# Risk Factors Associated to The Occurrence Of Isolated Systolic Hypertension: A Literature Review

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***Abstract***

*Introduction: Isolated systolic hypertension (ISH) is a growing public health concern, particularly among older adults, due to its strong association with cardiovascular morbidity and mortality. Objectives: This study aims to identify and analyze risk factors associated with ISH. Methods: This research is a literature study, with sources obtained from three open-access journal databases: PubMed, Wiley Online Library, and Google Scholar. Articles were selected based on specific inclusion criteria, including full-text articles, published between 2015 and 2025, written in English, focused on ISH risk factors, and excluding literature reviews. Findings: The search resulted in 8 articles for review. Risk factors are typically classified into two categories: modifiable and non-modifiable. Modifiable risk factors include obesity, alcohol consumption, low educational level, elevated fasting blood sugar levels, employment, retirement status, and income. Conversely, non-modifiable risk factors consist of older age and male sex. Conclusions: Risk factors related to the incidence of ISH were found in all literature, namely age, gender, obesity, alcohol consumption, diabetes mellitus, low educational level, income, and socioeconomic status. Recommendations: The findings emphasize the importance of lifestyle modification and regular blood pressure monitoring for high-risk populations to prevent ISH.*

***Keywords**: Blood Pressure, Cardiovascular, Elderly, Isolated Systolic Hypertension, Risk Factors*

## INTRODUCTION

Isolated systolic hypertension (ISH) is a condition in which systolic blood pressure (SBP) is continuously 140 mm Hg or higher with diastolic blood pressure (DBP) is less than 90 mm Hg. People over the age of 60 are more likely to have this type of hypertension, which is related to higher rates of cardiovascular disease (CVD) morbidity and mortality (Sorrentino & Bakris, 2024). Based on data from the 1999-2010 National Health and Nutrition Examination Survey (NHANES), the prevalence of untreated hypertensive individuals with isolated systolic hypertension is 9,4%, with 29,4% of those aged 60 and older, compared to 6,0% and 1,8% of those aged 40-59 and 18-39, respectively (Liu et al., 2015).

Isolated systolic hypertension (ISH) poses significant health risks, particularly for middle-aged and older adults. ISH is strongly associated with an increased risk of cardiovascular events, including stroke, coronary heart disease, and heart failure (Bavishi et al., 2016). A Japanese study found that ISH in individuals aged 30-49 was independently associated with higher cardiovascular disease (CVD) mortality risk over a 29-year follow-up period (Hisamatsu et al., 2020). Under the 2017 ACC/AHA guidelines (BP ≥130/80 mmHg), ISH significantly increases cardiovascular disease (CVD) risk. A UK Biobank study (N=385,955) found ISH associated with a 39% higher risk of composite CVD events (HR 1.39, 95% CI 1.27–1.52), including nonfatal myocardial infarction. hemorrhagic stroke, and CVD-related death (Li et al., 2021).

Studies have shown that ISH prevalence increases significantly with age. In Iran, ISH prevalence was 15.89% among adults aged 40-70, with increasing age, body mass index,

diabetes, and waist-to-hip ratio identified as significant risk factors (Hosseinzadeh et al., 2022). Additional risk factors identified are high salt intake, low fruit consumption, lack of physical activity, and elevated BMI (Anurupa et al., 2019). Young and middle-aged individuals with isolated systolic hypertension exhibit heterogeneity, possibly resulting from excessive pulse pressure amplification from the aorta to the peripheral arteries and reflecting accelerated aging (Kobalava & Kotovskaya, 2015).

Despite its clinical significance, ISH remains underdiagnosed and undertreated (Oh & Cho, 2020). Therefore, identifying its risk factors is crucial for early intervention and prevention. Previous studies have identified both modifiable and non-modifiable risk factors. However, a comprehensive synthesis of recent evidence is needed to guide clinical practice and public health strategies. Thus, the objective of this review is to identify and categorize risk factors associated with isolated systolic hypertension (ISH).

## RESEARCH METHODS

This research is a literature study, with sources obtained from three open-access journal databases: PubMed, Wiley Online Library, and Google Scholar. Articles were selected based on specific inclusion criteria, including full-text articles, published between 2015 and 2025, written in English, focused on ISH risk factors, and excluding literature reviews. Articles that did not discuss factors associated with isolated systolic hypertension were excluded.

