



Ultra-Processed Food Consumption Patterns and Sedentary Lifestyle Associated with Hypertension among Adults Aged 35–54 Years

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Abstract

Hypertension is a major public health concern among adults, and lifestyle factors such as ultra-processed food (UPF) consumption and sedentary behavior may contribute to elevated blood pressure. This study aimed to analyze the association between UPF consumption patterns and sedentary lifestyle with hypertension among adults aged 35 to 54 years in the working area of the Summersari Primary Health Center, Jember Regency. An analytical observational study with a cross-sectional design was conducted involving 100 adults selected through purposive sampling. Data on UPF consumption over the past 3 months were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), while sedentary behavior over the past week was assessed using the Sedentary Behavior Questionnaire (SBQ). Blood pressure was measured twice using a digital sphygmomanometer at 5-minute intervals. Hypertension was defined as systolic blood pressure ≥ 130 mmHg and diastolic blood pressure ≥ 80 mmHg. Data were analyzed using the Chi-square test. UPF consumption frequency was significantly associated with hypertension ($p = 0.008$; OR = 3.33, 95% CI: 1.45–7.69). Significant associations were also observed for UPF consumption amount ($p = 0.004$) and sedentary lifestyle ($p = 0.018$). These findings indicate that UPF consumption patterns and sedentary lifestyle are relevant factors in hypertension prevention among adults aged 35 to 54 years. Promoting healthier food choices and reducing sedentary behavior may support hypertension prevention in this population.

Keywords: blood pressure; dietary behavior; food consumption; physical inactivity

INTRODUCTION

Hypertension is a condition characterized by a persistent increase in blood pressure above normal levels due to one or more risk factors (Wulandari et al., 2023). It is classified into primary and secondary hypertension, with approximately 90 to 95% of cases categorized as primary hypertension without a specific identifiable cause (Helpitnati et al., 2023). Hypertension is known as the “silent killer” because it is often asymptomatic until it leads to complications in vital organs such as the heart, brain, kidneys, and eyes (Husaini and Fonna, 2024).

According to the World Health Organization (WHO), the global prevalence of hypertension among adults aged 30 to 79 years reached 33% in 2025 (WHO, 2025). In Indonesia, the prevalence of hypertension among individuals aged ≥ 15 years was 29.2% (598,983 cases) based on the Indonesian Health Survey (SKI) 2023. At the provincial level, East Java ranked second nationally, with a prevalence of 32.8% (93,307 cases) among individuals aged ≥ 15 years (Health Development Policy Agency, 2024). At the district level, Jember Regency recorded 319,056 cases of hypertension among the same age group

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(East Java Health Profile, 2024). Within Jember Regency, Summersari Sub-district recorded the highest number of hypertension cases, which increased by 10.5% from 5,907 in 2024 to 6,527 in 2025. Of these cases, 1,356 occurred among adults aged 35 to 54 years, the age group examined in this study.

Hypertension is influenced by various risk factors, one of which is an unhealthy dietary pattern, including high consumption of ultra-processed food (UPF) (Rahmadhani, 2021). UPF consumption has been associated with hypertension through various mechanisms affecting vascular function and blood pressure regulation (Magriplis and Panagiotakos, 2026). A study by Larasati and Putriningtyas (2025) reported that individuals with frequent UPF consumption had a 6.5-fold higher odds of developing hypertension (OR = 6.505). The frequency and amount of UPF consumption represent different dimensions of dietary exposure. Consumption frequency reflects how often an individual consumes UPF, whereas the amount consumed reflects the magnitude of exposure to UPF and its potentially adverse nutritional components (Ichsan and Febriyanti, 2024). Higher amounts of UPF consumption may be associated with greater intake of sodium, added sugars, saturated fats, and energy, all of which are dietary components relevant to blood pressure regulation and cardiometabolic health.

