

International Journal of HEALTH AND MEDICAL RESEARCH

Journal: <https://research-education.com/index.php/ijhmr>

Retrospective Cohort Study Analysis of Blood Pressure Incidents: A Case Study of Specialist Hospital, Jalingo, Taraba State, Nigeria

Authors

Kabiru Bala¹, Ilker Etikan², Muhammad Alhaji Dauda³, Muhammad Sani Galadima⁴,
Dauda Habu Ciroma⁵, Yahya Kodabu⁶, Yohana Awai⁷

^{1,7}Department of Statistics, School of Basic and Applied Sciences, Taraba State Polytechnic, P.M.B 1030, Jalingo

²Near East University Faculty of Medicine, Head of Biostatistics Department, Near East Avenue, Postcode: 99138, Nicosia, North Cyprus, Mersin 10, Turkey

^{3,4}Department of Statistics, Federal Polytechnic Damaturu, Yobe State, Nigeria

⁵National Directorate of Employment (NDE), 1st floor, Federal Secretariat Complex along Gashua road, Damaturu, Yobe State.

⁶Tertiary Education Trust Fund (Tetfund), No. 6, Zambezi Crescent off Aguiyi Ironsi Street, Maitama, P.M.B 361, Garki, Abuja

Correspondence Author

Kabiru Bala

Department of Statistics, School of Basic and Applied Sciences, Taraba State Polytechnic, P.M.B 1030, Jalingo

Abstract

Background: Blood pressure (BP) remains the most significant concern in Sub-Saharan Africa. The abnormalities led to hypertension and cardiovascular conditions in both old and younger generations.

Methods: A cohort retrospective study of 273 Blood pressure (BP) treatment patients in Jalingo Specialist Hospital, Taraba State, Nigeria, was followed using spanning data from January to December 2025. To run the analysis, the study employed sample tests, general linear models, contingency, and Phi coefficients.

Results: Mann-Whitney test ascertained a significant difference between SBP and DBP among marital status ($p = 0.000$). Age among BP stages ($p = 0.000$) and age among treatment ($p = 0.001$) both confer a significant effect. The ANCOVA models established that the four levels of BP stages remained highly significant when SBP was controlled ($p = 0.000$), except that it lost significance when DBP was controlled ($p = 0.051$). The MANOVA verified that both the BP stages and treatment on the combination of SBP and DBP were significant ($p = 0.001$), with the treatment explaining a larger effect size of 12.2% variance than the BP stage (8.5%). The contingency and Phi coefficient demonstrated no association between gender and BP stages, gender and economic status, and gender and marital status ($p = 0.342$, $p = 0.488$, and $p = 0.067$).

Conclusion: The therapeutic approach of Lifestyle changes and beta blockers heavily modified the narrative, revealing high risk in female, unmarried couples, and medium economic earnings. In addition, the age bracket (30-39) was another serious concern for this study.

Keywords: Analysis of variance; Beta blocker; Blood pressure; General Linear Models; Pillai's Criterion.

© 2026 The Author(s). This article is licensed under the Creative Commons Attribution 4.0 International (CC BY 4.0) License: <https://creativecommons.org/licenses/by/4.0/>

1. Introduction

BP surfacing is linked to hypertension, especially when blood pressure exceeds the arterial walls. The hidden symptoms appear in different modes, causing heart disorders ^[1]. One major worldwide health concern is hypertension, and it is mandatory to handle the related issues surrounding it ^[2]. The stretching of arterial walls by blood volume is the primary factor determining arterial blood pressure. Due to increased blood flow into the arterial system, pressure rises during systole and falls after the peak of ejection ^[3]. People become victims of the silent killer without knowing until they are examined. There is a need for individuals and the government to control and reduce the so-called BP and hypertension-related issues ^{[4], [5]}. Hypertension and diabetes are the primary causes of chronic renal disease, heart attacks, strokes, and heart failure. Therefore, to maximise clinical benefits, BP must be lowered with the required medication ^[6]. BP often rises during working hours and falls during sleeping hours.

An elevated risk of hypertension and cardiovascular disease has been associated with circadian rhythm disruption ^[7]. Abnormality of BP is a condition in which a person's blood pressure (BP) is higher than the normal or ideal range, of 140 mmHg for the systolic and 90 mmHg for the diastolic ^[8]. A persistent SBP of 140 and DBP of 90 requires antihypertensive drugs, it led to mortality, especially in older age, as people experience physical changes because of degenerative hypertension, cardiovascular disorder, and high BP ^[9]. BP readings that deviate significantly from the mean are typically considered outliers or noise in clinical practice. Additionally, an elevated blood pressure reading prompts a second measurement, allowing the decision-maker to either disregard or accept the higher reading. Therefore, to diagnose and treat hypertension, there is a need to use the current endorsed guidelines, known as the average of multiple blood pressure readings ^[10]. Immediate detection of cardiovascular and hypertension conditions fosters successful treatment achievement ^[11].

