JOURNAL FOR SOCIAL SCIENCE STUDIES
An International Peer-Reviewed Open Access Journal

ISSN (Online): 3006-2071 | ISSN (Print): 3006-2063
Volume 4 • Issue 6 • October 2026

ROLE OF INTEROCEPTIVE AWARENESS AND SOMATIC SYMPTOMS IN PREDICTING GENERALIZED ANXIETY AMONG HYPERTENSIVE ADULTS

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DOI: https://doi.org/10.5281/zenodo.23311632

Keywords
Interoceptive Awareness, Somatic Symptoms, Generalized Anxiety, Hypertension

Article History
Received: *25 June 2026*
Accepted: *16 September 2026*
Published: *12 October 2026*

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Abstract

Hypertension is often associated with anxiety and somatic complaints, but the role of interoceptive awareness was not established well. The purpose of current research was to determine if interoceptive awareness and the severity of somatic symptoms predict generalized anxiety symptoms among hypertensive adults. This cross-sectional design recruited 200 hypertensive adults who completed the Interoceptive Awareness Scale (MAIA-2), Patient Health Questionnaire (PHQ-15), and Generalized Anxiety Disorder scale (GAD-7). The data was not normal therefore Spearman's correlation was used to examine the associations between interoceptive awareness, somatic symptom severity, and generalized anxiety. Regression analysis was used to determine the predictive capacity of interoceptive awareness and somatic symptoms on generalized anxiety. The analysis revealed a strong positive correlation between somatic symptom severity and generalized anxiety, $r_s(198)=.754$, $p<.001$, but no significant correlation was found between interoceptive awareness and somatic symptoms, $r_s(198)=.014$, $p=.842$, or generalized anxiety, $r_s(198)=.046$, $p=.516$. The regression result revealed that interoceptive awareness and somatic symptoms predicted 71.3% of the variance in generalized anxiety, $F(2, 197)=245.22$, $p<.001$. Somatic symptom severity was a significant predictor of generalized anxiety symptoms, $\beta=.84$, $p<.001$, but interoceptive awareness was not a significant predictor of generalized anxiety symptoms, $\beta=.03$, $p=.480$. The results suggest that generalized anxiety symptoms among hypertensive adults are primarily driven by their physical symptoms rather than their general interoceptive awareness.

INTRODUCTION

Hypertension is one of the most common chronic conditions globally, and its prevalence is projected to exceed 1.5 billion people worldwide by 2025 (Qiu et al., 2023). Living with a chronic physical illness means ongoing demands on a person's

JOURNAL FOR SOCIAL SCIENCE STUDIES
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Volume 4 • Issue 6 • October 2026

attention to bodily sensations, including symptoms that may or may not be directly caused by the illness. At the same time, hypertension frequently co-occurs with psychological distress. A meta-analysis indicated that anxiety disorders are much prevalent in hypertensive patients than in the general population, and that the frequency of comorbid hypertension and anxiety is roughly 38% (Tareke et al., 2022; Qiu et al., 2023). This comorbidity raises the question of which psychological processes associate the physical experience of hypertension to anxiety symptoms. Two processes of note are interoceptive awareness, a person's ability to notice, attend to, and interpret signals arising from within the body, and somatic symptom severity, the physical complaints a person reports experiencing. While both have theoretical links to anxiety, their relative contribution to anxiety has rarely been studied together in a hypertensive sample (Price & Hooven, 2018).

Anxiety and Hypertension

There seems to be a reciprocal association between anxiety and hypertension. According to one study (Qiu et al., 2023), anxiety disorders were more common in patients with hypertension (37.9%) than in the general population (12.4%). There has also been evidence of a positive correlation between anxiety severity and blood pressure, with higher mean anxiety scores among patients with uncontrolled blood pressure (Aslan Ceylan et al., 2023). Chronic anxiety and the physiological arousal it causes may contribute to elevated blood pressure (Loke & Ching, 2022). Because hypertension and anxiety can therefore reinforce each other, understanding what drives anxiety specifically within a hypertensive population has practical value for both medical and psychological care (Pan et al., 2015).

