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# The Relationship Between Hypertension and Socioeconomic Status and Food Intake

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## Abstract

**Background:** High blood pressure is known as a major risk factor for myocardial infarction and renal impairment. Various factors, including the pattern of food intake and physical activity, are effective in the incidence of hypertension.
**Objectives:** This study aimed at evaluating the relationship between dietary factors and hypertension in Hormozgan Province, South of Iran.
**Methods:** This descriptive study was conducted on 5075 adults aged more than 18 years from Hormozgan in 2016. Samples were selected through cluster sampling and randomly. The subjects' information, including demographic information, dietary intake, anthropometric status, and blood pressure, were collected.
**Results:** The high blood pressure in men was higher than in women. There was a significant relationship between systolic and diastolic blood pressure and age, body mass index, wrist and waist circumference, and waist-to-hip ratio. There was a statistically significant reverse relationship between hypertension and fruits intake, dairy products, fish, and decrease meat and nonalcoholic drink consumption.
**Conclusions:** Regarding the high prevalence of hypertension among people and its strong association with food intake, improving dietary patterns should be considered as an essential preventive action.

*Keywords:* Hypertension, Blood Pressure, Food Groups, Diet Pattern

## 1. Background

Cardiovascular disease accounts for nearly 30% of all deaths worldwide. High blood pressure and metabolic syndrome are the most important risk factors for cardiovascular disease (1). More than 25% of American and Canadian adults suffer from high blood pressure (2). In general, it is anticipated that the number of individuals with high blood pressure worldwide will reach 1.6 billion by 2025 (3). The prevalence of hypertension is increasing in the Iranian population, as 26 out of about 100 people have high blood pressure, of whom about 13 individuals are unaware of their high blood pressure (4). There are several strategies for controlling high blood pressure, including changing lifestyle and drug therapy (5). Several studies have shown that lifestyle changes, such as increasing physical activity, fitness, body mass index (BMI), and reduction of the consumption of sodium and alcohol lead to lower blood pressure (6). Lifestyle-related interventions and diet are important behavioral strategies for reducing the risk of cardiovascular disease (7). The Dietary approach to prevent hypertension (DASH), which is associated with the consumption of fruits and vegetables, low-fat dairy products, whole grains, nuts, and fish also limits the use of red meat, saturated fats, sweets, and sweetened drinks and is effective in reducing blood pressure (8). Considering the Ir 1anian traditional eating habits and also because Hormozgan Province is located near the sea, this study evaluated the dietary factors affecting hypertension, especially lifestyle-related factors in South of Iran.

## 2. Objectives

This study aimed at assessing the relationship between dietary factors and hypertension in Hormozgan Province, South of Iran.

## 3. Methods

This cross-sectional descriptive study was conducted on 5,057 adults aged over 18 years from Hormozgan Province, South of Iran. Samples were selected through cluster sampling and randomly. The clusters were 100 public health centers chosen randomly from the rural and urban areas of Hormozgan, and 50 individuals were selected from each cluster. The study was approved by the Ethics Committee of the Hormozgan Medical University. Demographic information, including age, marital status, and socioeconomic characteristics, such as education level, occupation, dietary intake, and anthropometric status, were collected using a questionnaire. The subjects' nutritional patterns, including mean daily, weekly, and monthly serving of fruit and vegetable, fish, meat, nonalcoholic drinks, milk, dairy, and cereals per were also questioned.

Blood pressure was measured twice for each person at intervals of 20 min using the Omron blood pressure measuring device in a sitting position by trained nurses at home. The average of the two measurements was used for data analysis. Hypertension was defined as (A) systolic blood pressure (SBP) > 140 mmHg and/or diastolic blood pressure (DBP) > 90 mmHg, according to the ESC/ESH 2018 guidelines; (B) self-reported hypertension; and (C) self-report of antihypertensive medication use.

Data analysis was done by SPSS software. To examine the relationship between anthropometric status and age and hypertension, the Mann-Whitney test (nonparametric) and independent *t*-test were used. The relationship between socioeconomic variables and hypertension was measured by the chi-square test. Multiple logistic regression was used to find the relationship between dietary intakes and blood pressure after adjustments for age and BMI.