Different statistical techniques were employed by different researchers to solve different silent killers and related circumstances. The worrisome nature of BP in society prompted Intellectuals to use a multivariate mixed model to consider cases of BP among Covid victims ^[12]. Sample test, ANOVA, and Chi-square were employed to predict BP-related issues ^[2]. Linear regression analyses investigated differences in cases related to BP and hypertension ^[7]. The effect of different BP levels and diabetes was investigated using Cox proportional hazard regression [14]. Random effect examines BP and heart failure ^[15]. The innovation in this study is the application of sample test, ANOVA, ANCOVA, MANOVA, Phi, and Contingency Coefficient to investigate and evaluate the BP and related incidents in Taraba State Specialist Hospital, Jalingo.

2. Methods

In this study, associates of BP-treated patients visiting Taraba State Specialist Hospital, Jalingo, were investigated. The data was generated from the hospital record unit covering the period from January to December 2025.

A random sampling was employed to select 273 patients. Data were collected on demographic characteristics such as age, gender, marital status, and socioeconomic status. In addition, the study data include diastolic blood pressure (DBP), systolic blood pressure (SBP), BP stages (stage 1, stage 2, elevated, and normal), and treatment (ACE inhibitor, calcium channel blocker, diuretic, ARB, to mention a few).

Measures of central tendency and dispersion were used to describe the characteristics, position, and variation in the data distribution. The study also employed a sample test to test the significance difference. ANOVA and ANCOVA were utilized to assess continuous mean variation while controlling baselines of (SBP and

DBP). MANOVA employed Pillai's Trace criterion test consecutive interaction on the joint merge SBP/DBP dependent variables. Categorical relationships were represented using Phi and the contingency coefficient.

3. Result Discussion

3.1. Categorical BP variables results.

In Table 1, the cases of BP in the specialist hospital during the coverage period, females accounted for 50.2%, and males were 49.8% participation. However, in Asia, the escalating occurrence of BP is in the young group ^[16], and the rise of BP in females requires further investigation and regulation ^[17]. Subsequently, the high risk of BP was about 59.35 higher in unmarried patients than in married patients (40.7). Patients with medium economic earnings showcase high BP (45.4%) prevalence, then low income (29.3%) and high income (25.3%) earnings. The BP stage shows a higher risk of 35.5% in stage 1, trailed by stage 2 (33%), elevated (22.3%), and normal (9%). Focusing on an estimate, excessive BP of (120-80) is responsible for about 20% of all mortality occurrences ^[18]. Age bracket 30-39 presented a higher BP incidence of 37%, followed by the age bracket 40-49 (30%), 50-59 (16.8%), 60 (9.2), and 20-29 (6.2). Lifestyle changes formed about 28.8%, successfully applied during the treatment period, compared to ACE inhibitor (19.4%), ARB (13.8), Diuretic (12.1), Calcium channel (11), Beta blocker (10.3), and lifestyle + ARB (4.4), respectively.

Table 1: Demographic data result

Variables		N	Percentage
Gender	Male	136	49.8
	Female	137	50.2
Marital status	Married	111	40.7
	Single	162	59.3
Economic status	Medium	124	45.4
	High	69	25.3
	Low	80	29.3
BP stages	Stage1	97	35.5
	Stage2	90	33.0
	Elevated	61	22.3
	Normal	25	9.0
Age group	20-29	17	6.2
	30-39	101	37.0
	40-49	84	30.8
	50-59	46	16.8
	60 above	25	9.2
Treatment	ACE inhibitor	53	19.4
	calcium channel blocker	30	11.0
	Lifestyle changes	79	28.8
	Diuretic	33	12.1
	ARB	38	13.8
	Beta blocker	28	10.3
	Lifestyle +ARB	12	4.4

3.2. Sample test, SBP and DBP among genders and marital status

In Table 2, both the SBP and DBP by gender and marital status failed the normality test for conducting the sample test. However, the Mann-Whitney test results for SBP and DBP among genders were statistically

insignificant ($p = 0.077$ and $p = 0.053$). Revealing the SBP and DBP among the genders are similar. An individual can be SBP or DSP without being male or female. But SBP and DBP among marital status were both significant ($p = 0.001$ and $p = 0.001$). indicating there was a higher risk of 143.7 SBP cases in the married couples than in the unmarried couples (135.2). Similarly, on average, there was a higher level of about 91.2 DBP in married couples than in unmarried couples (86.4%). The study demonstrates that hypertensive measurements are more common among married couples. These results conclude that being married is allied with elevated SBP and DBP.

