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Factors affecting seasonal changes in blood pressure in North India: A population based four-seasons study

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ABSTRACT

Objective: There are no community based, longitudinal, intra individual epidemiological studies on effect of weather and season on blood pressure. We evaluated the effect of season and temperature on prevalence and epidemiology of BP in tropical climate.

Methods and results: It was a longitudinal cross sectional survey of rural and urban subjects in their native surroundings. BP was measured in four different seasons in same subjects. A total of 978 subjects (452 rural and 521 urban) were included in the current analysis. Demographic characteristics such as age, gender, education, occupational based physical activity and body mass index were recorded. Mean BP, both systolic and diastolic were significantly higher in winter season as compared to summer season. Mean difference between winter and summer was 9.01 (95% CI: 7.74–10.28, $p < 0.001$) in systolic BP and 5.61 (95% CI: 4.75–6.47, $p < 0.001$) in diastolic BP. This increase in BP was more marked in rural areas and elderly subjects. Prevalence of hypertension was significantly higher during winter (23.72%) than in summer (10.12%).

Conclusion: BP increases significantly during winter season as compared to summer season. Increase is more marked in rural areas and elderly subjects. Seasonal variation in BP should be taken into account while looking at prevalence of hypertension in epidemiological studies.

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1. Introduction

Weather considerably influences cardiovascular health. It is a well-known phenomenon that cardiovascular morbidity and mortality increases during winter.¹ This observation is attributed to multiple physiological changes that occur during winter, such as increased sympathetic activity, alteration in the coagulation profile, endothelial dysfunction, and increased blood pressure (BP).^{2,3}

Of various weather parameters such as temperature, relative humidity, frost, and sunshine, outdoor temperature is the most important determinant of BP fluctuation and is inversely correlated with BP.⁴ Studies have shown that BP increases with decrease in

temperature.^{4–12} The climatic conditions in tropical areas are considerably different from those in temperate areas, with extremely hot summers and near zero temperatures during winters, resulting in an unusually large seasonal variation in temperature. In addition to geographical location, many other factors affect the strength of the association between temperature and BP in low–middle income countries such as India. A considerable proportion of the population consists of manual labourers and farmers who work in natural outdoor conditions. Housing conditions (lack of central heating) and other known risk factors of hypertension (obesity, age and social stress) are different as compared to western countries which can modify the effect of season on blood pressure.⁵

Despite being one of the most populous areas of the world, no adequately powered community-based study has been conducted in Asia in out-of-clinic settings, evaluating the effect of

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temperature variation on BP within same subjects in general population. Thus, we conducted a community-based longitudinal study involving subjects from both rural and urban areas. The aim of this study is to determine within-subject fluctuation in BP in out-of-clinic settings in native surroundings (either home or workplace) for evaluating the effect of change in season and outdoor temperature on BP.

Recently, it was also reported that seasonal variations are more marked in rural areas.⁶ Since two third population of India resides in villages, the current analysis was done to see rural urban difference and other factors affecting seasonal variation in blood pressure.

2. Material and methods

This was a community based prospective longitudinal study conducted in rural and urban areas of Ludhiana, Punjab. The state of Punjab is located in the north west of India. The latitude and longitude of Ludhiana city are 30°55'N and 75°54'E which is shown in Fig. 1. Rural areas included six villages (Jaghera, Jhammat, Lehra, Sahara Majra, Pohir and Rurka) of field practice areas of Rural health training centre of department of community Medicine, Dayanand Medical College & Hospital, Ludhiana. All the villages are located within 20–40 kms geographical distance from the urban area. Majority of the population in rural area belonged to farming community. Population in urban areas comprised of manual laborers in factories, officers, teachers and technical staff in agricultural university and school. Study population consisted of both the sexes with age group of 18 years and above.

Enrollment of the subjects was started in summer season. The same subjects were followed for 4 seasons: summer season (May, June), Post-monsoon season (September, October) and Winter

season (December, January) and Spring (March, April). These months were chosen based on observed temperature variation in different months in north India as per the Indian Meteorological Department (IMD). Coldest months are December and January. The severe cold wave conditions abate as temperature starts declining during February. March and April represent a transition period from extreme cold weather to hot weather. May and June are the hottest months of the year. Temperature starts falling during post monsoon season. Hence, September and October are the months when transition to winter season starts occurring.

The demographic characteristics of subject viz. age, gender, education were recorded on a predesigned performa. Occupation based physical activity, smoking and alcohol consumption were also noted.

