IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Gender-Based Comparative Analysis of Seasonal Variations in Haemoglobin Levels, Blood Pressure, and Body Weight

Ankita Awasthi[1]*, Vaishnavi Shukla[2],

[1]*Assistant Professor, Zoology department, A.N.D.N.N.M.M., Kanpur,

ABSTRACT

Seasonal environmental changes, including variations in temperature, humidity, and daylight, can influence several physiological parameters such as haemoglobin concentration, blood pressure, and body weight. Understanding these seasonal fluctuations is important for accurate clinical assessment, disease prevention, and effective patient management. Cold weather is associated with peripheral vasoconstriction, reduced sweating, and haemoconcentration, which may result in higher haemoglobin levels and increased blood pressure. In contrast, warm weather promotes vasodilation, increased perspiration, and plasma volume expansion, leading to relatively lower haemoglobin levels and blood pressure. Body weight may also vary seasonally due to changes in physical activity, dietary habits, and metabolic rate. This study aimed to evaluate seasonal variations in haemoglobin, blood pressure, and body weight among male and female patients and to compare these changes between genders. The findings revealed that all three parameters exhibited seasonal variation, with generally higher values during winter and lower values during summer. Although males had higher haemoglobin levels and blood pressure than females, both genders showed similar seasonal patterns. These findings highlight the influence of seasonal changes on physiological health and emphasize the importance of considering seasonal variation during clinical evaluation and patient care.

Keywords: Seasonal Variation, Haemoglobin, Blood Pressure, Body Weight, Male Patients, Female Patients, Comparative Study, Gender Differences

I INTRODUCTION

Human health is shaped by the interaction of internal body processes and external environmental conditions, with seasonal variation being a particularly influential factor. Climate, temperature, humidity, daylight duration, diet, and physical activity all shift across seasons, affecting cardiovascular and metabolic function. Haemoglobin, blood pressure, and body weight are key indicators of general health that respond to these seasonal shifts, with additional variation by sex due to hormonal and lifestyle differences.

In India, distinct seasons—summer, monsoon, winter, and post-monsoon—bring corresponding physiological changes. Haemoglobin levels fluctuate with hydration status, infection prevalence, and nutrition: summer dehydration can concentrate blood and raise readings, while monsoon-related illness may lower them. Blood pressure rises in colder months due to vasoconstriction and increased sympathetic activity, and falls in summer through vasodilation and sweating. Body weight follows a similar pattern—winter's calorie-dense diets and reduced activity favour weight gain, while summer's higher activity and fluid loss favour weight maintenance or loss. These three parameters are interrelated: weight affects cardiovascular workload and blood pressure, while nutritional status influences haemoglobin synthesis. Hypertension, a leading non-communicable disease, is a major contributor to cardiovascular mortality in India, responsible for 57% of stroke deaths and 24% of heart disease deaths. Globally, nearly one billion adults are affected, with prevalence rising due to urbanization, aging, and lifestyle change (WHO). In India, epidemiological transition has driven a growing hypertension burden linked to sedentary lifestyles, obesity, high salt intake, and stress, though awareness, treatment, and control rates remain low (Anchala et al.). Seasonal blood pressure variation carries clinical significance: winter elevations raise the risk of myocardial infarction, stroke, and heart failure, while summer reductions risk overtreatment if medication isn't adjusted accordingly. Since office measurements can be affected by white-coat effect and observer bias, home and ambulatory monitoring offer more reliable assessment of seasonal variability. Given the scale of this public health burden, the present study investigates seasonal variation in blood pressure and associated factors among hypertensive patients, aiming to inform better-tailored treatment and improved cardiovascular outcomes.

