Galore International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Vol. 10; Issue: 4; Oct.-Dec. 2025
Website: www.gijhsr.com
Review Article *P-ISSN: 2456-9321*

Association of Hemoglobin and Blood Pressure: Systematic Review

La Ode Alifariki

Department of Nursing, Faculty of Medicine, Halu Oleo University, Kendari, Indonesia

Corresponding Author: La Ode Alifariki

DOI: https://doi.org/10.52403/gijhsr.20250414

ABSTRACT

Blood pressure is one of the parameters for disturbances in the cardiovascular system. There is scientific evidence that Haemoglobin can affect blood pressure, but the results appear inconsistent from several studies that have analyzed this relationship. This study aims to evaluate the relationship between haemoglobin and blood pressure in several relevant studies. This study complies with the 2020 version of Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. The literature search used four reputable databases: PubMed, ScienceDirect, Wiley Online Library, and ProQuest. Two authors independently screened, extracted, and assessed study quality using the JBI critical appraisal tool. In the initial search of the entire database, there were 21,665 studies. Eleven articles were declared eligible, and extraction was carried out. Based on the extraction and descriptive analysis results, a strong relationship was found between Haemoglobin and blood pressure in healthy people and co morbidities. The greatest significant relationship was found in SBP. Haemoglobin should be a predictor of cardiovascular disorders based on the significance of its relationship with blood pressure.

***Keywords*:** Haemoglobin, Systolic Pressure, Diastolic Pressure, Hypertension

INTRODUCTION

Blood pressure is one of the vital signs which is a predictor of disturbances in the cardiovascular system. It has been reported that 54% of the stroke cases and47% of the ischemic heart disease cases could be attributed to a high blood pressure (Olsen et al. 2016). Mild changes in blood pressure of about 2–3 mm Hg can lead to fatal adverse events (Bangalore et al. 2017). Blood pressure consists of systolic blood pressure and diastolic blood pressure (Siagian and Tukatman 2021; Sudayasa et al. 2020). Systolic blood pressure occurs due to contractions of the heart muscle. At the same time, DBP arises due to the condition of the heart that returns to its original shape after carrying out contractions(Dieterle 2012). Based on guidelines from the American Heart Association, the normal range for SBP is 120 mmHg and 80 mmHg for DBP for adults. The increase in both pressures is known as Hypertension, and then the increase is classified into four categories, including elevated, stage 1, stage 2, and crisis Hypertension (Flack and Adekola 2020; James et al. 2014).

Haemoglobin, a protein contained in red blood cells, is vital for human life because of its important function of binding oxygen and carbon dioxide throughout the body's cells(Rizvi et al. 2017). The number of red blood cells certainly has a major influence on haemoglobin levels in the blood, even though the reverse is not the case, where low haemoglobin levels cannot ensure that

red blood cells are also low or decreasing(Paone et al. 2014).

Some studies have shown that haemoglobin levels are associated with Hypertension. Systolic and diastolic BP may increase by rising haemoglobin. High haemoglobin can cause blood vessels contraction, and then increases blood pressure. However, some other studies have reported that BP is not associated with blood viscosity in healthy individuals(Atsma et al. 2012; Kawamoto et al. 2012; Mukkamala and Hahn 2017). The results of the study by Atsma et al. on healthy blood donors in the Netherlands showed that haemoglobin levels were positively correlated with BP (Atsma et al. 2012). In another study, Xuan et al. reported that there was a positive relationship between haemoglobin levels and systolic and diastolic BP (Xuan et al. 2018). The mechanism that may lead to increased BP in people with high haemoglobin levels is not fully understood; however, several biological mechanisms have been proposed for the association between haemoglobin and BP(Göbel et al. 1991; Hu et al. 2020; Lee, Rim, and Kim 2015).

The available studies provide confusing conclusions, and there is no clear certainty as to the extent of the relationship between Haemoglobin and blood pressure. For this reason, this study aims to get a definite picture of the results of evaluations conducted on studies that analyzed the relationship between Haemoglobin and blood pressure. To our knowledge, systematic studies have yet to address this theme. We built this review based on the question, "how is the relationship between Haemoglobin level and systolic and Diastolic blood pressure? Is there a significant difference between normal people and people who have comorbidities?"

MATERIALS & METHODS

Protocol

This study complies with the 2020 version of Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines(Page et al. 2021).

Eligibility Criteria

The studies included in this study were observational, involving adult patients in various conditions except for pregnant women. In contrast, experimental studies, reviews, editorial reports, theses/dissertations, and non-English were excluded from this study.

