Jurnal Info Kesehatan
Vol. 22, No. 1, March 2024, pp. 16-23
P-ISSN 0216-504X, E-ISSN 2620-536X
DOI: *10.31965/infokes.Vol22Iss1.1438*
Journal homepage:*http://jurnal.poltekeskupang.ac.id/index.php/infokes*

RESEARCH **Open Access**

The Relationship between Drinking Coffee and Hypertension in Several Countries: Systematic Review and Meta-Analysis

Syahrizal Syarif [1a*], Mivtahurrahimah [1b]

[1] Department of Epidemiology, Faculty of Public Health, University of Indonesia, Depok, West Java, Indonesia

[a] Email address: rizalure@yahoo.com.au
[b] Email address: mivtahurrahimah22@gmail.com

Received: 21 January 2024 Revised: 29 January 2024 Accepted: 2 February 2024

Abstract
Coffee is the most consumed drink in the world and has the highest caffeine content. Caffeine in coffee has an effect on hypertension, which is a leading cause of death throughout the world. However, the long-term effect of drinking coffee on the risk of hypertension is still controversial. This study aimed to determine the relationship between drinking coffee and the risk of hypertension through a meta-analysis study of several cross-sectional survey studies using the search engines PubMed, Science Direct, Proques, and Scopus. Search results via search engines found 3 relevant articles for analysis. A significant association was found between drinking coffee and hypertension with a combined risk of 1.58 (95% CI: 1.46, 1.72). Lifestyle changes through regulating coffee drinking patterns can be one of the government and stakeholder programs as primary prevention of hypertension among adults, especially since drinking coffee is currently very popular.

Keywords: Coffee, Hypertension, Systematic Review, Meta-Analysis.

Corresponding Author:

Syahrizal Syarif
Department of Epidemiology, Faculty of Public Health, University of Indonesia, Depok, West Java, Indonesia
Email: heldanazar65@gmail.com

1. INTRODUCTION

Caffeinated drinks are among today's most widely consumed and popular drinks (Doepker et al., 2022). It is estimated that approximately 85% of Americans consume caffeine daily with an average intake of 135 mg. Coffee has the highest caffeine content among drinks containing caffeine (van Dam et al., 2020). It is estimated that global consumption of coffee reaches 500 billion cups per year, and more than 150 million bags (60 kg) of coffee were consumed in 2016 (Butt & Sultan, 2011). This widespread coffee consumption has resulted in more and more researchers focusing on the impact of coffee consumption on health (van Dam et al., 2020).

Caffeine affects the cardiovascular, respiratory, gastrointestinal, and kidney systems (Barcelos et al., 2020; Chen et al., 2022; Hu et al., 2018; Iriondo-Dehond et al., 2021). This also influences hypertension by increasing systolic and diastolic blood pressure (Cappelletti et al., 2015). Caffeine can increase blood pressure by blocking adenosine receptors in blood vessels and by causing vasoconstriction (Han et al., 2022; Umemura et al., 2006).

Hypertension is the strongest predictor of mortality in both high- and low-income countries (Lopez et al., 2006; Mills et al., 2020; Zhou et al., 2021). Around 1.39 billion adults worldwide suffer from hypertension with a prevalence reaching 28% in high-income countries (D'Elia et al., 2019). It is estimated that there will be an increase in the prevalence of hypertension worldwide by 30% by 2025 (Kearney et al., 2005). Based on this, preventing an increase in the prevalence of hypertension can be prevented at least by controlling coffee consumption (Zhang et al., 2011).

As early as the 1930s, it was recognized that coffee consumption was a potential risk factor for blood pressure due to the acute pressure effect of caffeine (Miranda et al., 2021). However, the long-term effect of coffee drinking on the risk of hypertension was still controversial in several randomized controlled trials and cohort studies (Xie et al., 2018). Recent studies have also shown that coffee consumption habits in healthy groups were not associated with an increased risk of hypertension (95% CI: 0,61 - 1.52) (O'Keefe et al., 2013).

The results of the dose-response meta-analysis from research conducted by D'Elia, et al (2019) also show the same thing, the habit of moderate coffee consumption is not related to the risk of hypertension in the general population and there is a non-linear inverse dose-response relationship that occurs between coffee consumption and the risk of hypertension (Q=5.98, p=0.20, I2=33%) (D'Elia et al., 2019). However, no meta-analysis studies have been conducted generally on large cross-sectional survey population groups.

