

# BASIS: The blood pressure awareness and insight scale

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Impaired illness awareness or not accepting that one has hypertension (HTN) may be an important predictor of treatment adherence and optimal blood pressure control. The purpose of this study was to perform a systematic review of available instruments to evaluate HTN awareness, and subsequently present a novel scale that measures the core domains of subjective illness awareness in HTN. Based on the absence of any validated HTN specific measure identified through our review, the Blood Pressure Awareness and Insight Scale (BASIS) was developed ([www.illnessawarenessscales.com](http://www.illnessawarenessscales.com)). An online survey platform was used to collect data on 100 participants. BASIS showed good concurrent ( $r(98) = .65$ ,  $P < 0.001$ ) and discriminant validity, internal consistency (Cronbach's  $\alpha = .75$ ), and 1-month test-retest reliability (ICC = 0.77). BASIS is a comprehensive, easy-to-use instrument specifically designed to measure subjective HTN awareness. BASIS may be used in research studies and clinical practice to assess the impact of HTN awareness on treatment adherence and clinical outcomes.

## 1 | INTRODUCTION

Impaired illness awareness or not accepting that one has hypertension (HTN) is an understudied construct that may negatively influence treatment adherence and desired clinical outcomes.<sup>1</sup> Despite the availability of effective antihypertensive drugs, less than 30% of treated patients with HTN maintain optimal blood pressure (BP).<sup>2</sup> Uncontrolled HTN due to poor medication adherence is associated

with an increased risk of cardiovascular disease and all-cause mortality.<sup>3–5</sup> A longitudinal study revealed that nonadherent patients at the 2nd and 10th year of follow-up, after initiating antihypertensive drugs, had 3.81 and 3.01 higher odds, respectively, of death due to stroke compared to adherent patients.<sup>6</sup>

Various factors may influence patients' treatment adherence,<sup>6–8</sup> including health care system issues, patient demographics (ie, age and gender), medication factors (ie, dose, cost, polypharmacy and

adverse effects), and patients' beliefs and attitudes toward HTN and its treatment.<sup>7</sup> Previous studies suggest that patients' awareness or perception of their illness is an important predictor of compliance.<sup>7,9-11</sup> Although of clinical relevance, subjective awareness of having HTN remains a poorly articulated construct and its influence on acceptance of need for treatment, BP control, and the risk of HTN-related complications remains to be investigated.

In this work, the term illness awareness refers to one's subjective awareness and acceptance of having HTN and not one's knowledge of the illness. Impaired illness awareness is an acknowledged feature of several other conditions, including neurodegenerative disorders, traumatic brain injury, and psychotic disorders.<sup>12,13</sup> Conceptually, illness awareness is recognized as a multidimensional construct that generally consists of 4 core domains: (1) General illness awareness or acceptance, (2) accurate symptom attribution to the illness, (3) awareness of need for treatment, and (4) awareness of negative consequences due to the illness.<sup>13-15</sup> This model of illness awareness can be applied to other medical conditions, such as HTN. For example, an individual who accepts having HTN, at the same time, may deny the need to take antihypertensive medications and minimize the long-term negative health effects despite receiving HTN related education. He or she is likely to have intact general illness awareness, but impaired awareness of the need for treatment and negative consequences of HTN.

In order to determine the implications of subjective illness awareness on medication adherence and clinical outcomes, a psychometrically validated measure specific to HTN, its symptoms, treatment, and consequences is needed. The aims of the current study were to: (1) systematically review the currently available measures of assessing illness awareness in HTN, and (2) subsequently develop a scale that is easy to administer, reliable, and psychometrically valid to assess HTN awareness and its core domains in adults ([www.illness-awarenessscales.com](http://www.illness-awarenessscales.com)).

