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Original article

The Impact of Lifestyle Factors on Arterial Blood Pressure and Its Control in Hypertensive Patients

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Abstract
Hypertension, a major global health challenge, is the leading preventable risk factor for cardiovascular diseases. Lifestyle choices—particularly unhealthy diets, physical inactivity, and obesity—play a central role in both its progression and control. These modifiable behaviors drive physiological changes that elevate blood pressure, underscoring the importance of targeted interventions to mitigate cardiovascular risks worldwide. This cross-sectional study examines the association between lifestyle factors—including physical inactivity, obesity, fast food consumption, and smoking—and blood pressure levels among 302 adults in Zawia City, Libya. The analysis revealed significant associations between elevated blood pressure and older age ($\chi^2 = 31.773$, $p < 0.001$), lower educational attainment ($\chi^2 = 13.756$, $p = 0.008$), and obesity ($\chi^2 = 12.124$, $p = 0.007$). Physical activity and vegetable consumption exhibited borderline statistical significance, suggesting potential protective effects. However, no significant associations were observed with gender, marital status, fruit intake, fast food consumption, or smoking, indicating that demographic and body mass index (BMI)-related factors may be more influential in this population. These findings underscore the importance of obesity management, age-specific interventions, and targeted health education for individuals with lower socioeconomic status. The study aligns with existing global evidence on modifiable hypertension risk factors and recommends promoting physical activity, weight control, and diets rich in vegetables. Further longitudinal research is needed to elucidate the observed non-significant trends and strengthen causal inferences.

Keywords. *Hypertension, Cardiovascular Diseases, Lifestyle Factors, Cross-Sectional Study.*

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Introduction

Hypertension, a prevalent global health concern, is a leading modifiable risk factor for cardiovascular morbidity and mortality, including stroke, myocardial infarction, and heart failure [1]. Chronically elevated blood pressure (BP) in the systemic arteries is diagnostic of systemic arterial hypertension. The standard method of expressing blood pressure is as a ratio between the systolic and diastolic readings [2]. Regarding the prevalence of hypertension worldwide, only 35% of individuals in the Americas suffer from hypertension, compared to 46% of adults in Africa. Compared to low-income countries, the prevalence of hypertension is lower in high-income countries (35% vs. 40%) [3]. While genetic and environmental factors influence its pathogenesis, lifestyle choices—particularly dietary patterns, physical inactivity, and obesity—are pivotal in both the development and management of elevated blood pressure. Modern dietary shifts toward energy-dense, ultra-processed foods, coupled with increasingly sedentary behaviors, have exacerbated hypertension rates worldwide [4,5]. These trends underscore the urgent need to elucidate how specific lifestyle factors, such as frequent fast-food consumption, excess body weight, and prolonged physical inactivity, interact to elevate blood pressure in diverse populations.

Emerging evidence highlights the dual role of lifestyle in hypertension progression and mitigation. In normotensive individuals, chronic intake of sodium-laden fast food, saturated fats, and added sugars promotes weight gain and metabolic dysfunction, fostering a transition to prehypertension or overt hypertension [6]. Concurrently, sedentary habits impair vascular health, exacerbating insulin resistance and systemic inflammation [7]. For those with diagnosed hypertension, these factors compound pathophysiological

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mechanisms, including increased vascular resistance and blood volume, leading to poorer blood pressure control. Conversely, lifestyle modifications—such as adopting heart-healthy diets like the DASH (Dietary Approaches to Stop Hypertension) plan, regular aerobic exercise, and sustained weight loss—demonstrate profound benefits in reducing blood pressure and enhancing cardiovascular outcomes [8]. Therefore, this study examined the association between key lifestyle factors (physical inactivity, obesity, fast food consumption, and smoking) and blood pressure levels among the population in Zawia city, Libya. Also, identify the most significant modifiable risk factors contributing to elevated blood pressure in this population.

Methods

Study design

This cross-sectional observational study was conducted during the first half of 2023 to assess the relationship between lifestyle factors (fast food consumption, vegetables and fruit intake, obesity, physical inactivity, and smoking) and blood pressure (BP) dynamics in normotensive adults and hypertension patients. The participant population in this study is 302 (normotensive, BP ≤120/80 mmHg and hypertensive, BP ≥ 130/85 mmHg or on medication) adults aged 18–65 years residing in Zawia City, Libya. Participants are selected through random sampling across neighborhoods (primary and secondary health care centers, educational institutions, and public Centers) to ensure demographic diversity.