In addition to unhealthy dietary patterns, a sedentary lifestyle is also a risk factor for the development of hypertension. A sedentary lifestyle is defined as behavior characterized by minimal physical movement and low energy expenditure, in which sitting and lying postures dominate daily activities (Ferencia et al., 2023). High levels of sedentary behavior (≥ 35 hours per week) have been associated with impaired cardiovascular function, increased body weight and insulin resistance, reduced high-density lipoprotein (HDL) cholesterol levels, and increased plasma triglyceride and low-density lipoprotein (LDL) cholesterol levels (Unger et al., 2020). Consistent with these findings, Qaimima et al. (2024) reported that individuals with a sedentary lifestyle had a prevalence of hypertension 17.986 times higher than that of non-sedentary individuals (PR = 17.986).

Hypertension is increasingly observed among adults and may be influenced by lifestyle factors such as work-related stress, unhealthy dietary

patterns, and low physical activity levels (Taamu et al., 2024; Indrasari et al., 2025). This is particularly concerning because hypertension may remain asymptomatic while contributing to cardiovascular complications, reduced quality of life, decreased productivity, and increased healthcare burden (Isni et al., 2023). Although the association between UPF consumption and hypertension has been widely studied, previous research has predominantly focused on consumption frequency without considering the amount. Assessing both frequency and amount may provide a more comprehensive understanding of UPF exposure and its association with hypertension.

Furthermore, evidence from Indonesia remains limited regarding the simultaneous assessment of UPF consumption frequency and amount in relation to hypertension, particularly when considered alongside a sedentary lifestyle among adults aged 35 to 54 years. Therefore, this study aimed to analyze the association between UPF consumption patterns and a sedentary lifestyle with hypertension among adults aged 35 to 54 years within the working area of Summersari Primary Health Center, Jember Regency. By examining these interrelated factors, this study provides evidence to support the development of preventive and promotive strategies that address modifiable lifestyle factors associated with hypertension among adults.

MATERIALS AND METHOD

Design and subjects

This research was an analytic observational study with a cross-sectional design, conducted from March to April 2026 in the working area of the Summersari Primary Health Center, Jember Regency, covering the villages of Summersari, Wirolegi, Antirogo, Tegal Gede, and Karangrejo. The study population consisted of adults aged 35 to 54 years who attended the Integrated Primary Health Service Post (*Posyandu Integrasi Layanan Primer/ILP*) within the health center's working area. Respondents were selected using purposive sampling according to the predefined inclusion criteria. The sample size was calculated using the Lemeshow formula with a 95% confidence level ($Z = 1.96$), a maximum estimated proportion of 50% ($p = 0.50$), and a precision of 10% ($d = 0.10$). The calculation yielded a minimum

sample size of 96 respondents, which was rounded up to 100 respondents.

The inclusion criteria were adults aged 35 to 54 years who had resided in the working area of Summersari Primary Health Center for at least 6 months and were willing to participate in the study. The exclusion criteria were respondents who did not complete the entire research process and pregnant women. The use of antihypertensive medication was not an exclusion criterion. This study received ethical approval from the Health Research Ethics Committee (KEPK), Faculty of Dentistry, Universitas Jember, under approval number 3760/UN25.8/KEPK/DL/2026.

Data collection and measurement

The independent variables in this study were UPF consumption patterns and sedentary lifestyle, while the dependent variable was the incidence of hypertension. Data on UPF consumption patterns over the past 3 months were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). This instrument consists of 9 groups and 50 types of UPFs commonly consumed in the study area. The frequency of UPF consumption was categorized based on the mean score of respondents' UPF consumption (mean = 57) into "rare" (< mean) and "frequent" ($\geq$ mean) (Larasati and Putriningtyas, 2025). In addition, UPF consumption was calculated in grams per day and categorized into low (1–49 g day⁻¹), moderate (50–99 g day⁻¹), and high ($\geq$ 100 g day⁻¹) (Li and Shi, 2022).

Sedentary lifestyle was measured using the Sedentary Behavior Questionnaire (SBQ), which assessed the duration of 9 sedentary activities on weekdays and weekends over the past week. The SBQ has demonstrated acceptable reliability and validity for assessing sedentary behavior among adults, with the validity study including adults with a mean age of 41 years for women and 44 years for men (Rosenberg et al., 2010). The total duration of sedentary activities was then categorized into low (< 21 hours per week), moderate (21 $\leq$ 35 hours per week), and high ($\geq$ 35 hours per week) (Ferencia et al., 2023).

