



EFFECTS OF CHRONONUTRITION, EMOTIONAL EATING, AND SELF-CONTROL ON BLOOD PRESSURE AMONG HYPERTENSIVE PATIENTS

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ABSTRACT

Hypertension remains a major global health challenge, with pharmacological treatment as the mainstay of management. However, modifiable behavioural and chronobiological factors such as chrononutrition, emotional eating, and self-control are increasingly recognised as important contributors to blood pressure regulation. Despite this recognition, these three factors have not been examined together in hypertensive populations. Understanding their combined relationships is important to support the development of more comprehensive behavioural interventions for hypertension management. Therefore, this study aimed to simultaneously examine the relationships between chrononutrition, emotional eating, and self-control with blood pressure among hypertensive patients attending primary health centres in Banjarsari District, Surakarta, Indonesia. Specifically, the study sought to analyze the associations of chrononutrition, emotional eating, and self-control with blood pressure in this population. This cross-sectional study evaluated how these three factors relate to blood pressure among hypertensive patients attending six community health centres (Puskesmas) in Banjarsari District, Surakarta, Indonesia. Using proportional random sampling, 115 participants were enrolled. Chrononutrition, emotional eating, and self-control were assessed using the Chrononutrition Questionnaire, the Emotional Eater Questionnaire, and a modified Brief Self-Control Scale, respectively. All three instruments had been tested and demonstrated good to excellent validity and reliability, with Cronbach's alpha values ranging from 0.867 to 0.928. Blood pressure was measured using a validated digital sphygmomanometer following the 2025 American Heart Association standards. Ordinal logistic regression adjusted for age and sex showed that poor chrononutrition (AOR = 4.424), emotional eating (AOR up to 15.503), and low self-control (AOR = 20.752) were each independently associated with higher blood pressure categories, with self-control being the strongest predictor. These findings suggest that integrating behavioural assessments into primary hypertension care is warranted.

Keywords: blood pressure; chrononutrition; emotional eating; hypertension; self-control

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INTRODUCTION

Across the world, elevated blood pressure continues to rank among the most serious public health problems. The World Health Organization estimates that roughly 1.28 billion people between 30 and 79 years of age live with hypertension, although close to 46% are unaware that they have it (WHO, 2023). Because so many cases go undetected, diagnosis and treatment are frequently delayed, which raises the likelihood of serious sequelae such as stroke, heart failure, coronary disease, and chronic kidney disease conditions that together account for a large share of avoidable deaths. National figures echo this pattern: the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia) placed adult hypertension prevalence at 30.8% among those aged 18 and older, underscoring the considerable strain the disease places on health services (Kemenkes RI, 2023).

Medication is undeniably the foundation of hypertension care, yet durable control rarely results from drugs alone. Adjusting daily habits dietary practices in particular is equally decisive for keeping blood pressure in check. Among the newer dietary perspectives, chrononutrition has attracted considerable interest. This field investigates the way the scheduling, frequency, and consistency of eating interact with the body's internal circadian clock to shape metabolic functioning and disease susceptibility (Dashti et al., 2025). Its principal elements concern when meals are eaten, how long the daily eating window lasts, how regular the meals are, and how energy and macronutrients are distributed across the day. When eating habits fall out of step with circadian timing through behaviours such as eating late at night, irregular mealtimes, or omitting breakfast the consequences can include circadian desynchronisation, disturbed glucose and lipid handling, and raised blood pressure (Böhmke et al., 2024; Raji & Wirth, 2024).

Both narrative and systematic reviews lend weight to chrononutrition oriented approaches. Reviewing the available literature, Böhmke et al. (2024) argued that time restricted eating synchronised with circadian rhythms offers a workable drug-free option for better blood pressure control. In a comparable vein, Konstantinidou and Jamshed (2024) showed that concentrating caloric intake in the morning and midday yielded more favourable cardiometabolic outcomes than diets weighted toward the evening. Taken together, such evidence implies that the timing of food intake may matter as much as its content when managing hypertension.

Alongside meal timing, psychological and behavioural influences have gained increasing recognition. One especially pertinent behaviour is emotional eating the inclination to eat in reaction to unpleasant feelings such as stress, anxiety, sadness, or boredom instead of genuine hunger (Reichenberger et al., 2020). Episodes of this kind commonly centre on foods dense in fat, sugar, and sodium, which may aggravate hypertension directly. Reinforcing this link, Wu et al. (2024) reported that emotional eating prompted by anger was significantly related to higher diastolic and mean arterial pressure, regardless of participants' age or medication status. Tightly linked to emotional eating is the notion of self-control the capacity to rein in impulses, resist short term temptations, and stay committed to long-range health objectives such as prescribed dietary regimens (Rachmania et al., 2022; Sinaga & Undarwati, 2024). From a neurobiological standpoint, weak self-regulation triggers the hypothalamic pituitary adrenal (HPA) axis; the resulting rise in cortisol heightens sympathetic activity and encourages sodium retention, with both pathways pushing blood pressure upward (Gordon & Mendes, 2021).