## 4. Results

The prevalence of hypertension in the studied population was 23.2%. Anthropometric characteristics, age, socioeconomic status, and blood pressure of the participants are presented in Table 1. Marital status, education, and occupation of the subjects were significantly correlated with blood pressure. The results showed that being single and unemployed and a low level of literacy affected blood pressure. Hypertension was higher in men (25.9%) than in women (21.6%). The prevalence of systolic and diastolic blood pressure was 18.6%, 19.1% in women, and was 23.4% and 21.5% in men, respectively. There was a statistically significant relationship between systolic and diastolic blood pressure and age, BMI, wrist and waist circumference, and waist-to-hip ratio (Table 1). Also, there was a statistically significant relationship between taking fruits, dairy products, and fish and a lower chance of developing hypertension (Table 2). For example, people who consumed four servings of fruits a day had about a 51% lower risk of developing hypertension than those consumed one serving of fruits. Meat and beverage consumption was also associated with a higher chance of developing hypertension. People who consumed two glasses of beverage a week had a 22% lower chance of hypertension than those who consumed more than four glasses per week (Table 2). It is noteworthy that to increase the accuracy of these correlations, the controlling factors, such as age and BMI, were adjusted.

## 5. Discussion

The prevalence of hypertension in the studied population was 23.2%. Our results were consistent with those reported in a study conducted on 1,235 workers of the oil company in Kharg Island with the same climate; however, they did not eat homemade foods (9). The Safari Moradabadi (10) studied 1531 individuals aged over 30 years in Bandar Abbas and estimated the prevalence of hypertension to be 35.3%, which was more than our results and can be due to the higher age range of the subjects or changing in their lifestyle through these four years (2012 - 2016). People living in areas near the sea in the South and North of Iran eat more fish, whereas those in living in the center of Iran and the west and east areas with cold climates take more red meat with high fat. The consumption of salt in the southern areas is more than other areas due to the specific dressing used in this area and the heat, as well.

The marital status, education, and occupation of the participants were significantly associated with hypertension. These results showed that single and unemployed people with a lower level of education had higher blood pressure. Regarding the level of education and occupation, several studies have shown the results consistent with our study (11). Most studies have shown that marriage reduces the risk of hypertension (12). However, Jiang et al. (13) could not find a relationship between marital status and occupational position and hypertension. Being single, especially among older adults, as well as unemployment, cause a lot of mental engagement for people leading to an increase in stress and anxiety, and ultimately high blood pressure. Indeed, individuals with a higher level of education are more informed about how to prevent hypertension.

In the present study, the prevalence of hypertension in

**Table 1.** Distribution of the Anthropometric Variables, Social Characteristics, Age, and Sex in People Aged Over 18 Years in Hormozgan in Terms of Systolic and Diastolic Blood Pressure[a]