Search Strategy

A literature search was carried out on four databases, including PubMed, ScienceDirect, Willey online library, and Proquest, ranging from 2000 to 2023. The keywords adjusted to the Medical Subject Heading (MeSH) include Blood Pressure/ systolic blood pressure/ Diastolic blood pressure/arterial pressure, Haemoglobin/Hb/ Hemoprotein. These keywords are then combined using the help of Boolean OR/AND operators. Hand-searching is done through reference lists of relevant articles and common databases such as Google Scholar and Research Gate.

Study Selection

In the first step, two independent reviewers were asked to review relevant articles separately, and then filtered the articles based on titles and abstracts that met the requirements. After that, the two reviewers assessed whether the studies that were screened were relevant or not. To resolve disagreements, the lead author decides when differences occur between the two reviewers.

In addition, the systematic of this review is not limited to haemoglobin levels but also red blood cell levels, which are closely related to the amount of haemoglobin circulating in the circulation. For blood pressure, existing studies use the term Hypertension or patients, and we keep that in mind. This study focuses on the level of Hemoglobin or the quantity of more or less amount of Hemoglobin available in circulation. For this reason, we ignored all other variables that are confounders of Hypertension. Although Hemoglobin was declared an indirect cause of Hypertension,

in the end, we only focused on how much the Hemoglobin level increased and decreased and its effect on Hypertension. The complexity of Hypertension in pregnant women and children to be compared with Hypertension in adults is the basis for eliminating studies involving pregnant women and children.

Data Extraction

To answer the questions of this systematic review, the data chart includes references, year of publication, country/region, study design, sample size, mean age, mean SBP, mean DBP, mean hemoglobin, and relationship status. Two authors independently extracted data from studies that were declared eligible. The first author will recheck the extraction results to ensure completeness.

Study Quality Assessment

The quality of the systematic review methodology reflects the risk of bias or validity in the process and results. Study quality was assessed using the Joanna Briggs Institute (JBI) critical appraisal tool for observational studies. The JBI checklist consists of eight questions with the answer options Yes, No, Unclear, and Not Applicable. The assessment results are interpreted in terms of High, Medium, and Low study quality. High quality will be given to studies with a percentage of YES answers of ≥85%, medium quality with a percentage of ≥75%, and Low quality if you get a percentage of ≤74%.

RESULT

In the initial search of the entire database, there were 21,665 studies. After removing 21,571 studies because they were duplicative and non-English, 94 studies entered the screening stage on titles and abstracts. The results for eligibility resulted in 11 articles which were then extracted. This entire process is illustrated in figure 1 concerning the PRISMA flow diagram for selecting eligible studies.