## 2 | METHODS

### 2.1 | Systematic literature review

A systematic review of English language publications of any design from 1966 to January 2017 describing assessment instruments for subjective HTN awareness in adults (aged  $\geq 18$  years) with elevated BP levels was conducted using OVID database (Medline®, PsycINFO, and Embase) on January 10, 2017. The following terms were used to conduct the search: "awareness" or "illness awareness" or "anosognosia" or "agnosia" or "illness perception" or "denial" or "insight into illness" and "hypertens\*" or "metabolic" and "assessments" or "scales" or "questionnaires." To remove duplicates, database preference was selected in the following order: (1) OVID Medline®, (2) PsycINFO, and (3) Embase and "has abstracts" was selected for field preference. No study setting limits were imposed on the search. Articles were included if they contained or provided description of one or more assessments used to evaluate subjective awareness of abnormal BP levels among hypertensive adults. We excluded studies

primarily restricted to psychiatric and neurological disorders, as well as to other medical conditions, including obesity, hypercholesterolemia, hyperlipidemia, and diabetes. Studies focusing on knowledge rather than subjective awareness of HTN were also omitted. Reference sections of articles were also gleaned for additional relevant articles overlooked by the search strategy.

HTN awareness measures were evaluated on the degree to which they assessed the core domains of illness awareness and other psychometric properties (ie, convergent and discriminant validity and inter-rater and test-retest reliability).

### 2.2 | Scale development and validation

Item development for BASIS ([www.illnessawarenessscales.com](http://www.illnessawarenessscales.com)) was guided by a previously published measure of illness awareness<sup>16</sup> and scales and questionnaires identified through our systematic review that measure certain aspects of illness awareness in patients with HTN.<sup>9,17-25</sup> Based on the 4 existing theoretical domains of illness awareness, 9 items were initially included in BASIS.<sup>13-15</sup> Three items were developed to measure general illness awareness and need for treatment, 2 items for symptom attribution, and 1 item for the awareness of negative consequences domains. As symptoms of HTN are usually not clinically overt, participants have the option of selecting "not applicable" if they have not experienced any prior symptoms. Each item is scored using a 10-point Likert scale, from "strongly disagree" to "strongly agree," to derive an average total score and subscale score for each of the 4 domains. Several items are reverse scored to minimize self-response bias. For instance, the general illness awareness domain is measured from both an illness perspective (ie, "I have high blood pressure") and health perspective (ie, "I have normal blood pressure"). Scale items were reviewed by health care professionals at Toronto General Hospital, including internists, surgeons, psychiatrists, psychologists, social workers, and nurse practitioners who have expertise in working with patients with metabolic and cardiovascular conditions.

Participants were recruited via an online panel from Research Now, a digitalized survey platform. Participants were broadly represented with respect to age ( $M = 59.3$ ,  $SD = 12.2$ , Range = 28-78) and region of residence in Canada, except Quebec (41% Ontario, 50% Western provinces, and 9% Atlantic provinces). Research Now has built-in quality control checks to ensure the validity of the collected data. Further information is available on the Research Now website (<https://www.researchnow.com>). A total of 100 participants were included in the study based on recommended sample size requirements for conducting factor analyses.<sup>26-28</sup> For inclusion in the study, participants had to have a prior diagnosis of HTN, and a resting BP measurement within 2 weeks of initiating the study. All participants included were on medication for HTN. In order to capture the full spectrum of HTN awareness and medication adherence, participants were recruited based on quotas for the following categorizations from the 4-item Morisky Medication Adherence Scale (MMAS-4):<sup>29</sup> (1) low adherence ( $n = 20$ ), (2) medium adherence ( $n = 47$ ), and (3) high adherence ( $n = 33$ ).

As part of the survey, participants' demographic and clinical information were collected. Participants also completed the brief illness perception questionnaire (B-IPQ),<sup>20</sup> and positive and negative affect schedule (PANAS).<sup>30</sup> The B-IPQ is a psychometrically validated scale that was developed to measure illness perception in chronic disease. As per scale developer instructions, B-IPQ items were individually tailored for HTN by replacing "illness" with "high blood pressure" (eg, "how much do you think your treatment can help with your high blood pressure?"). The PANAS measures participants' positive and negative affective states for use in clinical and nonclinical adult samples. Prior to completing BASIS, participants were instructed to read brief background information on HTN, including a clear definition, associated symptoms, potential negative consequences, and available treatment options. This was done to minimize the effects of participant's degree of illness-related knowledge in order to measure participant's subjective illness awareness.