Blood pressure was measured by the researcher using a digital sphygmomanometer (TaffOmicron BW-3205, Taffware, Indonesia). The device had been calibrated by the local healthcare staff before data collection. Blood pressure was measured twice with a 5-minute

interval to reduce the bias of white-coat hypertension (Mancia et al., 2021). Respondents were categorized as non-hypertensive (systolic < 130 mmHg and diastolic < 80 mmHg) and hypertensive (systolic $\geq$ 130 mmHg and/or diastolic $\geq$ 80 mmHg) (Jones et al., 2025).

The Indonesian version of the SBQ instrument used was valid and reliable, demonstrating a content validity index (CVI) of 0.83 to 0.92, construct validity ranging from $r = 0.469$ to 0.683 , and Cronbach's alpha reliability of 0.86 (Rahman et al., 2026). Meanwhile, the SQ-FFQ instrument was also tested on 30 non-sample respondents using the Pearson product-moment correlation test with validity values ranging from 0.374 to 0.801 and Cronbach's alpha reliability of 0.925.

Data analysis

Data analysis was performed using IBM SPSS Statistics version 30. Univariate analysis was used to describe respondents' characteristics. The Chi-square test was used to examine the association of UPF consumption patterns and sedentary lifestyle with hypertension. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Characteristics of respondents

Based on Table 1, most respondents were aged 45 to 54 years (57%), female (70%), and still actively employed (73%). A total of 60% of respondents had hypertension, 47% had normal body mass index (BMI), 63% had no family history of hypertension, and 96% had no history of other diseases. In addition, 55% of respondents had a "frequent" frequency of UPF consumption, while 55% consumed a high amount of UPFs. The "high" sedentary lifestyle category was the most common among respondents, accounting for 40%.

The average UPF consumption among respondents was 359.08 g day⁻¹, with the lowest intake at 43.90 g day⁻¹ and the highest at 968.31 g day⁻¹. Meanwhile, the average duration of a sedentary lifestyle was 32.73 hours per week, with the lowest duration at 15.75 and the highest at 63 hours per week.

Types of UPF frequently consumed by respondents

Based on the frequency distribution of UPF consumption shown in Table 2, several types of products were frequently consumed by the

respondents. These included bouillon powder, various types of candy, instant noodles, frozen sausages, marinade seasonings, sweet soy sauce, packaged chili sauce, chips, wafers, frozen nuggets, seasoning flour, cookies, and biscuits. These products belong to the categories of instant seasonings, snack foods, cereal-based products, processed meat products, bakery products, and confectionery products (candies and chocolates).

Bivariate analysis of UPF consumption and sedentary lifestyle with hypertension

Based on Table 3, the proportion of respondents with hypertension was higher among those with frequent UPF consumption (40%), a high UPF intake (40%), and a high level of sedentary lifestyle (30%). The Chi-square test showed a significant association between UPF consumption frequency and hypertension ($p = 0.008$; OR = 3.333; 95% CI: 1.45–7.69). Respondents with “frequent” UPF consumption had 3.333 times higher odds of hypertension than those with “rare” UPF consumption. Furthermore, both the UPF consumption amount ($p = 0.004$)

and sedentary lifestyle ($p = 0.018$) were also significantly associated with hypertension.

Association between UPF consumption patterns and hypertension

In this study, UPF consumption patterns based on frequency and amount were significantly associated with hypertension among adults aged 35 to 54 years in the working area of the Summersari Primary Health Center. Respondents with frequent UPF consumption tended to have a higher proportion of hypertension, as did respondents with higher amounts of UPF consumption. The distribution of respondents also showed that those with “frequent” UPF consumption were predominantly classified as having higher UPF consumption amounts, whereas those with “rare” consumption were more commonly classified as having low to moderate consumption amounts. This pattern indicates that the frequency and amount of UPF consumption often occurred together among the respondents and may provide contextual support for the observed associations with hypertension.