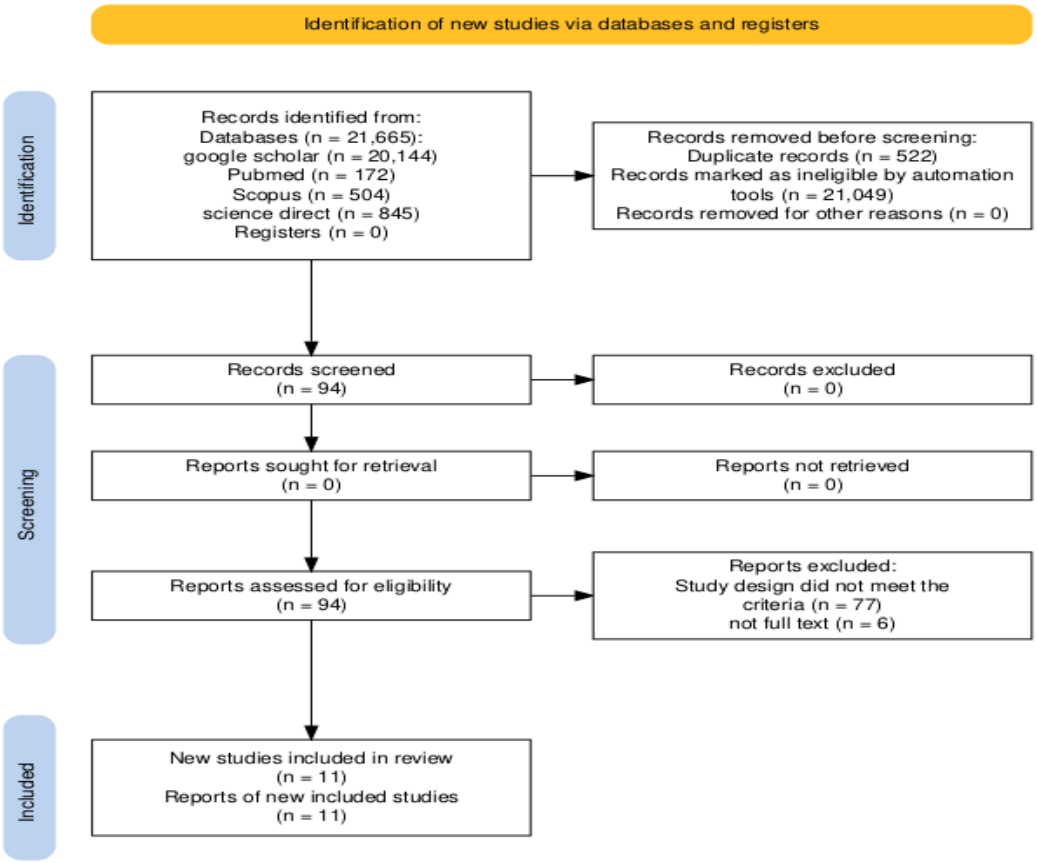

Figure 1. PRISMA flow chart

Table 1. Characteristics of eligible studies

Author, Year, Country	Study Design	Sample size	Mean Age	Blood Pressure		Hemoglobin Level	Relationship
				Mean SBP	Mean DBP		
Atsma et al., 2012, Netherland	Cohort	Men= 50,641 Women= 50, 736	Men=49.3 Women=42.4	Men=136.5 Women=126	Men=49.3 Women=42.4	Men=9.4 Women=8.5	Positive Association
Bazamandegan et al., 2023, Iran	Cross-sectional	Men= 4,396 Women= 5,002	Men= 49.78 Women= 49.79	Men= 107.25 Women= 105.32	Men= 71.37 Women= 70.07	Men= 15.04 Women= 13.22	Significant relationship (OR = 1.090)
Ghosh Et al., 2021, India	Comparative Cross-sectional	Group 1=81 (No Comorbidity) Group 2= 106 (with comorbidity)	Group 1= 68.9 Group 2 = 66.3	Group 1 = 142.8 Group 2 = 142.6	Group 1 = 80.6 Group 2 = 81	Group 1 = 12.5 Group 2 = 11.8	Positive correlation in Group 1 SBP p=0.046 DBP p=0.083
Kawamoto et al., 2012, Japan	Cross-sectional	**Group 1:** Men= 31 Women= 57 **Group 2:** Men= 29 Women= 56 **Group 3:** Men= 36 Women= 55 **Group 4:** Men= 24 Women= 55	**Group 1:** Men= 73 Women=69 **Group 2:** Men= 71 Women= 68 **Group 3:** Men= 67 Women= 66 **Group 4:** Men= 63 Women= 68	**Group 1:** Men= 136 Women=137 **Group 2:** Men= 145 Women= 139 **Group 3:** Men= 144 Women= 145 **Group 4:** Men= 143 Women= 151	**Group 1:** Men= 76 Women= 77 **Group 2:** Men= 82 Women= 79 **Group 3:** Men= 86 Women= 83 **Group 4:** Men= 85 Women= 86	**Group 1:** Men=10.0–14.0 Women=10.0–12.6 **Group 2:** Men=14.1–14.9 Women=12.7–13.2 **Group 3:** Men=15.0–15.9 Women=13.3–13.9 **Group 4:** Men=≥16.0 Women=≥14.0	Significant relationship in women (SBP p= 0.007; DBP p= 0.001), in Men only in DBP p= 0.001
Kim et al., 2016, South Korea	Cross-sectional	Men= 1629 Women= 2708	Men= 57.1 Women= 56.3	Men= 121.9 Women= 119.4	Men= 77.8 Women= 71.9	Men= 15 Women= 13.2	Significant relationship ORs of 1.47 for Men; 1.39 for women
Lee et al., 2015,	Cross-sectional	Men= 8,721	Men= 46.4	Men= 117.8	Men= 77.4	Men= 9.5	Positive relationship

South-Korea		Women= 11,355	Women= 45.6	Women= 112.2	Women= 72.2	Women= 8	
Rasmussen et al., 2015, Kenya	Cross-sectional	Non-Anemia=857 Anemia=310	Non-Anemia=38.9 Anemia=38	Non-Anemia=120 Anemia=115	Non-Anemia=74 Anemia=72	Non-Anemia=8.9 Anemia=6.5	Significant association P<0.01
Shimizu et al., 2014, Japan	Cross-sectional	Men= 1,191 Women= 2,012	Men= 63.5 Women= 62.4	Men= 139 Women= 136	Men= 83 Women= 80	Men= 13.6 Women= 12.3	Significant relationship P=0.001
Son et al., 2020, South-Korea	Cohort	Q1= 23,705 Q2= 23,691 Q3= 23,702 Q4= 23,700	Q1= 53.4 Q2= 53.1 Q3= 53.5 Q4= 53.7	Q1= 116.5 Q2= 116.6 Q3= 116.5 Q4= 116.3	Q1= 73 Q2= 73.1 Q3= 73 Q4= 72.7	Q1= 4.5 Q2= 8.5 Q3= 12.2 Q4= 20.2	Significant association
Tanindi et al., 2012, Turkey	Cohort	Pre HT=74 HT=128 Control=36	Pre HT=45.43 HT=53.03 Control=38.03	Pre HT=133.07 HT=157.13 Control=110.75	Pre HT=84.39 HT=96.64 Control=74	Pre HT=14.05 HT=13.56 Control=14.67	Strongly associated (p<0.05)
Xuan et al., 2018, China	Cohort	Male=3,888 Female=5,293	Male=62.4 Female=60.76	Male=135.85 Female=134.35	Male=87.35 Female=83.77	Male=14.77 Female=12.92	Significant correlation P<0.001

