychotherapy on a group of hypertensive patients who were chosen based on the severity of their psychopathological symptoms. More specifically, people who complained of psychological symptoms that were clinically significant and met the criteria for the diagnosis of a mental disorder were involved. The criterion used to recruit patients with psychological distress was the GSI parameter of the SCL-90-R, which is considered the best overall indicator of intensity and depth of mental suffering (Schmitz et al., 1999). This work made it possible to offer a psychological intervention for those people who need psychotherapy aimed at promoting the change of dysfunctional thoughts and behaviours. In our sample, about 20% of the participants manifested psychiatric comorbidities to hypertension, confirming what has already emerged in the literature (Hamam et al., 2020; Nicholson et al., 2006; Özpelit et al., 2015; Riaz et al., 2021; Roest et al., 2010), although other authors found a higher percentage, equal to half of the sample (Kupper & Denollet, 2018; Oliva et al., 2016). Moreover, psychopathological distress was found to indirectly predict HR at baseline. Confirming the initial hypotheses, it was deemed appropriate to proceed with psychological treatment to improve the psychophysical well-being of these individuals.

Taking into account the reported symptomatology, the most frequent symptoms regarded anxious activation with marked somatisations, altered mood in a depressive and irritable sense, and obsessions and compulsions. In addition, a slight interpersonal sensitivity with paranoid ideation emerged. Anxiety is the most frequent

TABLE 3 Repeated measures ANOVA for the psychological symptoms (SCL-90-R) with pre-/postintervention and post- to follow-up differences compared through post hoc analyses (Bonferroni correction).

	T0		T1		T2				Post hoc (Bonferroni correction)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*		Mean diff.	*SE*	*p*
SOM	1.62	0.83	0.78	0.45	0.76	0.43	29.50	<0.001	T0 > T1	0.84	0.22	<0.01
									T1 > T2	0.02	0.08	n.s.
O-C	1.48	0.77	0.75	0.46	0.84	0.51	25.87	<0.001	T0 > T1	0.73	0.13	<0.001
									T1 > T2	−0.08	0.07	n.s.
IS	0.80	0.61	0.42	0.37	0.42	0.85	16.48	<0.001	T0 > T1	0.38	0.09	<0.01
									T1 > T2	−1.66	0.05	n.s.
DEP	1.53	0.79	0.79	0.58	0.74	0.46	34.33	<0.001	T0 > T1	0.74	0.16	<0.001
									T1 > T2	0.04	0.10	n.s.
ANX	1.32	0.71	0.74	0.53	0.70	0.38	19.64	<0.001	T0 > T1	0.58	0.14	<0.01
									T1 > T2	0.04	0.05	n.s.
HOS	0.82	0.44	0.43	0.31	0.47	0.35	21.89	<0.001	T0 > T1	0.38	0.07	<0.001
									T1 > T2	−0.04	0.05	n.s.
PHOB	0.63	0.84	0.27	0.47	0.27	0.48	3.55	n.s.	T0 > T1	0.35	0.18	n.s.
									T1 > T2	0.01	0.03	n.s.
PAR	1.18	0.78	0.55	0.42	0.50	0.46	16.05	<0.001	T0 > T1	0.63	0.14	<0.001
									T1 > T2	0.06	0.08	n.s.
PSY	0.65	0.58	0.37	0.31	0.33	0.34	11.71	<0.01	T0 > T1	0.28	0.11	n.s.
									T1 > T2	0.04	0.05	n.s.
GSI	1.18	0.60	0.61	0.35	0.60	0.32	31.79	<0.001	T0 > T1	0.57	0.12	<0.001
									T1 > T2	0.01	0.04	n.s.

Abbreviations: ANX, anxiety; DEP, depression; GSI, Global Severity Index; HOS, hostility; IS, interpersonal sensitivity; O-C, obsessive-compulsive; PAR, paranoid ideation; PHOB, phobic anxiety; PSY, psychoticism; SOM, somatisation.

TABLE 4 Comparison between pretreatment and follow-up values of serum cortisol levels and heart rate; paired sample t-test.

	T2					
T0	*M*	*SD*	*M*	*SD*	*t* (16)	*p*
Medical measurements						
Cortisol (in μg/dl)	17.78	4.95	17.8	5.12	−0.018	0.49
Heart rate (in bpm)	71.69	11.17	71.77	11.09	−48	0.48

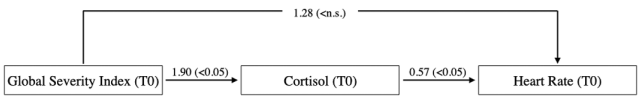

FIGURE 1 Results of mediation model (β, p). All coefficients are standardised.

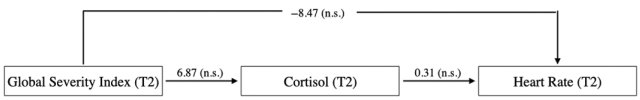

FIGURE 2 Results of mediation model (β, p). All coefficients are standardised.

psychological symptom of distress in the population of hypertensive patients, followed by depression (Institute of Health Metrics and Evaluation, 2022), as it is associated with somatisations resulting from autonomic hyperactivity. In agreement with the recent literature, psychological distress is generally associated with personality configurations and behavioural habits predisposing the onset of physical diseases, especially of cardiological interest (Kupper & Denollet, 2018; Oliva et al., 2016). A large number of researchers and authors talk about the "distressed" (or type D) personality, bearing in mind that it is characterised by high levels of negative affectivity and social inhibition, frequently detected in hypertensive patients (up to 53%; Kupper & Denollet, 2018; Oliva et al., 2016).

