

# Evaluating the Effectiveness of DASH and Mediterranean Diets in treating Adolescent Hypertension

Belva Biju<sup>1</sup>, Dulce Adeli Lopez-Palacios<sup>#</sup>, Virginia Harvey<sup>#</sup>

<sup>1</sup>Parkview High School, USA

<sup>#</sup>Advisor

## ABSTRACT

The prevalence of pediatric and adolescent hypertension has increased in recent years. Diets such as Mediterranean and DASH (Dietary Approaches to Stop Hypertension) offer non-intrusive ways to reduce hypertension by decreasing sodium and fat intake. Genetic predisposition plays a significant role in hypertension, but lifestyle factors, particularly diet, are more influential in determining the severity and onset of the condition. The review aims to understand the influence of DASH and Mediterranean diets in decreasing systolic blood pressure and diastolic blood pressure in adolescents. We primarily analyzed two studies that conducted dietary interventions in order to assess their effectiveness in lowering blood pressure. Both studies highlighted the potential of dietary interventions, with Couch et al. (2020) focusing on the DASH diet and the Helena study finding a significant association between the Mediterranean diet and blood pressure reduction. Adherence to dietary patterns like the DASH and Mediterranean diets can significantly reduce the risk of heart attacks and strokes later in adulthood for those diagnosed with hypertension in their teenage years.

## **Introduction**

The prevalence of pediatric and adolescent hypertension has increased in recent years from 1.3% in the 1990s to 6% in the 2010s (Pérez-Gimeno et al., 2024). A 6-year cohort study published in 2020, measured the blood pressure of 43,825 pediatric patients across 165 primary care sites over the course of 72 months and compared the blood pressure measurements from 2 consecutive 36 month periods. The study found that 4.3% (1881) children among 43,825 met the criteria for hypertension 3.5% [1515] stage 1, 0.8% [366] stage 2, and 4.9% (2144) met criteria for elevated blood pressure in the first 36 months (Kaelber et al., 2020). A healthy diet can substantially reduce the risk of developing heart disease. Additionally, a study published in 2016 concluded that “A high-quality diet in adolescence is associated with a significantly lower risk of developing at least one clinical risk factor for CVD” (Dahm et al., 2016). Early-life onset of high blood pressure is associated with the development of cardiovascular diseases in adulthood. For adolescents diagnosed with Primary or Secondary Hypertension adjusting their diet can be a form of medical nutrition therapy that can potentially prevent the progression of cardiovascular issues in adulthood.

## Essential hypertension or Primary hypertension

Essential (primary) hypertension occurs when you have abnormally high blood pressure that’s not the result of a medical condition. This form of high blood pressure is often due to obesity, family history, and an unhealthy diet. However, the condition is reversible with medications and lifestyle changes. “Essential hypertension is the most common form of hypertension in adults, and it is recognized more often in adolescents than in younger children.” (Raj

et al., 2011). “According to a research article, approximately 6.16% of adolescents are diagnosed with essential hypertension each year. Increased body mass index and reduced consumption of vegetables and fruits were found to be statistically significant risk factors for hypertension.”(M.R. et al., 2007). Lifestyle changes, particularly diet, play a pivotal role in managing essential hypertension, which is often observed in adolescents and can be treated effectively through non-pharmacological approaches like the DASH and Mediterranean diets.

## *OBESITY*

Adolescent hypertension is widely attributed to the adolescent obesity epidemic. Overweight/obese children and adolescents are more likely to become obese adults with a higher risk of developing chronic, non-communicable diseases, including cardiovascular diseases, type 2 diabetes mellitus, and Arterial Hypertension (AH) (Bricarello et al., 2018). Most studies suggest a strong correlation between body mass index and blood pressure, strongest in those classified as overweight or obese. In a study published in the *Journal of Human Hypertension*, researchers measured blood pressure in 4th graders of a developing country in the African region. They found that the prevalence of elevated BP was 9.1% in both boys and 10.1% in girls. Both systolic and diastolic BP were strongly associated with body mass index (BMI) in boys and in girls (Chioloro et al., 2006).