Somatic Symptoms and Anxiety

Somatic symptoms, physical complaints such as pain, fatigue, dizziness, and gastrointestinal discomfort, are common in people with chronic illness and are closely tied to psychological distress. The Patient Health Questionnaire was developed as a brief, test for somatic symptom, and increasing PHQ-15 scores have consistently been associated with greater functional impairment and higher rates of anxiety and depressive symptoms (Kroenke et al., 2002). Within hypertensive and other medically ill populations, somatic symptoms can be difficult to disentangle from symptoms of anxiety itself, since both involve bodily sensations such as a racing heart, chest discomfort, or dizziness. A patient who notices and reports more physical symptoms may, as a result, also report more anxiety, either because the symptoms themselves are distressing or because the same underlying physiological arousal produces both.

Interoceptive Awareness

Sensation, interpretation, and integration of internal body signals are all part of interoception (Mehling et al., 2012). Noticing, Not-Distracting, Not-Worrying, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening, and Trusting are the eight dimensions that make up the Interoceptive Awareness Scale (MAIA-2) (University of California San Francisco Osher Center, 2018). Because how a person attends to and interprets bodily sensations may affect how those sensations are felt emotionally, interoceptive awareness has been suggested to be relevant to a wide range of psychological and somatic difficulties, including mood disorders, anxiety, and somatic symptom disorders (Jenkinson et al., 2024). The evidence suggesting a link between interoceptive awareness and anxiety and somatic symptoms, however, is mixed. Some dimensions of the MAIA have only weak or inconsistent associations with anxiety and worry measures, and awareness of body sensations as such has been argued to not serve as a proxy measure of anxiety (Mehling et al., 2012). In a non-clinical sample, the Multidimensional Assessment of Interoceptive Awareness, version 2, was partly developed to separate a hypervigilant, anxiety-driven attention style from a more mindful and adaptive one

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Volume 4 • Issue 6 • October 2026

(Scheffers et al., 2024), implying that a single total MAIA score may obscure opposing relationships among its subscales. Other work has found that specific facets, rather than overall interoceptive awareness, relate to anxiety and depressive symptoms (Lee et al., 2024); for example, the Noticing subscale has been linked to worse psychological and somatic outcomes in some samples (Suzuki et al., 2021), while Attention Regulation and Trusting have been linked to lower anxiety severity in others. Given these mixed subscale-level findings, it is unclear how a composite, total interoceptive awareness score relates to anxiety once somatic symptom severity is accounted for, particularly in a medically ill population such as hypertensive adults (Wolters et al., 2022).

Rationale of the Study

Hypertensive adults routinely monitor bodily sensations as part of managing their condition, which makes this population well suited to examining how interoceptive awareness and somatic symptom relate to anxiety. Because the comorbidity between hypertension and anxiety is substantial, and because somatic symptoms and interoceptive processes are both theoretically relevant to anxiety but have rarely been compared directly within the same regression model, the present study examined their joint and relative contributions to generalized anxiety in a sample of hypertensive adults.

Objectives:

The objectives were;

1. To examine the relationships among interoceptive awareness, somatic symptom severity, and generalized anxiety symptoms in hypertensive adults.
2. To determine whether interoceptive awareness and somatic symptom severity predict generalized anxiety symptoms.
3. To identify the relative contribution of each predictor to generalized anxiety symptoms.

On the basis of the literature reviewed above, the following hypotheses were tested.

Hypotheses:

H1: Somatic symptom severity is positively related to, and predicts, generalized anxiety symptoms.
H2: Interoceptive awareness is related to generalized anxiety and to somatic symptom.
H3: Interoceptive awareness and somatic symptom severity together significantly predict generalized anxiety symptoms.

Method

Research Design

A cross-sectional research design was used to examine the relationships among interoceptive awareness, somatic symptom severity, and generalized anxiety symptoms in hypertensive adults.

Participants and Sampling

The sample comprised 200 hypertensive adults. The sample was relatively evenly split by gender (50.5% female, 49.5% male). Most participants were younger than 60 years, with 45.0% aged 40–59 years and 44.5% aged 20–39 years. Most participants were unmarried (81.5%) and unemployed (76.5%). Regarding health profile, 84.0% reported a family history of hypertension, and nearly half (48.5%) had been diagnosed with hypertension for 1 to 5 years. Half of the sample (50.5%) was currently on medication for hypertension, and 51.5% reported the presence of other medical conditions.