In addition, in our sample, other psychopathological symptoms attracted our attention. For instance, the elevated score of the obsessions and compulsions scale documented a certain rigidity of thought in which specific actions and behaviours are implemented to reduce anxious activation. To our knowledge, obsessive-compulsive tendencies were never described before per se among hypertensives, but were associated with irritable mood (Bonaguidi

et al., 1996; Khayyam-Nekouei et al., 2013; Nabi et al., 2008), which can be observed in our group of patients as well. In this regard, numerous studies have demonstrated that subjects with high levels of hostility have a much higher frequency of heart diseases (Klabbers et al., 2009; McCranie et al., 1986). Rigid behavioural habits may have the potential to disrupt emotional and psychophysiological balance involving particularly intense physiological reactions to stress or even a long-term condition of chronic stress (Davidson & Mostofsky, 2010; Eaker et al., 2004; Miličić et al., 2016). In particular, a psychophysical stressful condition can cause coronary artery spasm, which involves the activation of various neurohormonal regulatory mechanisms. In other words, chronic hyperactivity of the HPA axis may lead to the secretion of catecholamines and cortisol, which mobilise lipids and favour the proliferation of smooth muscle fibres and the hyper aggregation of the platelet. Additionally, the HPA axis-related hormones act in the brain to activate the sympathetic nervous system (with increased mean arterial pressure and HR) and inhibit the parasympathetic branch of the autonomic system (Cacioppo et al., 2010; Kregel et al., 1990). Consequently, these processes are particularly threatening for hypertension by contributing to the development/acceleration of coronary arteriosclerosis and predisposing or triggering myocardial infarction (Bonaguidi et al., 1996; Pruneti et al., 2002; Wirtz & von Känel, 2017).

Observing the trend of pre-/postpsychotherapy symptoms, and at the 6-months follow-up, it was found that psychological treatment is effective in reducing psychopathological distress. Nonetheless, the most interesting aspect concerned the weight of psychological symptoms in predicting HR variance. Psychological distress was demonstrated to indirectly predict HR through elevated serum cortisol levels at baseline. This finding highlights that psychological distress can contribute to tachycardia in subjects with hypertension involving the cortisol hormone. In the medical literature, it is known that slight accelerations in HR can be associated with psychophysical stress in patients with heart-related conditions under drug treatment (Pruneti et al., 2002) and, thus, affect their medical pathology. The crucial result was, moreover, that psychological distress no longer affected HR variance at T2. Unfortunately, the effectiveness of psychotherapy in reducing medical parameters such as cortisol and HR was not observed directly. It was hypothesised that these biological parameters need more time to be changed or that they are further influenced by other lifestyle-related variables (diet, smoking, physical activity, etc.) that should be considered in future research. Carrying out an analysis between subjective and objective aspects is never simple, as the latter parameters need more time to undergo modifications (Pruneti et al., 2022). To this end, the physician deemed it useful to measure the serum cortisol level and measure HR 6 months after the end of the intervention. Although the absence of the T1 measurement can be considered a limitation of the study, the results were surprising, suggesting that psychological treatment may be promising in protecting the physical health of hypertensive subjects. In summary, our pilot study underlines the need to implement future studies, possibly of a longitudinal type, which could further lengthen investigation times by including re-evaluations after 12 or 24 months, as well as possible relapses.

This pilot study certainly needs further confirmation with a larger sample size, and the results need to be replicated in a study with a control group, but, nevertheless, the data are encouraging. A psychotherapeutic process may be effective in reducing symptoms of psychological distress that have an indirect impact on HR among hypertensive patients.

5 | CONCLUSIONS

One of the purposes of the psychological intervention was achieved but still needs to be validated in further studies. To our knowledge, this is the first study in the literature that has considered psychological distress as a modifiable risk factor for hypertension. It is believed that psychological interventions can be useful for the patient's health, both physical and mental. Ascertaining a relationship between mental health and physical well-being could further validate the need to offer assessment and psychological services in hospital wards. Obviously, from a multidimensional perspective, the intervention offered by psychologists should be added to the other programmes proposed by nurses, pharmacists and physicians. A multidisciplinary intervention could enhance the effects of each of these treatments and offer patients the greatest number of effective interventions currently available. In any case, being able to contribute to the improvement of psychological health and lifestyle appears to be beneficial for the patient, the community and the National Health System in terms of economic savings.

INSTITUTIONAL REVIEW BOARD STATEMENT

This study was conducted in accordance with the recommendations of the local ethics committee at the Hospital of Lecce. In Italy, until 2018, no ethical approval was required for observational nature studies, since they were not defined as medical/clinical research, according to the Italian law no. 211/2003. The study was conducted before 2018 and used non-invasive measures. Furthermore, this study complies with the Declaration of Helsinki and with Italian privacy law (Legislative decree No. 196/2003). No treatments or false feedback was given, and no potentially harmful evaluation methods were used. Participation was voluntary, and participants could withdraw at any time without any negative consequences. All data were stored using an anonymous ID for each participant.

INFORMED CONSENT

All data were handled in accordance with the ethical standards established in the 1964 Helsinki Declaration. Subjects' anonymity was preserved, and the data obtained were used solely for scientific purposes. All patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of their story.

AUTHOR CONTRIBUTIONS

Sara Guidotti: Writing – original draft; formal analysis; data curation. **Francesca Giordano:** Conceptualization; investigation. **Omar Carlo Gioacchino Gelo:** Conceptualization; investigation; methodology. **Clemente Salerno:** Investigation; methodology. **Carlo Pruneti:** Supervision.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data presented in this study are available upon reasonable request from the corresponding author.

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