Table 2 Normality results for SBP and DBP on sex and marital status

	N	Mean	Median	S.D	Min	Max	IQ	Mann W.
SBP	Male	137.4706	135.0000	13.22118	118.00	165.00	22.00	$p = 0.077$
	Female	139.8175	138.0000	13.04811	118.00	165.00	20.00	
DBP	Male	87.5809	86.0000	8.03285	76.00	105.00	15.00	$p = 0.053$
	Female	89.0949	88.0000	8.54562	50.00	105.00	12.50	
SBP	Married	143.6937	140.000	13.22998	118.00	165.00	20.00	$p = 0.001$
	Single	135.1914	133.0000	11.98163	118.00	165.00	15.00	
DBP	Married	91.1622	91.0000	8.85493	50.00	105.00	12.00	$p = 0.001$
	Single	86.4074	86.0000	7.34471	75.00	105.00	11.00	

3.3. ANOVA of age against economic status, BP stages, and treatment levels

The results in Table 3 considered the normality test for both the socioeconomic status and treatment levels. After the failure of the test, Kruskal Wallis adopted showed socioeconomic status was not the leading cause of BP in aged patients ($p = 0.883$). However, the BP stage has an effect on aged patients ($p = 0.001$), revealing there is a statistically significant mean difference in BP stage 2 (47.64), followed by normal (42.12), BP stage 1 (39.10), and BP elevated (31.95). Similarly, the adopted Kruskal-Wallis test after failing the normality test indicates that the treatments applied were significantly different ($p = 0.001$). In addition, the most effective drug found among the treatments was Beta blocker (49.79), followed by Diuretic (49.12), ACE inhibitor (43.98), Lifestyle+ARB (40.54%), Calcium blocker (39.83%), ARB (39.05), and Lifestyle changes (32.45), respectively.

Table 3: Normality test Age (socioeconomic, BP stages and treatment levels)

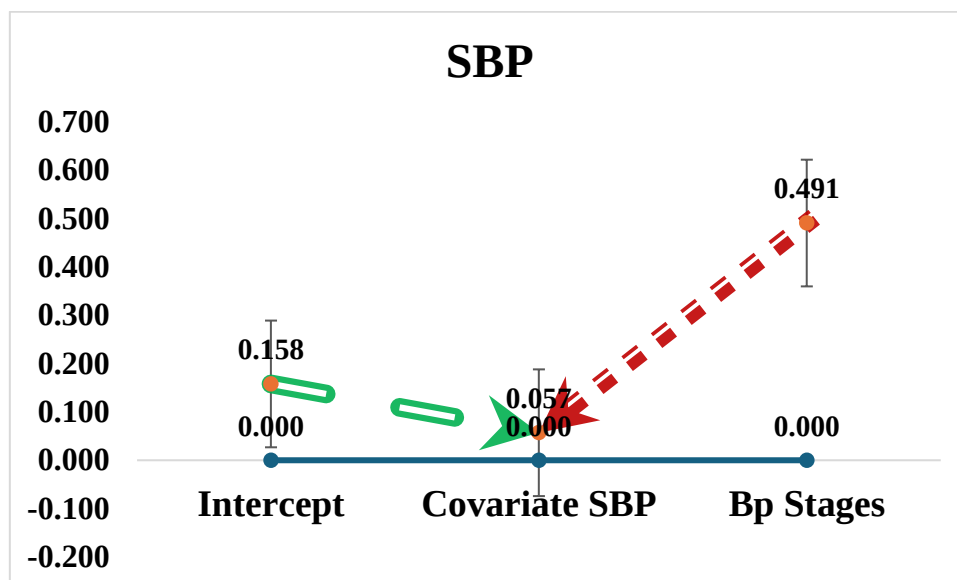
Variable	N	MEAN	MEDIAN	S.D	MIN	MAX	IQ	Kruskal W. P-value
Medium	124	40.52	39.00	7.746	26	60	14	$p = 0.883$
High	89	40.35	42.00	8.507	28	56	13	
Low	80	40.92	39.00	8.280	29	57	15	
Stage 1	97	39.10	39.00	4.881	31	54	8	$p = 0.001$
Stage 2	90	47.64	49.00	6.798	29	60	9	
Elevated	61	31.95	31.00	3.206	28	40	3	
Normal	25	42.12	43.00	7.667	26	55	13	
ACE inhibitor	53	43.98	45.00	7.640	35	56	15	$p = 0.001$
Calcium C. blocker	30	39.83	37.00	6.303	32	52	12	
Lifestyle changes	78	32.45	31.00	3.956	26	46	3	
Diuretic	33	49.12	50.00	4.068	37	60	2	
ARB	38	39.05	39.00	2.681	34	43	4	
Beta blocker	38	49.79	49.50	4.533	44	57	10	
Lifestyle +ARB	13	40.54	43.00	5.270	27	44	2	