Characteristics of eligible studies

We have collected 11 articles discussing the relationship between Haemoglobin and SBP, and DBP excluding studies involving pregnant women and children. Most of the studies were from South Korea (n=3), Japan (n=2), and one each from the Netherlands, Iran, India, Kenya, Turkey, and China. Most of the study designs used cross-sectional (n = 7) and cohort (n = 4) involving 244,305 men and women aged ≥38 years.

Summary of study quality assessment

Based on the assessment of study quality using the JBI checklist, it was stated that nine studies (Atsma et al. 2012; Bazmandegan et al. 2023; Ghosh, Rehman, and Ahamed 2021; Kawamoto et al. 2012; Kim-Mitsuyama et al. 2019; Lee et al. 2015; Rasmussen et al. 2016; Shimizu et al. 2014; Son et al. 2020; Xuan et al. 2018)is in the High quality category with a percentage range of 87.5% to 100%. Two studies (Son et al. 2020; Tanindi et al. 2012) were stated to be in the Medium quality category with a percentage of 75%.

Table 2. Summary of JBI assessment for study quality

Studies	1	2	3	4	5	6	7	8
Atsma et al.	Y	NA	Y	Y	Y	Y	Y	Y
Bazamandegan et al.	Y	Y	Y	U	Y	Y	Y	Y
Ghosh Et al.	Y	Y	Y	Y	Y	U	Y	Y
Kawamoto et al.	Y	Y	Y	Y	Y	Y	Y	Y
Kim et al.	Y	Y	Y	Y	Y	N	Y	Y
Lee et al.	Y	Y	Y	N	Y	Y	Y	Y
Rasmussen et al.	Y	Y	Y	U	Y	Y	Y	Y
Shimizu et al.	Y	Y	Y	Y	Y	Y	Y	Y
Son et al.	Y	NA	Y	Y	N	Y	Y	Y
Tanindi et al.	Y	NA	Y	N	Y	Y	Y	Y
Xuan et al.	Y	NA	Y	Y	Y	Y	Y	Y

Y: yes; N: No; U: unclear

Link between Hb and SBP

This binding is illustrated by the change in each increase/decrease in Hb values related to pressure in the arteries, which is indicated by the SBP value. Several studies have shown that SBP values have entered the hypertension category with pressure values of 136.5 (Atsma et al. 2012), 136 (Kawamoto et al. 2012), 139 (Shimizu et al. 2014), 157.13 (Tanindi et al. 2012), 135.85 (Xuan et al. 2018). Looking at its spread, in general, increases in SBP tend to be experienced in the male sex and without co morbidities. Overall, this association shows positive and significance. The average increase in SBP is 1.3 mmHg.

Link between Hb and DBP

It illustrates the relationship between haemoglobin and arterial pressure when the heart rests. An increase in DBP is also a marker of hypertension cases. The included studies show that the DBP value tends to decrease based on the standard DBP pressure value of 80mmHg. Even in one study, the sample DBP was found to be 49.3 for the male group and 42.4 for the female group (Atsma et al. 2012). The sample's age is 49.3 for the male group and 42.4 for the female group. The Hb value for the male group is 9.4 and 8.5 for the female group, where the Hb at that level is certainly low or has decreased (Atsma et al. 2012). Meanwhile, for Hb values within the normal range (14.0), DBP is 76 – 86 mmHg (Kawamoto et al. 2012).

DISCUSSION

This systematic review of observational studies analyzing the relationship between Haemoglobin and blood pressure was carried out on eleven articles from several reputable databases. In general, haemoglobin levels are significantly related

to blood pressure, both SBP and DBP. For this reason, this can strengthen the reason for including the factor of haemoglobin levels as one factor that affects the increase in blood pressure in hypertension and non-hypertension sufferers. Although, in detail, there are differences between gender, comorbidities, and age in haemoglobin levels and blood pressure.