Measures

Multidimensional Assessment of Interoceptive Awareness (MAIA-2)

Interoceptive awareness was measured through the Multidimensional Assessment of Interoceptive Awareness-2 (MAIA-2; University of California San Francisco Osher Center, 2018). This 37-item self-report scale consists of items scored on a Likert scale from 0 (never) to 5 (always) and is divided into eight subscales: Noticing, Not-Distracting, Not-Worrying, Attention Regulation, Emotional

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Awareness, Self-Regulation, Body Listening, and Trusting. Reverse scoring is utilized for pertinent items in the Not-Distracting and Not-Worrying subscales for mean calculations, while an overall score can be obtained by averaging the items. The MAIA-2 can be accessed at no cost for research purposes, as it does not require written authorization (University of California San Francisco Osher Center, 2018). Consequently, it has shown sufficient internal consistency and construct validity in both healthy and clinical groups (University of California San Francisco Osher Center, 2018).

Patient Health Questionnaire-15 (PHQ-15)

Somatic symptom severity was assessed using the Patient Health Questionnaire-15 (PHQ-15; Kroenke et al., 2002). This 15-item self-report measure asks respondents how bothered they have been by physical symptoms (e.g., stomach pain, back pain, headaches, chest pain, dizziness, trouble sleeping) over the past four weeks. Each item is rated on a 0 (not bothered) to 2 (bothered a lot) scale yielding to a total score ranging from 0 to 30 with higher scores indicating greater somatic symptom severity. Scores of 5, 10, and 15 have been proposed as cutoffs for low, medium, and high somatic symptom severity respectively (Kroenke et al., 2002). The PHQ-15 has demonstrated good validity and acceptable internal consistency in primary care and other medical populations (Kroenke et al., 2002).

Generalized Anxiety Scale

Generalized anxiety was assessed using the Generalized Anxiety Disorder-7 (GAD-7) scale (Spitzer et al., 2006). This 7-item self-report measure asks respondents how often, over the past two weeks, they have been bothered by symptoms (e.g., feeling nervous or anxious, being unable to stop worrying, feeling afraid that something awful might happen). Items are rated on a 0 (not at all) to 3 (nearly every day) scale resulting in a total score ranging from 0 to 21. Scores of 5, 10, and 15 represent cutoffs for mild, moderate, and severe anxiety respectively (Spitzer et al., 2006). The GAD-7 has demonstrated good reliability and validity as a measure of anxiety severity (Spitzer et al., 2006).

Data Analysis

The data were analyzed using SPSS. Descriptive statistics, Spearman correlation and multiple linear regression analysis was done for analysis.

Results

The sociodemographic profile of the 200 hypertensive adults comprising the sample has been summarized above. The sample was relatively evenly split by gender with 50.5% females and 49.5% males. A large majority of the participants were younger than 60 years old with 45.0% of them being in the 40–59 age bracket and 44.5% in the 20–39 age bracket. The majority of the participants were unmarried (81.5%) and unemployed (76.5%). With respect to health profiles, 84.0% of the sample reported a family history of hypertension and nearly half (48.5%) had been diagnosed with hypertension for 1 to 5 years. Furthermore, 50.5% of the sample were currently on medication for their condition and 51.5% reported the presence of other medical conditions.

A Spearman correlation coefficient was computed because the data were not normally distributed. It aimed to assess the relationships among interoceptive awareness (MAIA total), somatic symptom severity (PHQ-15 total), and generalized anxiety symptoms (GAD total) in the sample of 200 participants. A strong, positive and statistically significant correlation was found between somatic symptoms and generalized anxiety, $r_s(198) = .754$, $p < .001$, suggesting that higher levels of physical somatic symptoms were strongly associated with higher levels of generalized anxiety symptoms. There was no statistically significant relationship between interoceptive awareness and somatic symptom severity, $r_s(198) = .014$, $p = .842$. Similarly, the relationship between interoceptive awareness and

JOURNAL FOR SOCIAL SCIENCE STUDIES
An International Peer-Reviewed Open Access Journal

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Volume 4 • Issue 6 • October 2026

generalized anxiety symptoms was not statistically significant, rs(198) = .046, p = .516.