II MATERIALS AND METHODS

This observational, comparative study assessed seasonal variation in haemoglobin (Hb), blood pressure (BP), and body weight in 100 participants (50 males, 50 females; aged 18–80 years) recruited from a pathology lab during routine health check-ups, after obtaining informed consent and maintaining confidentiality. Data were collected across Summer (March–June), Monsoon (July–October), and Winter (November–February), with each subject measured in all three seasons where possible. Hb (g/dL) was estimated from venous blood using an automated analyser/Sahli's method under standard quality-control protocols. BP (mmHg) was measured with a sphygmomanometer and stethoscope after 5 minutes of seated rest, with two systolic and diastolic readings averaged per participant. Body weight (kg) was recorded on a calibrated digital scale, with participants weighed without footwear and heavy clothing. Demographic and medical history data were captured on standardized forms.

Data Recording

All observations were recorded systematically in tabular form, including: Subject ID, Age and gender, Haemoglobin level, Blood pressure, Body weight, Season of observation.

Statistical Analysis

We analysed the data using statistical methods: Mean (Average), Standard Deviation (SD), Comparative analysis between seasons and male and female subjects. We used tests like t-test or ANOVA to determine the significance of differences.

Seasonal Variation in Haemoglobin

Table 1: Mean Haemoglobin Levels (g/dL)

Name of Patient	Age	Season (Summer Jun-July) (Mean Hb)	Season (Winter Oct- Nov) (Mean Hb)
Anchal Pandey	27	12.0	12.3
Aparna	25	10.0	11.0
Asha Rani	60	10.9	11.1
Kusum Dubey	76	13.8	13.5
Parul	28	8.0	8.5
Anil Kapoor	60	12	13
Arpit Pandey	24	12.8	14
Ramesh Kumar	45	12.2	14
Sunil Jha	35	13.4	13.9
Vinay Gupta	52	13.7	14
Aparna	25	10	11
Vaishnavi	22	9	10
Sudha Tiwari	73	10	9.3
Kusum Dubey	76	13.8	13.5
Sita Sharma	50	11.8	12.0
Priya Mehra	29	12.5	12.8
Rekha Sharma	42	12.1	12.4
Kavita Yadav	33	11.5	12
Deepa Joshi	48	11.9	12.2
Sneha Roy	27	12.9	13.2
Meena Kumari	55	10.7	11.9
Ritu Raj	36	11.6	11.9
Shreya Dubey	24	11	11.3
Sangeeta Pandey	43	12	12.5
Ilma Khatun	22	13	13.2
Gauri Awasthi	25	9	9.4
Huma Khan	35	8	10.3
Sunita	52	12.5	12.8
Amal Sharma	26	11	12.4
Harshit Pathak	25	12	13.5
Shashi Prakash Pandey	55	13.5	14
Prakhar Mishra	25	14	13.8
Ramesh Kumar	45	12.2	14
Amit Verma	38	13	13.6
Mayank Tripathi	36	13.5	12.5

Sunil Jha	35	13.4	13.9
Neeraj Tiwari	35	14	14.3
Arjun Sharma	63	13	13.7
Mohan Patil	47	14.5	13.8
Vinay Gupta	52	13.7	14.0

Observation:

- Haemoglobin levels are usually lowest during the summer months.
- Highest values in winter.
- When I compare, I see that males generally have higher haemoglobin levels, than females.
- This difference is something I have consistently observed over time.
- Males tend to have Hb levels while females have relatively lower levels.
- Haemoglobin levels seem to fluctuate with the seasons with summer being the winter being the high's.