The search for articles or journals uses keywords and boolean operators (AND, OR) which are used to make article searches more specific, making it easier to determine the articles or journals used. Some of the keywords used to search for literature in this study are the combination of "risk factor", "determinant", and "isolated systolic hypertension".

The search process yielded 2,454 results based on the keywords provided. After removing duplicates, a total of 2,452 records remained, which were subsequently screened based on predefined inclusion criteria. This screening narrowed the selection to 235 records, which were further evaluated to exclude studies not addressing factors associated with isolated systolic hypertension, resulting in a final inclusion of eight studies. Then, the researchers conducted a review of the eight articles to provide information about the influential contributors of ISH and to provide recommendations for ISH prevention. Figure 1 shows the strategy for searching and selecting the articles. The selected articles are listed in table 1. These articles demonstrate an association between the incidence of ISH and both modifiable and non-modifiable factors.

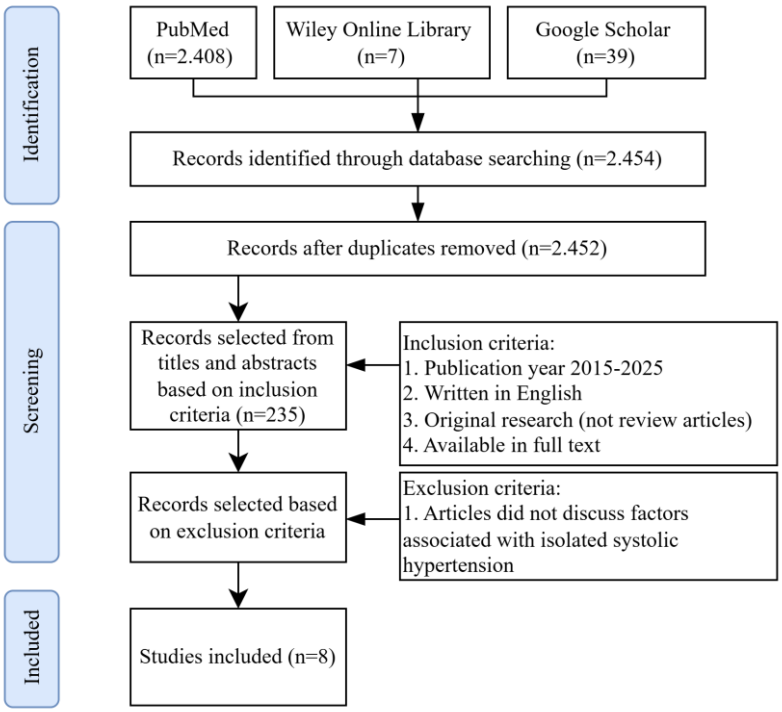


Figure 1. Operational Framework for Literature Database

## RESULTS AND DISCUSSION

The following articles were identified and examined to identify factors associated with the incidence of isolated systolic hypertension (ISH). A comprehensive review of the literature reveals that risk factors associated with ISH include modifiable risk factors such as obesity, alcohol consumption, low educational level, elevated fasting blood sugar levels, employment, retirement status, income; and non-modifiable risk factors consist of older age and male sex. Aging or older age was studied in 6 studies, male sex was studied in 1 study, obesity was studied in 5 studies, elevated blood sugar was studied in 2 studies, drinking was studied in 1 study, low educational level was studied in 1 study, employment was studied in 1 study, retirement status was studied in 1 study, and income was studied in 1 study.

Table 1. Characteristics of included studies

| Author/ Years | Study Design | Population | Findings |
|---|---|---|---|
| Asgari et al. (2016) | Prospective, observational cohort study | Adults aged 20 years and older | Significant risk factors for developing ISH were older age (HR=1.07), higher baseline systolic blood pressure (HR=1.11), and higher BMI (HR=1.04). In contrast, female gender didn't have a protective effect on ISH incidence. |
| Ephraim et al. (2016) | Single-site, cross-sectional, observational study | Diabetes mellitus patients | Age was identified as an independent risk factor (1.057 times higher odds) for ISH with a mean age of 56.20 years for those with ISH. Fasting blood glucose, |

