Review Article

Urology, Nephrology and Andrology International
Volume 8 Number 1, January - June 2023
DOI: http://dx.doi.org/10.21088/unai.2456-5016.8123.2

A Review of Blood Pressure Variations among General Population & those on Haemodialysis

Kiran V.T.[1], Lakshminarayana G.R.[2], Arya M.B.[3], V. Daniel[4]

How to cite this article:
Kiran V.T., Lakshminarayana G.R., Arya M.B., *et al*. A Review of Blood Pressure Variations among General Population & those on Haemodialysis. Uro, Nephro and Andro Int2023; 8 (1):15–24.

Abstract

Normal Blood Pressure (BP) is the key factor for sustaining a healthy life. BP variation is related to daily life including body position, breathing rhythm, stress level, physical condition etc. Hypertension as well as Hypotension will lead to many complications in the healthy life of the general as well as dialysis population. The prevalence of Hypertension in Urban communities is higher than that in Rural communities. Complications of uncontrolled hypertension will affect various organs in our body as an acute or chronic effect. Factors affecting Hypertension in the dialysis population slightly differ from the general populationdue to renal failure. It is certainthat preventive measures or controlling measures of BP variation are only possible when we can understand the normal physiology of BP as well as the factors which affect BP maintenance in our body. This paper will help you to understand various aspects of BP variation in general as well as the dialysis population.

Keywords: Haemodialysis; Dialysis Water; BP; Kidney Disease.

INTRODUCTION

Blood pressure is the key indicator of how well our circulatory system is functioning. BP should not be so high or low to maintain the normal well-being of our body. Sufficient BP helps to distribute sufficient oxygen and nutrients all over our body and elimination of waste products efficiently from different parts of the body. BP maintenance in our body by different mechanisms and any alterations in the mechanism will lead to an inappropriate level of BP in our body. Our body will control our BP in different ways like short-term control of BP by the autonomous nervous system, long-term control by rennin angiotensin aldosterone system (RAAS), antidiuretic hormone, Atrial natriuretic peptide (ANP) and prostaglandins. The organ systems such as circulatory system, urinary system & nervous system (especially the autonomous nervoussystem) are closely related to BP regulations and the other main biological product present in the human body which involves

***Author Affiliation*:** [1]Assistant Professor, [3,4]Lecturer, Department Health Seciences, The Apollo University, Chittoor 517127, Andhra Pradesh, India, [2]Consultant Nephrologist, Department of Nephrology, EMS Memorial Co-operative Hospital and Research Centre, Perinthalmanna, Malappuram 679322, Kerala, India.

Corresponding Author: **Lakshminarayana G.R.**, Consultant Nephrologist, Department of Nephrology, EMS Memorial Co-operative Hospital and Research Centre, Perinthalmanna, Malappuram 679322, Kerala, India.

E-mail: drlng23@gmail.com

Received on: 30.06.2023 **Accepted on:** 15.06.2023

in the regulation of BP is angiotensin converting enzyme & bradykinin.[1]

Some factors in our daily life will lead to BP variation. BP varies through out the day depending on body position, breathing rhythm, stress level, physical condition, medication in take, what we eat and drink, and time of the day. Depending on body position, there are slightly higher diastolic and systolic pressure values when we measure the sitting position than the supine position.[2] Slow breathing exercises can reduce BP in a short period.[3] These both havea relationship between Low BP and anxiety.[4] Work-related stress is having a role in increasing BP.[5] When you are exercising the BP will increase and when you stop it will come back to normal and the time taken to get back your Blood pressure to normal will tell you whether you are healthy or not. In healthy people, it will come back to normal soon.[6]

Studies define normal BP as 120-139 mm Hg systolic systoli cand 75-84 mm Hg diastolic. Blood pressure <120/75 mm Hg is hypotensive and >140/85 is hypertensive and it is applicable in the normal community as well as the Dialysis community.[8] Instructions and steps needed for optimal BP measurement are shown in Fig. 1.

Role of Medicines in BP Variations

Medications that we are taking have a role in the BP variations. Pain medications and anti-inflammatory medicines like Indomethacin, acetaminophen, aspirin, naproxen sodium, ibuprofen, piroxicam etc. will cause you to retain water or damage your kidney and increase your BP. Antidepressants like venlafaxine, monoamine oxidase inhibitors, tricyclic antidepressants, try cyclic antide pressants, fluoxetine etc. will increase your BP. Birth control pills or birth control devices made of hormones will increase BP by narrowing of blood vessels and the risk is higher if your age is >35 yrs. Intake of caffeine-containing medicines and products will cause a temporary increase in BP. Cold medicines which contain decongestants like pseudoephedrine & phenylephrine will increase BP. Herbal supplements like Amica, Bitter orange, Ephedra, Ginseng, Guarana, Licorice, and Hypericum Perforatum can raise your BP or interact with BP medications to affect its efficiency. Some powerful drugs like Bevacizumab, Gefitinib, Imatinib, Pazopanib, Ramucirumab etc. ere used to treat autoimmune disorders and cancer can also cause hypertension. Immunosuppressants like cyclosporine and Tacrolimus can also cause

