Brief Report

Seasonal Variations of Blood Pressure in Adults: Tehran Lipid and Glucose Study

Sahar Askari MSc Student[1], Golaleh Asghari PhD Student[2], Arash Ghanbarian MD•[3], Marjan Khazan MSc[4], Shahram Alamdari MD[5], Fereidoun Azizi MD[4]

Abstract

There is no comprehensive report on seasonal variations in individuals' blood pressure (BP) in Iranian subjects. The aim of this study is to evaluate individuals' BP during the four seasons of the year in a large number of adults in Tehran.

In a population-based study in Tehran, over a period of ten years (from 1998 to 2011) during the follow up of the four phases of the TLGS, data from a total of 29777 participants aged 20-80 years (42.29% male and 57.71% female) were collected. The participants' systolic and diastolic BP (SBP and DBP) were measured in every season, and adjusted for weight, age, sex, body mass index, and ambient temperature, history of diabetes mellitus and anti-hypertensive drugs, and their mean SBPs and DBPs were compared.

Mean SBP and DBP was 116.79 and 75.29 in spring, 116.11 and 74.81 in summer, 117.45 and 75.95 in fall and 119.03 and 76.28 mmHg in winter. There was a statistically significant difference between mean SBP in summer and winter ($P < 0.010$). The difference between mean SBP in winter and spring and the difference of mean DBP in winter and summer were near significance level ($P = 0.058$ and 0.086, respectively).

Compared to summer and spring, the individuals' SBP was higher during winter and their DBP in winter was also higher compared to summer. More attention should be paid to BP measurement in epidemiological studies.

Keywords: Blood pressure, diastole, season, systole

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Introduction

Blood pressure (BP) is a major independent risk factor for cardio- and cerebro-vascular disorders and involved in metabolic syndrome. BP is associated with several environmental factors; some studies demonstrate an inverse relationship between BP and ambient temperature resulting from seasonal variations,[1–3] indicating higher BP during colder months, resulting higher prevalence of cardiovascular and cerebro-vascular diseases in winter.[4] Different factors are associated with seasonal variation of BP; larger seasonal variations of BP are associated with latitudes closer to the equator.[5] Body height is significantly correlated with the winter increase in BP in both men and women, even after adjustment for potential confounding variables.[6] BP might be related to individuals' weight and air pollution, as well.[7,8] Consequently, seasonal variation of BP is associated with several geographical and anthropometric variables.

While the seasonal variations in BP have been studied in different countries and among various ethnic populations, there is no comprehensive report of seasonal variation from Iran. In this study, the seasonal variations of BP from 1998 to 2011 in participants of a large population-based study, the Tehran Lipid and Glucose Study (TLGS), have been evaluated.

Methods and Materials

The TLGS is a longitudinal study designed to estimate the prevalence of cardiovascular risk factors including lipid and glucose disorders, obesity, smoking, and hypertension in a representative sample of an urban Iranian population in Tehran district No. 13. Details of the rationale and design of the study have been published elsewhere.[9]

The study population in the four phases of TLGS consisted of 29777 individuals including 9979, 5923, 6151 and 7724 participants in each consecutive phase. Among these participants aged 20–80 years, 42.29% were male and 57.71% were female. During the ten-year follow-up, systolic and diastolic BP (SBP and DBP) were measured in each phase. The participants of the four phases were not the same, so adjustment was done for weight, age, sex, body mass index, ambient temperature, history of diabetes mellitus, and anti-hypertensive drugs.

For measuring BP, individuals were initially told to rest for 15 minutes. Then, a qualified physician measured their BP twice in a seated position after one more measurement for determining peak inflation level using a standard mercury sphygmomanom-

Authors' affiliations: [1]Research Center for Development of Medical Studies, Endocrine Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran. [2]Nutrition and Endocrine Research Center, Obesity Research Center, Research Institute for Endocrine Science, Shahid Beheshti University of Medical Sciences, Tehran, Iran. [3]Prevention of Metabolic Disorders Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran. [4]Endocrine Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran. [5]Research Center for Development of Medical Studies, Obesity Research Center, Research Institute for Endocrine Science, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

•**Corresponding author and reprints:** Arash Ghanbarian MD, Prevention of Metabolic Disorders Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Postal address: No.24, Shahid Arabi St., Yemen Blvd., Chamran Exp., Tehran, Iran. Tel: +98-212-243-2500, Fax: +98-212-241-6264, Email: ghanbarian@endocrine.ac.ir

Table 1. Multiple comparisons of systolic and diastolic blood pressure in four seasons