3.4. Univariate General Linear Model Techniques of ANCOVA

Table 4 uses the general linear model of ANCOVA techniques to run the analysis. According to these results, BP stages have a significant effect on the age of patients while controlling for the SBP ($p = 0.000$), but DBP failed while controlling for BP stages. However, the BP stage with four levels explained a higher effect of 49.6% in DBP than SBP (49.1%). In an Asian study, controlling SBP helped manage stroke incidence and myocardial infarction in patients with high BP [19]. Figure 2 is a schematic representation of the SBP and DBP chart.

Table 4: SBP and DBP Test between-subjects effects with a confounder

	SBP/DBP	F	Sig	Partial Eta Squared
Result A	Intercept	50.157	0.000	0.158
	Covariate SBP	16.308	0.000	0.057
	Bp Stages	86.162	0.000	0.491
Result B	Intercept	53.670	0.000	0.167
	Covariate DBP	13.654	0.000	0.048
	Bp Stages	87.852	0.051	0.496



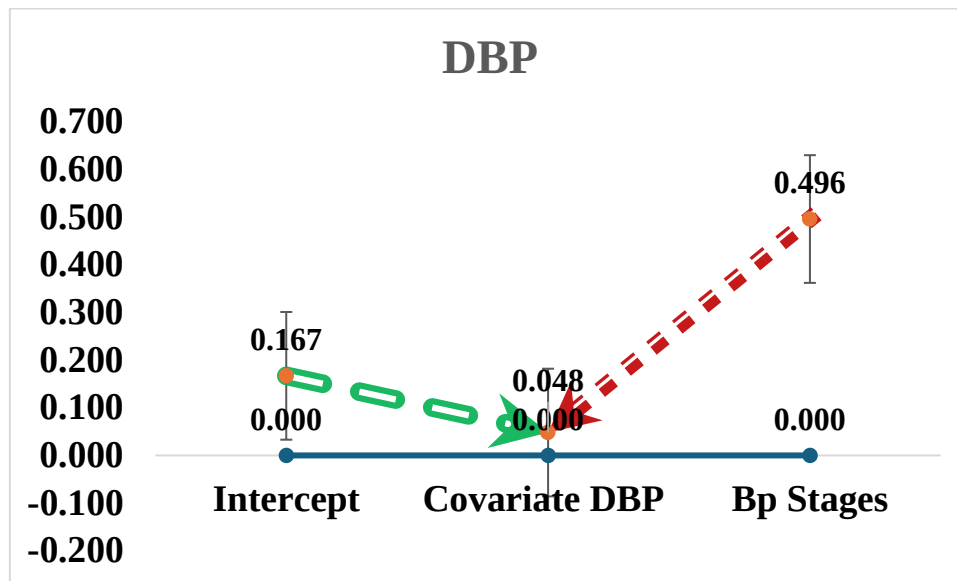


Fig. 1. Line chart for SBP and DBP

3.5. MANOVA results for BP stages and treatment on the combination of SBP and DBP

In this portion, Pillai's Criterion was used to interpret the analysis. The results in Table 5 show that BP stage levels and different treatments on the combination of SBP and DBP were significant ($P = 0.002$ and $P = 0.001$). This ascertained that the reading combination of (SBP and DBP) is similar across all the levels of BP stages and different treatments. The partial Eta square for different treatments explained a larger effect size of 6.5% than that for the BP stages (3.7%). Figure 3 is the 3-D chart for BP stages and treatment levels.

