

Perseverative Cognition as a Mediator Between Personality Traits and Blood Pressure

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Purpose: Several authors link hypertension with psychological dispositions such as stress, personality, and anxiety, some propose that stress is not enough to explain arterial hypertension and others propose the perseverative cognition model to explain. The aim of this study was to relate personality traits and blood pressure profile of a group of workers, examining the results of perseverative cognition as a possible mediating variable concerning blood pressure.

Patients and Methods: Cross-sectional design study, with a sample of 76 employees of a Colombian university. The NEO-FFI, RRS, and blood pressure measurement instruments were applied; data were reviewed through correlation and mediation analysis.

Results: We found evidence of association between neuroticism and perseverative cognition ($\rho=0.42$ with brooding; $\rho=0.32$ with reflection), but no evidence about mediation of perseverative cognition between personality and blood pressure.

Conclusion: It is necessary to keep researching the mechanisms related to the occurrence of hypertension.

Keywords: perseverative cognition, personality, blood pressure, hypertension, cross-sectional study

Introduction

Hypertension affects one billion people in the world (WHO, 2013), its clinical care is expensive, prolonged, and can cause myocardial infarctions and strokes, among other comorbidities; it is estimated to be the cause of nine million deaths annually, with a prevalence of 24% in Colombia [95% CI 19–29%; $p<0.001$].¹ Its origin is multifactorial, and it has been associated with three major factors: biological, behavioral, and psychological, the latter contemplates the effects of stress on the central nervous system (CNS), the cardiovascular system, negative emotions (anger, anxiety, or depression), and individual variables.^{2–4}

High blood pressure has been associated with psychological factors such as stress, anxiety, depression, and personality,^{2,4} these findings indicate that stress and emotional reactions represent physiological correlates in which the CNS regulates peripheral vascular activity, which affects glandular secretions, organs, muscles, blood and different processes, which can have a triggering or aggravating role in certain disorders such as arterial hypertension. The link between stress and cardiovascular disease is given by several psychobiological mechanisms and the acute and chronic activation of the sympathetic nervous system that can contribute to the development of hypertension or worsening of blood pressure (BP) levels in blood;⁵ in addition, in situations of prolonged stress mood worsening and increased cortisol have been reported.^{6–9}

Likewise, many studies associate hypertension with personality factors such as neuroticism, which is related to coping styles and response to stressors, finding reports of the presence of high levels of neuroticism (characterized by low emotional control and an overreaction before stressors) in the North American population with HT.¹⁰ Other studies have found as a common factor, that negative social interactions were associated with a short-term increase in BP in youth and adults and with a long-term increase in blood pressure in elderly patients, they also relate blood pressure reactivity and recovery to stress as a possible underlying pathway linking type D personality and cardiovascular events.^{11–13}

There are three known pathways by which personality affects behavior and health: hyperactivation, behavioral predisposition, and aggressiveness; these refer to an over-response and chronicity of the sympathetic system to non-threatening stimuli and to personality as an indicator of a biological substrate that facilitates the susceptibility of disease.^{10,12,14} Although this trait of neuroticism is associated, the relationship with hypertension is not clear since it is not known if it is a moderating factor or a triggering factor of this condition.

Hypertension has also been linked to anxiety, and, establishing that individuals with this trait would be more likely to experience states that can generate a psychophysiological activation of the sympathetic system, which increases the possibility of developing hypertension or a higher frequency of cardiometabolic alterations in anxious subjects.¹⁵ Dauelsberg and Cornejo¹⁶ mention studies that concluded that anxiety would have a magnitude of 9% influence on the development of essential arterial hypertension. Moreover, Gasperin et al¹⁷ conducted a meta-analysis of 69 articles related to the effect of psychological stress on increased blood pressure, concluding that, although an association was found in the relevance of stress control in the management of blood pressure, this magnitude of the effect was relatively small (OR: 1.21; 95% CI: 1.14–1.28; $p < 0.001$), and suggest that more research needs to be done on the role of stress in the pathogenesis of hypertension.

The active cognitive representations of stressors must be prolonged to extend their physiological concomitants, this mediating process is called perseverative cognition (CP), and is manifested in phenomena such as worry, rumination, and anticipatory stress.¹⁸ CP is a common stress response, but it has often been ignored by biopsychological models of stress and health that have focused on the physiological activation that occurs during stress, some studies present methodological difficulties and account for poorly addressed effects that occur in anticipation of or after stressful events.^{18,19} A model proposed by Brosschot et al²⁰ indicates that CP moderates the health consequences of stressors because it can prolong stress-related affective and physiological activation, both before and after such factors, the authors review evidence that worry, rumination, and anticipatory stress are associated with increased cardiovascular activity. Ottaviani et al¹⁹ suggest that CP could act directly on somatic disease, through prolonged activation of the cardiovascular, immune, endocrine, and neurovisceral systems.