Table 1. Characteristics of respondents (n = 100)

Variables	Criteria	n (%)
Age (years)	35–44	43 (43)
	45–54	57 (57)
Gender	Male	30 (30)
	Female	70 (70)
Occupation	Employed	73 (73)
	Unemployed/Housewife	27 (27)
Body mass index (BMI)	Underweight (< 18.5)	11 (11)
	Normal (18.5–22.9)	47 (47)
	Overweight (23–24.9)	8 (8)
	Obesity Class I (25–29.9)	27 (27)
	Obesity Class II (≥ 30)	7 (7)
Family history of hypertension	Yes	37 (37)
	No	63 (63)
History of other diseases	Yes (Type 2 diabetes mellitus)	4 (4)
	No	96 (96)
Blood pressure status (mmHg)	Hypertension ($\geq 130/80$)	60 (60)
	Non-hypertension (< 130/80)	40 (40)
UPF consumption frequency	Rare (< mean total score frequency)	45 (45)
	Frequent ($\geq$ mean total score frequency)	55 (55)
UPF consumption amount (g day ⁻¹)	Low (1–49)	15 (15)
	Moderate (50–99)	30 (30)
	High (≥ 100)	55 (55)
Sedentary lifestyle (hours per week)	Low (< 21)	25 (25)
	Moderate ($21 \leq 35$)	35 (35)
	High (≥ 35)	40 (40)

Table 2. Types of UPF frequently consumed by respondents (n = 100)

Type of UPF	UPF group	Frequently consumed (%)
Bouillon powder	Instant seasonings	66
Candies (various types)	Confectionery products	57
Instant noodles	Cereal-based products	55
Frozen sausages	Processed meat products	54
Marinade seasoning	Instant seasonings	54
Sweet soy sauce	Instant seasonings	54
Chips	Snack foods	53
Packaged chili sauce	Instant seasonings	53
Wafers	Snack foods	52
Cookies	Bakery products	52
Biscuits	Bakery products	52
Frozen nuggets	Processed meat products	52
Seasoning flour	Instant seasonings	52

The observed pattern may be related to dietary practices among adults, particularly the preference for foods that are practical, readily available, and easy to consume. Based on observations during the study, respondents commonly consumed snacks, instant noodles, frozen foods, sugar-sweetened beverages, and instant seasonings. These products were considered practical, relatively affordable, readily available, and highly palatable. Some respondents also reported routinely consuming UPFs as part of their daily dietary habits. UPF products were easily accessible through various food outlets in the study area, including modern supermarkets, frozen food stores, small shops, and local food stalls. The ease of access and wide availability of these products may have facilitated repeated consumption and contributed to the high frequency of UPF consumption observed among the respondents.

The association between UPF consumption and hypertension can be explained by the high content of sodium, added sugar, and saturated fat in UPF products. First, high sodium intake from UPF consumption can increase blood pressure through mechanisms of fluid retention, increased systemic peripheral resistance, endothelial dysfunction, and changes in arterial structure and function (Wati et al., 2023). These conditions lead to increased blood volume and cardiac workload, thereby elevating blood pressure, particularly in individuals with salt sensitivity (Larasati and Putriningtyas, 2025). Several UPF products in Indonesia have been reported to contain sodium levels exceeding the WHO reference values based on Global Sodium Benchmarks (approximately

770 mg 100 g⁻¹). These products include instant noodles with an average sodium content of 1,275.31 mg 100 g⁻¹, processed cheese (1,207.60 mg 100 g⁻¹), and sauces (1,868.90 mg 100 g⁻¹). In addition, some products, such as processed meat (711.58 mg 100 g⁻¹) and snack foods (736.83 mg 100 g⁻¹), have also been reported to contain sodium levels close to the reference limit (Istiqomah et al., 2021).

Second, excessive added sugar content in UPF can increase the risk of central obesity, insulin resistance, and the formation of advanced glycation end products (AGEs). AGEs, formed through the reaction of glucose with proteins or fats, are known to increase oxidative stress and trigger inflammatory responses. These processes lead to endothelial dysfunction and vascular damage, both of which contribute to increased blood pressure (Larasati and Putriningtyas, 2025).