Data collection

Data collection integrates a culturally adapted Arabic face-to-face questionnaire structured by the expert authors who confirm its validity. The questionnaire comprises structured sections designed to collect data on socio-demographic characteristics, dietary habits (including frequency of fast-food consumption, vegetable and fruit intake), frequency of physical activity, smoking status, and medical history. Additionally, clinical measurements were conducted by the researchers, including blood pressure (BP) assessment using electronic sphygmomanometers, height measurement, and weight recording to calculate body mass index (BMI) for each participant.

Statistical analyses

Independent variables include demographic features, fast food intake, Vegetable and fruit intake, BMI, physical inactivity, and smoking, while dependent variables focus on systolic/diastolic BP, controlled for age, gender, income, and education level. Statistical analyses employ SPSS v26, utilizing descriptive statistics (frequencies, means) and chi-square, and statistical significance when P-value ≤ 0.01.

Ethical approval

The ethical approval was obtained from the Research and Consultation Department of the Faculty of Medicine, University of Zawia ensures participant confidentiality, and participants' data were anonymized and stored securely to ensure privacy. In addition to confidentiality, the study emphasized the principle of informed consent. Before their participation, individuals were fully informed about the nature, purpose, and objectives of the research.

Results

First, this study provides an analysis of the effects of various demographic factors on arterial blood pressure, as shown in Table 1, revealing several significant associations. Notably, age demonstrated a highly significant relationship with blood pressure status (χ^2 = 31.773, p < 0.001), with the prevalence of high blood pressure increasing progressively with age, particularly among individuals aged 50 and above. Additionally, educational level showed a significant association with blood pressure (χ^2 = 13.756, p = 0.008), where individuals with basic or high school education exhibited higher proportions of high blood pressure compared to those with university or postgraduate education. Occupation also emerged as a significant factor (χ^2 = 18.661, p = 0.002), with medical professionals showing a lower prevalence of high blood pressure, whereas retirees and those in unspecified occupational categories had higher rates. Conversely, no significant associations were observed between gender (χ^2 = 1.010, p = 0.315) or marital status (χ^2 = 2.809, p = 0.422) and blood pressure status,

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indicating that these factors do not significantly influence blood pressure in this sample. The relationship between place of residence and blood pressure approached but do not reach statistical significance ($\chi^2 = 7.130$, $p = 0.068$), warranting further investigation into its potential role.

Table 1. The effects of various socio-demographic factors on arterial blood pressure

Characteristics	Blood pressure				Chi square	P-value
	Normal		High			
	Count	%	Count	%		
Gender						
Male	117	33.7	25	7.2	1.010	0.315
Female	177	51.0	28	8.1		
Age						
20-29	77	22.2	2	0.6	31.773	< 0.001
30-39	56	16.1	4	1.2		
40-49	77	22.2	16	4.6		
50-59	55	15.9	16	4.6		
60-69	23	6.6	9	2.6		
70 and above	6	1.7	6	1.7		
Education level						
Basic education	42	12.1	16	4.6	13.756	0.008
High school	57	16.4	15	4.3		
Higher diploma	5	1.4	0	0.0		
University	159	45.8	17	4.9		
Postgraduate	31	8.6	5	1.4		
Marital status						
Single	69	19.6	8	2.3	2.809	0.422
Married	212	61.1	42	12.1		
Widowed	8	2.3	1	0.3		
Divorced	5	1.4	2	0.6		
Place of residence						
Center of Zawia City	168	48.4	25	7.2	7.130	0.068
West of Zawia City	54	15.6	6	1.7		
South of Zawia City	70	20.2	21	6.1		
Occupation						
Teacher	68	19.6	12	3.5	18.661	0.002
Medical professions	52	15.0	2	0.6		
Administrative work	90	25.9	13	3.7		
Student	19	5.5	1	0.3		
Retired	16	4.6	6	1.7		
Other	49	14.1	19	5.5		

Second, the study examines the associations between lifestyle factors and arterial blood pressure, as shown in Table 2, yielding several key insights. A significant relationship was observed between body mass index (BMI) and blood pressure status ($\chi^2 = 12.124$, $p = 0.007$), with obese individuals exhibiting a markedly higher prevalence of high blood pressure (9.8%) compared to those with normal BMI (2.0%). Physical activity approached but did not reach statistical significance ($\chi^2 = 3.068$, $p = 0.080$), suggesting a potential trend that may warrant larger-scale investigation. Similarly, vegetable consumption showed a borderline association with blood pressure ($\chi^2 = 8.508$, $p = 0.075$), hinting at a possible protective effect, though further research is needed to confirm this relationship.