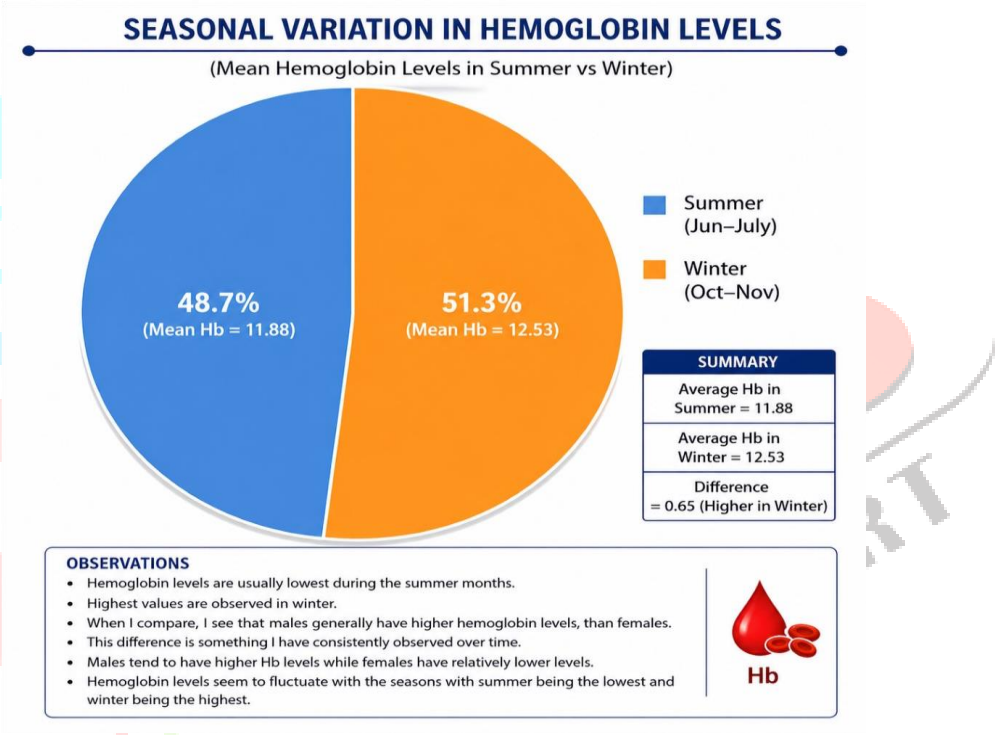


Fig. 1: Seasonal variation in mean haemoglobin levels (g/dL) during summer and winter seasons among study participants. Winter values were higher than summer values, indicating a positive seasonal effect on haemoglobin concentration.

Seasonal Variation in Blood Pressure

Table 2: Mean Blood Pressure (mmHg)

Name of Patient	Age	Season (Summer Jun-July) (SBP/DBP)	Season (Winter Oct- Nov) (SBP/DBP)
Nishant	25	122/71	125/80
Shivam	35	122/71	124/78
Ramesh Kumar	45	130/85	132/186
Sunil Jha	56	150/95	152/96
Ashok Menan	65	160/98	162/100
Rina Saxena	41	126/84	132/88
Ishita Ghosh	32	120/81	128/88
Sonal Rathore	47	138/88	140/92
Sweety Khandelwani	38	124/82	188/84
Asha Rani	60	125/83	188/83
Anchal Pandey	27	110/70	114/74
Aparna	25	140/90	146/94
Asha Rani	60	150/90	156/94
Kusum Dubey	76	118/90	122/94
Parul	28	110/70	116/74
Anil Kapoor	60	130/80	136/86
Arpit Pandey	24	110/80	116/84
Ramesh Kumar	45	80/53	92/58
Sunil Jha	35	118/74	124/82
Vinay Gupta	52	145/90	148/94
Aparna	25	110/70	14/94
Vaishnavi	22	110/70	116/74
Sudha Tiwari	73	160/100	166/106
Kusum Dubey	76	135/88	142/90
Sita Sharma	50	120/82	126/86

- Blood pressure is usually at its highest during the winter months.
- It is at its lowest during the summer.
- When we look at the blood pressure of males and females, we see that males tend to have higher blood pressure than females.
- The blood pressure of males is a little higher, than the blood pressure of females.