| Variables | Individuals with High SBP (N = 1042) | Individuals with Normal SBP (N = 4010) | Individuals with High DBP (N = 1016) | Individuals with Normal DBP N = (2047) | P Value4[b, c] | |
|---|---|---|---|---|---|---|
| | | | | | SBP | DBP |
| **Age** | 56.4 ± 15.04 | 43.6 ± 13.2 | 50.7 ± 14.9 | 45.1 ± 14.2 | < 0.001 | < 0.001 |
| **Sex** | | | | | < 0.001 | 0.03 |
| Female | 485 (46.7) | 1585 (39.6) | 445 (44) | 1620 (40.3) | | |
| Male | 553 (53.2) 553 | 2420 (60.4) | 567 (56) | 2402 (59.7) | | |
| **Marital status** | | | | | < 0.001 | 0.01 |
| Single | 822 (80.3) | 3414 (86.5) | 834 (83.3) | 3396 (85.7) | | |
| Married | 32 (3.1) | 262 (6.6) | 55 (5.5) | 236 (6) | | |
| Widow/divorced | 170 (16.6) | 272 (6.9) | 112 (11.2) | 330 (8.3) | | |
| **Education**[d] | | | | | < 0.001 | 0.99 |
| Illiterate/elementary | 634 (70.7) | 1959 (56.9) | 521 (59.8) | 2068 (59.7) | | |
| Guidance/diploma | 218 (24.3) | 1177 (34.2) | 279 (32) | 1113 (32.1) | | |
| Academic | 45 (5) | 309 (9) | 71 (8.2) | 282 (8.1) | | |
| **Occupation** | | | | | < 0.001 | < 0.001 |
| Unemployed/housewife | 660 (66.2) | 2610 (67.2) | 618 (63.6) | 2647 (67.9) | | |
| Manual worker | 90 (9) | 512 (13.2) | 83 (8.5) | 519 (13.3) | | |
| self-employment | 107 (10.7) | 311 (8) | 118 (12.1) | 298 (7.6) | | |
| Employee | 140 (14) | 449 (11.6) | 153 (15.7) | 434 (11.1) | | |
| **Body mass index** | 5.2 ± 25.8 | 24.8 ± 6.3 | 26.4 ± 5.09 | 24.7 ± 6.3 | < 0.001 | < 0.001 |
| Wrist | 17.3 ± 8.04 | 16.9 ± 5.9 | 17.4 ± 8.03 | 16.8 ± 5.4 | < 0.001 | < 0.001 |
| Waist | 90.9 ± 14.8 | 85.7 ± 17.2 | 91.3 ± 15.5 | 85.6 ± 17.05 | < 0.001 | < 0.001 |
| Waist-to-hip ratio | 0.92 ± 0.10 | 0.88 ± 0.16 | 0.91 ± 0.11 | 0.88 ± 0.16 | < 0.001 | < 0.001 |

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure.
[a] Values are expressed as No. (%) or mean ± SD.
[b] A comparison of the normal quantitative variables between the two groups was done by independent *t*-test and non-normal quantitative variables was applied the Mann-Whitney test.
[c] To compare qualitative variables between two groups, the chi-square and Fischer's exact tests were used.
[d] There was a relationship between the level of education (qualitative) and diastolic blood pressure (quantitative) (P < 0.001).

men was higher than in women. Although several studies have proved that in adolescence, blood pressure in men is higher than the women, consistent with most studies (14), we found that hypertension increased with aging. This increase can be attributed to hormonal changes and increased vascular resistance due to vessel wall thickening.

In the present study, by an increase in BMI and waist-hip ratio, the blood pressure increased, which is consistent with other studies (15). Also, increased body fat is associated with an increase in the risk of metabolic diseases, such as blood pressure, diabetes, and dyslipidemia (16).

In our study, there was a reverse correlation between the consumption of fruits, dairy products, low-fat red meat (goats) with hypertension. Taking these foods has not considered a healthy diet, a food pattern, including all types of foods, and eating a varied and balanced diet. Several studies have confirmed the association between the consumption of vegetables and fruits and a reduction in blood pressure (17). Minerals in vegetables and fruits (especially potassium and magnesium) (18), the presence of various antioxidants (19), and fiber (20) in vegetable-based foods are important factors in reducing blood pressure.

There was a reverse correlation between fish intake and hypertension in this study.

Although Ke et al. (21) showed the effect of fish consumption on a reduction in both systolic and diastolic blood pressure, Gillum et al. (22) could not demonstrate the impact of the fish consumption on blood pressure. We found the effect of dairy products on the reduction of blood pressure, which can be attributed to the high content of calcium and magnesium available in dairy products and has been confirmed by several studies, as well (23). Also, the proteins of the milk, including casein and whey, have a blood pressure-lowering effect (24).