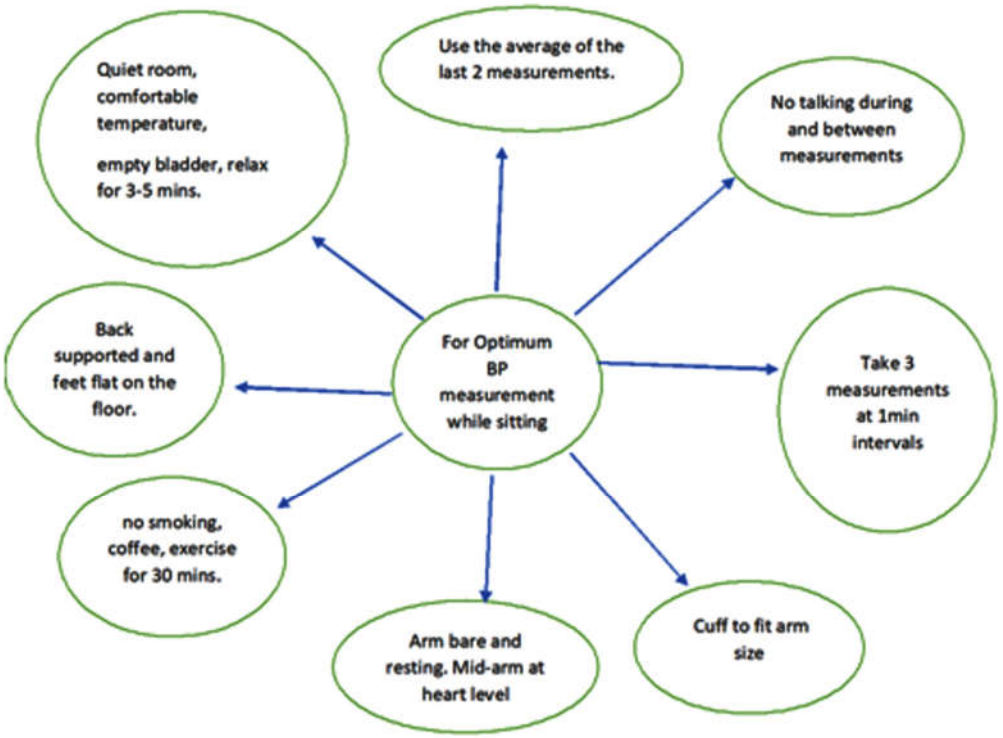

Fig. 1: Steps for optimum BP measurement (Sitting Posture)

hypertension. Stimulants like methylphenidate and some illegal drugs like Amphetamines, Anabolic steroids, and Cocaine can also lead to an increase in BP.[7]

Role of Time in BP Variations

BP variations according to the time are mainly lowering of BP at nighttime and increasing the BP by morning. Blood pressure will start to increase a few hours before you wake up and continue to rise in the day time. The peak level by the middle of the afternoon and late afternoon and evening starts to decrease. Health problems like Kidney disease, Thyroid diseases, Diabetics, Obstructive sleep apnea, Neurological problems and cardiovascular diseases can cause an abnormal BP pattern like high BP at night time. Factors which can lead to abnormal BP patterns include Night shift work, Tobacco use, Anxiety, too much stress, and taking BP medications that do not last for 24 hours. [8,9,10]

Role of Diet in BP Variation

There is a close relationship between dietary cations and BP variation. A higher intake of sodium will increase BP and a higher intake of calcium and magnesium will decrease BP.[11] BP will increase at a high rate with a high in take of sodium in a low energy in take diet than with a high-energy intake diet.[12] Dairy products and dietary calcium have significant relation with low systolic BP. Peptides of dairy products help to reduce BP especially systolic BP.[13] There is a higher chance of increased BP in non-vegetarians than in vegetarians. It is assumed that some nutrient of nutrients eaten in greater amounts in vegetarian food than in non-vegetarian food will help to reduce BP. Some studies argue against the role of animal products or their associated saturated fatty acids or proteins in hypertension. Polyunsaturated fatty acids present in the food have no significant relation with variation in BP.[14] Ordinary nitrate-rich food is associated with a significant decrease in diastolic pressure.[15] Intake of polyphenol-rich dark chocolate along with a normal diet can lead to a significant reduction in BP and also improve the formation of vasodilative nitric oxide.[16]