## *Dietary Influence of Hypertension in Adolescents*

An unhealthy diet, followed by the unregulated intake of macronutrients and imbalance of electrolytes has shown to influence the regulation of high blood pressure in adolescents and adults. “Nutrition is known to exert an undeniable impact on blood pressure with especially salt (sodium chloride), but also potassium, playing a prominent role” (Iqbal, Klammer, Ekmekcioglu et al., 2019). High sodium diets can significantly contribute to the development of high blood pressure. “The ‘salt hypothesis’ is that higher levels of salt in the diet lead to higher levels of blood pressure, increasing the risk of cardiovascular disease” (Freedman and Petitti et al., 2001). Consuming too much salt, usually through processed and packaged foods, causes our bodies to retain more water, which increases the volume of blood in your bloodstream and pressurizes the blood vessel walls raising the blood pressure. Low potassium diets can create an imbalance of sodium in cells and reduce the excretion of sodium through urine therefore increasing blood pressure. Researchers have said, “Concomitant to sodium reduction, higher potassium intake or supplementation has also been repeatedly shown to reduce the blood pressure of especially hypertensive persons.” (Iqbal, Klammer, Ekmekcioglu et al., 2019).

Medical professionals face a big challenge in implementing diets with less intrusive methods. “Both the Mediterranean and DASH diets are rich in fruits, vegetables, cereals, pulses, and nuts, entailing dietary intakes characterised by a low glycaemic load and rich antioxidant content” (Critselis et al., 2002-2012). The Dietary Approaches to Stop Hypertension (DASH Diet) and the Mediterranean (MedDiet) are two popular and effective dietary interventions proven to show antihypertensive effects. DASH consists of the following foods: fruits, vegetables, low-fat milk, whole grains, fish, poultry, beans, and nuts (NIH, U. 2006). The Dash Diet is effective because it recommends reducing sodium, foods and beverages with added sugars, and red meat. DASH diet inclines to limit saturated and trans fat, while increasing the intake of potassium, magnesium, calcium, protein, and fiber, nutrients that control blood pressure. The Mediterranean diet has been associated with beneficial effects on CVD risk factors such as glycaemia, blood pressure and lipid levels (Richardson et al., 2022). Intake of high fat containing foods can cause plaque build up in the arteries this can lead to Atherosclerosis or hardening of the arteries. Even though the Mediterranean diet has a higher fat content it is associated with numerous health benefits including cardiovascular disease prevention and diminished all-cause mortality (Critselis et al., 2020).

## Dietary Approaches to Stop Hypertension (DASH) Diet in adolescents

A clinical trial, which lasted for a span of 18 months and was conducted at the Hypertension Center at Cincinnati Children’s Hospital Medical Center, concluded that there was a greater improvement in systolic blood pressure at the end of the trial for participants who followed the DASH diet. The study proved that the DASH diet was an effective intervention for treating stage 1 hypertension in adolescents. Implementing the DASH diet led to a significant decrease of 5.0 mm Hg in systolic blood pressure and a decrease of 0.6 mm Hg in diastolic blood pressure. “Mean reduction in systolic BP (mm Hg and z-scores) from baseline to 6 months was greater in DASH compared with Regular Course diet participants” (C. Couch et al., 2020). The participants of the study were divided into two groups: one following the DASH diet and the other adhering to a regular course diet. The study was conducted on adolescents ranging from 11 to 18 years old, who received phone calls, face-to-face sessions, a 3-month dietitian consultation, and weekly mailings regarding strategies to follow the DASH diet. The diet plan recommended 1600 calories per day for females aged 11-13, 1800 for females aged 14-18 and males aged 11-13, and 2200 for males aged 14-18. The group of participants who followed the DASH diet were advised to intake fresh fruits and vegetables, moderate amounts of lean meat, low-fat dairy, and nuts and seeds. Table 1 includes the list of food items the participants in the DASH diet were recommended to consume.