In this study, there was a significant relationship between blood pressure and nonalcoholic drink (artificial sweeter), which has confirmed by several studies (25). High levels of fructose (a simple sugar), high glycemic load, and

**Table 2.** Relationship Between Systolic and Diastolic Blood Pressure and Dietary Intake in People Aged Over 18 Years in Hormozgan[a, b]

| Food Intake (Weekly) | Individuals with High SBP (N = 1042) | OR (CI %95) | Adj-OR (CI %95) | Individuals with High DBP (N = 1016) | OR (CI %95) | Adj-OR (CI %95) | Individuals with HTN (SBP and DBP) (N = 1395) | Adj-OR (CI %95) |
|---|---|---|---|---|---|---|---|---|
| **Fruits** | | | | | | | | |
| 1 Serving[c] | 158 (23.3) | Ref | Ref | 147 (21.7) | Ref | Ref | 205 (30.3) | Ref |
| 2 Servings | 252 (20.7) | 0.85 (0.68 - 1.07) | 0.94 (0.74 - 1.2) | 226 (18.6) | 0.82 (0.65 - 1.03) | 0.86 (0.68 - 1.1) | 307 (25.2) | 0.83 (0.66 - 1.04) |
| 3 Servings | 299 (19.1) | 0.77 (0.62 - 0.96)[d] | 0.99 (0.78 - 1.2) | 322 (20.5) | 0.93 (0.74 - 1.1) | 1.06 (0.84 - 1.3) | 433 (27.6) | 1.07 (0.86 - 1.3) |
| 4 Servings | 50 (11.8) | 0.44 (0.31 - 0.62)[d] | 0.5 (0.35 - 0.73)[d] | 46 (10.8) | 0.43 (0.3 - 0.62)[d] | 0.47 (0.33 - 0.68)[d] | 68 (16) | 0.49 (0.35 - 0.67)[d] |
| **Fish** | | | | | | | | |
| None | 96 (23.2) | Ref | Ref | 90 (21.8) | Ref | Ref | 128 (31) | Ref |
| 1 Serving | 212 (20) | 0.82 (0.62 - 1.08) | 0.82 (0.6 - 1.1) | 212 (20) | 0.89 (0.68 - 1.1) | 0.89 (0.67 - 1.1) | 293 (27.6) | 0.85 (0.65 - 1.1) |
| 2 Servings | 339 (20.5) | 0.85 (0.66 - 1.1) | 0.84 (0.63 - 1.1 | 328 (19.9) | 0.89 (0.68 - 1.1) | 0.86 (0.66 - 1.1) | 450 (27.3) | 0.81 (0.63 - 1.04) |
| More than 2 Servings | 377 (20.9) | 0.87 (0.67 - 1.1) | 0.77 (0.58 - 1.03) | 364 (20.2) | 0.9 (0.69 - 1.1) | 0.85 (0.65 - 1.1) | 495 (27.4) | 0.77 (0.6 - 0.98)[d] |
| **Meat** | | | | | | | | |
| None | 398 (25.3) | 1.4 (1.06 - 1.09)[d] | 1.04 (0.76 - 1.4) | 352 (22.3) | 1.1 (0.86 - 1.5) | 0.99 (0.74 - 1.3) | 497 (31.6) | 0.94 (0.71 - 1.2) |
| 1 - 2 Servings | 558 (18.5) | 0.95 (0.72 - 1.2) | 0.73 (0.54 - 1.05) | 571 (19) | 0.95 (0.72 - 1.2) | 0.84 (0.63 - 1.1) | 770 (25.6) | 0.73 (0.56 - 0.96)[d] |
| More than 2 servings | 68 (19.2) | Ref | Ref | 70 (19.8) | Ref | Ref | 98 (27.7) | Ref |
| **Milk (daily)** | | | | | | | | |
| None | 546 (20.7) | Ref | Ref | 536 (20.4) | Ref | Ref | 733 (27.8) | Ref |
| Up to 2 servings | 415 (21.1) | 1.02 (0.88 - 1.1) | 0.95 (0.81 - 1.1) | 397 (20.2) | 0.98 (0.85 - 1.1) | 0.96 (0.82 - 1.1) | 557 (28.3) | 0.97 (0.85 - 1.1) |
| 2 - 4 Servings | 39 (20.5) | 0.98 (0.68 - 1.4) | 0.77 (0.51 - 1.1) | 32 (16.8) | 0.79 (0.53 - 1.1) | 0.66 (0.44 - 1) | 46 (24.2) | 0.67 (0.46 - 0.96)[d] |
| More than 4 servings | 26 (18.3) | 0.85 (0.55 - 1.3) | 0.75 (0.46 - 1.2) | 29 (20.4) | 1 (0.66 - 1.5) | 0.94 (0.61 - 1.4) | 33 (23.2) | 0.71 (0.46 - 1.09) |
| **Unrefined cereals** | | | | | | | | |
| None | 41 (34.2) | 2.25 (1.5 - 3.3)[d] | 1.1 (0.74 - 1.7) | 33 (27.5) | 1.6 (1.07 - 2.4)[d] | 1.1 (0.74 - 1.7) | 51 (42.5) | 1.2 (0.85 - 1.8) |
| 2 - 4 Servings | 367 (24) | 1.37 (1.1 - 1.5)[d] | 1.1 (0.97 - 1.3) | 334 (21.8) | 1.1 (1.02 - 1.3)[d] | 1.09 (0.93 - 1.2) | 455 (29.8) | 1.03 (0.89 - 1.1) |
| More than 4 servings | 617 (18.7) | Ref | Ref | 625 (19) | Ref | Ref | 861 (26.1) | Ref |
| **Nonalcoholi c drink** | | | | | | | | |
| None | 526 (24.5) | 1.5 (1.2 - 1.8)[d] | 1.1 (0.97 - 1.4) | 496 (23.1) | 1.2 (1.03 - 1.4) | 1.09 (0.91 - 1.3) | 675 (31.4) | 1.07 (0.9 - 1.2) |
| Up to 2 servings | 302 (18) | 1.02 (0.84 - 1.2) | 0.85 (0.69 - 1.06) | 280 (16.7) | 0.82 (0.68 - 1) | 0.77 (0.62 - 0.94)[d] | 401 (23.9) | 0.78 (0.65 - 0.94)[d] |
| Up to 4 servings | 197 (17.6) | Ref | Ref | 217 (19.5) | Ref | Ref | 290 (26) | Ref |