Similarly, Clancy et al²¹ found how CP, through a cognitive representation of past or feared future stressful events, mediates the relationship between stress and physical illness when stressors are perseverated upon in thought because when stress is prolonged, susceptibility to health problems related to it, increases. Findings confirmed by other researchers such as Ottaviani et al¹⁹ indicate that prolonged responses to stress and its psychophysiological activation can lead to a generalized pathogenic state, related to the onset of somatic disease; also indicate that narrative reviews have been conducted associating CP with somatic complaints and sustained activation of the cardiovascular, endocrine and immune system and longitudinal studies showing that perseverative cognition leads to somatic diseases, such as non-fatal myocardial infarction and fatal coronary heart disease up to 20 years later. Despite these data, Ottaviani et al¹⁹ indicate the limited existence of meta-analyses related to CP and blood pressure, they do so in a review of 12 studies that showed important associations between CP and increased systolic and diastolic blood pressure. Later, in a subsequent systematic review,²² he proposes that the cognitive inflexibility that characterizes CP is reflected in two pathways: physiological (greater rigidity of the autonomic nervous system) and cerebral (functional reduction of the prefrontal connectivity of the amygdala); the studies reviewed focused on heart rate variation, reinforcing the lack of research from blood pressure correlation studies.

Therefore, it is clear that there is an important relationship between hypertension and psychological aspects such as stress, anxiety, and personality, as well as the impact of these factors on the occurrence and maintenance of the disease, however, information on the magnitude of some of these factors, as well as the models or mechanisms that allow this impact still require an approach with methodological rigor as in the case of stress, that seems insufficient to explain the occurrence of the disease,¹⁷ in addition, as explained by Brosschot et al,¹⁸ Ottaviani et al¹⁹ and Ottaviani²² there is an important need to explore other psychobiological and health models that respond to mediating factors between prolonged stress and health processes, in this case, the perseverative cognition model, which has not been widely studied. CP is presented as a factor that could expand the information on the possible relationship of personality factors with blood pressure. In conjunction with this purpose, it was proposed to carry out this study, which sought the mediating role of perseverative cognition between personality and blood pressure in a group of employees of a Colombian University.

Materials and Methods

Participants

The sample was composed of 79 employees of the Cooperative University of Colombia: 51 women and 24 men, between 25 and 70 years old. The sample number was obtained using the finite sample formula available in <http://www.raosoft.com/samplesize.html> and was calculated with a 5% error of 95% confidence level. The selection was made in a simple random probabilistic manner, in which the people of the population were assigned a number and then 79 randomized numbers were obtained by an automated generator. Were excluded people who indicated being under the influence of psychoactive substances and people who contracted psychiatric treatment.

Measures

NEO Five-Factor Inventory (NEO-FFI) is a personality measurement instrument that addresses five factors: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness, it is a short version of the NEO-PI that was originally developed in the United States and adapted and validated in different countries of the world. In its Colombian version, it has Cronbach's alpha coefficients of 0.703 for neuroticism, 0.698 for extraversion, 0.621 for openness, 0.624 for agreeableness, and 0.705 for conscientiousness, which constitutes adequate levels of internal consistency.²³

Ruminative Responses Scale - RRS^{24,25} evaluates the presence of the ruminative response style, a response pattern that consists of excessive focus on the causes and consequences of depressive symptoms consists of 22 items. Recently, the adaptation of the reduced version of the Ruminative Response Scale has been published.²⁵ This version has the advantage of greater simplicity and speed in the application since it only consists of 10 items and maintains a good internal consistency index ($\alpha = 0.86$).

Digital Blood Pressure Monitor. To measure systolic blood pressure (when the heart contracts) and diastolic blood pressure (when the heart relaxes), the monitor used was the Citizen reference CH-650. It has a measurement accuracy for blood pressure of ± 3 mmHg.

Procedure

This research complies with the Declaration of Helsinki and with the Colombian regulation for research with humans. Prior to approval of the Bioethics Committee of the Cooperative University of Colombia (Acta 009 of 2016), the collection of information was carried out with the written informed consent of each participant, application of the NEO-FFI and RRS instruments through a digital questionnaire; later a blood pressure measurement was carried out in the facilities of the University, ensuring that they were sitting with their backs supported, quiet for 5 minutes, with your feet on the floor, without crossing. Data were collected between December 2020 and July 2021. Taking into consideration, during this period due to government and biosecurity measures, university employees were working remotely, so pressure measures were taken during periods when restrictive measures allowed face-to-face attendance and gradual return to the workplace. Regarding the data analysis, these were reviewed using correlation techniques and a mediation analysis was applied with the JASP Software designed by Jasp Team (2020, version 0.14.1).