Role of Alcohol in BP Variation

Alcohol consumption is having an impact on BP. Binge drinking patterns can have a disadvantageous effect on BP but no such disadvantageous fluctuations in BP may see in regular consumption patterns. There can be a higher BP level the day after a high consumption of alcohol compared to a day after a lower consumption of alcohol. It may take several days to come back the BP to the usual level after an episode of higher alcohol consumption[17] Annual alcohol in take and drinking frequency is having a strong impact on BP. Different alcoholic beverages can have similar effects on BP.[18] Red wine polyphenolics will not reduce the effect of alcohol on Blood pressure.[19]

Role of Non-Alcoholic Beverages on BP Variations

There can be an acute increase in systolic BP due to the exposure of 'Bisphenol A'(BPA) which is present in canned beverages. BPA is a chemical which is used in plastic bottles and the inner coating of beverage canes. BPA can cause hypertension as well as decreased heart rate.[20] Sugar-sweetened soft drink consumption also can cause an acute increase in BP.[21] Consumption of commercially available multi-component energy drinks which contains caffeine will cause an acute increase in blood but a high dose of component like taurine can cause an acute decrease in BP.[22] Reduced consumption of sugar sweetened beverages is significantly associated with reduced BP.[23] Energy Beverages like "Red Bull" can increase systolic BP of 10mmHg and heart rate of 5-6 beats/min.[24]

Hypotension and the Causes

Conditions that can cause low BP than normal (hypotension) are pregnancy, heart problems, endocrine problems, dehydration, blood loss, severe infection, severe allergic reaction, and lack of nutrients in your diet. In pregnancy lowering of BP is due to the rapid extremely low heart rate, heart valve problems, heart attack and heart failure can lead to hypotension. Endocrine problems like Parathyroid disease, Adrenal insufficiency (Addison's disease), Low blood sugar (Hypoglycaemia), and even diabetics can trigger hypotension. Problems like fever, vomiting, severe diarrhoea, overuse of diuretics and strenuous exercise can lead to hypotension due to dehydration. Losing blood severely using any internal injury or external injury will reduce the amount of blood in your vascular system and which leads to hypotension. Severe infection can lead to increased inflammatory mediators in blood which can lead to vasodilatation and hypotension. Lack of nutrients like vitamin B12, Folate, Iron can lead to poor production of Red blood cells and which can lead to Hypotension.[25]

The Hypertension:"The Silent Killer"

The increased BP than normal (hypertension) can be divided into primary and secondary based on causes. Primary hypertension does not have clear causes and it is believed to be linked to genetics, poor diet, lack of exercise and obesity. Secondary hypertension can be due to the conditions that affect your kidneys, arteries, heart or endocrine system and also can be due to pregnancy.[26]

Importance of Hypertension Management

Avoiding or management of elevated BP is helpful to avoid diseases which affect especially heart, brain, Kidneys and other organs. It is believed that 1.13 billion people suffer from hypertension. In 2015 1 in 4 men and 1 in 5 women had hypertension as per the world health organization (WHO). Hypertension is one of the major causes of early death worldwide.[27] A study in Nigeria concluded that uncontrolled hypertension is a risk factor for Stroke, Heart failure, ischemic heart disease and chronic kidney disease.[28]

Risk Factors for Hypertension

Risk factors can be divided into modifiable and non-modifiable factors.

Unhealthy dietary patterns (high salt, high saturated and trans fats, poor consumption of fruits and vegetables), Physical activity, use of tobacco and alcohol and being overweight or obese are considered modifiable risk factors.[29]

Family history of hypertension, age (>65 years), and coexisting diseases like diabetes or kidney disease are considered non-modifiable factors.[30]

Symptoms of Hypertension

Most of the time it is not having warning signs or symptoms and it is called a "Silent killer". Symptoms can include early morning headaches, nose bleeds, variation in heart rhythms, visual disturbances, Buzzing in earsand severe hypertension it can be fatigue, nausea, vomiting, confusion, anxiety, chest pain and muscle tremors.[27]

Complications of Uncontrolled Hypertension.