In contrast, no significant associations were found between fruit consumption frequency ($\chi^2 = 6.589$, $p = 0.159$), fast food intake ($\chi^2 = 4.289$, $p = 0.232$), or smoking status ($\chi^2 = 0.147$, $p = 0.929$) and blood pressure status. Notably, 54.2% of participants reported consuming fruits 1–3 times weekly, while 41.8% indicated no fast-food consumption. These findings underscore the critical role of BMI in hypertension risk, alongside potential trends

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in physical activity and vegetable intake, while highlighting the limited influence of other dietary habits and smoking in this sample.

Table 2. The effects of various lifestyle factors on arterial blood pressure

Characteristics	Blood pressure				Chi square	P-value
	Normal		High			
	Count	%	Count	%		
Physical activity						
Yes	117	33.8	28	8.1	3.068	0.080
No	176	50.9	25	7.2		
BMI level						
Underweight	6	1.7	0	1.1	12.124	0.007
Normal	63	18.2	7	2.0		
Overweight	110	31.8	12	3.5		
Obese	114	32.9	34	9.8		
Number of times eating fruits per week						
I do not eat	33	9.5	1	0.3	6.589	0.159
Daily	14	4.0	1	0.3		
Sometimes	7	2.0	2	0.6		
1-3 times	188	54.2	41	11.8		
> 3 times	52	15.0	8	2.3		
Number of times eating vegetables per week						
I do not eat	20	5.8	0	0.0	8.508	0.075
Daily	25	7.2	4	1.2		
Sometimes	4	1.2	2	0.6		
1-3 times	112	32.3	15	4.3		
> 3 times	133	38.3	32	9.2		
Number of times eating fast food per week						
I do not eat	145	41.8	33	9.5	4.289	0.232
Sometimes	22	6.3	5	1.4		
1-3 times	100	28.8	11	3.2		
> 3 times	27	7.8	4	1.2		
Smoking						
I do not smoke	234	67.4	43	12.4	0.147	0.929
Ex-smoker	8	2.3	1	0.3		
I currently smoke	52	15.0	9	2.6		

Discussion

The study findings underscore the complex interplay between demographic factors and blood pressure (BP) dynamics, offering critical insights for hypertension management. While gender and marital status showed no significant association with BP in this study, the lack of gender disparity contrasts with studies attributing hypertension risk to hormonal or physiological differences. This divergence may suggest that modifiable lifestyle factors—such as diet, physical inactivity, or stress—supersede biological sex as dominant contributors to BP elevation in this population. Similarly, the absence of a marital status effect challenges assumptions about the protective role of social support, implying that socioeconomic stressors or individual health behaviors may exert stronger influences on BP regulation.

Age emerged as a robust predictor of hypertension, with a striking association ($\chi^2 = 31.773$, $p < 0.001$) observed in older adults (50+ years). This aligns with global evidence linking aging to arterial stiffening, endothelial dysfunction, and reduced vascular compliance [9]. The elevated hypertension prevalence in older subgroups highlights the urgency of age-specific interventions, such as routine BP screening and tailored lifestyle programs targeting dietary sodium reduction and physical activity. Education level further demonstrated significant associations, with lower educational attainment correlating with higher BP—a trend likely mediated

by disparities in health literacy, healthcare access, and socioeconomic resources. These findings advocate for targeted health education campaigns to empower less-educated populations with hypertension prevention strategies.

Occupation also played a pivotal role, as individuals in medical professions exhibited lower BP rates, likely due to heightened health awareness and workplace wellness infrastructure. Conversely, retirees and those in non-specialized roles faced elevated risks, potentially linked to sedentary habits or occupational stress. Though the place of residence did not reach statistical significance ($\chi^2 = 7.130$, $p = 0.068$), the marginal trend suggests regional disparities in healthcare access or environmental stressors warrant further investigation. Collectively, these results emphasize the need for multifactorial interventions addressing age, education, and occupation-driven inequities. Public health policies should prioritize workplace wellness programs, community-based education, and equitable healthcare access to mitigate hypertension burdens, particularly in high-risk demographic subgroups. Future studies should explore longitudinal relationships between these factors and BP trajectories to inform culturally adaptive prevention frameworks.