**Table 1.** Lists the food items and calorie intake

Food Plan	Female		Male	
	11-13	14-18	11-13	14-18
Age Range, y	11-13	14-18	11-13	14-18
Calories	1600	1800	1800	2200
Servings/d //				
Bread, cereal, rice, and pasta (1 oz)	5	6	6	8
Vegetables (½ cup)	4	5	5	6
Fruit (½ cup)	3	3	3	4
Low-fat dairy (1 cup)	3	3	3	3
Lean meat, poultry	5	6	6	7
Dry beans, nuts, seeds, and eggs (¼ cup)	1	1	1	1
Fats and oils (1 tsp)	2	2	2	2
Sweets and desserts (1 tbsp sugar)	1	1	1	2

From: Dietary approaches to stop hypertension dietary intervention improves blood pressure and vascular health in youth with elevated blood pressure.

### Results

The primary outcome was the change in systolic blood pressure (SBP) and diastolic blood pressure (DBP) from baseline to 6 months and 18 months. The initial blood pressure (systolic/diastolic) of participants was an average of 127.0/77.1 mm Hg. The initial blood pressure for participants who followed the original course diet was measured to be an average of 126.0/75.8 mm Hg. At the end of 6 months, the blood pressure of participants who followed the DASH diet was measured to be an average of 122.8/76.5 mm Hg, while participants who followed the regular course diet at the end of 6 months had an average blood pressure of 124.3/75.1 mm Hg. The participants on the DASH diet experienced a decrease of 5.0 mm Hg in systolic blood pressure at the end of 6 months, which is considered clinically significant. According to the American College of Cardiology, a drop of even 2 mm Hg in blood pressure can significantly reduce the risk of developing heart disease by up to 10%. At the end of the 18-month period, the blood pressure of participants who followed the DASH diet was measured to be an average of 124.6/76.6 mm Hg. The participants who followed the regular course diet at the end of 18 months had an average blood pressure of 125.2/72.4 mm Hg (C. Couch et al., 2021). Even though there was a larger decrease in systolic blood pressure within the first 6 months, a 2.4 mm Hg reduction is still significant compared to the increase in systolic blood pressure in the regular course diet group. Though less substantial, the decrease of 0.5 mm Hg in diastolic blood pressure is still a positive change. The participants who received the DASH diet treatment showed an improvement in their systolic blood pressure, flow-mediated dilation, and a better DASH score (C. Couch et al., 2020). Table 2 provides the differences between systolic and diastolic blood pressure in adolescents following the DASH and regular course diets from baseline to 6 and 18 months.

**Table 2.** Compares the reduction of blood pressure in DASH and Regular course diets

Outcome	Time	Least square means (95% CI)	
		DASH*	Regular Course Diet (RC)
Systolic blood pressure, mm Hg	Baseline	127.0 (124.3 to 129.7)	126.0 (123.1 to 128.8)
	6 mo	122.8 (119.6 to 125.9)	124.3 (121.1 to 127.6)
	18 mo	124.6 (121.5 to 127.8)	125.2 (123.1 to 128.8)
Systolic blood pressure, z-score	Baseline	1.5	1.3
	6 mo	1.0	1.1
	18 mo	1.0	1.0
Diastolic blood pressure, mm Hg	Baseline	77.1 (73.7 to 80.5)	75.8 (72.2 to 79.4)
	6 mo	76.5 (72.9 to 80.1)	75.1 (71.4 to 78.8)
	18 mo	76.6 (72.8 to 80.5)	72.4 (68.4 to 76.4)

Diastolic blood pressure, z-score	Baseline	1.1	0.9
	6 mo	1.0	0.8
	18 mo	0.9	0.5

\*Dietary Approaches to Stop Hypertension. From: Dietary approaches to stop hypertension dietary intervention improves blood pressure and vascular health in youth with elevated blood pressure

Fibromuscular Dysplasia is the narrowing of the arteries due to the abnormal growth of cells in the walls of the carotid arteries. The clinical study also presented improved FMD (Fibromuscular Dysplasia) in adolescents who followed the DASH Diet from baseline to 18 months. Therefore, the study also suggested that the DASH Diet would have a favorable effect on the vascular health of adolescents.