Uncontrolled hypertension can lead to serious damage to the heart by making the arteries harden and leading to a poor supply of oxygen and blood to the heart muscles leads angina, heart attack, Heart failure, irregular heartbeat and death. It will be so hard for the heart to pump against the increased pressure in the vessels which can lead to the thickening of the walls of the ventricle known as left ventricular hypertrophy (LVH). This LVH will lead to a decrease in the efficiency of the pumping of the heart and cause heart failure. Hypertension can cause weakened and narrowed blood vessels in your kidney and will affect the normal functioning of the kidney. Hypertension can lead to vision loss by narrowing, thickening or toning of blood vessels in the eyes. Hypertension will lead to metabolic syndrome which will increase the incidence of heart disease, diabetes and stroke. Hypertension will also develop memory problems and difficulty in understanding. Increased BP can make weaken your blood vessels and lead to bulging known as Aneurysm. Rupturing of Aneurysm is fatal. Uncontrolled hypertension can burst, block or narrow the arteries which supply blood and oxygen to the brain leading to stroke and vascular dementia.[31]

Prevalence of Hypertension in India

According to the meta-analysis done by Raghupathy Anchala from the year 1950 to 2013, 33% of urban people and 25% of rural people in India are Hypertensive, of these 25% of rural and 42% of urban Indians are aware of their hypertensive condition. In the case of treatment, only 25% of the rural Indians and 42% of the urban people are getting treatment. 1 in 10 of the rural and 1 in 5th of the urban population have their hypertension in control.[32]

Factors causing the high prevalence of Hypertension among the Urban community in India.

In a typical developing country, the high prevalence of hypertension among the urban population is the consequence of changes in lifestyle patterns, diet and stress, increased population and reduced job opportunities.[33] Family history of hypertension, Body mass index (BMI) is more than or equal to 25 Kg/m2 and high waist-hip ratio (WHR) is found to be the most important risk factor for hypertension among Urban communities in India.[34]

Hypertension in Haemodialysis(HD) Population around the Globe

Hypertension is most common in people on maintenance Haemodialysis and it is always difficult to control. As per Kidney dialysis outcome quality initiatives guidelines (KDOQI) hypertension in the dialysis community can be considered as a

pre-dialysis BP of >140/90 mmHg or when post-dialysis BP >130/80 mmHg.[35]

Factors Causing Hypertension in the Dialysis Population

The factors which can consider a role in hypertension in this group of people are sodium and fluid over load in their body, increased arterial stiffness, Activation of the sympathetic nervous system, activation of the rennin-angiotensin-aldosterone system, the imbalance between endothelium derived vasodilators and vasoconstrictors, high incidence of sleep apnea, Use of recombinant erythropoietin. An increase in cardiac output, peripheral vascular resistance or both can cause sustained elevation of BP in the dialysis community and the prominent pathogenic mechanism of BP variation depends on sodium level and excess fluid in the body.[36]

Hypertension Management in HD Population

Non-pharmacologic methods focusing on sodium and volume excess are most useful in controlling hypertension in this community but when it is not controlled by this method, the use of antihypertensive medication is recommended.[36]

Hypertension Pattern in the HD Community

Intradialytic hypertension is a rise of more than or equal to 10mmHg in systolic BP from pre- to post-dialysis in at least 4 to 6 consecutive dialysis sessions. Approximately 10 to 20% of the dialysis treatments show intradialytic hypertension and the causes were unknown.[37] As per the literature, the interdialytic ambulatory systolic BP should be <130mmHg and the average home systolic BP to be <140mmHg.[38]

Blood Pressure Variations in the HD Community based on Climate Change

People on maintenance HD seem to have a lower BP in summer and higher in winter.[39]

The Optimum BP to be Maintained in a Dialysis Community

There are no strict guidelines for BP maintenance in the dialysis community and it vary from person to person. According to National Kidney Foundation Kidney Disease Outcome Quality Initiative guidelines (NKF KDOQI) (2005), the target BP for predialysis can be <140/90 mmHg and post dialysis BP can be <130/80 mmHg.[40]

Epidemiology of BP Variations in the Dialysis Community

A study conducted in Mississippi among 649 People on maintenance HD (HD) showed that age was the only significant factor related to the lowering of BP other than race, time on dialysis, aetiology of End Stage Renal Disease (ESRD), adequacy of dialysis and several excess volume parameters. They found that people aged > 65 years had lowered BP compared to other age groups and there was no significant difference in the effect of Angiotensin-Converting Enzyme Inhibitors (ACE), Calcium Channel Blockers (CCB), Sympotholitics (Symp), and Vasodilators (Vaso) on hypertension management in Hemodialysis population.[41]

Zorica Kauric-Klein also showed in her study that the choice of antihypertensived id not influence BP response and the excessive ideal weight gain affected increased diastolic BP among the HD community.[42] It is a known fact that the control of BP will help to avoid left ventricular hypertrophy, cardiovascular morbidity and mortality in the HD community as well as the general community.[43] Most of the studies reveal that systemic hypertension can cause the progression of atherosclerosis, left ventricular hypertrophy, left ventricular dilatation, heart failure and death.[44,45,46]