Results

Regarding the results of blood pressure, a mean of 118.47 mmHg was obtained for systolic pressure and 79.82 mmHg for diastolic pressure, which is consistent with normal blood pressure levels; compared to the analysis of personality traits, it should be noted that for neuroticism there was a tendency to low scores, which accounts for stable people, who tend to respond emotionally weakly and quickly return to their baseline after each reaction, characterized by tranquility and carefreeness. Although the scores are within normal ranges (percentile for personality scores), the trait of agreeableness is presented with a higher score than others ($M=73.85$), a characteristic that indicates people with a tendency to share with others and to believe in them, to be frank, and possibly understand very well the emotional needs of those around them. The other personality traits presented at an average level. Finally, the results of perseverative cognition are at an average level, pointing to a low score in brooding ($M = 8.51$; Normative mean =10.1) and reflection ($M = 8.27$; Normative mean = 10.1). (See [Table 1](#)).

Table 1 Descriptive Statistics

	Average	Deviation
Systolic Pressure	118.47	17,705
Diastolic Pressure	79.82	15,595
Neuroticism	34.86	32,804
Extraversion	49.54	32,077
Openness	42.06	28,335
Agreeableness	73.85	29,584
Conscientiousness	62.57	31,531
Brooding	8.51	2,511
Reflection	8.27	3,066

Correlations

No statistically significant correlation was found between blood pressure and perseverative cognition (see Table 2). Regarding the variables of personality and perseverative cognition, it was found that neuroticism correlates positively with both brooding and reflection, while openness to experience presents a negative correlation with systolic pressure, indicating that people who prefer atypical experiences have lower levels of systolic pressure.

Table 2 Correlations

	Spearman's Rho	p
Neuroticism-SP	-0.166532	0.142420
Neuroticism-DP	-0.078227	0.493179
Neuroticism-Brooding	0.422083***	< 0.001
Neuroticism-Reflection	0.340589**	0.002131
Extraversion-SP	-0.187116	0.098690
Extraversion-DP	-0.147335	0.195059
Extraversion-Brooding	-0.029171	0.798568
Extraversion-Reflection	-0.008962	0.937518
Openness-SP	-0.223645*	0.047559
Openness-DP	-0.155911	0.170036
Openness-Brooding	-0.146275	0.198329
Openness-Reflection	-0.068841	0.546616
Agreeableness-SP	0.075789	0.506787
Agreeableness-DP	0.055419	0.627608
Agreeableness-Brooding	-0.117631	0.301861
Agreeableness-Reflection	0.006253	0.956386
Conscientiousness-SP	0.133816	0.239707
Conscientiousness-DP	0.135285	0.234540
Conscientiousness-Brooding	-0.204156	0.071119
Conscientiousness-Reflection	-0.048294	0.672551
SP-DP	0.810621***	< 0.001
SP-Brooding	0.019570	0.864076
SP-Reflection	0.071209	0.532876
DP-Brooding	0.027319	0.811110
DP-Reflection	0.098128	0.389591
Brooding-Reflection	0.703452***	< 0.001

Notes: *p < 0.05, **p < 0.01, ***p < 0.001.

Abbreviations: SP, Systolic Pressure; DP, Diastolic Pressure.

Mediation Models

In the first model in which perseverative cognition mediates the relationship between personality and systolic pressure, the results indicate a low score with the reflection (0.17) and brooding (0.17), in this case, the scores of the personality variables are low too; in summary the perseverative cognition do not mediate between personality and systolic pressure (Figure 1).

In the second mediation model, with perseverating cognition mediating the relationship between personality and diastolic pressure, the results show low scores with the reflection (0.15) and brooding (0), and the scores for the personality variables remain low. The model shows that perseverative cognition does not mediate between personality and diastolic pressure (Figure 2).

Discussion

The main objective of this research was to determine the mediating role of perseverating cognition between personality and blood pressure, the results indicate that such mediation is not statistically significant, which contrasts with previous findings that have tried to outline the role of psychosocial factors in the genesis and evolution of arterial hypertension, with mixed results in factors such as perseverative cognition, stress, anxiety, depression, affective state and personality,^{10,12,16,17,21,22,26} which leaves a panorama of inconclusive results.