Relationship between hemoglobin and blood pressure

A study in the Netherlands found that the mean SBP increased with increasing Hb levels. Based on gender, the SBP increased by 1.3 mm Hg per millimole per liter in Hb level for men. Meanwhile, for women, the SBP increased by 1.8 mmHg for each millimole per liter increase in Hb level (Atsma et al. 2012). There is a difference of 0.8 mmHg, which some might think has no significant effect. However, it should be considered that On a population level, differences of 1 to 2 mm Hg in blood pressure already mean a substantial difference in cardiovascular mortality and morbidity (Egan et al. 2019; Forouzanfar, Liu, and Roth 2017; Huffman and Lloyd-Jones 2017; Lackland and Weber 2015; Roth et al. 2020).

Bazmandegan and colleagues in Iran also found that the relationship between BP and haemoglobin in males and females showed a positive trend and a linear increase between BP and hemoglobin levels. They also found that the increasing trend was higher in females than males. The gender difference in BP may be due to stimulated red blood cells in males compared to females (Warren and Grossmann 2022). Ghosh and team stated that a rise of about three mmHg of SBP with a 1 gm/dL increase in Hb indicates that treatment of anemia in the presence of hypertension needs to be monitored with extra precautions as an increase in Hb may further aggravate or add up to the existing cardiovascular risks (Ghosh et al. 2021). Reports show that a slightly low Hb level is beneficially associated with arterial stiffness in elderly females, reducing the risk of adverse cardiovascular incidents (Kawamoto et al. 2012). In a population in rural Korea, Kim and colleagues found a significant positive association between haemoglobin concentrations and the prevalence of hypertension. Even after excluding participants with hypertension at baseline, higher hemoglobin levels were significantly associated with higher SBP, DBP, and hypertension (Kim-Mitsuyama et al. 2019). Blood viscosity is one of the themes that may explain the positive cross-sectional association between haemoglobin and blood pressure. Earlier studies have reported that elevations of haematocrit and haemoglobin increase blood viscosity, which may, in turn, elevate blood pressure levels and worsen cardiovascular function (Bilo et al. 2019). In pathological conditions such as impaired concentration of red blood cells, Sickle cell anemia patients with frequent crises and increased hyper-hemolysis states have been found to have an increased prevalence of elevated systolic blood pressure and pulmonary hypertension (Oguanobi et al. 2010).

Atsma and colleagues also found comparable patterns for DBP where DBP rises 1.4 mm Hg per millimole per liter increase in Hb level in men and 1.5 mm Hg per millimole per liter of Hb in women (Atsma et al. 2012). Meanwhile, Lee and team found that DBP increased by 3.2 mmHg with every 1 mmol/l increase in the Hb concentration in both men and women after adjusting for age, BMI, total cholesterol, alcohol drinking, current smoking, mild renal dysfunction, and DM (Lee et al. 2015).

Disturbances in the condition of red blood cells that affect haemoglobin levels are often associated with hypertension, stroke, and even elevated blood pressure as the first symptom (Kosmachevskaya, Novikova, and Topunov 2021; Michel and Martin-Ventura 2020). As mentioned in a study conducted by Oguanobi in Kenya, Sickle cell anemia has a significant effect on changes in blood pressure, especially in DBP (Oguanobi et al.

2010). In addition to blood volume, both Hb and blood pressure may be related to the renin-angiotensin-aldosterone system. Angiotensin II may play a role in erythropoietin production (Guo et al. 2019) and may be incited by the sympathetic nervous system, which is known to affect erythropoietin production because subjects with autonomic neuropathy have erythropoietin-responsive anemia. The relationship mechanism between Hb and blood pressure is still unclear, and elucidation requires further research. It is also unclear whether haemoglobin is responsible for increasing blood pressure or vice versa. We found no definite answer to this problem in the eleven studies we collected.

Our assumptions after a review of the eleven included studies, Clinically, it must be acknowledged that there are complexities in explaining the relationship between Hemoglobin and Hypertension. We realize there is a need for a comprehensive study related to haemoglobin for all variables that have a relationship with the incidence of hypertension. It can be obtained through clinical conditions associated with a quantitative decrease in Hemoglobin, for example, bleeding, kidney damage, iron deficiency, and red blood cell disorders, down to the level of affinity between haemoglobin for red blood cells and oxygen. Apart from all that, the thing that can be firmly held based on the results of this study is that clinically it does appear that haemoglobin levels go hand in hand with fluctuations in blood pressure.

LIMITATION

Barriers to access to several reputable databases were the biggest in conducting this study. We should have collected some relevant literature of better quality, but only a small amount is open access. In addition, this study only focuses on Haemoglobin and blood pressure without further analyzing other factors that have the potential to be directly related to fluctuations in blood pressure. Future studies can explore further to solve this issue.