Short-term BP variation in the HD community can be due to the factors like age, pre-dialysis BP, anti-hypertensive drugs, dialysis duration, vascular access, ultrafiltration volume and serum albumin. Pre-HD Systolic BP is considered the decision-making parameter for the management of hypertension as well as a modifiable risk factor for death and cardiovascular outcomes in the HD community.[47,48] The literature says that the variability of systolic BP is a strong and independent predictor for all causes of mortality in the HD community[49,50] Factors like the white-coat effect, fear of needling, fluctuations in volume status, and anxiety to start or closing HD can make an in accurate pre-HD or post-HD BP reading.[51] Factor like increased arterial stiffness responsible for hypertension is more frequently occurring in the HD community mainly due to the imbalance in calcium and phosphorous metabolism followed by calcification of the vessels.[52]

Intradialytic Hypotension

Intradialytic hypotension is one of the main complications faced by the HD community. It can create uncomfortable symptoms during HD and leads to less efficient HD session. It can also lead

to vascular access failure especially internal access by clotting and can also lead to cardiovascular morbidity and mortality. An adequate HD prescription, optimum dietary and dialysate sodium, ultrafiltration profiling, avoidance of acetate and cooling of dialysate may be useful to avoid intradialytic hypotension.[53,54] Intradialytic hypotension is defined as a drop in systolic pressure greater than or equal to 20mmHg or mean arterial pressure of greater than or equal to 10mmHg, presence of end-organ ischemia and the need for an intervention to increase BP and improve the symptoms of hypotension.[55]

Variations in BP and Mortality Rate in the HD Community

As per the recent literature people on maintenance, HD had a pre-dialysis systolic BP of <110 mmHg and a higher systolic BP of 150-159 mmHg showed high mortality.[56,57,58] It is well known that the presence of hypertension is directly proportional to cardiovascular morbidity and mortality, but the higher life span of the hypertensive dialysis population is noted in so many studies especially people aged >65 years with congestive heart failure or coronary artery disease. [59,60,61]

CONCLUSION

It is concluded that BP variation can be due to many factors which we are not even considering in our daily life. BP variations in general and the dialysis community need special consideration because they can make an impact on their quality of life and long survival. The impact of usual daily activity as well as the factors by our lifestyle related to BP variation and related health issues. Further studies are needed to find out more factors which will affect BP is needed to avoid upcoming health issues in our community.

Disclosure

The authors declare no conflicts of interest about the content and the publication of this paper.

ACKNOWLEDGEMENT

The authors are grateful to Dr Praveen Hoogar (Research Coordinator, The Apollo University) and The Apollo University, Chittoor, Andhra Pradesh for the support.

REFERENCES

1. https:// teachmephysiology.com /cardiovascular-system/circulation/control-blood-pressure/#:~:text=Short%2 Dterm%20 regulation %20 of%20blood %20 pressure%20 is %20 controlled%20 by%20the,blood%20vessel%2C%20 triggering%20the%20baroreceptors.,Accessedon16/10/20201.44pm.
2. Lacruz,M.E.,Kluttig,A.,Kuss,O.,Tiller,D.,Medenwald,D.,Nuding,S.,Greiser,K.H.,Frantz,S.,&Haerting,J. (2017).Short-termBPvariability–variationbetweenarmside,bodyposition and successive measurements: a population-basedcohortstudy. BMCCardiovascularDisorders,1–9.https://doi.org/10.1186/s12872-017-0468-7.
3. Anderson,D.E.,Mcneely,J.D.,&Windham,B.G.(2010).RegularslowbreathingexerciseaffectsBPandbreathingpatternsatrest.Journal of Human Hypertension, 807–813. https://doi.org/10.1038/jhh.2010.18.
4. Hildrum, B., Mykletun, A., Stordal, E., Bjell and, I.,Dahl, A. A., & Holmen, J. (2007). Association of lowBP with anxiety and depression : theNord-Trøndelag Health Study. 53–58. https://doi.org/10.1136/jech.2005.044966.
5. Mucci, N., Giorgi, G., Ceratti, S. D. P., Fiz-pérez, J.,Mucci, F., & Arcangeli, G. (2016). Anxiety, Stress-Related Factors, and BP in YoungAdults. 7 (October), 1–10. https://doi.org/10.3389/fpsyg.2016.01682.
6. https://www.healthline.com/health/blood-pressure-after-exerciseAccessedon3/11/2020 at 9.0 pm.
7. https://www.mayoclinic.org/diseases-conditions/ high-blood-pressure/ in-depth/blood-pressure/art-20045245Accessedon3/11/2020at 9.25pm.
8. Parati,G.,&Staessen,J.A.(2007).Day–nightBP variations: mechanisms, reproducibilityandclinical relevance.2377–2380.
9. Verdecchia,P.,Angeli,F.,Mazzotta, G., Garofoli,M., Ramundo, E., Gentile, G., Ambrosio, G., Reboldi,G., & Commentary, S. E. (2012). Ambulatory BPMonitoringDay-NightDipandEarly-MorningSurgeinBPPrognosticImplications.34–42.https://doi.org/10.1161/Hypertensionaha.112.191858.
10. https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/expert-answers/blood-pressure/faq-20058115Accessedon3/11/2020at11pm.
11. Kesteloot, H., & Joossens, J. V. (2015). Relationshipof DietarySodium,Potassium,Calcium,andMagnesiumwithBP.
12. Murtaugh,M.A.,Beasley,J.M.,Appel,L.J.,Guenther,P.M.,Mcfadden,M.,Greene,T.,&Tooze,J