Abbreviations: Adj-OR: adjusted odds ratio; BMI, body mass index; DBP, diastolic blood pressure; HTN, hypertension; SBP, systolic blood pressure.
[a] Values are expressed as No. (%) or median (range).
[b] To compare qualitative variables between two groups, multiple logistic regression adjusted for age and body mass index was used.
[c] The "serving size" indicates the amount of food stated in the United States Department of Agriculture (USDA) Food Guide Pyramid and My Pyramid.
[d] P value < 0.05.

calories of nonalcoholic drinks cause weight gain, abdominal fat, high blood pressure, insulin resistance, and dyslipidemia that ultimately lead to metabolic syndrome, diabetes, and cardiovascular disease (26).

There was a significant reverse relationship between the consumption of meat and blood pressure in this study; however, previous studies have shown that the high consumption of meat, especially red meat, may contribute to hypertension (27). A few prospective studies have been conducted on the relationship between meat consumption and the risk of high blood pressure. In the South of Iran and Hormozgan, people prefer to eat goat meat instead of sheep meat with lower fat. Wang et al. (27) found that consumption of red meat was associated with hypertension; however, there was no relationship between eating poultry meat and blood pressure.

A large sample size selected from all cities of Hormozgan Province was the strength of this study that made it as a large study conducted to assess the status of hypertension in Hormozgan Province. The lack of a food frequency questionnaire to examine the nutritional status of the subjects was the weakness of this study. Although in most cases, dietary recall, food records, and food frequency were used to obtain food intake, due to the large sample size, the subjects' low level of knowledge, and the lack of an experienced nutritionist through the research, a questionnaire that was short and easy to understand was used. It is hoped that more accurate and comprehensive information can be obtained in the coming years on the food intake pattern of the people living in the province.

### *5.1. Conclusions*

The food intake pattern was strongly linked to blood pressure; therefore, receiving fruits, fish, and dairy products can decrease blood pressure. Also, increased meat and nonalcoholic drinks consumption can negatively affect blood pressure.

## Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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## Footnotes

**Authors' Contribution:** Study concept and design: Hossein Farshidi. Analysis and interpretation of data: Farideh Dastsouz and Asma Zadeh Abbasi. Drafting of the manuscript: Farkhondeh Razmpour. Critical revision of the manuscript for important intellectual content: Farkhondeh Razmpour and Roghayeh Ezati Rad. Administrative, technical, and material support: Roghayeh Ezati Rad. Study supervision: Hossein Farshidi and Marzieh Nikparvar.

**Conflict of Interests:** The authors declared that they have no competing interests.

**Ethical Approval:** This study was approved by the Research Ethics Committee of Hormozgan University of Medical Sciences (approval code: HUMS.REC.1394.174).

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## References

1. Mendis S, Puska P, Norrving B; WHO. *Global atlas on cardiovascular disease prevention and control*. Geneva: World Health Organization; 2011.
2. World Health Organization. *Diet, nutrition, and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation*. **916**. Geneva: World Health Organization; 2003.
3. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: Analysis of worldwide data. *Lancet*. 2005;**365**(9455):217–23. doi: 10.1016/S0140-6736(05)17741-1. [PubMed: 15652604].
4. Malekzadeh MM, Etemadi A, Kamangar F, Khademi H, Golozar A, Islami F, et al. Prevalence, awareness and risk factors of hypertension in a large cohort of Iranian adult population. *J Hypertens*. 2013;**31**(7):1364–71. discussion 1371. doi: 10.1097/HJH.0b013e3283613053. [PubMed: 23673348]. [PubMed Central: PMC3766446].
5. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical practice guidelines for the management of hypertension in the community: A statement by the American Society of Hypertension and the International Society of Hypertension. *J Clin Hypertens (Greenwich)*. 2014;**16**(1):14–26. doi: 10.1111/jch.12237. [PubMed: 24341872].
6. Whelton PK, He J, Appel LJ, Cutler JA, Havas S, Kotchen TA, et al. Primary prevention of hypertension: clinical and public health advisory from the National High Blood Pressure Education program. *JAMA*. 2002;**288**(15):1882–8. doi: 10.1001/jama.288.15.1882. [PubMed: 12377087].
7. Cruickshank JK. Worldwide prevalence, awareness, treatment and control of hypertension. *J Hypertens*. 2004;**22**(1):21–4. doi: 10.1097/00004872-200401000-00004. [PubMed: 15106786].