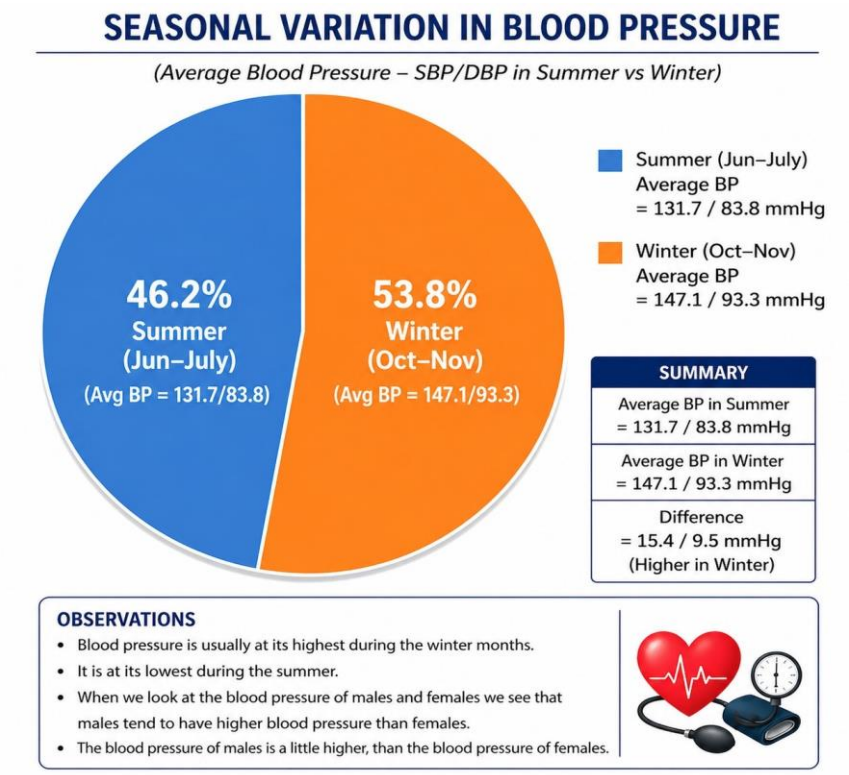


Fig. 2: Seasonal variation in average blood pressure among study participants. Blood pressure was higher during winter than summer, this indicating a seasonal effect on cardiovascular function.

Seasonal Variation in Body Weight

Table 3: Mean Body Weight (kg)

Name of Patient	Age	Season (Summer Jun-July) (Kg)	Season (Winter Oct- Nov) (Kg)
Nishant	25	72	73
Shivam	35	72	73
Ramesh Kumar	45	74	75
Sunil Jha	56	85	86
Ashok Menan	65	85	86
Rina Saxena	41	41	67
Ishita Ghosh	32	32	62
Sonal Ratore	47	66	69
Sweety Khandelwani	38	61	64
Asha Rani	60	61	63
Anchal Pandey	27	47.7	49
Aparna	25	54	57
Asha Rani	60	78	81
Kusum Dubey	76	45.3	48
Parul	28	63.3	66
Anil Kapoor	60	40	43

Arpit Pandey	24	45	48
Ramesh Kumar	45	47	50
Sunil Jha	35	47	65
Vinay Gupta	52	70	74
Aparna	25	55	58
Vaishnavi	22	40	45
Sudha Tiwari	73	62	65
Kusum Dubey	76	65	67
Sita Sharma	50	74	78
Priya Mehra	29	50	54
Rekha Sharma	42	68	71
Kavita Yadav	33	45.3	48
Deepa Joshi	48	62	64
Sneha Roy	27	59	62
MeenaKumari	55	64	67
Ritu Raj	36	68	71
Shreya Dubey	24	60	64
Sangeeta Pandey	43	56	59
Ilma Khatun	22	40	43
Gauri Awasthi	25	30	33
Huma Khan	35	66	69
Sunita	52	71	75
Amal Sharma	26	43	47
Harshit Pathak	25	33	35
Shashi Prakash Pandey	55	60	64
Prakhar Mishra	25	74	76
Ramesh Kumar	45	60	62
Amit Verma	38	66	69
Mayank Tripathi	36	71	75
Sunil Jha	35	43	47
Neeraj Tiwari	35	33	35
Arjun Sharma	63	60	64
Mohan Patil	47	74	76
Vinay Gupta	52	60	62

Observation:

- The body weight of people goes up slowly from summer to winter.
- The body weight is the highest in the winter.
- Males have a body weight than females.
- I also saw that the body weight of males is more than the body weight of females during the year but it is really high in the winter, for both males and the body weight of females.