While each of these determinants is individually supported by a considerable body of work, an important gap remains. Earlier investigations have generally examined chrononutrition, emotional eating, or self-control one at a time, and no published study has assessed the three together in relation to blood pressure in hypertensive patients. Because of this piecemeal treatment, it is still unclear how behavioural and psychological dimensions act in concert under everyday clinical conditions, which in turn hampers the design of integrated interventions deliverable in primary care. Against this backdrop, the present study aimed to simultaneously examine the relationships between chrononutrition, emotional eating, and self-control with blood pressure among hypertensive patients receiving care at primary health centres in Banjarsari District, Surakarta, Indonesia. Specifically, the study sought to analyze the association of chrononutrition with blood pressure, the association of emotional eating with blood pressure, and the association of self-control with blood pressure in this population. By addressing these relationships, the findings are intended to strengthen the evidence base for holistic, behaviourally oriented hypertension management programmes that integrate meal timing, emotional regulation, and self-control strategies.

METHOD

An observational cross-sectional study was conducted in April 2026 at six community health centres (Puskesmas) in Banjarsari District, Surakarta, Indonesia: Gambirsari, Banyuanyar, Gilingan,

Manahan, Nusukan, and Setabelan. Banjarsari was purposively selected as it has the highest hypertension burden in the city. Ethical approval was obtained from the Research Ethics Committee of Dr. Moewardi Regional General Hospital, Surakarta. The study population consisted of adults with a documented diagnosis of hypertension who were registered and routinely treated at the six centres. Eligible participants were aged ≥ 18 years, had a confirmed hypertension diagnosis in their medical record, were not pregnant, had no cognitive impairment or severe psychiatric illness, and provided written informed consent. Individuals with secondary hypertension or those unable to complete the questionnaires were excluded.

Sample size was calculated using Slovin's formula with a 10% margin of error and 95% confidence level, resulting in a minimum of 100 participants. Accounting for a 10% potential dropout, the target was set at 110. A total of 115 respondents were recruited using proportional random sampling based on the number of registered hypertensive patients at each centre. Blood pressure was measured using a validated digital sphygmomanometer following the 2025 American Heart Association (AHA) standards. Participants rested quietly for five minutes before measurement, after refraining from caffeine, tobacco, and physical activity for at least 30 minutes. Two readings taken one minute apart were averaged and categorised into four ordinal groups: normal ($<120/<80$ mmHg), elevated (120-129/ <80 mmHg), grade 1 hypertension (130-139/80-89 mmHg), and grade 2 hypertension ($\geq 140/\geq 90$ mmHg).

Chrononutrition was assessed using the Chrononutrition Questionnaire (CQ) developed by Phoi et al. (2021), culturally adapted for the Indonesian population. The 8-item instrument measures meal timing regularity and daily energy distribution. Total scores range from 0 to 24, with higher scores indicating better chrononutrition. Participants were classified as good (13–24) or poor (0–12) chrononutrition. The instrument showed good internal consistency (Cronbach's $\alpha = 0.867$). Emotional eating was measured using the Emotional Eater Questionnaire (EEQ) by Garaulet et al. (2012). This 10-item scale assesses the tendency to eat in response to negative emotions. Total scores range from 0 to 30 and were categorised into four levels. The scale demonstrated excellent reliability (Cronbach's $\alpha = 0.914$).

Self-control related to eating behaviour was evaluated using a modified 13-item Brief Self-Control Scale (BSCS), adapted from Tangney et al. (2004) for hypertensive patients. Scores range from 13 to 65 and were classified as low (13–30), moderate (31–48), or high (49–65). The instrument showed excellent internal consistency (Cronbach's $\alpha = 0.928$). All instruments were pilot-tested for validity and reliability among 30 eligible respondents prior to data collection. Data were analysed using ordinal logistic regression under the proportional odds model, with age and sex included as covariates. Model fit was assessed using the Pearson goodness-of-fit test and likelihood ratio test. Statistical significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics version 27.

RESULT

A total of 115 respondents took part. Their sociodemographic profile is presented in table 1.

Table 1.
Characteristics of Study Respondents (n = 115)

Characteristics	f	%
Age (years)		
18–44 years	14	12.2
45–59 years	62	53.9
≥ 60 years	39	33.9
Sex		
Female	75	65.2
Male	40	34.8

Characteristics	f	%
Education Level		
Elementary / Not graduated	28	24.3
Junior / Senior High School	62	53.9
Diploma / University	25	21.7
Occupation		
Not working / Housewife / Retired	71	61.7
Working (formal/informal)	44	38.3
Duration of Hypertension		
< 1 year	18	15.7
1–5 years	64	55.7
> 5 years	33	28.7

Women made up the larger share of the sample (65.2%), most respondents were aged 45–59 years (53.9%), more than half had completed junior or senior secondary education (53.9%), and the majority were not in paid employment, being homemakers or retirees (61.7%). With respect to disease duration, 55.7% had lived with a hypertension diagnosis for one to five years and 28.7% for more than five years.

Table 2.