The differences in definitions of coffee exposure between studies mean that the relationship between coffee consumption and hypertension risk cannot be analyzed precisely(Poole et al., 2017; Wong et al., 2021). Moreover, there are no meta-analysis studies regarding coffee drinking and hypertension in large populations through surveys with cross-sectional studies. Therefore, this study aims to determine the relationship between drinking coffee and the risk of hypertension using a meta-analysis study of several recently published cross-sectional survey studies.

2. RESEARCH METHOD

This meta-analysis was designed, analyzed, and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Ahn & Kang, 2018). A systematic search was done by identifying relevant journals on the search engines PubMed, ScienceDirect, Proquest, and Scopus using the search words "coffee", "caffeine", "hypertension", and "blood pressure". The journal search was limited to publications from 2018 to 2023.

Independent reviewers screened titles and abstracts for eligible articles. Disagreements were resolved by discussion. Then, based on the full text of the identified articles, their eligibility for inclusion was assessed according to our inclusion and exclusion criteria. Studies were included if they met the following criteria: 1) a population-based cross-sectional study of people with hypertension and 2) an adult group population (≥ 15 years).

Furthermore, the exclusion criteria were articles that did not provide clear results and explanations regarding the research topic and did not have risk values and a clear group distribution table for the incidence of hypertension and coffee drinking. The categorization of the coffee-drinking variable was measured based on the coffee drinking of the 24 before the research was conducted.

3. RESULTS AND DISCUSSION

A total of 1,782 articles were identified through Pubmed (154), Proquest (730), ScienceDirect (532), and Scopus (366) search engines based on search terms and inclusion criteria. However, 1,737 articles were excluded after reviewing the titles, articles with full text, and duplicate titles and authors, so 35 articles were found that were relevant for analysis. Next, article exclusion was carried out based on the irrelevant title and abstract assessment of 26 articles, so 9 articles were suitable for analysis. Finally, 3 articles were found relevant for analysis, met the criteria, and could be accepted after excluding 3 articles through full-text review (figure 1).

Table 1. The Characteristics of Studied Subjects

Researchers	Title	Location	Sample	OR	Variables controlled are based on Multivariate analysis
Shah et al., (2023)	Coffee intake and hypertension in Korean adults: results from KNHANES 2012–2016	Korea	KNHANES 2012–2016, which included 12.133 participants (19 years or older)	0,84 (0,73-0,99)	Age, gender, education, body mass index (BMI), current smoking, heavy drinking, diabetes, and hypercholesterolemia, energy intake, income, and region of residence.
Fan et al., (2023)	Coffee consumption and abdominal aortic calcification among adults with and without hypertension, diabetes, and cardiovascular diseases	United States	2.548 participants data from the National Health and Nutrition Examination Survey (NHANES)	0.72 (0.21-1.22)	Age, gender, race, education level, marital status.
Sathi et al., (2022)	Prevalence, trends and associated factors of hypertension and diabetes mellitus in Bangladesh: Evidence from BHDS 2011 and 2017–2018	Bangladesh	11,686 adults as a study sample for the analysis	1,06 (0,95-1,17)	Age, education, occupation, residence, and wealth status.