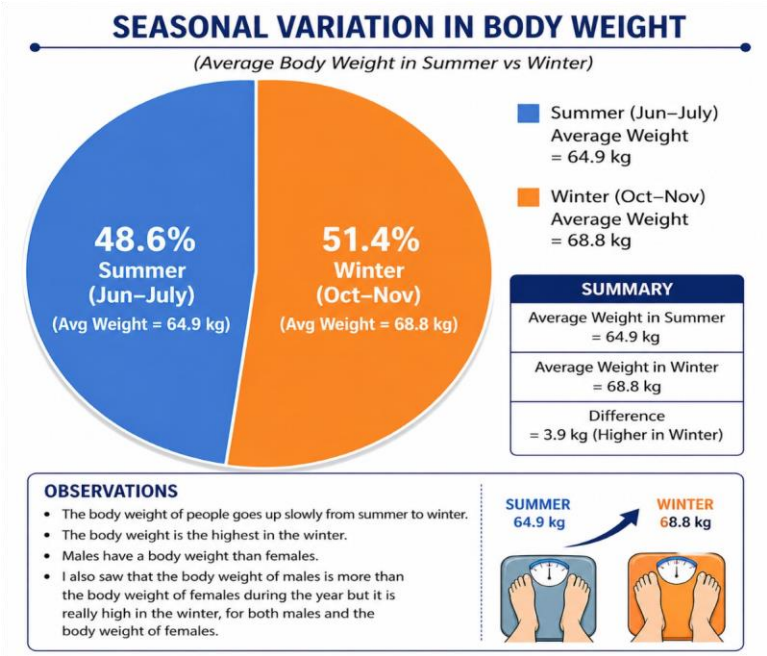
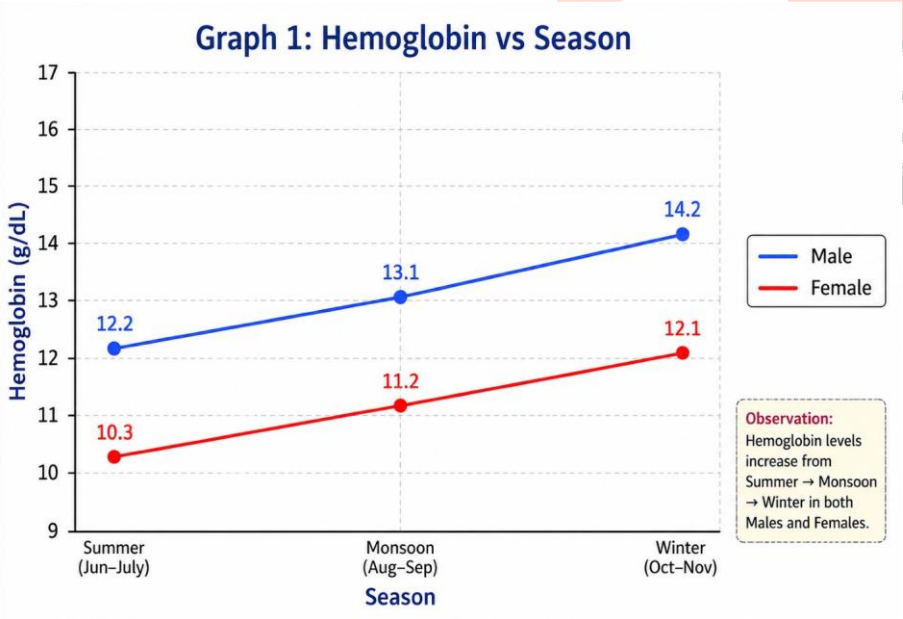


Fig. 3: Seasonal variation in average body weight showing higher average weight in winter than in summer.