8. Siervo M, Lara J, Chowdhury S, Ashor A, Oggioni C, Mathers JC. Effects of the dietary approach to stop hypertension (DASH) diet on cardiovascular risk factors: A systematic review and meta-analysis. *Br J Nutr*. 2015;**113**(1):1–15. doi: 10.1017/S0007114514003341. [PubMed: 25430608].
9. Fakhrzadeh H, Batoei M, Faridnia P, Taeb M. Overweight and obesity in oil industry workers on Kharg Island. *Iran South Med J*. 2002;**5**(73-81).
10. Safari Moradabadi A. Prevalence of hypertension and respective risk factors in adults in Bandar Abbas, Iran. *Hormozgan Med J*. 2014;**18**(3):201–9.
11. Conen D, Glynn RJ, Ridker PM, Buring JE, Albert MA. Socioeconomic status, blood pressure progression, and incident hypertension in a prospective cohort of female health professionals. *Eur Heart J*. 2009;**30**(11):1378–84. doi: 10.1093/eurheartj/ehp072. [PubMed: 19297384]. [PubMed Central: PMC2721710].
12. Wang H. Effects of marital status and transition on hypertension in Chinese women: A longitudinal study. *Annual meeting of the Population Association of America*. 2005.
13. Jiang B, Liu H, Ru X, Zhang H, Wu S, Wang W. Hypertension detection, management, control and associated factors among residents accessing community health services in Beijing. *Sci Rep*. 2014;**4**:4845. doi: 10.1038/srep04845. [PubMed: 24784167]. [PubMed Central: PMC4007080].
14. Rampal L, Rampal S, Azhar MZ, Rahman AR. Prevalence, awareness, treatment and control of hypertension in Malaysia: A national study of 16,440 subjects. *Public Health*. 2008;**122**(1):11–8. doi: 10.1016/j.puhe.2007.05.008. [PubMed: 17981310].
15. Bays HE, Chapman RH, Grandy S, Shield Investigators' Group. The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: Comparison of data from two national surveys. *Int J Clin Pract*. 2007;**61**(5):737–47. doi: 10.1111/j.1742-1241.2007.01336.x. [PubMed: 17493087]. [PubMed Central: PMC1890993].
16. WHO. *Obesity and overweight fact sheet*. Geneva: World Health Organization; 2016.
17. Alonso A, de la Fuente C, Martin-Arnau AM, de Irala J, Martinez JA, Martinez-Gonzalez MA. Fruit and vegetable consumption is inversely associated with blood pressure in a Mediterranean population with a high vegetable-fat intake: The Seguimiento Universidad de Navarra (SUN) study. *Br J Nutr*. 2004;**92**(2):311–9. doi: 10.1079/BJN20041196. [PubMed: 15333163].
18. Pamnani MB, Bryant HJ, Clough DL, Schooley JF. Increased dietary potassium and magnesium attenuate experimental volume dependent hypertension possibly through endogenous sodium-potassium pump inhibitor. *Clin Exp Hypertens*. 2003;**25**(2):103–15. doi: 10.1081/ceh-120017931. [PubMed: 12611422].
19. Liu S, Lee IM, Ajani U, Cole SR, Buring JE, Manson JE, et al. Intake of vegetables rich in carotenoids and risk of coronary heart disease in men: The physicians' health study. *Int J Epidemiol*. 2001;**30**(1):130–5. doi: 10.1093/ije/30.1.130. [PubMed: 11171873].
20. Whelton SP, Hyre AD, Pedersen B, Yi Y, Whelton PK, He J. Effect of dietary fiber intake on blood pressure: A meta-analysis of randomized, controlled clinical trials. *J Hypertens*. 2005;**23**(3):475–81. doi: 10.1097/01.hjh.0000160199.51158.cf. [PubMed: 15716684].
21. Ke L, Ho J, Feng J, Mpofu E, Dibley MJ, Feng X, et al. Modifiable risk factors including sunlight exposure and fish consumption are associated with risk of hypertension in a large representative population from Macau. *J Steroid Biochem Mol Biol*. 2014;**144 Pt A**:152–5. doi: 10.1016/j.jsbmb.2013.10.019. [PubMed: 24189545].
22. Gillum RF, Mussolino ME, Madans JH. Fish consumption and hypertension incidence in African Americans and whites: The NHANES I epidemiologic follow-up study. *J Natl Med Assoc*. 2001;**93**(4):124–8. [PubMed: 12653399]. [PubMed Central: PMC2593988].
23. Ackley S, Barrett-Connor E, Suarez L. Dairy products, calcium, and blood pressure. *Am J Clin Nutr*. 1983;**38**(3):457–61. doi: 10.1093/ajcn/38.3.457. [PubMed: 6613914].
24. Jauhiainen T, Korpela R. Milk peptides and blood pressure. *J Nutr*. 2007;**137**(3 Suppl 2):825S–9S. doi: 10.1093/jn/137.3.825S. [PubMed: 17311982].
25. Nguyen S, Choi HK, Lustig RH, Hsu CY. Sugar-sweetened beverages, serum uric acid, and blood pressure in adolescents. *J Pediatr*. 2009;**154**(6):807–13. doi: 10.1016/j.jpeds.2009.01.015. [PubMed: 19375714]. [PubMed Central: PMC2727470].
26. Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*. 2010;**121**(11):1356–64. doi: 10.1161/CIRCULATIONAHA.109.876185. [PubMed: 20308626]. [PubMed Central: PMC2862465].
27. Wang L, Manson JE, Buring JE, Sesso HD. Meat intake and the risk of hypertension in middle-aged and older women. *J Hypertens*. 2008;**26**(2):215–22. doi: 10.1097/HJH.0b013e3282f283dc. [PubMed: 18192834].