### 2.2.1 | Validity

Convergent validity of BASIS was evaluated with B-IPQ.<sup>20</sup> Pearson correlation analyses were performed between BASIS average total and subscale scores with B-IPQ total and item scale scores. Discriminant validity of BASIS was evaluated with PANAS.<sup>31</sup> BASIS average total and subscale scores were analyzed with both positive and negative affect scores to distinguish the construct of HTN awareness from emotional states. Bonferroni correction for multiple testing was applied.

An exploratory principle components analysis was performed to evaluate the factor structure of BASIS.<sup>32</sup> Initially, parallel analysis was carried out to determine the number of factors to extract based on the eigenvalues from the original data that exceeded the 95th percentile of the eigenvalues from a randomly generated dataset with the same distribution as the original data.

### 2.2.2 | Reliability

Internal consistency of BASIS was evaluated using Cronbach's alpha ( $\alpha$ ) and corrected item-to-total correlation (CITC). Items with CITCs > 0.25 were retained for scale validation.<sup>33</sup> One-month test-retest reliability was evaluated in 10 randomly chosen participants to detect an intra-class correlation coefficient (ICC) of 0.7 at  $\alpha = .05$  and power of 80%.<sup>34</sup> The two-way mixed model of ICC was evaluated at the 95% confidence interval (CI).<sup>35</sup>

Statistical analysis was performed using the SPSS statistical software, version 23.0.

## 3 | RESULTS

### 3.1 | Systematic literature review

Our search identified 734 publications. The titles and abstracts were read by 2 of the authors (PG and PS). Of these, 664 were deemed irrelevant. The remaining full-text articles ( $n = 70$ ) were reviewed to

select for those applicable to the assessment of illness awareness in HTN. Fifty-six articles were excluded (see Figure S1 for reasons). A search of the remaining articles' reference sections resulted in the identification of 4 additional scales: the illness revised perception questionnaire (IPQ-R)<sup>36</sup>; B-IPQ<sup>20</sup>; the beliefs about medicines questionnaire (BMQ),<sup>9</sup> and treatment satisfaction questionnaire for medication (TSQM).<sup>19</sup> Hence, the remaining 18 full-text articles were retained, of which 10 were seminal articles describing original scales and 8 were subsequent studies utilizing previously developed scales (Figure S1). Original scales (ie,  $n = 10$ ) were reviewed for the degree to which they assess the core domains of illness awareness.<sup>9,17-24,36</sup> The findings are summarized in Table S1. Material S1 describes the measures and their psychometric properties in detail.

### 3.1.1 | Summary

To date, there are no validated, brief measures specific to the assessment of subjective HTN awareness. Currently available assessments range from single to multi-domain measures with dichotomous to multichotomous response items. While many scales appear to generally cover the general illness awareness and awareness of need for treatment domains, some measures only partially assess other domains. Our review identified 4 psychometrically validated measures. The B-IPQ, an abbreviated, user-friendly version of the IPQ-R, has demonstrated good test-retest reliability, and predictive, concurrent and discriminant validity in a variety of chronic illnesses. It is the only validated measure that assesses all 4-illness awareness domains; however, it has not been psychometrically tested in a hypertensive sample. Although the TSQM is validated for use in hypertensive samples, it was specifically designed to measure patients' satisfaction with their medication and does not assess subjective illness awareness. Similarly, the BMQ was designed to assess patients' beliefs and attitudes toward their medication and not subjective illness awareness.