.A.(2018).OriginalArticle.https://doi.org/10.1161/Hypertensionaha.117.10602.

13. Ruidavets, J., Bongard, V., Simon, C., Arveiler, D.,Amouyel, P., Ducimetie, P., Bingham, A., & Ferrie, J.(1996). Independent contribution of dairy productsandcalciumintaketoBPvariationsatapopulation level.671–681.

14. Kass,H.(2018).foodsandnutrients13invegetarians:effectsofspecific.March.

15. Sobko,T.,Marcus,C.,Govoni,M.,&Kamiya,S.(2010). NitricOxideDietarynitrateinJapanesetraditional foodslowers diastolic BPin healthy volunteers. Nitric Oxide, 22(2), 136–140.https://doi.org/10.1016/j.niox.2009.10.007.

16. Nitric,B.(2007).Chapter9–Heartand Blood Vessels / 213 Context .— Observational studies linkregular intake of cocoa-containing foods to lowercardiovascularmortality. Short-terminterventionsof at most 2 weeks indicate that high doses of cocoacanimprove(pp.213–215).

17. France, R., Ireland, N., Marques-vidal, P., Arveiler,D.,Evans,A.,Amouyel,P.,Ferrières,J.,&Ducimetière, P. (2001). Different Alcohol DrinkingandBPThe PrimeStudy.

18. Pajak, A., Szafraniec, K., Kubinova, R., Malyutina,S.,Peasey,A.,Pikhart,H., Nikitin, Y., Marmot,M., & Bobak, M. (2013). Binge Drinking and BP:Cross-SectionalResultsoftheHapieeStudy.8(6).https://doi.org/10.1371/journal.pone.0065856.

19. Zilkens, R. R., Burke, V., Hodgson, J. M., Barden,A., Beilin, L. J., &Puddey, I. B. (2005). Red Wineand Beer Elevate BP in NormotensiveMen.874–879.https://doi.org/10.1161/01.HYP.0000164639.83623.76.

20. Beverages,C.,&Blood,I.(2014).CannedBeverages andBPExposuretoBisphenolA FromDrinking CannedBeveragesIncreasesBP.313–319.https://doi.org/10.1161/Hypertensionaha.114.04261.

21. He,F.J.,&Macgregor,G.A. (2014). Salt andsugar: their effects on BP. https://doi.org/10.1007/s00424-014-1677-x.

22. Steinke,L.,Lanfear,D.E.,Dhanapal,V.,&Kalus, J. S. (2014). Effect of " Energy Drink "Consumptionon HemodynamicandElectrocardiographicParameters in Healthy Young Adults. 43, 596–602.https://doi.org/10.1345/aph.1L614.

23. Chen, L., Caballero, B., Mitchell, D. C., Loria,C.,Lin,P.,Champagne,M.,Elmer,P.J.,Ard,J.D.,Batch,B.C.,Anderson,C.A.M., & Appel,L.J.(2013). ReducingConsumptionofSugar-Sweetened Beverages Is. https://doi.org/10.1161/Circulationaha.109.911164.

24. Higgins, J. P., Ms, T. D. T., Higgins, C. L., &Exsc, B.(2010). Energy Beverages: Content and Safety. MayoClinic Proceedings, 85(11), 1033–1041. https://doi.org/10.4065/mcp.2010.0381.

25. https://www.mayoclinic.org/diseases-conditions/low-blood-pressure/diagnosis-treatment/drc-20355470Accessedon22/10/20202.40pm.

26. https://www. mayoclinic.org/ diseases-conditions/secondary - hypertension/symptoms-causes/syc- 20350679#:~:text=Secondary%20hypertension%20differs%20from%20thelack%20of%20 exercise %20 and %20 obesity. Accessed on23/10/202010.30am.

27. https://www.who.int/news-room/fact-sheets/detail/hypertension#:~:text=What%20are%20the%20 risk %20 factors, and %20 being %20 overweight %20or%20obese.Accessedon13/02/2021,1:28pm.