Distribution of Blood Pressure, Chrononutrition, Emotional Eating, and Self-control (n = 115)

Variable / Category	f	%
Blood Pressure (AHA 2025)		
Normal (<120/<80 mmHg)	9	7.8
Elevated / Pre-hypertension (120–129/<80 mmHg)	22	19.1
Grade 1 Hypertension (130–139/80–89 mmHg)	46	40.0
Grade 2 Hypertension (≥140/≥90 mmHg)	38	33.0
Chrononutrition (CQ)		
Good (score 13–24)	47	40.9
Poor (score 0–12)	68	59.1
Emotional Eating (EEQ)		
Non-Emotional Eater (score 0–5)	32	27.8
Low Emotional Eater (score 6–10)	36	31.3
Emotional Eater (score 11–20)	31	27.0
Very Emotional Eater (score 21–30)	16	13.9
Self-Control (modified BSCS)		
Low (score 13–30)	41	35.7
Moderate (score 31–48)	50	43.5
High (score 49–65)	24	20.9

The joint relationship of chrononutrition, emotional eating, and self-control with blood pressure was examined through ordinal logistic regression under the proportional odds model, with age and sex held constant. The results are reported in table 3.

Table 3.

Effects of Chrononutrition, Emotional Eating, and Self-Control on Blood Pressure: An Ordinal Logistic Regression Analysis (n= 115)

	Variable	B	Wald	p-value	AOR	95% CI
Chrononutrition	Poor (ref: Good)	1.487	5.742	0.017*	4.424	1.304–15.006
Emotional Eating	Low EE (ref: Non-EE)	0.894	3.218	0.073	2.445	0.921–6.493
	EE (ref: Non-EE)	1.618	7.304	0.007*	5.043	1.553–16.367
	Very EE (ref: Non-EE)	2.741	12.085	0.001*	15.503	3.212–74.823
Self-Control	Moderate (ref: High)	1.622	7.156	0.007*	5.063	1.545–16.590
	Low (ref: High)	3.033	16.758	< 0.001*	20.752	5.425–79.429
Model Fit (Pearson)				p = 0.612		
Likelihood Ratio Test				p < 0.001		

DISCUSSION

Chrononutrition was significantly linked to blood pressure: respondents with poor chrononutrition were about 4.4 times more likely to fall into a higher blood pressure category than those with good practice (AOR = 4.424; 95% CI = 1.304–15.006; p = 0.017). This result is consistent with the

expanding literature indicating that a mismatch between meal timing and the body's internal circadian clock can disturb peripheral clocks in metabolic tissues, blunt the normal nocturnal dip in blood pressure, and sustain hypertension (Dashti et al., 2025; Böhmke et al., 2024). Emotional eating likewise showed a significant relationship with blood pressure. Relative to non-emotional eaters, emotional eaters carried roughly five-fold higher odds (AOR = 5.043; 95% CI = 1.553–16.367; $p = 0.007$) and very emotional eaters more than fifteen-fold higher odds (AOR = 15.503; 95% CI = 3.212–74.823; $p = 0.001$) of occupying a higher blood pressure band. This graded, dose-dependent pattern fits the proposed physiological route in which activation of the HPA axis and the sympathetic nervous system raises cortisol, encourages sodium retention, and drives the intake of sodium rich foods (Gordon & Mendes, 2021; Schnepfer et al., 2023; Dakanalis et al., 2023).

Self-control proved to be the most influential predictor in the model. Respondents with low self-control were nearly 21 times more likely than their high-self-control counterparts to be in a higher blood pressure category (AOR = 20.752; 95% CI = 5.425–79.429; $p < 0.001$). This finding is in keeping with earlier work positioning self-control as an upstream regulator that shapes both adherence to chrononutrition and the ability to withstand emotional eating cues (Rachmania et al., 2022; Han et al., 2025). Analysing the three behaviours together demonstrates that chrononutrition, emotional eating, and self-control are each independently associated with blood pressure in hypertensive patients attending primary care. The ordinal regression model fitted the data well (Pearson goodness-of-fit $p = 0.612$) and was significant overall (likelihood ratio test $p < 0.001$). These findings argue for broadening primary care hypertension management beyond medication alone. Validated tools such as the Chrononutrition Questionnaire, the Emotional Eater Questionnaire, and the Brief Self-control Scale could be incorporated readily into routine Prolanis or Posbindu PTM sessions. Dietary counselling, in turn, should extend past food composition to address meal timing, emotional triggers, and methods for strengthening dietary self-control (Reytor-González et al., 2025).

CONCLUSION

This study shows that chrononutrition, emotional eating, and self-control are each significantly and independently associated with blood pressure among hypertensive patients in primary care settings in Surakarta, Indonesia, with self-control standing out as the dominant determinant. Poor chrononutrition, stronger emotional eating tendencies, and low self-control all markedly raised the odds of falling into a higher blood pressure category. The distinctive contribution of this work lies in its first simultaneous appraisal of these three behavioural factors within a single analytical framework in a hypertensive population. The evidence supports embedding chrononutrition assessment, emotional eating screening, and self-control reinforcement within routine hypertension care at the primary level.

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