Table 5: Multivariate Test for BP stages and different treatments

Effect	Test	Value	F	Sign	Partial Eta Squared
Bp stages	Pillai's Trace	0.074	3.458	0.002	0.037
Treatments	Pillai's Trace	0.129	3.061	0.001	0.065

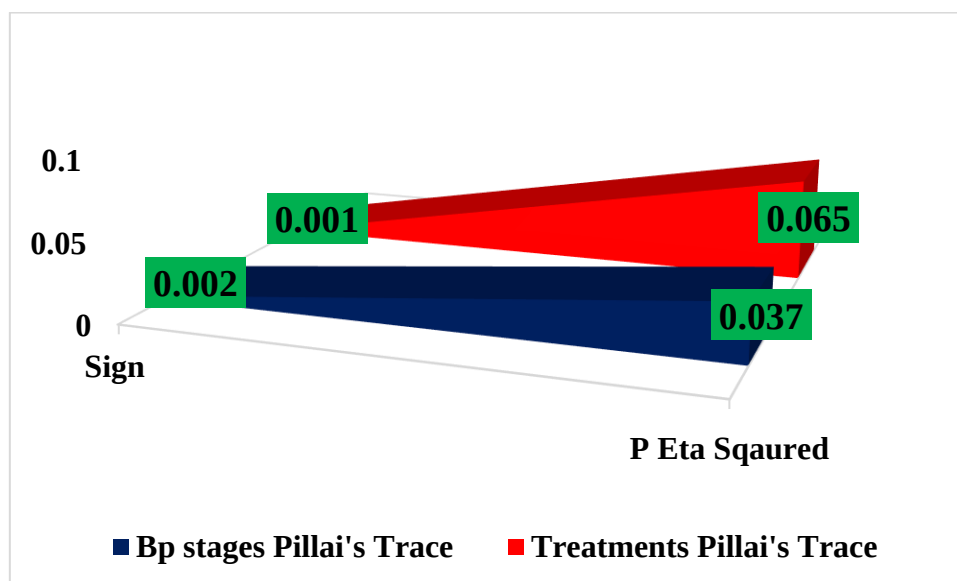


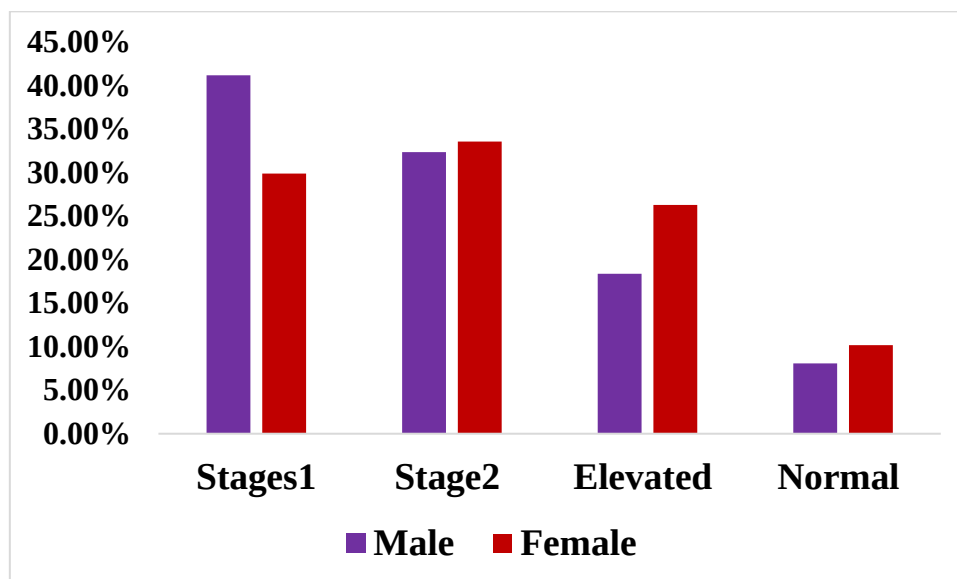
Fig. 2. BP stages and treatment 3-D chart

3.6. Contingency Coefficient (gender with BP stages) and (gender with economic status)

This bit of these results is utilized from Table 6, using the contingency coefficient. Considering the crosstabulation coefficient, the results show no association between gender and BP stages ($P = 0.195$). Despite this, gender proven there are more males with stage 1 BP (41.2%) than females (29.9%), Females with Stage 2 BP (33.3%) were higher than males (32.4%), Elevated BP stage shows about 26.3 female had higher BP compared to male (18.4%) and Normal stage shows there was about 10.2% people with normal BP compare male (8.1%). Consequently, the contingency coefficient between gender and economic status did not show any association (0.445). Indicating the gender status of patients with BP is not considered in relation to socioeconomic status. However, the results show there was a high percentage of females with medium BP (48.9%) compared to males (41.9%), there was a high percentage of males with high BP (25.7) compared to females (24.8%), and there was a lower percentage of BP in females (26.3) compared to males (32.4). See Fig. 4, diagrammatic visualization.