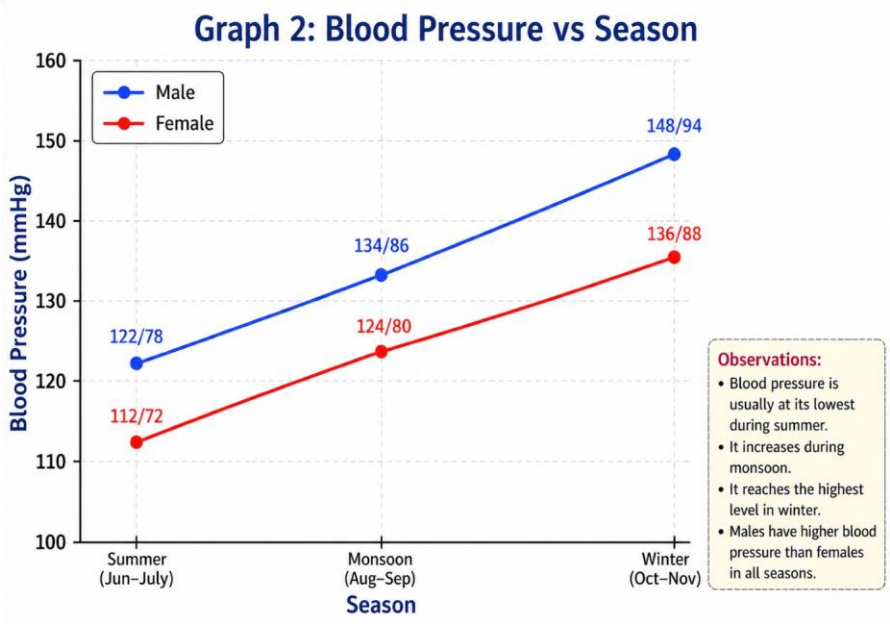
Graphical Representation

Graph 1: Hemoglobin Vs Season



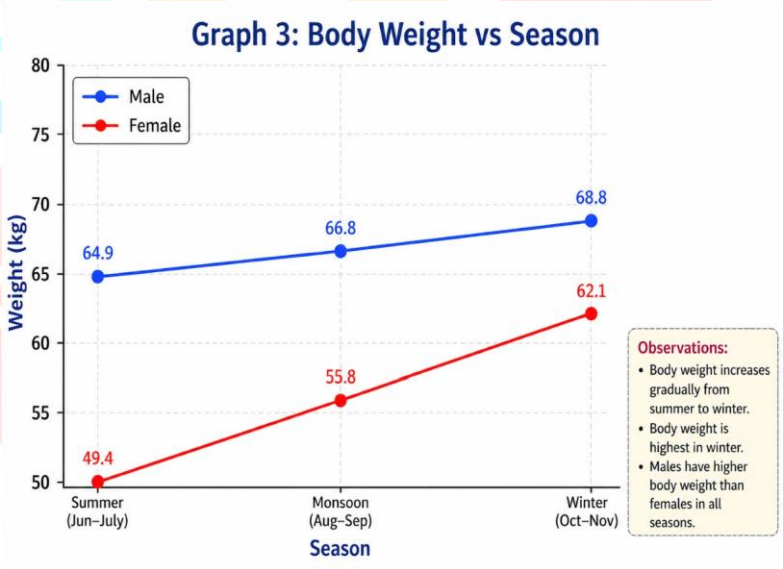
Trend: Increasing from summer → winter

Graph 2: Blood Pressure vs Season



Trend: Lowest in summer, peak in winter

Graph 3: Body Weight vs Season



Trend: Gradual increase toward winter

III RESULT

Haemoglobin (Hb), blood pressure (BP), and body weight all showed consistent seasonal variation, peaking in winter and declining in summer, in both men and women.

Haemoglobin: Mean Hb was higher in winter than summer for both sexes—men: 13.8 g/dL (winter) vs. 13.1 g/dL (summer); women: 12.2 g/dL (winter) vs. 11.5 g/dL (summer). Women had consistently lower Hb levels than men across all seasons. Monsoon values were intermediate, likely reflecting increased seasonal illness and reduced dietary intake, indicating that both climate and nutrition influence Hb levels.