## 3.2 | Scale development and validation

### 3.2.1 | Demographic and clinical characteristics

The demographic and clinical characteristics of the 100 participants included in the study are listed in Table 1. Of the 100 participants, 74 reported having symptoms. Participants generally had controlled systolic ( $M = 127.1$ ,  $SD = 14.7$ ,  $Range = 102-191$  mm Hg) and diastolic BP ( $M = 77.7$ ,  $SD = 12.9$ ,  $Range = 40-129$  mm Hg) in association with being prescribed antihypertensive medication. A one-way ANOVA was performed to examine differences in BP and MMAS-4 adherence categorization. There was a significant group difference in systolic ( $F(2, 89) = 3.52$ ,  $P = .034$ ) and diastolic BP ( $F(2, 89) = 4.56$ ,  $P = .013$ ). The systolic and diastolic BP was higher in low adherence group ( $133.5 \pm 20.2$ ,  $P = .044$  and  $83.7 \pm 19.1$ ,  $P = .019$ , respectively) compared to high adherence group ( $122.4 \pm 10.1$  and  $72.9 \pm 10.6$ , respectively). There was no difference in education between groups ( $F(2,99) = 0.65$ ,  $P = .527$ ). Participants had moderate illness

**TABLE 1** Demographic and clinical characteristics

	Total sample
N	100
Gender (% female)	48.0%
MMAS-4 Score (low:medium:high adherence)	20:47:33
	Mean (SD)
Age, range, % ≥60	59.3 (12.2), 28-78, 58.0%
Resting systolic pressure, range	127.1 (14.7), 102-191
Resting diastolic pressure, range	77.7 (12.9), 40-129
Education (years)	15.2 (3.6)
Age of illness onset	45.3 (12.1)
Illness duration (years)	14.0 (9.1)
BASIS average total score <sup>a</sup>	6.4 (1.7)
BASIS general illness awareness <sup>b</sup>	6.1 (2.4)
BASIS symptom attribution <sup>c</sup>	5.0 (2.6)
BASIS awareness of need for treatment <sup>d</sup>	7.0 (1.7)
BASIS awareness of negative consequences <sup>e</sup>	7.4 (3.0)
B-IPQ total score	29.0 (11.5)
PANAS positive affect score	29.9 (7.3)
PANAS negative affect score	19.1 (8.1)

B-IPQ, Brief-Illness Perception Questionnaire; MMAS-4, Four-Item Morisky Medication Adherence Scale; PANAS, Positive and Negative Affect Schedule.

<sup>a</sup>BASIS average total score excludes item 2 due to poor internal consistency.

<sup>b</sup>BASIS general illness awareness includes items 3, 5, and 8.

<sup>c</sup>BASIS symptom attribution includes item 1. Item 2 deleted due to poor internal consistency.

<sup>d</sup>BASIS awareness of need for treatment includes items 4, 6, and 9.

<sup>e</sup>BASIS awareness of negative consequences includes item 7.

awareness as measured by the BASIS average total score ( $M = 6.4$ ,  $SD = 1.6$ ). There was no association between MMAS-4 adherence categorization and BASIS average total scores.

The correlation coefficients between BASIS and demographic and clinical data are presented in Table 2. There was a modest correlation between resting systolic pressure and BASIS, specifically the general illness awareness and awareness of need for treatment domains, indicating that participants with higher systolic BP are more likely to have HTN awareness. There was also a negative association between the BASIS general illness awareness domain and age, but not after Bonferroni correction. Of note, there was no association between BASIS and diastolic BP, years of education, age of illness onset, and illness duration.

### 3.2.2 | Validity

Table 2 lists the correlation coefficients to assess the convergent and discriminant validity of BASIS with B-IPQ and PANAS, respectively. BASIS average total score and subscale scores were moderately

associated with B-IPQ total score, indicating good convergent validity (Figure 1).

The BASIS average total and subscale scores were not correlated with positive affect scores with the exception of a weak association between the general illness awareness domain and positive affect scores. BASIS average total and subscale scores were weakly to moderately associated with negative affect scores. Taken together, BASIS demonstrated good discriminant validity (Table 2).