Table 6: Gender-BP stage and gender- economic status

Variables	Stages1	Stage2	Elevated	Normal	Contingency Coefficient
Male	56 (41.2)	44 (32.4)	25 (18.4)	11 (8.1)	$P = 0.195$
Female	41 (29.9)	46 (33.6)	36 (26.3)	14 (10.2)	
Variables	Medium	High	Low		$p = 0.445$
Male	57 (41.9)	35 (25.7)	44 (32.4)		
Female	67 (48.9)	34 (24.8)	36 (26.3)		



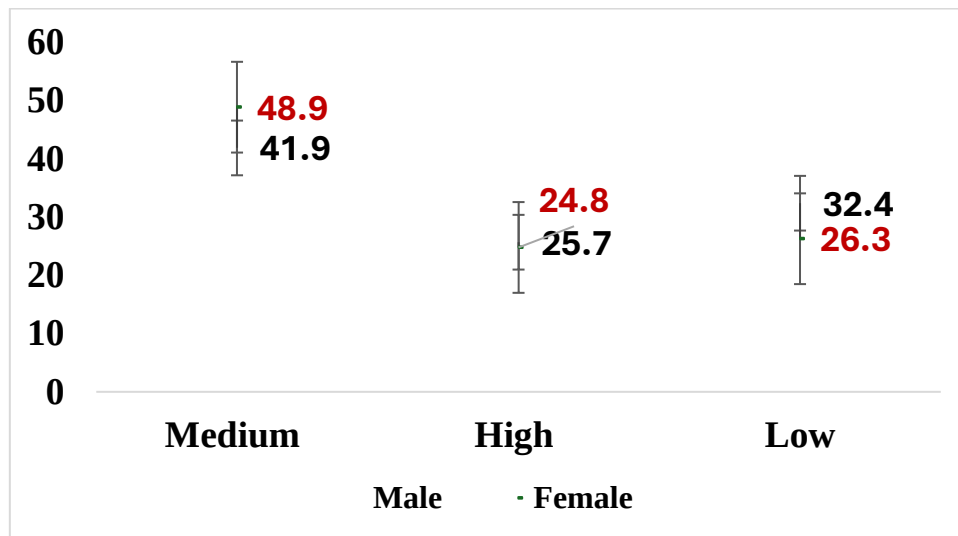


Fig. 3. Bar-graph BP states by gender and box-whisker chart for socioeconomic status by gender

3.7. Phi Coefficient Correlation of Gender with Marital Status

In this section, the results from a 2-by-2 table of gender and marital status were evaluated, indicating an association between gender and marital status ($p = 0.005$). The results also revealed that about 32.4% of males and 48.9% of females with BP are married, while 67.6% of males and 51.1% of females with BP are unmarried. The results also show there is a high percentage of BP in females (48.9) who are married, while there is a high percentage of BP in males (67.6) who are single (See Fig. 5). The association between BP parameters, including cardiovascular disorders, was assessed using a meta-analyses study ^{[20], [21], [22]}.