28. Ogah,O.S.,Okpechi,I.,Chukwuonye,I.I.,Akinyemi, J. O., Onwubere, B. J., Falase, A. O., ...& Sliwa, K. (2012). BP, the prevalenceofhypertensionandhypertensionrelatedcomplicationsinNigerianAfricans:Areview.WorldJournalofCardiology,4(12),327.

29. Boehme, A. K., Esenwa, C., & Elkind, M. S. (2017). StrokeRiskFactors,Genetics,andPrevention. Circulation Research, 120(3), 472–495. https://doi.org/10.1161/CIRCRESAHA.116.308398.

30. Loh, K. W., Rani, F., Chan, T. C., Loh, H. Y., Ng, C.W., & Moy, F. M. (2013). The association betweenrisk factors and hypertension in Perak, Malaysia.MedJMalaysia,68(4),291-6.

31. https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/symptoms-causes/syc-20373410#:~:text=Uncontrolled%20high%20blood%20pressure%20can,attack %2C%20stroke %20 or %20 other %20 complications. Accessedon14/02/2021at10:50pm.

32. Anchala,R.,Kannuri,N. K., Pant,H.,Khan, H.,Franco, O.H.,DiAngelantonio,E.,&Prabhakaran, D.(2014). HypertensioninIndia:asystematicreviewandmeta-analysisofhypertensionprevalence,awareness, and control. Journal of hypertension,32(6),1170–1177. https://doi.org/10.1097/HJH.0000000000000146.

33. Das, S. K., Sanyal, K., & Basu, A. (2005). Study ofan urban population survey in India: the growingtrendof the high prevalence of hypertension inadevelopingcountry.Internationaljournalofmedicalsciences, 2(2),70.

34. Ismail, I. M., Kulkarni, A. G., Meundi, A. D.,&Amruth,M.(2016).Apopulation-basedcomparativestudyofprevalenceandriskfactorsofhypertension among urban and rural populations ina coastal town of South India. Sifa Medical Journal,3(2), 41.

35. KidneyDiseaseOutcomesQualityInitiative. (2004).K/DOQIclinicalpracticeguidelinesonhypertensionandantihypertensiveagentsinchronic kidney disease. Am J Kidney Dis., 43(5), S1-S290.

36. Sarafidis,P.A., Persu, A., Agarwal, R., Burnier,M., DeLeeuw,P.,Ferro,C.J.,...& Zoccali, C.(2017).Hypertensionindialysispatients:aconsensus document by

the European Renal andCardiovascularMedicine(EURECA-m)workinggroup of the European Renal Association–EuropeanDialysis and Transplant Association (ERA-EDTA)andtheHypertensionandtheKidneyworkinggroupoftheEuropeanSocietyofHypertension(ESH).NephrologyDialysisTransplantation,32(4),620-640.

37. Georgianos,P.I.,&Agarwal,R.(2018).Meetthe Twins: Intradialytic and Interdialytic Hypertension.AmericanJournalofNephrology,48(4),292-295.

38. AgarwalR.(2011).Interdialytichypertension-anupdate. Advances in chronic kidney disease, 18(1),11–16.https://doi.org/10.1053/j.ackd.2010.10.001.

39. Agarwal,R.,Flynn,J.,Pogue,V.,Rahman, M.,Reisin, E., & Weir, M. R. (2014). Assessment andmanagement of hypertension in patients on dialysis.Journalofthe AmericanSocietyofNephrology,25(8),1630-1646.

40. Workgroup, K. D. (2005). K/DOQI clinical practice guidelinesforcardiovasculardiseaseindialysispatients.AmJ KidneyDis,45,S1-S153.

41. Salem,M.M.(1995).Hypertensioninthehemodialysis population: a survey of 649 patients.AmericanJournalofkidneydiseases,26(3),461-468.

42. Kauric-Klein,Z.(2013).FactorsAffectingBP Control in Hemodialysis. J hypertens, 2(2),113.

43. Agarwal, R., & Sinha, A. D. (2009). Cardiovascularprotection with antihypertensive drugs in dialysispatients:systematicreviewandmeta-analysis.Hypertension,53(5),860-866.

44. Agarwal, R., Nissenson, A. R., Batlle, D., Coyne, D.W., Trout, J. R., & Warnock, D. G. (2003). Prevalence,treatment, and control of hypertension in chronichemodialysispatientsintheUnitedStates. TheAmericanJournalofMedicine,115(4),291-297.

45. Takeda, A., Toda, T., Fujii, T., Shinohara, S., Sasaki,S.,&Matsui,N. (2005). Discordance of influenceof hypertension on mortality and cardiovascularrisk in hemodialysis patients. American Journal ofkidneydiseases,45(1),112-118.