Parallel analysis for BASIS identified 1 eigenvalue that exceeded 95th percentile eigenvalues generated from randomly generated data (Figure S2). The first 3 eigenvalues from the actual data and randomly generated data were 3.02, 1.40, and 0.99 and 1.73, 1.48, and 1.30, respectively. The single component accounted for 33.6% of variance in BASIS. The Kaiser-Meyer Olkin measure of sampling adequacy was 0.72. Table 3 displays the factor loadings and CITCs for each item.

### 3.2.3 | Reliability

The CITC for item 2 was less than 0.25 (Table 3). CITCs for all other items was  $>0.25$ . The Cronbach's  $\alpha$  excluding item 2 was .75, indicative of a strong internal consistency.<sup>37</sup>

One-month test-retest reliability for the BASIS sum total score evaluated in 10 participants was 0.77, 95% CI [0.07, 0.94].

## 4 | DISCUSSION

Impaired illness awareness in HTN is an understudied construct that may contribute to medication nonadherence. However, in order to better understand the impact of subjective illness awareness on clinical outcomes, a reliable and validated measure of HTN awareness is needed. The lack of a HTN specific scale led to the development and psychometric validation of BASIS, a novel, easy-to-use, comprehensive measure of subjective HTN awareness ([www.illnessawarenessscales.com](http://www.illnessawarenessscales.com)). BASIS consists of 8-items, each using a 10-point Likert scale to assess the core domains of illness awareness in HTN. Completion of BASIS takes approximately 2 minutes.

Based on our systematic review of the literature, currently available instruments do not comprehensively assess subjective HTN awareness or the domains of illness awareness. The use of only dichotomous (eg, Yes/No) and multiple-choice questions rather than rating scales (ie, Likert-type) can contribute to inaccuracies in the assessment of illness awareness in HTN, as they limit expression and response range. Of the 10 measures we encountered through our systematic search, only 4 (ie, IPQ-R, B-IPQ, TSQM, and BMQ) are psychometrically validated instruments. TSMQ and BMQ were designed to assess patient satisfaction with their medications and attitudes and beliefs toward them, respectively, and not subjective illness awareness. The B-IPQ, a leaner derivative of IPQ-R, has good test-retest reliability and predictive, concurrent, and discriminant validity. The B-IPQ is the only validated measure that covers all 4 domains of illness awareness. Although used previously to measure