CONCLUSION

This study concludes that haemoglobin levels are strongly related to changes in blood pressure, both SBP and DBP, so we strongly suggest that haemoglobin is mandatory as a predictor for cardiovascular disorders, especially hypertension. In pathological conditions, red blood cells can also be a cause in situations where blood pressure tends to increase, especially SBP.

In clinical practice, these results can be considered in monitoring the patient's condition concerning haemoglobin levels which can potentially develop hypertension. Several conditions can cause disturbances in haemoglobin levels. For this reason, dealing with patients with these conditions must be aware of the possibility of further worsening of the patient's condition.

Declaration by Authors

Ethical Approval: Not applicable

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Atsma, Femke, Ingrid Veldhuizen, Wim de Kort, Marian van Kraaij, Pieternel Pasker-de Jong, and Jaap Deinum. 2012. “Hemoglobin Level Is Positively Associated with Blood Pressure in a Large Cohort of Healthy Individuals.” Hypertension 60(4):936–41. DOI: 10.1161/HYPERTENSIONAHA.112.193565
2. Bangalore, Sripal, Bora Toklu, Eugenia Gianos, Arthur Schwartzbard, Howard Weintraub, Gbenga Ogedegbe, and Franz H. Messerli. 2017. “Optimal Systolic Blood Pressure Target after SPRINT: Insights from a Network Meta-Analysis of Randomized Trials.” The American Journal of Medicine 130(6):707–19. DOI: 10.1016/j.amjmed.2017.01.004
3. Bazmandegan, Gholamreza, Mitra Abbasifard, Hamid Ostadebrahimi, Mohammadreza Gholamrezapour, and

Zahra Kamiab. 2023. "Positive Association between Hemoglobin Concentration and Blood Pressure in Adults: A Cross-Sectional Study Based on Rafsanjan Cohort Study." International Journal of Hypertension 2023. doi: 10.1155/2023/6283711

4. Bilo, Grzegorz, Sergio Caravita, Camilla Torlasco, and Gianfranco Parati. 2019. "Blood Pressure at High Altitude: Physiology and Clinical Implications." Kardiologia Polska (Polish Heart Journal) 77(6):596–603. DOI: 10.33963/KP.14832
5. Dieterle, Thomas. 2012. "Blood Pressure Measurement–an Overview." Swiss Medical Weekly 142(0304): w13517–w13517. doi: smw.2012.13517
6. Egan, Brent, Sverre Kjeldsen, Guido Grassi, Murray Esler, and Guiseppe Mancia. 2019. "The Global Burden of Hypertension Exceeds 1.4 billion People: Should a Systolic Blood Pressure Target below 130 Become the Universal Standard?" Journal of Hypertension Publish Ah:1. doi: 10.1097/HJH.0000000000002021.
7. Flack, John M., and Bemi Adekola. 2020. "Blood Pressure and the New ACC/AHA Hypertension Guidelines." Trends in Cardiovascular Medicine 30(3):160–64. DOI: 10.1016/j.tcm.2019.05.003
8. Forouzanfar, M. H., P. Liu, and G. A. Roth. 2017. "Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115 Mm Hg, 1990-2015 (Vol 3, Pg 165, 2016)." JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION 317(6):648. doi: 10.1186/s12889-025-24706-9
9. Ghosh, Tandra, Tanveer Rehman, and Farhad Ahamed. 2021. "Relationship Between Hemoglobin and Blood Pressure Levels in the Context of Chronic Morbidity Among Older Adults Residing in a Developing Country: A Community-Level Comparative Cross-Sectional Study." Cureus 13(11). DOI: 10.7759/cureus.19540
10. Göbel, Bernd O., Annette Schulte-Göbel, Burkhard Weisser, Kilian Glönzer, Hans Vetter, and Rainer Düsing. 1991. "Arterial Blood Pressure: Correlation with Erythrocyte Count, Hematocrit, and Hemoglobin Concentration." American Journal of Hypertension 4(1_Pt_1):14–19. https://doi.org/10.1093/ajh/4.1.14
11. Guo, Daoxia, Zhengbao Zhu, Chongke Zhong, Hao Peng, Tian Xu, Aili Wang, Yanbo Peng, Tan Xu, Chung-Shiuan Chen, and Yongqiu Li. 2019. "Hemoglobin Level and Three-Month Clinical Outcomes among Ischemic Stroke Patients with Elevated Systolic Blood Pressure." Journal of the Neurological Sciences 396:256–61. doi: 10.1016/j.jns.2018.11.030. Epub 2018 Nov 27
12. Hu, Mengdie, Xiaoling Cai, Wenjia Yang, Simin Zhang, Lin Nie, and Linong Ji. 2020. "Effect of Hemoglobin A1c Reduction or Weight Reduction on Blood Pressure in Glucagon-like Peptide-1 Receptor Agonist and Sodium-glucose Cotransporter-2 Inhibitor Treatment in Type 2 Diabetes Mellitus: A Meta-analysis." Journal of the American Heart Association 9(7):e015323. DOI: 10.1161/JAHA.119.015323
13. Huffman, Mark D., and Donald M. Lloyd-Jones. 2017. "Global Burden of Raised Blood Pressure: Coming into Focus." Jama 317(2):142–43. doi:10.1001/jama.2016.19685
14. James, Paul A., Suzanne Oparil, Barry L. Carter, William C. Cushman, Cheryl Dennison-Himmelfarb, Joel Handler, Daniel T. Lackland, Michael L. LeFevre, Thomas D. MacKenzie, and Olugbenga Ogedegbe. 2014. "2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report from the Panel Members Appointed to the Eighth Joint National Committee (JNC 8)." Jama 311(5):507–20. doi: 10.1001/jama.2013.284427
15. Kawamoto, Ryuichi, Yasuharu Tabara, Katsuhiko Kohara, Tetsuro Miki, Tomo Kusunoki, Tateaki Katoh, Nobuyuki Ohtsuka, Shuzo Takayama, and Masanori Abe. 2012. "A Slightly Low Hemoglobin Level Is Beneficially Associated with Arterial Stiffness in Japanese Community-Dwelling Women." Clinical and Experimental Hypertension 34(2):92–98. DOI: 10.3109/10641963.2011.618202
16. Kim-Mitsuyama, Shokei, Hirofumi Soejima, Osamu Yasuda, Koichi Node, Hideaki Jinnouchi, Eiichiro Yamamoto, Taiji Sekigami, Hisao Ogawa, and Kunihiko Matsui. 2019. "Anemia Is an Independent Risk Factor for Cardiovascular and Renal Events in Hypertensive Outpatients with Well-Controlled Blood Pressure: A Subgroup Analysis of the ATTEMPT-CVD Randomized Trial." Hypertension Research