Cognitive representation of stressors (perseverative cognition) activates the stress response with different biological processes from the CNS to peripheral stress responses: increased cardiac activity, blood, pressure, and stress hormones; being perseverating accounts for prolonged activation, which involves constant emotional and physiological activations, with an impact on the health of the individual and becoming a mediator in the stress-disease process,^{5,18–21} however, this process despite being perseverating and having a relevant impact, appears spontaneously and its intensity can vary (in terms of frequency and duration) by different stimuli, conditions, and individual characteristics.

Personality, on the other hand, is a theoretically more stable construct that has also shown important implications in the health-disease process,^{10,12} with various studies linking its variables to hypertension, as is the case of neuroticism, of which high levels of this trait are present (characterized by low emotional control and an overreaction before stressors) in the American, Chinese, and Polish population with HTA,^{12,27,28} in contrast, other studies present inconclusive results as to a statistically significant relevance of the personality group.^{10,11}

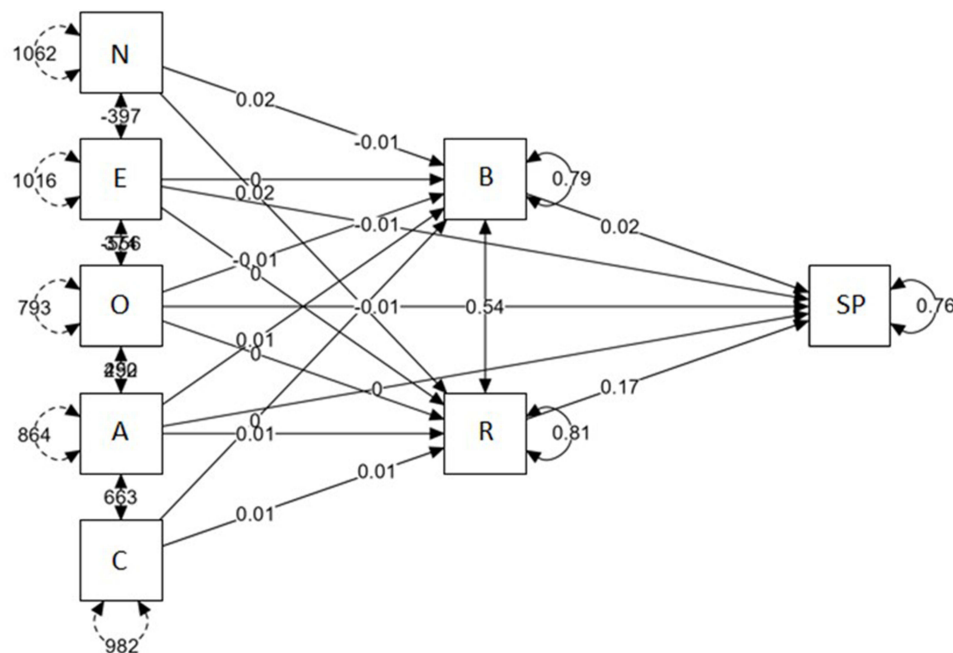


Figure 1 Perseverative cognition model mediating personality variables with systolic pressure.

Notes: This figure describes the mediating role of the subfactors of perseverative cognition with the 5 personality traits, on systolic blood pressure.