| Author/ Years | Study Design | Population | Findings |
|---|---|---|---|
| | | | microalbuminuria, occupation and obesity were not associated with the risk of ISH (P> 0.05). |
| Dagnew & Yeshaw (2019) | Cross-sectional study | Type 2 diabetes mellitus (T2DM) patients | The significant predictors of ISH among T2DM patients were: male sex (AOR=2.4), employment (AOR=3.22), age of 47-55 years (AOR=2.63), being single (AOR=2.26), education level of ≤ Grade 8 (AOR=2.94), and monthly income of 501-800 ETB (AOR=21.9), 801-1500 ETB (AOR=5.78), and > 1500 ETB (AOR=4.23). |
| Xie et al. (2021) | Nationwide, cross-sectional observational study | Adults aged 18 and over with primary hypertensio n | Aging i.e 75-84 years old (OR=2.25), ≥ 85 (OR=2.13), was positively associated with ISH. Higher BMI (OR=1.05) and smoking (OR=1.04) were not significant risk factors for ISH. |
| Hosseinzad eh et al. (2022) | Longitudinal, population-based observational study | Middle-aged and older adults aged 45-69 years | Several risk factors were identified as being significantly associated with ISH prevalence, including 70-74 years age group (OR=4.21), body mass index (BMI) (OR=1.03), diabetes (OR=1.64), retirement compared to practitioner job (OR=1.53), and waist to hip ratio (WHR) (OR=9.81). |
| Qian et al. (2022) | Retrospective, cross-sectional, observational study. | Adults with diastolic blood pressure < 90 mmHg | Traditional obesity indicators like BMI (OR=3.6, for younger adults), waist-to-height ratio (OR=2.5, for older adults), and WHR were strongly associated with the risk of isolated systolic hypertension (ISH). |
| Huang et al. (2024) | Community-based cross-sectional study | Older adults aged 80 years and older | Factors associated with higher ISH prevalence were drinking (1.85 times higher odds) and being overweight (1.88 times higher odds). Having a higher heart rate (≥75 beats/min) was associated with lower ISH prevalence (OR = 0.66). The associations of drinking and being overweight with higher ISH prevalence were significant in men, but not in women. |
| Asmare et al. (2025) | Institution-based cross- sectional observational study | Adults with type 2 diabetes mellitus | The key determinants of ISH identified in the study were older age (>65 years, 4.64 times higher odds), higher BMI (>25 kg/m2, 2.75 times higher odds), and elevated fasting |

| Author/ Years | Study Design | Population | Findings |
|---|---|---|---|
| | | | blood sugar (≥130 mg/dL, 2.32 times higher odds). |

There are a few dissimilar findings, but overall, the results from the chosen research are rather similar. The following sections provide context for these results by discussing and comparing them to the relevant literature and other accessible information.

**Older Age/Aging**

Isolated systolic hypertension (ISH) has been identified as the most prevalent form of hypertension among the elderly population. The mechanisms underlying ISH in older age are multifaceted and primarily involve changes in the vascular system due to aging. Those aged >65 years are at an increased risk of developing ISH, according to research conducted in a variety of geographical areas (Asgari et al., 2016; Ephraim et al., 2016; Dagnew & Yeshaw, 2019; Xie et al., 2021; Hosseinzadeh et al., 2022; Asmare et al., 2025). Aging is associated with endothelial dysfunction, which impairs the ability of blood vessels to dilate properly. This dysfunction contributes to increased vascular resistance and higher systolic pressure (Kartashova & Sarvilina, 2019).

**Male Sex**

Research indicates that sex plays a significant role in the prevalence and characteristics of isolated systolic hypertension (ISH). One study by Dagnew (2019) found that ISH is more prevalent in men within certain populations, such as patients with type 2 diabetes mellitus, where men had more than twice as likely to develop ISH compared to women. However, there are reports that contradict the findings of this study, indicating that females have a higher likelihood of developing hypertension than males (Apidechkul, 2018). The possible reason for males to get ISH is that they have a larger cardiac output and stroke volume than females, which can elevate systolic blood pressure (Schattenkerk et al., 2018).