### Mediterranean Diet

Countries of the Mediterranean region, such as Greece and Italy, had lower mortality from cardiovascular disease compared with northern European populations or the US, probably as a result of different eating habits (Rees et al., 2019). Sub-studies of the PREDIMED trial indicate that a Mediterranean diet supplemented with olive oil or nuts leads to reductions in SBP by 5.8–7.3 mmHg and DBP by 3.3–3.4 mmHg in adults compared to a low-fat control diet (Kozioł-Kozakowska et al., 2024).

The Helena study is a large European cohort study designed to examine the influence of lifestyle factors, including diet, on cardiovascular health in adolescents aged 12.5 to 17.5 years across 10 European cities. The Helena study found that adolescents who followed the Mediterranean diet showed reduced BP levels (Pérez-Gimeno et al., 2024). It specifically aimed to assess the impact of the Mediterranean diet on blood pressure levels in this population. The researchers used a scoring system to track adherence to the Mediterranean diet based on the consumption of foods such as fruits, vegetables, fish, and olive oil. They then analyzed the relationship between adherence to the Mediterranean diet and systolic/diastolic blood pressure.

### Results

Their study showed that for each point increase in the MDS (Mediterranean diet score), a protective effect was observed in both z-SBP (systolic blood pressure) ( $\beta = -0.4$ ) and z-DBP (diastolic blood pressure) ( $\beta = -0.29$ ). Table X shows the associations between MDS and both SBP and DBP z-scores, mediated by the interaction between MDS and BP (Pérez-Gimeno et al., 2024). Table 3 shows the reduction of systolic and diastolic blood pressure between males and females.

**Table 3.** Lists the reduction in systolic and diastolic z scores of blood pressure

	Mediterranean Diet Score	
	Beta	p-value
All Participants		
z-SBP*	- 0.40	< 0.001

z-DBP <sup>^</sup>	- 0.29	< 0.001
Male		
z-SBP	- 0.57	< 0.001
z-DBP	- 0.37	0.001
Female		
z-SBP	- 0.32	0.003
z-DBP	- 0.44	< 0.001

SBP\*(Systolic blood pressure)

DBP<sup>^</sup>(Diastolic blood pressure)

From: Interplay of the Mediterranean diet and genetic hypertension risk on blood pressure in European adolescents:

### Findings from the HELENA study

The EHDLA (Eating Healthy and Daily Life Activities) study, conducted on 12 to 17-year-olds living in Valle de Ricote, concluded that “adolescents with low or moderate adherence to the MD were more likely to present high-normal BP or hypertension than those who had high adherence to that dietary pattern” (Mesas et al., 2022). In the study, it was observed that those who reported high adherence to the MD diet and took a regular daytime nap were 42–46% less likely to present high BP or hypertension than those who did not comply with these behaviors. Their results were consistent with studies carried out in adolescents from other countries. This concludes that Mediterranean-style eating patterns can reduce cardiovascular risk factors, even in younger populations.

The Mediterranean diet focuses on plant-based foods and healthy fats such as fruits, vegetables, beans, nuts, and lentils. Olive oil, fish, and low-fat dairy are the primary sources of healthy fats. Choosing poultry, fish, and beans over red meat, which contains high saturated fat content, decreases the risk of high blood pressure.

## Discussion

The DASH diet is an effective method to decrease hypertension in adolescents due to the decrease of 5.0 mm Hg seen in the DASH diet participants. The negative association between Mediterranean diet scores and systolic and diastolic blood pressure in the participants from the HELENA study upholds the Mediterranean diet as a sustainable method to treat hypertension.