Table-1: Spearman Correlations among Interoceptive Awareness, Somatic Symptoms, and Generalized Anxiety

Variable	1	2	3
1. Multidimensional Assessment of Interoceptive Awareness	-	-	-
2. Patient Health Questionnaire-15	.014	-	-
3. Generalized Anxiety Disorder	.046	.754**	-

Note. N = 200. MAIA = Multidimensional Assessment of Interoceptive Awareness; PHQ-15 = Patient Health Questionnaire-15; GAD = Generalized Anxiety Disorder. All values are rounded to three decimal places to reflect the exact SPSS output. ** p < .01 (two-tailed).

The results demonstrate a robust link between physical somatic complaints and generalized anxiety. However, a person's general capacity for interoceptive awareness, as measured by the MAIA total score, did not appear to co-vary significantly with either anxiety or somatic symptoms within this sample.

A multiple regression was conducted to determine the extent to which interoceptive awareness (MAIA total) and somatic symptoms (PHQ-15 total) predict generalized anxiety symptoms (GAD total). The overall regression model was statistically significant, F(2, 197) = 245.22, p < .001. The predictor variables collectively accounted for 71.3% of the variance in generalized anxiety symptoms (R^2 = .713, adjusted R^2 = .711). This represents a large effect size (Cohen, 1992), indicating that the model was highly effective at predicting GAD scores.

Table-2: Multiple Regression Analysis Predicting Generalized Anxiety Disorder (GAD) Symptoms

Variable	*B*	*SE B*	β	*T*	*P*
(Constant)	-0.28	0.96	-	-0.29	.771
MAIA Total	0.01	0.01	.03	0.71	.480
PHQ-15 Total	0.44	0.02	.84	22.01	< .001

Note. N = 200. MAIA = Multidimensional Assessment of Interoceptive Awareness; PHQ-15 = Patient Health Questionnaire-15. Model R^2 = .713, *F*(2, 197) = 245.22, *p* < .001. All values are rounded to two decimal places, except for *p*-values. Somatic symptoms were a significant positive predictor of generalized anxiety (B = 0.44, p < .001). The standardized coefficient (β = .84) suggests a very strong relationship; for every unit increase in PHQ-15 scores, GAD scores increased by 0.44 units, holding the other variable constant. Interoceptive awareness did not significantly predict generalized anxiety in this model (B = 0.01, p = .480). The results suggest that somatic symptom severity (PHQ-15) is a robust and highly significant predictor of generalized anxiety, while the contribution of general interoceptive awareness (MAIA) to the prediction of anxiety disappears when somatic symptoms are controlled.

Summary of Hypothesis Tests

H1 was supported: somatic symptom severity was significantly and strongly correlated with

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Volume 4 • Issue 6 • October 2026

generalized anxiety, and was a significant positive predictor of it.

H2 was not supported: interoceptive awareness was not significantly related to either somatic symptoms or generalized anxiety.

H3 was supported in that the overall regression model was significant; however, this was due to somatic symptom severity, since interoceptive awareness did not contribute a significant unique effect.

Discussion

This study tested whether interoceptive awareness and somatic symptom severity predict generalized anxiety among hypertensive adults. Somatic symptom severity was a strong, significant predictor of anxiety, while interoceptive awareness, as a single total score, was unrelated to either somatic symptoms or anxiety and did not contribute uniquely to the regression model.