42(6):883–91. doi: 10.1038/s41440-019-0210-1. Epub 2019 Jan 21
17. Kosmachevskaya, Olga V, Natalia N. Novikova, and Alexey F. Topunov. 2021. "Carbonyl Stress in Red Blood Cells and Hemoglobin." Antioxidants 10(2):253. https://doi.org/10.3390/antiox10020253
18. Lackland, Daniel T., and Michael A. Weber. 2015. "Global Burden of Cardiovascular Disease and Stroke: Hypertension at the Core." Canadian Journal of Cardiology 31(5):569–71. DOI: 10.1016/j.cjca.2015.01.009
19. Lee, Sang-Guk, John Hoon Rim, and Jeong-Ho Kim. 2015. "Association of Hemoglobin Levels with Blood Pressure and Hypertension in a Large Population-Based Study: The Korea National Health and Nutrition Examination Surveys 2008–2011." Clinica Chimica Acta 438:12–18. DOI: 10.1016/j.cca.2014.07.041
20. Michel, Jean-Baptiste, and José Luis Martin-Ventura. 2020. "Red Blood Cells and Hemoglobin in Human Atherosclerosis and Related Arterial Diseases." International Journal of Molecular Sciences 21(18):6756. doi: 10.3390/ijms21186756
21. Mukkamala, Ramakrishna, and Jin-Oh Hahn. 2017. "Toward Ubiquitous Blood Pressure Monitoring via Pulse Transit Time: Predictions on Maximum Calibration Period and Acceptable Error Limits." IEEE Transactions on Biomedical Engineering 65(6):1410–20. doi: 10.1109/TBME.2017.2756018
22. Oguanobi, N. I., B. J. C. Onwubere, O. G. Ibegbulam, S. O. Ike, B. C. Anisiuba, E. C. Ejim, and O. Agwu. 2010. "Arterial Blood Pressure in Adult Nigerians with Sickle Cell Anemia." Journal of Cardiology 56(3):326–31. https://doi.org/10.1016/j.jjcc.2010.07.001
23. Olsen, Michael H., Sonia Y. Angell, Samira Asma, Pierre Boutouyrie, Dylan Burger, Julio A. Chirinos, Albertino Damasceno, Christian Delles, Anne-Paule Gimenez-Roqueplo, and Dagmara Hering. 2016. "A Call to Action and a Lifecourse Strategy to Address the Global Burden of Raised Blood Pressure on Current and Future Generations: The Lancet Commission on Hypertension." The Lancet 388(10060):2665–2712. doi: 10.1016/S0140-6736(16)31134-5
24. Page, Matthew J., Joanne E. McKenzie, Patrick M. Bossuyt, Isabelle Boutron, Tammy C. Hoffmann, Cynthia D. Mulrow, Larissa Shamseer, Jennifer M. Tetzlaff, Elie A. Akl, and Sue E. Brennan. 2021. "The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews." International Journal of Surgery 88:105906. doi: https://doi.org/10.1136/bmj.n71
25. Paone, Gaetano, Donald S. Likosky, Robert Brewer, Patricia F. Theurer, Gail F. Bell, Chad M. Cogan, and Richard L. Prager. 2014. "Transfusion of 1 and 2 Units of Red Blood Cells Is Associated with Increased Morbidity and Mortality." The Annals of Thoracic Surgery 97(1):87–94. DOI: 10.1016/j.athoracsur.2013.07.020
26. Rasmussen, Jon B., David L. Mwaniki, Lydia U. Kaduka, Mike K. Boit, Knut Borch-Johnsen, Henrik Friis, and Dirk L. Christensen. 2016. "Hemoglobin Levels and Blood Pressure Are Associated in Rural Black Africans." American Journal of Human Biology 28(1):145–48. DOI: 10.1002/ajhb.22758
27. Rizvi, Abeer, Patricia Macedo, Lydia Babawale, Hannah C. Tighe, J. Michael B. Hughes, James E. Jackson, and Claire L. Shovlin. 2017. "Hemoglobin Is a Vital Determinant of Arterial Oxygen Content in Hypoxemic Patients with Pulmonary Arteriovenous Malformations." Annals of the American Thoracic Society 14(6):903–11. DOI: 10.1513/AnnalsATS.201611-872OC
28. Roth, Gregory A., George A. Mensah, Catherine O. Johnson, Giovanni Addolorato, Enrico Ammirati, Larry M. Baddour, Noël C. Barengo, Andrea Z. Beaton, Emelia J. Benjamin, and Catherine P. Benziger. 2020. "Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: Update from the GBD 2019 Study." Journal of the American College of Cardiology 76(25):2982–3021. doi: 10.1016/j.jacc.2020.11.010
29. Shimizu, Yuji, Mio Nakazato, Takaharu Sekita, Koichiro Kadota, Kazuhiko Arima, Hironori Yamasaki, Noboru Takamura, Kiyoshi Aoyagi, and Takahiro Maeda. 2014. "Association between the Hemoglobin Levels and Hypertension in Relation to the BMI Status in a Rural Japanese Population: The Nagasaki Islands Study." Internal Medicine 53(5):435–40. DOI: 10.2169/internalmedicine.53.1353