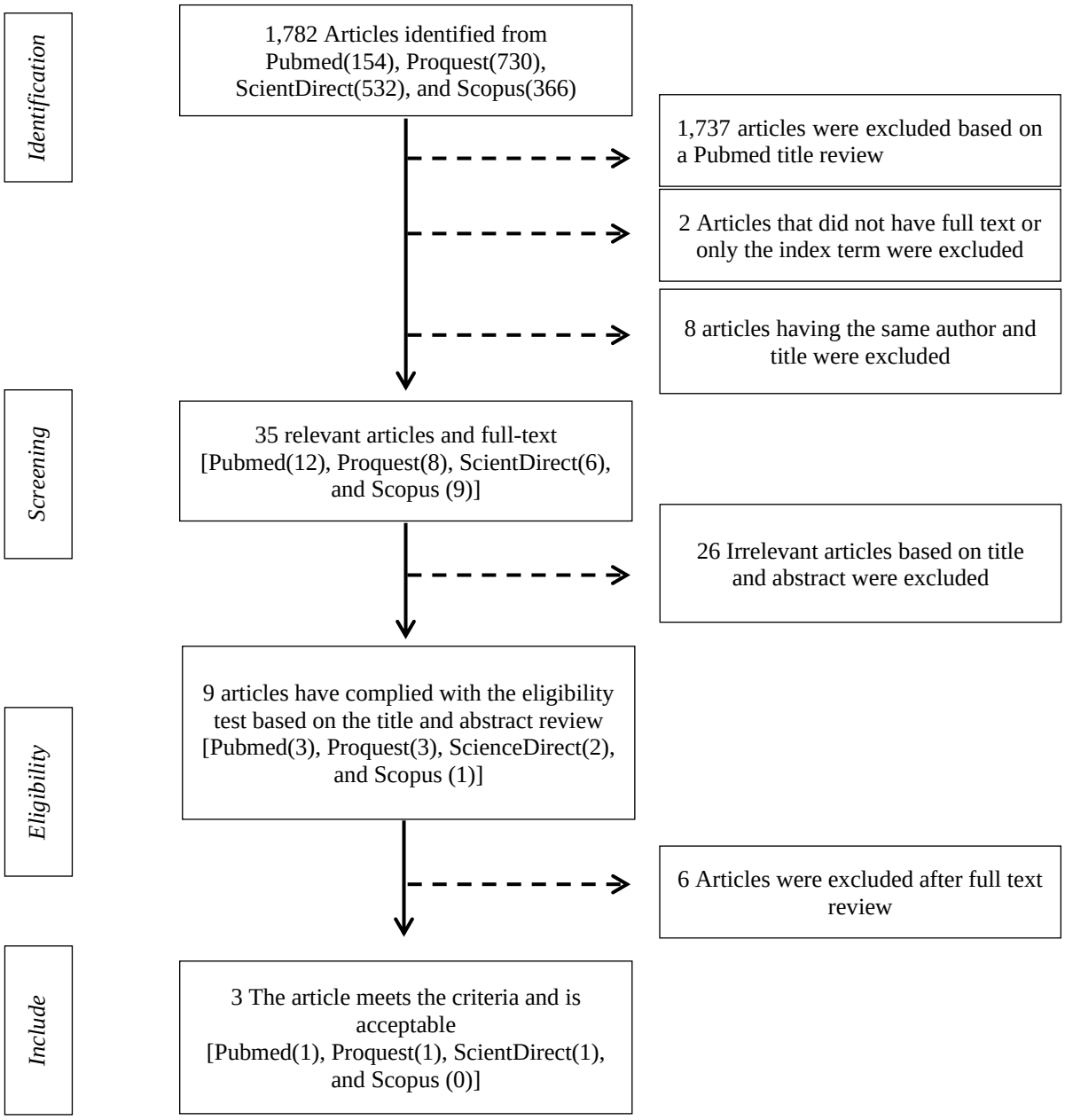

Figure 1. Flowchart of Relevant Articles on the Relationship between Coffee and Hypertension in Several Countries.

Article analysis was carried out on 3 articles which were found to include several countries, including Korea (2023), the United States (2023), and Bangladesh (2022). The research is carried out on large populations or communities through surveys. All studies generally control confounding variables such as age, gender, education, and employment, on the relationship between coffee drinking and the incidence of hypertension. Research from Surahi Shah, et al (2023) shows that there is a protective relationship between drinking coffee and hypertension (OR: 0.84, 95% CI: 0.73-0.99) (Shah et al., 2023). However, research from Haze Fen, et al (2023) and Nusrat, et al (2022) shows that there is no significant relationship

between drinking coffee and hypertension (OR: 0.72, 95% CI: 0.21-1.22 and OR: 1 .06, 95% CI: 0.95 - 1.17) (table 1) (Fan et al., 2023; Sathi et al., 2022).

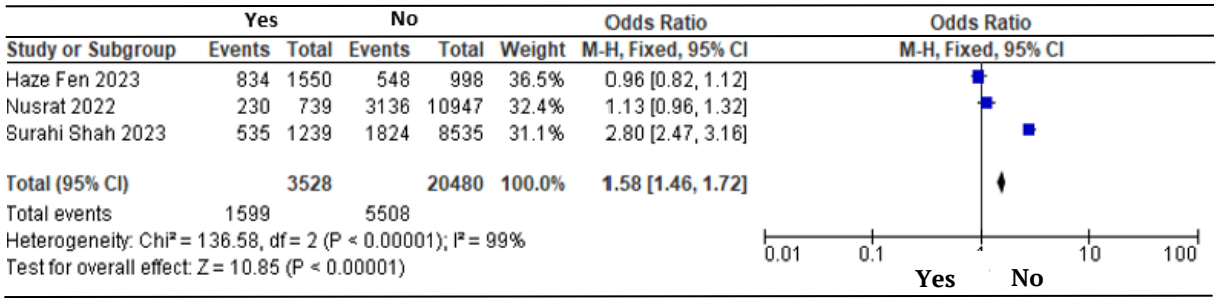

Figure 2. Forest Plot Meta-Analysis of the Relationship Between Drinking Coffee and Hypertension