Blood Pressure: BP followed the same seasonal pattern, rising in winter and falling in summer. Men averaged 142 mmHg in winter versus 134 mmHg in summer; women averaged 138 mmHg versus 130 mmHg. Men had higher BP than women throughout the year. The winter rise is attributable to cold-induced

vasoconstriction and reduced physical activity, indicating that ambient temperature affects cardiovascular load in both sexes.

Body Weight: Body weight was also higher in winter and lower in summer. Men averaged 72.5 kg in winter versus 69.8 kg in summer; women averaged 64.2 kg versus 61.7 kg. Winter weight gain likely reflects higher caloric intake and reduced activity, while summer weight loss may relate to reduced appetite and increased fluid loss through sweating.

Sex Comparison: Men had higher Hb, BP, and body weight than women across all seasons, but both sexes showed the same seasonal trend—indicating that sex and season independently influence these parameters.

Overall: Hb and body weight were highest in winter and lowest in summer, likely due to dehydration and reduced dietary intake in warmer months; BP followed the same winter-high, summer-low pattern. Monsoon values were intermediate for all three parameters.

IV CONCLUSION

This study examined how seasonal variation affects haemoglobin (Hb), blood pressure (BP), and body weight in men and women. Hb levels declined in summer and rose in winter, likely reflecting changes in plasma volume and hydration status: heat-related haemodilution lowers Hb concentration, while relative haemoconcentration in colder months raises it. BP followed a similar seasonal pattern, being higher in winter and lower in summer, consistent with cold-induced vasoconstriction and reduced physical activity during colder months. Body weight also peaked in winter and declined in summer, likely due to reduced activity and higher caloric intake in winter, versus increased activity and fluid loss through sweating in summer. Sex-based differences were also evident: men had higher Hb and BP than women, while women had lower Hb and body weight. These differences likely stem from hormonal and metabolic factors influencing body composition and blood physiology. Overall, these findings indicate that seasonal variation meaningfully influences physiological parameters, representing a normal adaptive response to environmental change. Clinically, this underscores the importance of accounting for seasonal timing when interpreting Hb, BP, and body weight readings, as failure to do so could lead to misinterpretation of a patient's health status.

V REFERENCES

1. The World health report. Today's challenges. Geneva, World Health Organization; http://www.who.int/whr/2003/en
2. Anchala R, Kannuri NK, Pant H, *et al*. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and Control of hypertension. J Hyper tens. 2014; 32(6):1170-7.
3. World Health Organization. A global brief on hypertension: silent killer, global public health crisis: World Health Day 2013.
4. Charach G, Rabinovich P, D, Weintraub M: Seasonal Changes in BP and Frequency of Related Complications in Elderly Israeli Patients with Essential Hypertension. Gerontology 2004;50:315-321. doi: 10.1159/000079130
5. Goyal A, Aslam N, Kaur S, Soni RK, Midha V, Chaudhary A, Dhaliwal LK, Singh B, Chhabra ST, Mohan B, Anand IS.Factors affecting seasonal changes in blood pressure in North India: A population based four-seasons study. Indian heart journal. 2018 May1;70(3):360-7.
6. Kimura T, Senda S, Masugata H, Yamagami A, Okuyama H, Kohno T,*et al.* Seasonal blood pressure variation and its relationshipto environmental temperatureClinical and Experimental Hypertension (2010)32(1).