**TABLE 2** Correlations for the BASIS, B-IPQ, and PANAS

	BASIS average total score <sup>a</sup>	BASIS general illness awareness <sup>b</sup>	BASIS symptom attribution <sup>c</sup>	BASIS awareness of need for treatment <sup>d</sup>	BASIS awareness of negative consequences <sup>e</sup>	B-IPQ total score	PANAS positive affect score	PANAS negative affect score
Age	-0.17	-0.31*	-0.20	-0.13	0.05	-0.39**	0.21*	-0.32*
Resting systolic pressure	0.28*	0.39**	0.21	0.26*	0.03	0.27*	-0.21*	0.26*
Resting diastolic pressure	0.09	0.14	0.18	0.03	-0.04	0.17	-0.10	0.26*
Education (years)	-0.06	0.11	-0.11	-0.00	0.06	0.12	0.07	-0.13
Age of illness onset	-0.14	-0.19	-0.16	-0.09	0.02	-0.33*	-0.19	0.51**
Illness duration (years)	-0.05	-0.16	-0.07	-0.05	0.04	-0.08	0.07	-0.11
BASIS item 1	0.68**	0.34*	-	0.16	0.30*	0.54**	-0.10	0.32*
BASIS item 2†	0.11	0.10	0.07	-0.01	0.10	0.24*	-0.14	0.24*
BASIS item 3	0.70**	0.79**	0.37*	0.56**	0.29*	0.39**	-0.11	0.23*
BASIS item 4	0.35*	0.30*	-0.02	0.62**	0.16	0.23*	-0.01	0.14
BASIS item 5	-0.64**	-0.85**	-0.18	-0.54**	-0.25*	-0.41**	0.28*	-0.34*
BASIS item 6	-0.49**	-0.43**	-0.25*	-0.78**	-0.11	-0.34*	0.35*	-0.33*
BASIS item 7	0.72**	0.29*	0.30*	0.16	-	0.27*	0.03	0.24*
BASIS item 8	0.43**	0.71**	0.31*	0.17	0.15	0.40**	-0.28*	0.51**
BASIS item 9	0.32*	0.31*	0.03	0.60**	0.06	0.10	0.07	0.05
BASIS average total score <sup>a</sup>	-	0.75**	0.68**	0.59**	0.72**	0.55**	-0.15	0.44**
BASIS general illness awareness <sup>b</sup>	0.75**	-	0.34*	0.53**	0.29*	0.51**	-0.30*	0.48**
BASIS symptom attribution <sup>c</sup>	0.68**	0.34*	-	0.16	0.30*	0.54**	-0.10	0.32*
BASIS awareness of need for treatment <sup>d</sup>	0.59**	0.53**	0.16	-	0.16	0.34*	-0.19	0.28*
BASIS awareness of negative consequences <sup>e</sup>	0.72**	0.29*	0.30*	0.16	-	0.27*	0.03	0.24*
B-IPQ total score	0.55**	0.51**	0.54**	0.34**	0.27*	-	-0.27*	0.60**
B-IPQ consequences	0.53**	0.44**	0.59**	0.25*	0.27*	0.80**	-0.23*	0.41**
B-IPQ timeline	0.18*	0.26*	-0.13	0.23*	0.09	0.27*	0.01	0.18
B-IPQ personal control	-0.41**	-0.45**	-0.30*	-0.24*	-0.18	-0.49**	0.21*	-0.38**
B-IPQ cure control	-0.08	-0.18	-0.00	0.01	-0.05	-0.28*	0.15	-0.24*
B-IPQ identity	0.44**	0.37**	0.58**	0.13	0.23*	0.81**	-0.29*	0.49**
B-IPQ concern	0.38**	0.35**	0.30*	0.37**	0.18	0.68**	-0.13	0.29*
B-IPQ understanding	-0.12	-0.29*	-0.08	-0.02	0.00	-0.02	0.18	-0.18

(Continues)

TABLE 2 (Continued)

	BASIS average total score <sup>a</sup>	BASIS general illness awareness <sup>b</sup>	BASIS symptom attribution <sup>c</sup>	BASIS awareness of need for treatment <sup>d</sup>	BASIS awareness of negative consequences <sup>e</sup>	B-IPQ total score	PANAS positive affect score	PANAS negative affect score
B-IPQ emotional response	0.36**	0.37**	0.39**	0.22*	0.12	0.79**	-0.31*	0.66**
PANAS positive affect score	-0.15	-0.30*	-0.10	-0.19	0.03	-0.27*	-	-0.26*
PANAS negative affect score	0.44**	0.48**	0.32*	0.28*	0.24*	0.60**	-0.26*	-

B-IPQ, Brief-Illness Perception Questionnaire; PANAS, Positive and Negative Affect Schedule.

<sup>a</sup>Grey highlight indicates that this item was deleted from the scale due to poor internal consistency.

<sup>b</sup>BASIS average total score excludes item 2 due to poor internal consistency.

<sup>c</sup>BASIS general illness awareness includes items 3, 5, and 8.

<sup>d</sup>BASIS symptom attribution includes item 1. Item 2 deleted due to poor internal consistency.

<sup>e</sup>BASIS awareness of need for treatment includes items 4, 6, and 9.

<sup>f</sup>BASIS awareness of negative consequences includes item 7.

\* $P < .05$ .

\*\* $P \leq .0002$ , Bonferroni correction for multiple comparisons.

illness perceptions in HTN,<sup>20</sup> it is not specific to HTN or subjective illness awareness. For example, the item "How concerned are you about your illness?" does not specifically assess the general illness awareness domain (ie, subjective awareness/acceptance of having an illness), as it may also assess patients' worries about their illness in relation to perceived consequences of their illness. Similarly, other items that do not directly measure subjective illness awareness or acceptance include "timeline" (ie, "How long do you think your illness will continue?") and "understanding" (ie, "How well do you feel you understand your illness?"). Nonetheless, based on our literature review, B-IPQ was the preferred measure to assess the convergent validity of BASIS.