A meta-analysis of the relationship between coffee drinking and hypertension was carried out on 3 articles. Forest plot meta-analysis shows a significant relationship between drinking coffee and the incidence of hypertension, with an odds ratio of 1.58 (95% CI: 1.46 - 1.72). This explains that adults who drink coffee have a 1.58 times higher risk of developing hypertension compared to adults who do not drink coffee. This is in line with research from Nusrat, et al (2022), which found that respondents who drank coffee had a higher risk of developing hypertension compared to respondents who did not drink coffee (OR: 1.06) (Sathi et al., 2022).

Analysis from several countries shows that an increase in the prevalence of hypertension accompanies high coffee consumption. The caffeine in coffee can stimulate the production of adrenaline which has effects on the cardiovascular system, such as increased blood pressure, endothelial dysfunction, inflammation, and decreased sensitivity to insulin, which may be associated with the risk of cardiovascular disease (Paiva C et al., 2019; Rodak et al., 2021; Rodríguez-Artalejo & López-García, 2018). Therefore, lifestyle changes through regulating coffee drinking patterns can become a program for the government and stakeholders as a primary preventative for hypertension among adults, especially since drinking coffee is currently very popular (Haghighatdoost et al., 2023).

The study from Haze Fan et al (2023) analyzed in this meta-analysis explains that the individual coffee intake variable was obtained from a 24-hour food recall interview, which allows for recall bias (Fan et al., 2023). However, Asghar Z. Naqvi argues that asking again about food consumption in the previous 24 hours can provide enormous benefits to credible estimates (Naqvi et al., 2014). Thus, when using 24-hour food recall to assess dietary intake, including coffee consumption, it is important to conduct it continuously to ensure consistency in respondent answers.

The main strengths of this meta-analysis are the collection of studies from a large population from different countries and ethnicities with a wide age range, a comprehensive literature search to identify relevant articles, and an analysis based on multiple confounding factors. This study's systematic review and meta-analysis analysis show the relationship between coffee drinking and hypertension in several countries. It provides the latest information for the last 5 years on adult groups in populations and communities, including 3 cross-sectional studies. However, a relatively high statistical heterogeneity value was found in this study. This could be because searching for journal articles via search engines allows skipping articles that are not published, thus impacting publication bias.

4. CONCLUSION

The results of a systematic review and meta-analysis of this research show a significant relationship between drinking coffee and the risk of hypertension in the adult group. Lifestyle changes through regulating coffee drinking patterns can be one of the government and stakeholder programs as a primary preventive strategy for the incidence of hypertension among adults, especially since drinking coffee is currently very popular. Furthermore, to identify deeper and more specific prevention programs in Indonesia, further research is needed through surveys of coffee-drinking communities and their relationship with hypertension in the adult population in Indonesia.

REFERENCES

Ahn, E., & Kang, H. (2018). Introduction to systematic review and meta-analysis. *Korean Journal of Anesthesiology*, *71*(2), 103–112. https://doi.org/10.4097/kjae.2018.71.2.103

Barcelos, R. P., Lima, F. D., Carvalho, N. R., Bresciani, G., & Royes, L. F. (2020). Caffeine effects on systemic metabolism, oxidative-inflammatory pathways, and exercise performance. In *Nutrition Research* (Vol. 80, pp. 1–17). Elsevier Inc. https://doi.org/10.1016/j.nutres.2020.05.005

Butt, M. S., & Sultan, M. T. (2011). Coffee and its consumption: Benefits and risks. In *Critical Reviews in Food Science and Nutrition* (Vol. 51, Issue 4, pp. 363–373). https://doi.org/10.1080/10408390903586412

Cappelletti, S., Daria, P., Sani, G., & Aromatario, M. (2015). Caffeine: Cognitive and Physical Performance Enhancer or Psychoactive Drug? *Current Neuropharmacology*, *13*, 71–88.