30. Siagian, Heriviyatno J., and Tukatman Tukatman. 2021. "Karakteristik Merokok Dan Tekanan Darah Pada Pria Usia 30-65 Tahun: Cross SectionalStudy." Jurnal Kesehatan Komunitas 7(1):106–9. DOI: hps://doi.org/10.25311/keskom.Vol7.Iss1.871
31. Son, Minkook, Junyong Park, Kyungil Park, and Sung Yang. 2020. "Association between Hemoglobin Variability and Incidence of Hypertension over 40 Years: A Korean National Cohort Study." Scientific Reports 10(1):1–9. https://doi.org/10.1038/s41598-020-69022-x
32. Sudayasa, I. Putu, La Ode Alifariki, Rahmawati, Indria Hafizah, Jamaludin, Nining Milasari, Nisda, and Andi Nilawati Usman. 2020. "Determinant Juvenile Blood Pressure Factors in Coastal Areas of Sampara District in Southeast Sulawesi." Enfermeria Clinica 30(Supplement 2):585-588. doi: 10.1016/j.enfcli.2019.07.167.
33. Tanindi, Asli, Fatih Esad Topal, Firdevs Topal, and Bulent Celik. 2012. "Red Cell Distribution Width in Patients with Prehypertension and Hypertension." Blood Pressure 21(3):177–81. DOI: 10.3109/08037051.2012.645335
34. Warren, Annabelle M., and Mathis Grossmann. 2022. "Haematological Actions of Androgens." Best Practice & Research Clinical Endocrinology & Metabolism 101653. DOI: 10.1016/j.beem.2022.101653
35. Xuan, Yan, Junli Zuo, Shuping Zheng, Jinbao Ji, and Yi Qian. 2018. "Association of Hemoglobin and Blood Pressure in a Chinese Community-Dwelling Population." Pulse 6(3–4):154–60. doi: 10.1159/000494735

How to cite this article: La Ode Alifariki. Association of hemoglobin and blood pressure: systematic review. *Gal Int J Health Sci Res*. 2025; 10(4): 115-125. *DOI: https://doi.org/10.52403/gijhsr.20250414*

******