The results of our psychometric assessment indicate that BASIS demonstrates good convergent and discriminant validity with B-IPQ and PANAS, respectively. Of note, BASIS average total score and the awareness of need for treatment domain were not correlated with B-IPQ "cure control" (ie, "How much do you think your treatment can help your HTN?"). A possible explanation for the lack of association is the distinction between the B-IPQ item, "How much do you think your treatment can help..." (B-IPQ), which implies "hope" or "confidence," and the BASIS items "I NEED blood pressure lowering medication" and "I NEED to make healthy lifestyle changes..." which are specific to awareness of need for evidenced based treatments currently recommended for the management of HTN in adults. Interestingly, there appeared to be a stronger association between BASIS and negative affect than positive affect scores. This observation may be due a relationship between increased illness awareness and negative emotional states, such as depression, that has been observed in other conditions.<sup>38,39</sup> Speculatively, although impaired illness awareness may act as a barrier to lifestyle modifications and treatment engagement, it may also protect against negative emotions.<sup>39</sup>

Although 2 items were initially designed to measure symptom attribution, the results of the reliability analysis led to the exclusion of item 2 (ie, "my experiences are due to other reasons than

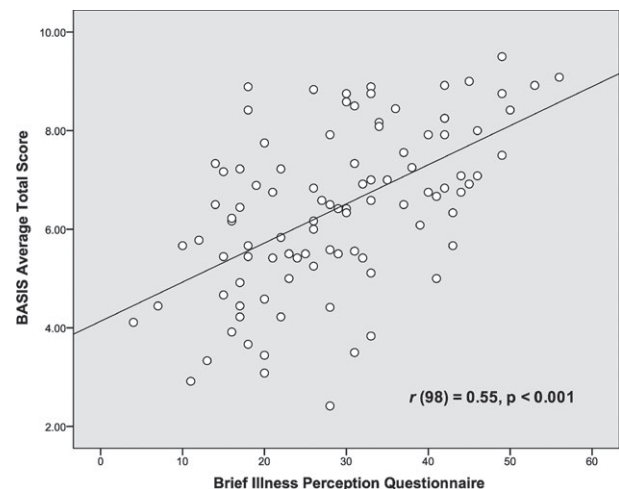


FIGURE 1 Convergence ( $r$ ) for BASIS average total score with the Brief Illness Perception Questionnaire (B-IPQ) total score



**TABLE 3** BASIS factor loadings and internal reliability

Expected domain	Items	Factor loading (Principle component method)	Corrected Item-To- Total Correlation (CITC)
Symptom attribution	1. My health related experiences are due to having high blood pressure	0.481	0.317
Symptom attribution <sup>†</sup>	2. My health related experiences are due to other reasons than my high blood pressure regardless of what other people think (eg, doctors, family, friend, etc.)	-0.098	-0.089
General illness awareness	3. I have high blood pressure (ie, hypertension)	0.848	0.733
Awareness of need for treatment	4. I NEED to make or maintain healthy life style changes to improve my diet and increase the amount I exercise	0.415	0.270
General illness awareness	5. I have normal blood pressure	0.802	0.628
Awareness of need for treatment	6. I can safely carry on my current lifestyle (ie, eating/drinking and exercising as I currently do)	0.662	0.464
Awareness of negative consequences	7. My high blood pressure has led or can lead to negative health consequences (eg, heart disease, heart attack, heart failure, stroke, near stroke, kidney/renal disease, vision loss, etc.)	0.493	0.321
General illness awareness	8. My blood pressure is regularly in the hypertensive range (ie, >140/90)	0.611	0.356
Awareness of need for treatment	9. I need blood pressure lowering medication	0.443	0.317

Cronbach's alpha excluding item 2 is .749. <sup>†</sup>Grey highlight indicates that this item was deleted from the scale due to poor internal consistency.

my hypertension regardless of what other people think [eg, doctors, family, friends, etc.]"). The other remaining item showed good reliability and convergent and discriminant validity, justifying the inclusion of the single symptom attribution item. With the exclusion of this item, BASIS demonstrated strong internal consistency and test-retest reliability.