On the other hand, this study explored associations between lifestyle factors and blood pressure status, yielding insights that both align with and diverge from global evidence. While physical activity demonstrated no statistically significant relationship with blood pressure ($\chi^2 = 3.068$, $p = 0.080$), the proximity of the p-value to the conventional significance threshold suggests a potential trend warranting deeper exploration. This finding partially resonates with a study, which documented significant blood pressure reductions among hypertensive individuals who exercise regularly [10]. Similarly, another study observed lower blood pressure in physically active Japanese populations [11]. The marginal significance in the current sample may reflect insufficient statistical power, heterogeneity in activity measurement, or confounding variables such as exercise intensity or genetic predisposition. These nuances underscore the necessity of longitudinal studies to clarify whether modest protective effects exist in specific subpopulations.

In contrast, BMI exhibited a robust association with blood pressure ($\chi^2 = 12.124$, $p = 0.007$), with 9.8% of obese participants presenting hypertension compared to 2.0% of normal-BMI individuals. This aligns conclusively with global literature that identifies obesity as a risk factor for hypertension [12]. Another study proved that systemic hypertension is more prevalent in obese individuals than in other populations [13]. The pathophysiological mechanisms—such as insulin resistance, inflammation, and sympathetic nervous system activation—likely mediate this relationship, reinforcing obesity as a critical modifiable risk factor in hypertension management.

Fruit consumption frequency showed no significant correlation with blood pressure ($\chi^2 = 6.589$, $p = 0.159$), despite 54.2% of participants consuming fruits 1–3 times weekly. This mirrors the equivocal global literature: Oyebode et al. (2014) linked higher fruit intake to reduced blood pressure in the U.K. [14]. In addition, a meta-analysis-based study in 2023 found effects of high fruit and vegetable intake in decreasing the risk of hypertension [15]. Discrepancies may arise from variations in fruit types (e.g., potassium-rich vs. high-glycemic varieties), portion sizes, or interactions with overall dietary patterns, such as concurrent sodium intake. The non-significance here may also reflect measurement limitations, as frequency alone may inadequately capture nutrient density or total dietary context.

Vegetable consumption approached marginal significance ($\chi^2 = 8.508$, $p = 0.075$), hinting at a possible protective effect. This trend aligns with robust evidence, including the DASH diet trials to control hypertension in CKD patients [16]. The near-significance in this study may stem from insufficient vegetable diversity or quantity, or confounding by preparation methods (e.g., sodium-laden sauces offsetting benefits). Future studies should quantify servings and nutrient profiles to disentangle these factors.

Fast food consumption revealed no significant association ($\chi^2 = 4.289$, $p = 0.232$), despite 41.8% abstaining entirely. However, a cohort study in the U.S and a cross-sectional study in Jordan found a significant positive association between the frequency of fast-food consumption and hypertension [17] [18]. This may be because of fast food composition, such as regional variations in sodium or trans-fat content, or compensatory dietary habits (e.g., concomitant healthy eating) may obscure associations. Additionally, social desirability bias in self-reported consumption could attenuate observed effects.

Finally, smoking status showed no blood pressure association ($\chi^2 = 0.147$, $p = 0.929$), contrasting with a study of 5,439 Japanese workers revealed that persistent smokers had a markedly greater prevalence of hypertension

compared to non-smokers [19]. This inconsistency may reflect differential smoking behaviors (e.g., pack-years, inhalation depth) or counteracting physiological responses, such as nicotine's transient vasoconstrictive effects versus weight suppression in smokers. Residual confounding by unmeasured variables, such as alcohol use or stress, may further cloud this relationship.

Recommendations

First, promote Physical Activity. Although the association between physical activity and blood pressure was not statistically significant, the near-significant trend suggests that promoting physical activity could still be beneficial for blood pressure control. Second, address Obesity, the significant association between BMI and blood pressure highlights the importance of weight management programs to reduce hypertension risk. Third, encourage healthy diets. The potential protective effects of vegetable consumption suggest that public health campaigns should promote increased vegetable intake as part of a healthy diet. Finally, the near-significant physical activity and vegetable consumption trends warrant further investigation with larger sample sizes and more detailed dietary assessments.

Conclusion

Lifestyle factors such as obesity, lack of exercise, and fast-food consumption are major contributors to elevated blood pressure in normal individuals and uncontrolled hypertension in patients. These factors exacerbate the physiological mechanisms that regulate BP, leading to increased cardiovascular risk. However, lifestyle modifications offer a powerful, non-pharmacological approach to managing hypertension and preventing cardiac diseases. By adopting a healthy diet, maintaining a healthy weight, engaging in regular physical activity, and managing stress, individuals can significantly improve their BP control and reduce their risk of cardiovascular complications. For hypertensive patients, these changes can complement medical treatment, leading to better outcomes and improved quality of life.

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Conflict of interest. Nil

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