**Obesity/BMI/Waist-to-Hip Ratio**

High body mass index (BMI), obesity, overweight, and a high waist-to-hip ratio are all risk factors for ISH and other noncommunicable diseases. High body mass index (BMI >25 kg/m2) is a major risk factor for developing ISH, as shown in the studies by Asgari et al. (2016), Hosseinzadeh et al. (2022), Qian et al. (2022), Huang et al. (2024), and Asmare et al. (2025). Obesity is linked to high insulin and leptin levels, which results in increased sympathetic nervous system activity and elevated vasoconstriction, chronotropy, and antinatriuresis, eventually leading to hypertension (Asgari et al., 2016). Increased activity of the Renin-Angiotensin-Aldosterone System (RAAS) in obese individuals also leads to higher levels of angiotensin II and aldosterone. These hormones promote sodium retention and vasoconstriction, raising blood pressure and contributing to ISH (D'Elia & Strazzullo, 2018).

**Diabetes/Elevated Blood Sugar**

Diabetes, particularly type 2 diabetes, is closely linked to the development of isolated systolic hypertension (ISH). Elevated fasting blood sugar levels (≥ 130 mg/dl) have been shown to be associated with increased peripheral artery resistance due to vascular remodeling. Additionally, these levels have been observed to be associated with elevated body fluid volume, a consequence of hyperinsulinemia and hyperglycemia resulting from insulin resistance (Hosseinzadeh et al., 2022; Asmare et al., 2025). Furthermore, elderly individuals with a prolonged history of diabetes are more likely to manifest substantial vascular alterations, thereby elevating their susceptibility to hypertension (Asmare et al., 2025). Thus, diabetes has been found to accelerate vascular remodeling and arterial stiffness due to the formation of advanced glycation

end-products, which have been demonstrated to reduce arterial elasticity, contributing to higher systolic blood pressure and pulse pressure (Ohishi, 2018).

**Alcohol Consumption**

Among adults, the most notable contemporary risk factor is alcohol consumption. This risk factor plays a significant role for the development of hypertension in a study conducted by Huang et al. (2024). Findings from di Federico et al. (2023) also found a positive association between alcohol consumption and systolic blood pressure, while for diastolic blood pressure, the association is modified by sex and geographic location.

**Low Educational Level**

The research by Dagnew (2019) was conducted in Ethiopia, found that low educational level is significantly associated with higher rates of isolated systolic hypertension (ISH), particularly among older adults. This finding is similar to a study in non-Hispanic black adults which reported that decreased education level had a higher prevalence of untreated ISH compared to those with higher education (Li et al., 2014). The probable reason for the higher ISH among patients with lower education levels is the lack of awareness about lifestyle modifications.

**Socioeconomic Status**

Socioeconomic status, including income, employment, and retirement status influences the management of isolated systolic hypertension. The odds of ISH were higher in patients with a higher monthly income (Dagnew, 2019). This may be because individuals with higher incomes are more likely to be obese and have a sedentary lifestyle. This finding is inconsistent with a previous study by Tan et al. (2019), which states that low-income individuals often face financial barriers that hinder the effective management of hypertension. Despite the existence of safety nets, some patients lack the resources to navigate the healthcare system effectively, resulting in delayed treatment.

Employment status is also significantly associated with ISH. The association between employment and ISH may be due to the fact that employed individuals have sedentary lifestyles, while unemployed individuals may engage in physical activities while searching for daily work (Dagnew, 2019). Individuals with ISH who work overtime are more likely to experience elevated blood pressure and also tend to have disturbed unwinding abilities (Rau, 2006). Studies have shown that retirement can influence blood pressure levels (Hosseinzadeh et al., 2022). This finding aligns with a Chinese study that revealed retirement increases systolic blood pressure (SBP) and pulse pressure, especially among men and individuals with lower education levels (Mi et al., 2024).

## CONCLUSION

In conclusion, risk factors related to the incidence of ISH were found in all literature and influenced by both modifiable and non-modifiable factors, namely: age, gender, obesity, alcohol consumption, diabetes mellitus, low educational level, and socioeconomic status. The findings emphasize the importance of lifestyle modification such as improving diet, reduction in alcohol consumption, and increasing physical activity, which is essential for prevention of ISH. Regular blood pressure monitoring is also critical, especially for high-risk groups like older adults and men.

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