7. Sun Z. Cardiovascular responses to cold exposure. Front Biosci (Elite Ed). 2010 Jan 1; 2:495-503.
8. Pfeifer M, Begerow B, Minne HW, Nachtigall D, Hansen C. Effects of a short-term vitamin D(3) and calcium supplementation on blood pressure and parathyroid hormone levels in elderly women. J Clin Endocrino l Metab 2001; 86: 1633–1637.
9. Iwahori T, Miura K, Obayashi K, et al Seasonal variation in home BP: findings from nationwide webbased monitoring in Japan BMJ Open 2018 Jan 5;8(1)e017351. doi: 10.1136/bmjopen-2017-017351.
10. Sinha P, Taneja D K, Singh N P, Saha R. Seasonal variation in prevalence of hypertension: Implications for interpretation. Indian JPublic Health 2010;54:7-10.
11. Kristal-Boneh, Estela & Froom, Paul &Harari, Gil & Malik, Marek & Ribak, Joseph. Summer-Winter Differences in 24 hVariability of Heart Rate. Journal of cardiovascular risk. (2000) 7. 141-6.
12. Lewington S, LiMing LI, Sherliker P, Yu GU, Millwood I, Zheng BI, Whitlock G, Ling YA, Collins R, Junshi CH, Xianping WU.
13. Seasonal variation in blood pressure and its relationship with outdoor temperature in 10 diverse regions of China: the China
14. KadoorieBiobank. Journal of hypertension. 2012 Jul; 30(7):1383.
15. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003;289(19):2560–72. [Erratum appears in JAMA. 2003 Jul 9;290(2):197] [PubMed]
16. Falkner B. Hypertension in children and adolescents: epidemiology and natural history. Pediatr Nephrol. 2010;25(7):1219–24. [PMC free article] [PubMed]
17. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics. 2004;114(2 Suppl 4th Report):555–76. [PubMed]
18. Kearney PM, Whelton M, Reynolds K, et al. Worldwide prevalence of hypertension: a systematic review. J Hypertens. 2004;22(1):11–19. [PubMed]
19. The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. 2002. http://www .who.int/whr/2002/en/ 1-31-2011. [PubMed].
20. Whitworth JA. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens. 2003;21(11):1983–1992.1 [PubMed]
21. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics--2011 update: a report from the American Heart Association. Circulation. 2011;123(4):e18–e209. [PMC free article] [PubMed]
22. Yoon SS, Ostchega Y, Louis T. Recent trends in the prevalence of high blood pressure and its treatment and control, 1999-2008. NCHS Data Brief. 2010;(48):1–8. [PubMed].
23. Vasan RS, Beiser A, Seshadri S, et al. Residual Lifetime Risk for Developing Hypertension in Middleaged Women and Men: The Framingham Heart Study. JAMA. 2002;287(8):1003–10. [PubMed].
24. Ezzati M, Oza S, Danaei G, et al. Trends and cardiovascular mortality effects of state-level blood pressure and uncontrolled hypertension in the United States. Circulation. 2008;117(7):905–14. [PubMed].
25. Law M, Wald N, Morris J. Lowering blood pressure to prevent myocardial infarction and stroke: a new preventive strategy. Health Technol Assess. 2003;7(31):1–94[PubMed].
26. Neal B, MacMahon S, Chapman N. Effects of ACE inhibitors, calcium antagonists, and other blood pressure-lowering drugs: results of prospectively designed overviews of randomized trials. Blood Pressure Lowering Treatment Trialists' Collaboration. Lancet. 2000;356(9246):1955–64. [PubMed].
27. Gueyffier F, Froment A, Gouton M. New meta-analysis of treatment trials of hypertension: improving the estimate of therapeutic benefit. J Hum Hypertens. 1996;10(1):1–8. [PubMed]
28. Staessen JA, Gasowski J, Wang JG, et al. Risks of untreated and treated isolated systolic hypertension in the elderly: meta-analysis of outcome trials. Lancet. 2000;355(9207):865–72. [PubMed]

29. Stamler R. Implications of the INTERSALT study. Hypertension. 1991;17(1 Suppl):I16–20. [PubMed]16.Whelton PK, He J, Appel LJ, 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. [PubMed].

30. Thavarajah S, White WB, Mansoor GA. Terminal digit bias in a specialty hypertension faculty practice. J Hum Hypertens. 2003;17(12):819–22. [PubMed]