## Conclusion

In conclusion, both the DASH and Mediterranean diets demonstrate promising potential as effective, non-pharmacological interventions for managing hypertension in adolescents. Evidence from various studies, including the clinical trials conducted by Couch et al. (2020) and the Helena study, highlights the positive effects of these dietary patterns in reducing blood pressure among adolescents with hypertension. While dietary changes are essential, it is equally important to include physical activity, weight, and stress management in order to achieve satisfactory results in the reduction of both systolic and diastolic blood pressure. Ultimately, adopting dietary strategies such as the DASH

and Mediterranean diets can provide adolescents with a non-intrusive means of managing hypertension and improving overall health.

## Limitations

Despite the positive results, several limitations in the existing research need to be addressed. One limitation of the Helena study, which examined the association between the Mediterranean diet, genetic risk, and blood pressure in adolescents, as well as the randomized controlled trial at the Hypertension Center at Cincinnati Children's Hospital Medical Center assessing the effects of DASH diet in adolescence, is that their studies were short-term. Both studies lasted less than 3 years, making it difficult to draw definite conclusions about the sustained benefits of these diets. While the studies still provide valuable insights into the initial effects of the interventions, future research should consider extending the follow-up period to better understand the long-term effects of both DASH and Mediterranean dietary interventions.

Another limitation is that the limited number of studies are conducted on adolescents with hypertension, assessing the effects of DASH and Mediterranean diets. Most research on dietary interventions for hypertension has primarily focused on adults, creating a gap in understanding the effectiveness of these interventions in younger populations. As a result, there is limited reliability regarding the specific impacts of the Mediterranean (MED) diet and the DASH diet on adolescents with hypertension. More research specifically targeting adolescents is needed to better understand how these dietary patterns affect blood pressure and overall cardiovascular health in this age group.

## Acknowledgments

I would like to thank Ms. Harvey for advising and helping us throughout the research.

## References

- Pérez-Gimeno, G., Seral-Cortes, M., Sabroso-Lasa, S., Esteban, L. M., Widhalm, K., Gottrand, F., Stehle, P., Meirhaeghe, A., Muntaner, M., Kafatos, A., Gutierrez, A., Manios, Y., Anastasiou, C. A., Gonzalez-Gross, M., Breidenassel, C., Censi, L., de Henauw, S., Labayen, I., Bueno-Lozano, G., Rupérez, A. I., ... Moreno, L. A. (2024). Interplay of the Mediterranean diet and genetic hypertension risk on blood pressure in European adolescents: Findings from the HELENA study. *European journal of pediatrics*, *183*(5), 2101–2110. <https://doi.org/10.1007/s00431-024-05435-4>
- Kaelber, D. C., Localio, A. R., Ross, M., Leon, J. B., Pace, W. D., Wasserman, R. C., ... & Fiks, A. G. (2020). Persistent hypertension in children and adolescents: a 6-year cohort study. *Pediatrics*, *146*(4). <https://publications.aap.org/pediatrics/article/146/4/e20193778/79660/Persistent-Hypertension-in-Children-and>
- Dahm, C. C., Chomistek, A. K., Jakobsen, M. U., Mukamal, K. J., Eliassen, A. H., Sesso, H. D., ... & Chiuve, S. E. (2016). Adolescent diet quality and cardiovascular disease risk factors and incident cardiovascular disease in middle-aged women. *Journal of the American Heart Association*, *5*(12), e003583. <https://www.ahajournals.org/doi/full/10.1161/JAHA.116.003583>
- Raj M. (2011). Essential hypertension in adolescents and children: Recent advances in causative mechanisms. *Indian journal of endocrinology and metabolism*, *15 Suppl 4* (Suppl4), S367–S373. <https://doi.org/10.4103/2230-8210.86981>