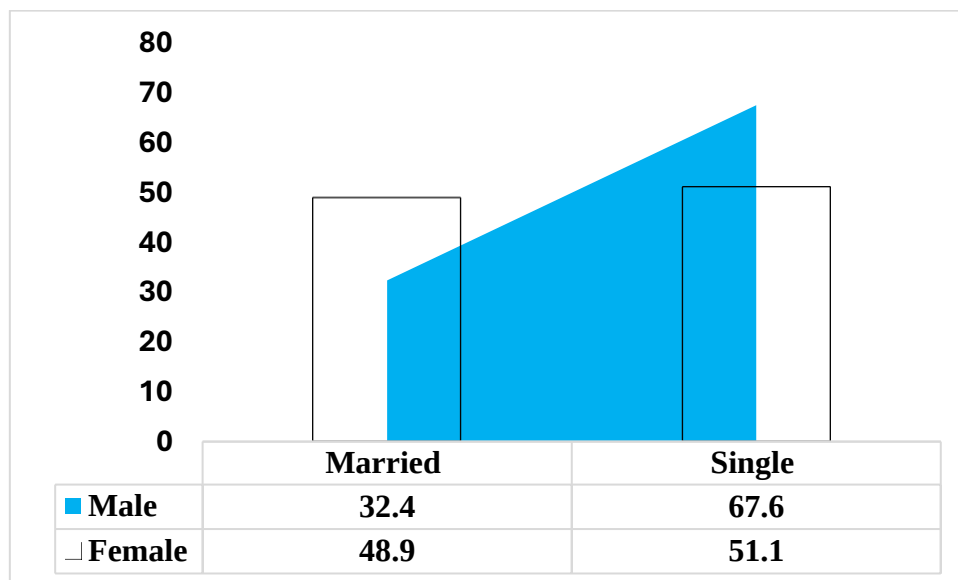


Fig. 5. & Table Bar graph for gender marital status

4. Conclusion

The SBP and DBP of married and single people were not identical, according to the BP cases conducted using a sample test. Humans can be SBP or DBP without becoming male or female. The ANOVA results demonstrated that socioeconomic status was not the foremost cause of BP in older years, but BP stage has an effect in older age. However, in ANCOVA BP stages, after controlling for the SBP was significant, but while controlling for the DBP, the BP had no significant effect in older patients. According to MANOVA findings, BP stages and treatment, while margining the SBP and DBP, were significant, revealing that all BP phases and treatment levels have the same combination of SBP and DBP readings. Discoveries from contingency and Phi coefficient demonstrated that there is no correlation between gender and BP phases, gender and economic level, and gender and marital status.

CRediT authorship contribution statement

Ilker Etikan, Muhammad Alhaji Dauda: Conceptualization. Dauda Habu Chiroma, Yahya Kodabu, Yohana Awai: Data curation. Kabiru Bala, Muhammad Sani Galadima: Formal Analysis. Kabiru Bala, Yohana Awai: Funding acquisition. Dauda Habu Chiroma, Muhammad Alhaji Dauda, Yahya Kodabu: Investigation. Muhammad Sani Galadima, Dauda Habu Chiroma: Methodology. Kabiru Bala, Yahya Kodabu, Yohana Awai: Project administration. Kabiru Bala, Yahya Kodabu: Resources. Kabiru Bala, Yohana Awai: Kabiru Bala, Yohana Awai: Software. Ilker Etikan, Kabiru Bala, Muhammad Alhaji Dauda: Supervision. Muhammad Sani Galadima, Kabiru Bala: Validation. Kabiru Bala, Yahya Kodabu, Dauda Habu Chiroma: Written original. Kabiru Bala, Ilker Etikan, Muhammad Sani Galadima, Muhammad Alhaji Dauda: Written review and editing

Ethics approval statement

The authors received an ethical approval letter.

Funding statement

No specific grant or funding was received by the authors.

Conflict of interest: No conflicts of interest

Acknowledgement: We would like to thank the management of Taraba State Specialist Hospital for providing us with data to achieve our objectives.

References

1. R. Malik *et al.*, "Relationship Between Blood Pressure and Incident Cardiovascular Disease: Linear and Nonlinear Mendelian Randomization Analyses," *Hypertension*, vol. 77, no. 6, pp. 2004–2013, Jun. 2021, doi: 10.1161/HYPERTENSIONAHA.120.16534.
2. M. Kulshreshtha and S. Chandel, "Mean arterial pressure may be a valuable tool for classifying blood pressure in physically actives: A cross-sectional study among females from North India," *Clin. Epidemiol. Glob. Health*, vol. 31, Jan. 2025, doi: 10.1016/j.cegh.2025.101912.
3. A. B. Sheikh *et al.*, "Blood Pressure Variability in Clinical Practice: Past, Present and the Future," *J. Am. Heart Assoc.*, vol. 12, no. 9, May 2023, doi: 10.1161/JAHA.122.029297.
4. R. Kreutz *et al.*, "2024 European Society of Hypertension clinical practice guidelines for the management of arterial hypertension," *Eur. J. Intern. Med.*, vol. 126, pp. 1–15, Aug. 2024, doi: 10.1016/j.ejim.2024.05.033.