Third, high levels of saturated and trans fats in UPF also play a role in the mechanism of hypertension. UPF products generally contain high fat content, particularly in packaged snack foods, bakery products, margarine, and processed meat products. Saturated fat consumption can increase low-density lipoprotein (LDL) cholesterol and triglyceride levels, while decreasing high-density lipoprotein (HDL) levels, thereby triggering dyslipidemia. This condition accelerates the formation of atherosclerotic plaques that cause blood vessel narrowing and impaired blood flow. As a result, there is a reduction in blood and oxygen supply to tissues, leading the body to respond by increasing cardiac workload and blood pressure (Lestari et al., 2024). In addition, high-fat intake, especially trans fats,

can trigger systemic inflammation through the release of pro-inflammatory cytokines that increase reactive oxygen species (ROS) production and reduce nitric oxide (NO) availability. These conditions lead to endothelial dysfunction and impaired vasodilation, resulting in vasoconstriction and increased peripheral resistance (Ferencia et al., 2023).

In addition to high levels of sodium, added sugars, and fats, the repeated consumption of UPFs also increases exposure to various food additives, such as preservatives, artificial sweeteners, emulsifiers, and synthetic flavorings. Long-term exposure to these substances is known to disrupt metabolic regulation, insulin sensitivity, and gut microbiota balance, contributing to chronic inflammation and an increased risk of hypertension (Rondinella et al., 2025).

The association observed in this study is consistent with previous research. Jairani et al. (2025) reported a significant association between UPF consumption habits and hypertension among adults aged 45 to 54 years ($p = 0.013$). Similarly, Li and Shi (2022), in a longitudinal cohort study, reported a dose-response relationship between UPF consumption and hypertension. Consuming 50 to 99 g day⁻¹ and ≥ 100 g day⁻¹ of UPF was associated with a 17% (HR = 1.17) and 20% (HR = 1.20) higher hazard of hypertension, respectively, compared with non-consumers among individuals aged ≥ 20 years. These findings are consistent with the present study, particularly regarding the association between higher UPF consumption amounts and hypertension. However, Kurniawati and Setyaningsih (2025) reported no significant

association between UPF consumption and hypertension among individuals aged 26 to 54 years ($p = 0.063$). The absence of a significant association may be related to the distribution of respondents, as most respondents with low UPF consumption had increased blood pressure. This distribution could have reduced the difference in hypertension prevalence between the UPF consumption categories, making the association less apparent. In addition, unexamined dietary and lifestyle factors could have influenced blood pressure levels and contributed to the observed findings.

Association between sedentary lifestyle and hypertension

A sedentary lifestyle refers to low-movement behavior characterized by activities performed in sitting or lying positions, excluding sleeping time (Amrynia and Prameswari, 2022). In this study, a sedentary lifestyle was significantly associated with hypertension among adults aged 35 to 54 years in the working area of the Summersari Primary Health Center. Based on the results, respondents' sedentary activities were dominated by screen time, such as watching videos on mobile phones, messaging, and using social media. In addition, other passive activities performed while sitting or lying positions were also frequently reported, such as casual conversations, phone calls, driving, and listening to music. The duration of sedentary behavior tended to increase in the afternoon and evening, particularly on weekends.

These findings are consistent with theories stating that a sedentary lifestyle is one of

Table 3. Association between UPF and sedentary lifestyle with hypertension

Variables	Hypertension		Non-Hypertension		Total		<i>p</i> -value	OR (95% CI)
	n	%	n	%	n	n (%)		
UPF consumption frequency								
Rare	20	44.4	25	55.6	45	100.0	0.008*	3.33 (1.45–7.69)
Frequent	40	72.7	15	27.3	55	100.0		
UPF consumption amount								
Low	4	26.7	11	73.3	15	100.0	0.004*	
Moderate	16	53.3	14	46.7	30	100.0		
High	40	72.7	15	27.3	55	100.0		
Sedentary lifestyle								
Low	10	40.0	15	60.0	25	100.0	0.018*	
Moderate	20	57.1	15	42.9	35	100.0		
High	30	75.0	10	25.0	40	100.0		