46. Ram, C. V. S., & Fenves, A. Z. (2009). Managementof hypertension in hemodialysis patients. Currenthypertensionreports11(4),292-298.

47. Liao, R., Li, J., Xiong, Y., Lin, L., Wang, L., Sun, S.,&Su,B.(2018).AssociationofpredialysisBPanditsvariabilitywithcardiovascularevents in hemodialysis patients. Kidney and BPResearch,43(4),1352-1362.

48. Shafi,T.,Sozio,S.M.,Bandeen-Roche,K.J.,Ephraim, P.L.,Luly,J. R.,Peter,W. L.S.,...&Boulware,L.E. (2014). Predialysis systolic BP variability andoutcomes in hemodialysis patients. Journal of theAmericanSocietyofNephrology,25(4),799-809.

49. Selvarajah, V., Pasea, L., Ojha, S., Wilkinson, I. B., &Tomlinson,L.A.(2014).Pre-dialysissystolicBPvariabilityisindependentlyassociatedwith all-cause mortality in incident haemodialysispatients. PloSone, 9(1),e86514.

50. Mazzuchi,N., Carbonell, E., &Fernández-Cean, J. (2000). Importance of BP control inhemodialysis patient survival. Kidney International,58(5),2147-2154.

51. Rohrscheib,M.R.,Myers,O.B.,Servilla,K.S.,Adams,C.D., Miskulin,D.,Bedrick,E.J.,...& Zager, P.G.(2008). Age-relatedBPpatterns and BP variability among hemodialysispatients.ClinicalJournaloftheAmericanSocietyofNephrology,3(5),1407-1414.

52. I Georgianos, P., A Sarafidis, P., & N Lasaridis, A.(2015). Arterial stiffness: a novel cardiovascular riskfactor in kidney disease patients. Current vascularpharmacology,13(2), 229-238.

53. Leung, K. C.,Quinn, R.R.,Ravani,P., &MacRae, J. M. (2014). Ultrafiltration bio feedback guided bybloodvolumemonitoringtoreduceintradialytichypotensiveepisodesinhemodialysis:studyprotocolforarandomizedcontrolledtrial.Trials,15,483.https://doi.org/10.1186/1745-6215-15-483.

54. Chou,J.A.,Kalantar-Zadeh,K.,&Mathew,A.T.(2017). A brief review of intradialytic hypotensionwith a focus on survival. Seminars in dialysis, 30(6),473–480.https://doi.org/10.1111/sdi.12627.

55. Stern,A.,Sachdeva,S.,Kapoor,R.,Singh,J.,&Sachdeva, S. (2014). High BP in dialysispatients:Cause,pathophysiology,influenceonmorbidity, mortality and management. Journal ofclinicalanddiagnosticresearch:JCDR,8(6),ME01.

56. Zager,P.G.,Nikolic,J.,Brown,R.H.,Campbell, M.A., Hunt,W.C.,Peterson,D.,...&Teredesai, P. (1998). "U" curve association of BPandmortalityinhemodialysis patients.KidneyInternational,54(2),561-569.

57. Port, F. K., Hulbert-Shearon, T. E., Wolfe, R. A.,Bloembergen,W.E.,Golper,T.A.,Agodoa, L.Y.,&Young, E. W. (1999). Predialysis BP andmortality risk in a national sample of maintenancehemodialysis patients. American Journal of kidneydiseases,33(3),507-517.

58. Lewington, S., Clarke, R., Qizilbash, N., Peto, R., &Collins, R. (2003). Age-specific relevance of usualBP to vascular mortality. The Lancet,361(9366),1391-1392.

59. Udayaraj, U. P., Steenkamp, R., Caskey, F. J., Rogers,C., Nitsch, D., Ansell, D., & Tomson, C. R. (2009).BP and mortality risk on peritonealdialysis. American Journal of kidney diseases, 53(1),70-78.

60. Chien, C. C., Yen, C. S., Wang, J. J., Chen, H. A.,Chou,M.T., Chu, C. C., Chio, C. C., Hwang, J.C., Wang, H. Y., Lu, Y. H., & Kan, W. C. (2012).Reverse epidemiologyofhypertension-mortalityassociations inhemodialysispatients:along-termpopulation-basedstudy. American JournalofHypertension,25(8),900–906.https://doi.org/10.1038/

ajh.2012.60

61. Chaudhary A, Kumari V, Neetu N. Sleep promoting among critically ill patients: earplugs/ eyemaskversus ocean sound—a randomized controlled trialstudy. Critical Care Research and Practice. 2020 Dec23;2020.