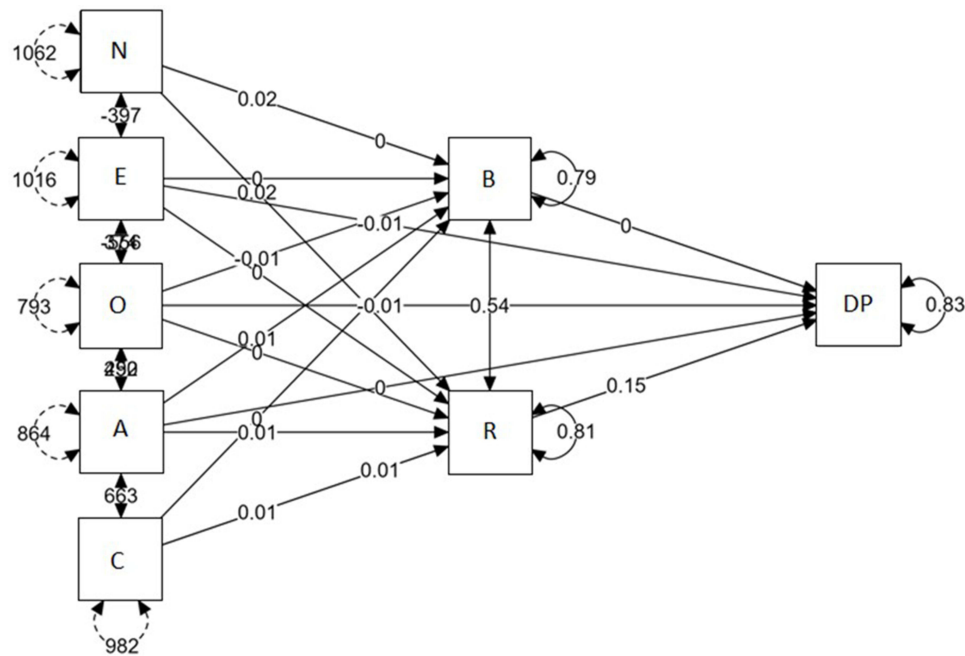


Figure 2 Perseverative cognition model mediating personality variables with diastolic pressure.

Notes: This figure describes the mediating role of the subfactors of perseverative cognition with the 5 personality traits, on diastolic blood pressure.

Although blood pressure has been widely studied and a relationship has been sought with variables such as perseverative cognition and personality, as well as the implications of these in the appearance and maintenance of arterial hypertension,^{19,22,26} few studies propose perseverative cognition as a mediator with personality variables or vice versa.

In the results, correlations were found between neuroticism and perseverative cognition, associating this trait with reflection (behaviors that tend to the analysis of the difficulties experienced) and brooding (a specific form of rumination that implies a thought with negative emotional valence (complaint), paying main attention to the discomfort experienced and a negative evaluation of oneself) are two factors of perseverative cognition that show a tendency to think about experiences and negative experiences. These factors, exposed in the original theory of response style of Nolen-Hoeksema and Morrow,²⁴ should not necessarily be harmful, since some forms of focus on painful feelings and experiences can be positive and necessary, presenting themselves as an adaptive function, so it could be thought that the mere presence of perseverative cognition (reflection and brooding) is not enough to generate prolonged activation at a level that negatively impacts the health.²¹

The personality trait with the highest score in the correlation was extraversion, which accounts for sociable people, with a tendency to establish links, capable of taking risks, acceptance of change, characteristics that are related to active coping strategies, emotional stability, and tendency to solve problems, in this case, the presence of reflection and brooding could serve these individuals as an adaptive mechanism with a tendency to seek problem-solving that does not necessarily have a negative impact by serving to solve the problematic situation.

The limitations of the present study were associated with the small sample size, this is due to circumstances related to remote work, distancing, and biosecurity measures around the prevention of contagion of Covid-19, which ended up reducing it and making it difficult to obtain information simultaneously, since in some cases the participants completed the tests and subsequently the blood pressure sample was taken, the day they could be in person at the workplace.

Although the issue of perseverative cognition and its relationship with the appearance of arterial hypertension has been widely studied, there are no studies with the same methodological design, or that include the proposed mediation model, which means that the results should be interpreted in moderation and should not be generalized with other populations different from that of the sample analyzed.

As already mentioned, the data were collected during the Covid-19 pandemic, which altered work, family, and social dynamics (implementation of remote work models with changes in work schedules, loads, functions, and productivity), something that must be considered since it can be related to stressful events or lifestyle modifications, work rhythm, social support, adaptation mechanisms, support networks and other factors that can influence the different activations of participants.^{29–31} For future work, it is recommended to apply the measurements to larger samples with more diverse populations, including other work contexts that allow a greater understanding of the phenomenon.

On the other hand, in this study perseverative cognition is considered as a two-dimensional trait (reflection and brooding), based on Hoeksma's theory of response styles, on which Broschott also relies for his hypothesis of perseverative cognition, in this conception reflection and brooding are subfactors of rumination, but there are other definitions and approaches of perseverative cognition, focused on concepts such as worry and rumination as central factors, so future studies could replicate the work taking into account the different facets of perseverative cognition.

Conclusion

In this study, no mediating role of perseverative cognition and personality was found with the measures of systolic and diastolic pressure, in this way we corroborate the null hypothesis, in which the measures of PC do not have a mediating role between personality traits and BP levels, results that may be of interest to the present research by suggesting the need to inquire about other aspects relevant to BP and the occurrence of hypertension.

According to the above, the role of personality as a mediator between perseverative cognition and BP could be explored in future research since this is a theoretically more stable construct and could have an important role in mediating thoughts of rumination and worry in relation to blood pressure. Other aspects related to hypertension, both physical and psychological, such as heart rate, heart recovery, anxiety, and depression could also be investigated.

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Disclosure

The authors report no conflicts of interest in this work, although R. Z-C and D. A-A are employees at Cooperative University of Colombia.

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