5. K. Kario, A. Okura, S. Hoshide, and M. Mogi, "The WHO Global report 2023 on hypertension warning the emerging hypertension burden in globe and its treatment strategy," May 01, 2024, *Springer Nature*. doi: 10.1038/s41440-024-01622-w.
6. A. A. M. Hezam, H. B. M. Shaghdar, and L. Chen, "The connection between hypertension and diabetes and their role in heart and kidney disease development," Apr. 01, 2024, *Wolters Kluwer Medknow Publications*. doi: 10.4103/jrms.jrms_470_23.
7. M. Kanki *et al.*, "Poor sleep and shift work associate with increased blood pressure and inflammation in UK Biobank participants," *Nat. Commun.*, vol. 14, no. 1, Dec. 2023, doi: 10.1038/s41467-023-42758-6.
8. M. G. Schultz, K. D. Currie, and K. Hedman, "professionals who specialise in exercise testing and prescription, with goals to," 2025.
9. O. I. A. Nuraini, E. D. Prajayanti, and Sutarwi, "Application of Swedish Massage for Blood Pressure in Elderly Hypertension at Karanganyar Regional Hospital," *Jurnal Kegawatdaruratan Medis Indonesia*, vol. 2, no. 2, pp. 152–165, Aug. 2023, doi: 10.58545/jkmi.v2i2.174.
10. [10] A. E. Schutte, A. Kollias, and G. S. Stergiou, "Blood pressure and its variability: classic and novel measurement techniques," Oct. 01, 2022, *Nature Research*. doi: 10.1038/s41569-022-00690-0.
11. S. Min *et al.*, "Wearable blood pressure sensors for cardiovascular monitoring and machine learning algorithms for blood pressure estimation," Sep. 01, 2025, *Nature Research*. doi: 10.1038/s41569-025-01127-0.
12. L. J. Laffin *et al.*, "Rise in Blood Pressure Observed Among US Adults During the COVID-19 Pandemic," Jan. 18, 2022, *Lippincott Williams and Wilkins*. doi: 10.1161/CIRCULATIONAHA.121.057075.
13. M. Kulshreshtha and S. Chandel, "Mean arterial pressure may be a valuable tool for classifying blood pressure in physically actives: A cross-sectional study among females from North India," *Clin. Epidemiol. Glob. Health*, vol. 31, Jan. 2025, doi: 10.1016/j.cegh.2025.101912.
14. H. Kim *et al.*, "Blood pressure levels and risk of end-stage renal disease in patients with type 2 diabetes who underwent percutaneous coronary intervention: a nationwide population-based study," *Sci. Rep.*, vol. 15, no. 1, Dec. 2025, doi: 10.1038/s41598-025-91835-x.
15. P. K. Baffour, L. Jahangiry, S. Jain, A. Sen, and D. Aune, "Blood pressure, hypertension, and the risk of heart failure: a systematic review and meta-analysis of cohort studies," *Eur. J. Prev. Cardiol.*, vol. 31, no. 5, pp. 529–556, Mar. 2024, doi: 10.1093/eurjpc/zwad344.
16. B. Islam, T. I. Ibrahim, W. Tingting, M. Wu, and Q. Jiabi, "Current status of elevated blood pressure and hypertension among adolescents in Asia: a systematic review," 2025, *University of Edinburgh*. doi: 10.7189/JOGH.15.04115
17. R. I. Jalo *et al.*, "Gender disparities in hypertension prevalence, awareness and healthcare seeking behaviour among young adults in Nigeria," *BMC Cardiovasc. Disord.*, vol. 25, no. 1, Dec. 2025, doi: 10.1186/s12872-025-04603-0.
18. W. H. Organization, "Global report on hypertension: the race against a silent killer." [Online]. Available: <https://books.google.com.ng/books?hl=en&lr=&id=KaIOEQAAQBAJ&oi=fnd&pg=PR5&ots=AlgAeCOgKG&sig=zP5FxxKDdAQNMOWiXPcTUsvbBeE&...>

19. K. Miura *et al.*, “Four blood pressure indexes and the risk of stroke and myocardial infarction in japanese men and women a meta-analysis of 16 cohort studies,” *Circulation*, vol. 119, no. 14, pp. 1892–1898, Apr. 2009, doi: 10.1161/CIRCULATIONAHA.108.823112.
20. Z. Ren *et al.*, “Age and blood pressure stratified healthy vascular aging, organ damage and prognosis in the community-dwelling elderly: insights from the North Shanghai Study,” *Clin. Hypertens.*, vol. 30, no. 1, Dec. 2024, doi: 10.1186/s40885-024-00288-3.
21. C. Lawes, “Blood pressure indices and cardiovascular disease in the Asia Pacific region: A pooled analysis,” *Hypertension*, vol. 42, no. 1, pp. 69–75, Jul. 2003, doi: 10.1161/01.HYP.0000075083.04415.4B.
22. R. Inoue *et al.*, “Predicting stroke using 4 ambulatory blood pressure monitoring-derived blood pressure indices: The Ohasama study,” *Hypertension*, vol. 48, no. 5, pp. 877–882, Nov. 2006, doi: 10.1161/01.HYP.0000242285.83728.ee.