The results of principle component analysis suggest a single factor solution for BASIS. Despite the lack of support for a multi-dimensional structure, each HTN awareness domain has different predictive clinical utility. As BASIS was developed based on a preexisting model, a confirmatory analysis rather than data-driven exploratory analysis may have been a preferable methodological approach. However, due to limited sample size and insufficient indicators (ie, few items) for each domain, a confirmatory factor analysis could not be carried out. Further investigation in a larger sample size is required to evaluate this hierarchical model of illness awareness.

Our study has a few limitations. First, with respect to our systematic review, although comprehensive, relevant articles not captured by our search terms may have been excluded. Additionally, relevant articles published in languages other than English may have been excluded by our search criteria. Second, in terms of our scale development and validation, the use of an online research platform will exclude individuals who do not have access to or who are not familiar with using electronics. Further, there may have been a selection bias toward including only motivated participants. However, previous studies report no differences in reliability or validity between online or clinically based surveys.<sup>40</sup> Third, participants selected for the validation of BASIS were treated with antihypertensive medication and generally had well-controlled BP ( $M = 127.1/77.7$ ,  $SD = 14.7/12.9$ ;

see Table 1). A possible explanation for the exclusion of participants with uncontrolled HTN is that we only included participants who had their resting BP checked within the past 2 weeks to ensure accurate diagnosis of HTN. As a result of this inclusion criterion, it is possible that participants who frequently monitor their BP were preferentially selected. That being said, participants had the option to check their BP (eg, by visiting their physician, pharmacy, or using a portable home BP monitor) in order to participate in the study. Further, this inclusion criterion supported the validity of the study by ensuring that participants were aware of their BP, limiting the influence of knowledge on participants' subjective level of illness awareness.

In summary, BASIS is a novel measure of subjective HTN awareness in adults. This study provides initial support for the psychometric validation of BASIS, a clinically practical self-report instrument with good concurrent and discriminant validity, strong internal consistency, and test-retest reliability. BASIS can be used in epidemiological studies or prospective treatment trials to investigate the extent to which illness awareness in HTN contributes to medication adherence and clinical outcomes. Further, BASIS may be valuable for neurophysiological or neuroimaging research to identify the brain regions implicated in impaired HTN awareness.

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## CONFLICT OF INTEREST

PG reports receiving fellowship awards and research support from the Canadian Institutes of Health Research (CIHR), OMHF, and CAMH. JK reports no conflicts of interest. PS reports no conflicts of interest. LQ reports no conflicts of interest. TB reports no conflicts of interest. FC reports receiving fellowship grants from the Ontario Graduate Scholarship (OGS) and CIHR. EP reports receiving research support from OGS and a CIHR Canada Graduate Scholarship—Master's, and is currently receiving research support from a CIHR Vanier Canada Graduate Scholarship. JKC reports receiving research support from a CIHR Canada Graduate Scholarship—Master's, and is currently receiving research support from a CIHR Doctoral Award. YI reports receiving fellowship grants from Keio University Medical Science Foundation, Mitsukoshi Foundation, Japan Foundation for Aging and Health, and manuscript fees from Dainippon Sumitomo Pharma. BP reports no conflicts of interest. SD is a Banting & Best Diabetes Center (University of Toronto) Dennis Scholar and Diabetes Canada New Investigator. SS reports receiving research funding from CIHR. AGG reports receiving research support from the following external funding agencies: the CIHR, US NIH, OMHF, NARSAD, Mexico Instituto de Ciencia y Tecnología del Distrito Federal, Consejo Nacional De Ciencia Y Tecnología, Ministry of Economic Development and Innovation of Ontario, Ontario AHSC AFP Innovation Fund, and W. Garfield Weston Foundation.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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