Somatic Symptoms and Anxiety

The strong association of somatic symptom severity with generalized anxiety ($\beta = .84$) reflects a substantial body of evidence linking PHQ-15 scores to psychological distress, including anxiety, across clinical and primary care populations (Kroenke et al., 2002). In the context of a hypertensive sample, this pattern can be interpreted in more than one way, physical symptoms associated with hypertension or its treatment, such as headaches, dizziness, fatigue, and a racing heart, overlap substantially with the somatic features of generalized anxiety, such as restlessness and difficulty relaxing (Spitzer et al., 2006; Kowalski et al., 2023). It is therefore possible that somatic symptoms and anxiety symptoms are, to some extent, different expressions of a shared underlying state of physiological arousal and distress, rather than two fully independent constructs, fitting with the broader literature describing anxiety and hypertension as commonly comorbid and bidirectionally related conditions (Qiu et al., 2023; Li et al., 2020). The very large portion of variance explained (71.3%) also suggests that, within this hypertensive sample, somatic complaints are a core part of how anxiety is experienced and reported. For clinicians working with hypertensive patients, this means that physical complaints should not necessarily be dismissed as purely medical in origin; a high burden of somatic symptoms may be a useful indicator of significant anxiety that warrants further psychological assessment (Toussaint et al., 2024).

Interoceptive Awareness and Anxiety

Interoceptive awareness (as measured by MAIA-2 total score) was not significantly related to either somatic symptoms or generalized anxiety in this sample, and did not add predictive value once somatic symptoms were incorporated. This finding is generally in line with previous findings cautioning that global scores of body-awareness should not be treated as proxies for anxiety (Mehling et al., 2012; Zartaloudi et al., 2023). MAIA-2 was specifically designed to separate a hypervigilant (anxiety-driven) attention style from a more adaptive, mindful one, across its eight subscales (Scheffers et al., 2024), and other work has found that only certain subscales, such as Noticing or Attention Regulation, relate meaningfully to psychological distress, while others do not (Lee et al., 2024; Suzuki et al., 2021). Averaging over all eight dimensions to create a single total score is thus likely to have obscured any positive subscale-level relationships with anxiety, if any (Ali et al., 2024).

It is also possible that within a hypertensive population that is routinely advised to monitor bodily signs such as blood pressure, interoceptive attention may function differently than in healthy or psychiatric samples. Due to the correlational nature and use of a single total score for the design of this study, these possibilities are speculative and should be tested directly with future research on the MAIA-2 subscales (Koroboki et al., 2010).

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An International Peer-Reviewed Open Access Journal

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Volume 4 • Issue 6 • October 2026

Implications

These findings suggest that, within hypertensive adults, interventions to reduce anxiety may be better addressed by directly targeting somatic symptom burden, through symptom management, psychoeducation about the overlap between physical and anxiety symptoms, and coordinated medical and psychological care, rather than general interoceptive-awareness training. This does not preclude a role for interoceptive processes in anxiety; rather, it suggests that any such role will likely not be captured by a single interoceptive-awareness score and may depend on which facet of interoception is involved.

Limitations and Future Directions

A few limitations and areas for future work should be noted. The correlational design prohibits causal or temporal conclusions about the relationships among interoceptive awareness, somatic symptoms, and anxiety. All measures were self-reported, and there was substantial conceptual overlap between somatic and anxiety symptoms (which may inflate their observed relationship). The substantial conceptual overlap between PHQ-15 items (e.g., chest pain, dizziness, racing heart) and somatic features of the GAD-7 is of particular concern and may partially explain the strength of association observed. The analysis used only the MAIA-2 total score; the eight subscales were not examined separately, potentially obscuring differential relationships between specific facets of interoceptive awareness and anxiety. The sample was limited to hypertensive adults recruited in a particular setting, which may limit generalizability to other medical or non-clinical populations.

Future work should examine the MAIA-2 subscales separately, investigate the direction of the relationships using longitudinal designs, and consider controlling for symptom overlap between somatic and anxiety measures. Work that combines self-report interoceptive measures with objective indices of interoceptive accuracy may help to clarify whether the null findings for interoceptive awareness reflect a true construct-specific issue or limitations of the self-report total score used here.

Conclusion

Among hypertensive adults, somatic symptom severity was a strong and significant predictor of generalized anxiety, while a global measure of interoceptive awareness was not significantly related to either somatic symptoms or anxiety. These findings emphasize the central role of physical symptom burden in the experience of anxiety among people with hypertension and suggest that future work should examine specific facets of interoceptive awareness rather than a single total score to clarify whether and how interoceptive processes contribute to anxiety in this population.

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