BP was recorded using standard protocol by the three experienced and trained nurses using sphygmomanometer. BP was recorded indoor in the native surroundings either home or work place between 9 am to 2 pm. It was assured that subjects were sitting in a comfortable setting with no consumption of caffeine in preceding one hour or smoking in preceding 15 min. BP devices were regularly calibrated. BP was recorded twice in right arm, in the sitting position. An average of two readings (recorded 5 min apart) was used for analysis. After the BP measurement, weight, height and waist hip ratio was measured during each season. Obesity was defined as body mass index ≥ 25 kg/m² as per the consensus statement of Asian classification.¹³

A preliminary report of this study was published earlier.¹⁴ Now, we are reporting the sub group analysis of the total subjects who had completed follow up of four seasons as defined above. A total of 978 eligible subjects were included in the current analysis.

All the subjects were informed regarding the procedures and objectives after the study. A written informed consent was

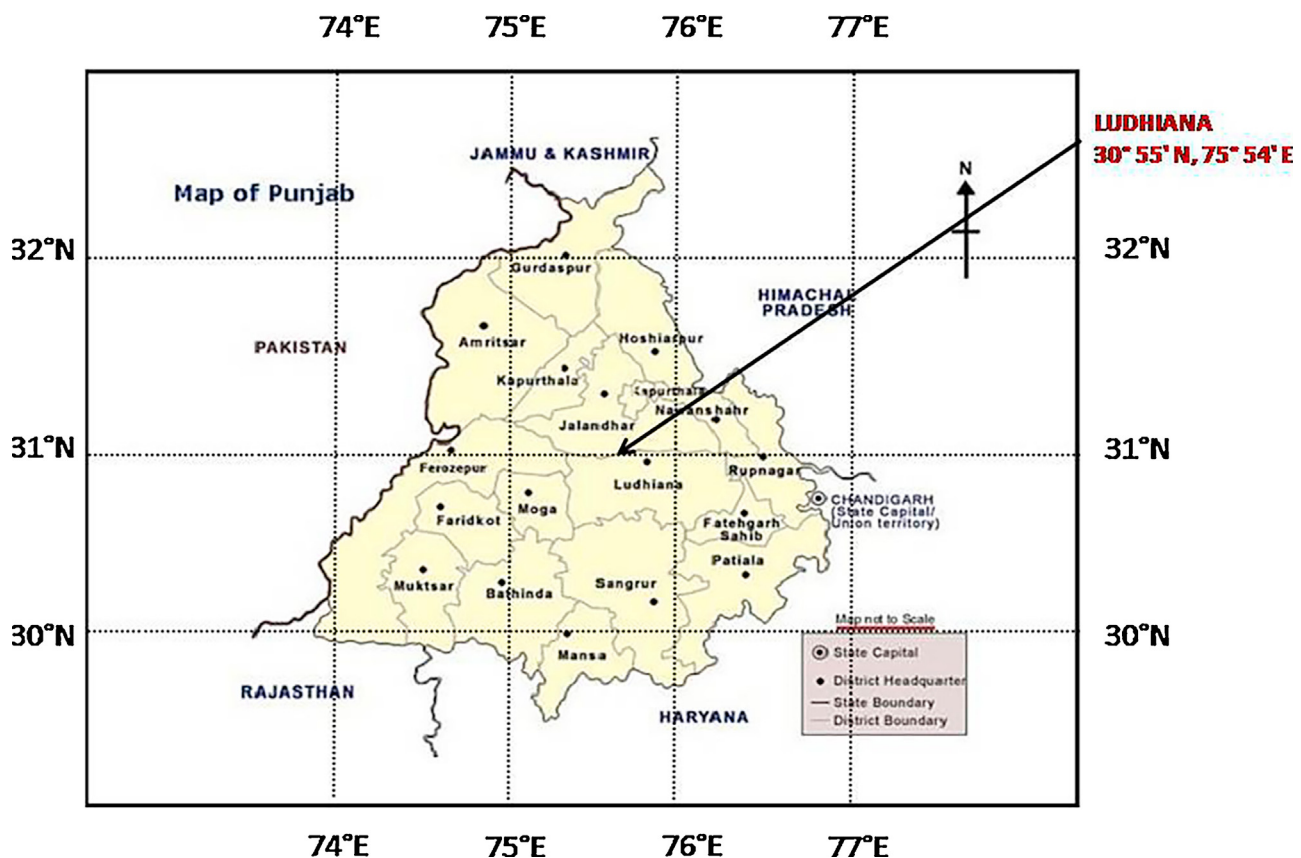


Fig. 1. Map of Punjab showing latitude and longitude of Ludhiana city.

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