- Savitha, M. R., Krishnamurthy, B., Fatthepur, S. S. R., Yashwanth Kumar, A. M., & Khan, M. A. (2007). Essential hypertension in early and mid-adolescence. *The Indian Journal of Pediatrics*, *74*, 1007-1011  
<https://link.springer.com/article/10.1007/s12098-007-0185-9>
- Bricarello, L. P., Poltronieri, F., Fernandes, R., Retondario, A., de Moraes Trindade, E. B. S., & de Vasconcelos, F. D. A. G. (2018). Effects of the Dietary Approach to Stop Hypertension (DASH) diet on blood pressure, overweight and obesity in adolescents: A systematic review. *Clinical nutrition ESPEN*, *28*, 1-11.  
<https://www.sciencedirect.com/science/article/abs/pii/S2405457718304571>
- Chiolero, A., Madeleine, G., Gabriel, A. *et al.* Prevalence of elevated blood pressure and association with being overweight in children of a rapidly developing country. *J Hum Hypertens* *21*, 120–127 (2007).  
<https://doi.org/10.1038/sj.jhh.1002125>
- Iqbal, S., Klammer, N., & Ekmekcioglu, C. (2019). The Effect of Electrolytes on Blood Pressure: A Brief Summary of Meta-Analyses. *Nutrients*, *11*(6), 1362. <https://doi.org/10.3390/nu11061362>
- Freedman, D. A., & Petitti, D. B. (2001). Salt and blood pressure: conventional wisdom reconsidered. *Evaluation Review*, *25*(3), 267-287.  
<https://portlandpress.com/clinsci/article-abstract/117/1/1/77704/Salt-and-high-blood-pressure>
- Critselis, E., Kontogianni, M. D., Georgousopoulou, E., Chrysohoou, C., Tousoulis, D., Pitsavos, C., & Panagiotakos, D. B. (2021). Comparison of the Mediterranean diet and the Dietary Approach Stop Hypertension in reducing the risk of 10-year fatal and non-fatal CVD events in healthy adults: the ATTICA Study (2002-2012). *Public health nutrition*, *24*(9), 2746–2757. <https://doi.org/10.1017/S136898002000230X>
- NIH, U. (2006). Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, Your guide to lowering your blood pressure with DASH. DASH eating plan. *DASH eating plan*.
- Richardson, L. A., Izuora, K., & Basu, A. (2022). Mediterranean Diet and Its Association with Cardiovascular Disease Risk Factors: A Scoping Review. *International journal of environmental research and public health*, *19*(19), 12762. <https://doi.org/10.3390/ijerph191912762>
- Couch, S. C., Saelens, B. E., Khoury, P. R., Dart, K. B., Hinn, K., Mitsnefes, M. M., ... & Urbina, E. M. (2021). Dietary approaches to stop hypertension dietary intervention improves blood pressure and vascular health in youth with elevated blood pressure. *Hypertension*, *77*(1), 241-251. <https://pubmed.ncbi.nlm.nih.gov/33190559/>
- Rees, K., Takeda, A., Martin, N., Ellis, L., Wijesekara, D., Vepa, A., ... & Stranges, S. (2019). Mediterranean-style diet for the primary and secondary prevention of cardiovascular disease. *Cochrane Database of Systematic Reviews*, (3). <https://pubmed.ncbi.nlm.nih.gov/30864165/>
- Kozioł-Kozakowska, A., Wójcik, M., Herceg-Čavrak, V., Cobal, S., Radovanovic, D., Alvarez-Pitti, J., Hartgring, I., Piórecka, B., Gabbianelli, R., & Drożdż, D. (2024). Dietary Strategies in the Prevention and Treatment of Hypertension in Children and Adolescents: A Narrative Review. *Nutrients*, *16*(16), 2786.  
<https://doi.org/10.3390/nu16162786>

Mesas, A. E., Jimenez-López, E., Martínez-Vizcaíno, V., Fernández-Rodríguez, R., Bizzozero-Peroni, B., Garrido-Miguel, M., Cavero-Redondo, I., & López-Gil, J. F. (2022). Are adherence to the Mediterranean diet and siesta individually or jointly associated with blood pressure in Spanish adolescents? Results from the EHDLA study. *Frontiers in public health*, *10*, 934854. <https://doi.org/10.3389/fpubh.2022.934854>