Note: OR = Odds ratio; CI = Confidence interval; * $p < 0.05$ indicates statistical significance

the behavioral risk factors contributing to hypertension. Prolonged sedentary behavior may affect the cardiovascular system through structural and functional vascular changes due to reduced shear stress on blood vessels, which triggers endothelial dysfunction, oxidative stress, and atherosclerotic processes (Destira and Mariani, 2021). In addition, low physical activity may reduce NO production, which plays a key role in vasodilation, resulting in increased arterial stiffness and peripheral resistance (Platini et al., 2024). Long-term sedentary behavior is also associated with an increased heart rate due to reduced muscle activity and suboptimal blood flow. This condition forces the heart to work harder to meet tissue oxygen demands, thereby increasing cardiac output and arterial wall pressure (Marlita et al., 2022).

Beyond cardiovascular effects, sedentary behavior is also linked to metabolic disorders characterized by insulin resistance. Insulin resistance contributes to endothelial dysfunction and increases BMI and obesity risk. In obese individuals, there is increased activation of the renin-angiotensin-aldosterone system (RAAS), which plays a role in fluid retention and increased blood pressure (Destira and Mariani, 2021). Therefore, sedentary behavior may influence hypertension through vascular, metabolic, and hormonal pathways.

The findings of this study are consistent with those of Qaimima et al. (2024), who reported an association between a sedentary lifestyle and hypertension among educators and education staff aged 20 to 59 years in Jember Regency ($p = 0.001$). Similar results were also reported by Ferencia et al. (2023), who found an association between sedentary lifestyle and elevated blood pressure among adults aged 25 to 55 years ($p = 0.045$). The present study primarily involved respondents who were housewives and employees in the private sector. High levels of sedentary behavior in both groups were attributed to daily activity patterns. Housewives tend to spend long periods in sitting positions accompanied by extended screen time, while private employees generally have work patterns dominated by prolonged sitting due to the use of technology-based devices.

However, these findings differ from those reported by Ananta and Damayanti (2023), who found no significant association between sedentary lifestyle and systolic blood pressure

($p = 0.932$) or diastolic blood pressure ($p = 0.979$) among individuals aged 19 to 59 years in the working area of the Kaliwates Primary Health Center, Jember Regency. This discrepancy may be due to the fact that hypertension in respondents is not solely influenced by sedentary behavior. In addition, individuals with high sedentary time may still engage in sufficient physical activity, thereby reducing the observable effect of sedentary behavior on blood pressure.

Study limitations

This study has several limitations that should be considered. First, the cross-sectional design does not allow temporal relationships or causal associations between UPF consumption, sedentary lifestyle, and hypertension to be established. Second, the use of purposive sampling may limit the generalizability of the findings to other populations. Third, UPF consumption was assessed using a modified SQ-FFQ based on respondents' recall, which may have introduced recall bias and affected the accuracy of the reported consumption data. Finally, not all potential confounding factors were assessed or controlled for in the analysis, such as BMI, occupational activity, total sodium intake, fat intake, stress, sleep quality, and smoking status, which may have resulted in residual confounding.

CONCLUSIONS

UPF consumption patterns and a sedentary lifestyle were associated with hypertension among adults aged 35 to 54 years. These findings highlight the relevance of healthier dietary patterns and reduced sedentary behavior in hypertension prevention. The Summersari Primary Health Center is encouraged to strengthen health education on healthy food choices, food labeling, and daily physical activity. However, the cross-sectional design limits causal interpretation. Future research should use longitudinal designs with larger samples and assess additional potential confounding factors to provide a more comprehensive understanding of the associations among UPF consumption patterns, sedentary lifestyle, and hypertension.

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DECLARATION OF GENERATIVE AI USE

During the preparation of this manuscript, the authors used generative artificial intelligence tools solely for language editing, grammar checking, and improving the clarity of the English language. All scientific content, data analysis, interpretation of the findings, and final decisions regarding the manuscript were conducted and verified by the authors. The authors take full responsibility for the content of the manuscript.

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