Chen, S., Li, J., Gao, M., Li, D., Shen, R., Lyu, L., Shen, J., Shen, X., Fu, G., Wei, T., & Zhang, W. (2022). Association of caffeine intake with all-cause and cardiovascular mortality in elderly patients with hypertension. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.1023345

D'Elia, L., La Fata, E., Galletti, F., Scalfi, L., & Strazzullo, P. (2019). Coffee consumption and risk of hypertension: a dose-response meta-analysis of prospective studies. *Eur J Nutr*, *58*(1), 271–280. https://doi.org/10.1007/s00394-017-1591-z

Doepker, C., Movva, N., Cohen, S. S., & Wikoff, D. S. (2022). Benefit-risk of coffee consumption and all-cause mortality: A systematic review and disability adjusted life year analysis. In *Food and Chemical Toxicology* (Vol. 170). Elsevier Ltd. https://doi.org/10.1016/j.fct.2022.113472

Fan, H., Xiong, Y., Huang, Y., Li, W., Xu, C., Feng, X., Hua, R., Yang, Y., Wang, Z., Yuan, Z., & Zhou, J. (2023). Coffee consumption and abdominal aortic calcification among adults with and without hypertension, diabetes, and cardiovascular diseases. *Nutrition, Metabolism and Cardiovascular Diseases*, *33*(10), 1960–1968. https://doi.org/10.1016/j.numecd.2023.06.013

Haghighatdoost, F., Hajihashemi, P., de Sousa Romeiro, A. M., Mohammadifard, N., Sarrafzadegan, N., de Oliveira, C., & Silveira, E. A. (2023). Coffee Consumption and Risk of Hypertension in Adults: Systematic Review and Meta-Analysis. In *Nutrients* (Vol. 15, Issue 13). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/nu15133060

Han, M., Oh, Y., & Myung, S. K. (2022). Coffee Intake and Risk of Hypertension: A Meta-Analysis of Cohort Studies. *Journal of Korean Medical Science*, *37*(45). https://doi.org/10.3346/jkms.2022.37.e332

Hu, E. A., Selvin, E., Grams, M. E., Steffen, L. M., Coresh, J., & Rebholz, C. M. (2018). Coffee Consumption and Incident Kidney Disease: Results From the Atherosclerosis Risk in

Communities (ARIC) Study. *American Journal of Kidney Diseases*, *72*(2), 214–222. https://doi.org/10.1053/j.ajkd.2018.01.030

Iriondo-Dehond, A., Uranga, J. A., Del Castillo, M. D., & Abalo, R. (2021). Effects of coffee and its components on the gastrointestinal tract and the brain–gut axis. In *Nutrients* (Vol. 13, Issue 1, pp. 1–34). MDPI AG. https://doi.org/10.3390/nu13010088

Kearney, P. M., Whelton, M. B., Reynolds, K., Muntner, P., Whelton, P. K., He, J., Muntner, M. P., He, J., Kearney, P. M., Whelton, M., Reynolds, K., Muntner, P., & Whelton, P. K. (2005). Articles Introduction Global burden of hypertension: analysis of worldwide data. In *www.thelancet.com* (Vol. 365). www.thelancet.com

Lopez, A. D., Mathers, C. D., Ezzati, M., Jamison, D. T., & Murray, C. J. (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet*, *367*(9524), 1747–1757. https://doi.org/10.1016/S0140-6736(06)68770-9

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. In *Nature Reviews Nephrology* (Vol. 16, Issue 4, pp. 223–237). Nature Research. https://doi.org/10.1038/s41581-019-0244-2

Miranda, A. M., Goulart, A. C., Benseñor, I. M., Lotufo, P. A., & Marchioni, D. M. (2021). Coffee consumption and risk of hypertension: A prospective analysis in the cohort study. *Clinical Nutrition*, *40*(2), 542–549. https://doi.org/10.1016/j.clnu.2020.05.052

Naqvi, A. Z., Davis, R. B., & Mukamal, K. J. (2014). Nutrient intake and peripheral artery disease in adults: Key considerations in cross-sectional studies. *Clinical Nutrition*, *33*(3), 443–447. https://doi.org/10.1016/j.clnu.2013.06.011