	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
Spring	116.8 ± 4.5	75.3 ± 2.7
Summer	116.1 ± 3.9	74.8 ± 2.5
Fall	117.4 ± 4.0	75.9 ± 2.5
Winter	119.0 ± 4.2[§‡]	76.3 ± 2.4
P value	0.009	0.083

Data are presented as mean ± SD, adjusted for weight, age, sex, body mass index, ambient temperature, history of diabetes mellitus, and anti-hypertensive drugs. [*] *P* values are for the comparisons across seasons, with the use of analysis of variance; [§]Significantly different from spring ($P = 0.058$), using post hoc Tukey analysis test; [‡]Significantly different from summer ($P = 0.006$), using post hoc Tukey analysis test.

eter calibrated by the Iranian Institute of Standards and Industrial Researches. Depending on the participant's arm circumference, a regular adult or large cuff was used. The cuff was placed at heart level on the participant's right arm and inflated at as high an increment rate as possible until the cuff pressure was 30 mmHg above the level at which the radial pulse disappeared. There was at least a 30-second interval between the two BP measurements. The mean of two measurements was considered as the participant's blood pressure. Systolic BP was defined as the appearance of the first sound (Korotkoff phase 1); and DBP was defined as the disappearance of the sound (Korotkoff phase 5) while deflating the cuff at a 2–3 mm per second decrements rate of the mercury column. Participants abstained from tea or coffee, physical activity, and smoking; and emptied their bladder 30 minutes prior to the measurement.[9] This study was approved by the appropriate Research Ethics Committee and written informed consent was obtained from all participants or their parents.

Data analyses were carried out on SPSS software package (version 17; SPSS Inc., Chicago, IL, USA). Baseline data are expressed as means ± SD. To determine any statistical differences among SBP and DBP in four seasons, ANOVA test was used and P-values < 0.05 were considered statistically significant. Post hoc Tukey test was applied to perform a pairwise comparison between seasons.

Results

Mean SBP and DBP were 116.8 and 75.3 in spring, 116.1 and 74.8 in summer, 117.4 and 75.9 in fall, and 119.0 and 76.3 mmHg in winter, respectively. Test analysis showed that the participants' SBP during winter was significantly higher than summer ($P < 0.01$). Compared to spring, mean SBP was higher in winter ($P = 0.058$) and mean DBP was higher in winter compared to summer ($P = 0.086$).

Discussion

The results of this study showed that the participants' mean SBP in winter was significantly higher than spring and summer, and mean DBP was higher in winter compared to summer.

Similar to our findings, several studies have reported that individuals' BP during winter and cold months of the year is higher than the warmer months.[1–4] Similar results have been found in certain groups including healthy people,[10,11] old people,[1] a large sample of people within different societies,[5] hypertensive patients[6] as well as patients with end-stage renal disease[12]. Besides, it seems that SBP has greater seasonal variation compared to DBP.[10] The SBP increase during winter was more pronounced than the DBP increase, with one study reporting that a 1°C decrease in the mean outdoor temperature is associated with rises of 0.43 mmHg in SBP and 0.29 mmHg in DBP.[10] Similarly in our study, the magnitude of increase in SBP was higher than in DBP and the difference of DBP during summer and winter, although near the significance level, was not statistically significant.

The precise etiology of the seasonal variations of BP is not fully understood, but several factors are thought to be involved. Cutaneous vasodilatations caused by high temperature during summer and increased sympathetic activity during winter have been implicated. Studies have demonstrated that the mean urinary corticosteroid level is highest during the coldest months of the year, falling gradually during the warmer months and rising again over the following winter. Moreover, there is increased sodium loss with profuse sweating in summer, which may lead to lower BP in these months of the year.

Although the seasonal alteration of BP is not extensive, with only a slight increase during winter, it seems to be an important factor in epidemiologic studies, which report that the incidence of cardio- and cerebro-vascular events is higher during winter and the colder months of the year, with seasonal variation of BP thought to be involved.[4] Thus, to prevent such adverse events, it seems that patients and physicians should pay better attention to patients' BP during winter.

Our study was performed on a large number of individuals and over a long duration; however, it does have certain limitations; the study population was limited to one district of Tehran. We did not follow the participants throughout the 10 years; instead, we studied the mean SBP and BDP of the TLGS participants in each phase of the follow up.

In conclusion, seasonal variations of BP in any population should be borne in mind when measuring and controlling BP.

Conflict of interests

Authors declare that they have no conflict of interests.

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