O'Keefe, J. H., Bhatti, S. K., Patil, H. R., Dinicolantonio, J. J., Lucan, S. C., & Lavie, C. J. (2013). Effects of habitual coffee consumption on cardiometabolic disease, cardiovascular health, and all-cause mortality. In *Journal of the American College of Cardiology* (Vol. 62, Issue 12, pp. 1043–1051). Elsevier USA. https://doi.org/10.1016/j.jacc.2013.06.035

Paiva C, Beserra B, Reis C, Dorea JG, Da Costa T, & Amato AA. (2019). Consumption of coffee or caffeine and serum concentration of inflammatory markers: A systematic review. *Crit Rev Food Sci Nutr*, *59*(4), 652–663. https://doi.org/10.1080/10408398.2017.1386159

Poole, R., Kennedy, O. J., Roderick, P., Fallowfield, J. A., Hayes, P. C., & Parkes, J. (2017). Coffee consumption and health: umbrella review of meta-analyses of multiple health outcomes. *BMJ (Clinical Research Ed.)*, *359*, j5024. https://doi.org/10.1136/bmj.j5024

Rodak, K., Kokot, I., & Kratz, E. M. (2021). Caffeine as a factor influencing the functioning of the human body—friend or foe? In *Nutrients* (Vol. 13, Issue 9). MDPI. https://doi.org/10.3390/nu13093088

Rodríguez-Artalejo, F., & López-García, E. (2018). Coffee Consumption and Cardiovascular Disease: A Condensed Review of Epidemiological Evidence and Mechanisms. In *Journal of Agricultural and Food Chemistry* (Vol. 66, Issue 21, pp. 5257–5263). American Chemical Society. https://doi.org/10.1021/acs.jafc.7b04506

Sathi, N. J., Islam, M. A., Ahmed, M. S., & Islam, S. M. S. (2022). Prevalence, trends and associated factors of hypertension and diabetes mellitus in Bangladesh: Evidence from BHDS 2011 and 2017–18. *PLoS ONE*, *17*(5 May). https://doi.org/10.1371/journal.pone.0267243

Shah, S., Cho, I. J., Lee, W., Pyun, W. B., & Ha, E. (2023). Coffee intake and hypertension in Korean adults: results from KNHANES 2012–2016. *Clinical Hypertension*, *29*(1). https://doi.org/10.1186/s40885-023-00239-4

Umemura, T., Ueda, K., Nishioka, K., Hidaka, T., Takemoto, H., Nakamura, S., Jitsuiki, D., Soga, J., Goto, C., Chayama, K., Yoshizumi, M., & Higashi, Y. (2006). Effects of acute

administration of caffeine on vascular function - PubMed. *Am J Cardiol.*, *98*(11), 1538–1541. https://doi.org/10.1016/i.1mjcard.2006.06.058.

van Dam, R. M., Hu, F. B., & Willett, W. C. (2020). Coffee, Caffeine, and Health. *New England Journal of Medicine*, *383*(4), 369–378. https://doi.org/10.1056/nejmra1816604

Wong, T. H. T., Wong, C. H., Zhang, X., Zhou, Y., Xu, J., Yuen, K. C., Wan, J. M. F., & Louie, J. C. Y. (2021). The Association between Coffee Consumption and Metabolic Syndrome in Adults: A Systematic Review and Meta-Analysis. In *Advances in Nutrition* (Vol. 12, Issue 3, pp. 708–721). Oxford University Press. https://doi.org/10.1093/advances/nmaa132

Xie, C., Cui, L., Zhu, J., Wang, K., Sun, N., & Sun, C. (2018). Coffee consumption and risk of hypertension: A systematic review and dose-response meta-Analysis of cohort studies. In *Journal of Human Hypertension* (Vol. 32, Issue 2, pp. 83–93). Nature Publishing Group. https://doi.org/10.1038/s41371-017-0007-0

Zhang, Z., Hu, G., Caballero, B., Appel, L., & Chen, L. (2011). Habitual coffee consumption and risk of hypertension: A systematic review and meta-analysis of prospective observational studies. *American Journal of Clinical Nutrition*, *93*(6), 1212–1219. https://doi.org/10.3945/ajcn.110.004044

Zhou, B., Perel, P., Mensah, G. A., & Ezzati, M. (2021). Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. In *Nature Reviews Cardiology* (Vol. 18, Issue 11, pp. 785–802). Nature Research. https://doi.org/10.1038/s41569-021-00559-8