Accepted Manuscript
Version of Record at: https://doi.org/10.1093/ajh/hpad098

Factors Associated with Antihypertensive Therapy Prescription in Youth Delaware Medicaid Recipients with Primary Hypertension Diagnosis

Carissa M. Baker-Smith, MD MPH MS[1,4] (ORCID: 0000-0002-7528-1586)

Mary J. McDuffie, MA[2]

Erin P. Nescott, MS[2]

Robert E. Akins, PhD[3,4] (ORCID 0000-0001-9706-0752)

[1]Cardiovascular Research and Innovation Program, Nemours Cardiac Center, Nemours Children's Health, Wilmington, Delaware

[2]Center for Community Research & Service, University of Delaware Biden School of Public Policy and Administration, University of Delaware; Newark, Delaware, USA

[3]Center for Pediatric Clinical Research and Development, Nemours Children's Health, Wilmington, Delaware

[4]Nemours Children's Health, Delaware; Wilmington, Delaware, USA

Address for correspondence: Carissa M. Baker-Smith, MD MPH MS FACC FAHA FAAP

Associate Professor of Pediatrics (Pediatric Cardiology)

Director of Pediatric Preventive Cardiology Program

Co-Director of Nemours Cardiac Center Cardiovascular Research and Innovation Program

Nemours Children's Health Wilmington; Wilmington, Delaware

Carissa.baker-smith@nemours.org

1600 Rockland Road

Wilmington, Delaware 19803

302-651-6600 (phone)

302-651-5345 (fax)

Twitter: carissabakersm1

Abbreviations and Acronyms:

ACE= Angiotensin-converting enzyme

ACEI= Angiotensin-converting enzyme inhibitor

ADI= Area deprivation index

ARB= Angiotensin receptor blocker

BB= Beta blocker

BP= Blood pressure

CCB= Calcium channel blocker

CCRS= Center for Community Research and Service

DASH= Dietary Approaches to Stop Hypertension

DMMA= Division of Medicaid and Medical Assistance

GIS= Geographic information systems

HTN= Hypertension

ICD= International classification of diseases

NHANES=National Health and Nutrition Examination Survey

NHB= Non-Hispanic Black

NHW= Non-Hispanic White

SES= Socioeconomic status

Abstract:

Background: Higher neighborhood deprivation is associated with hypertension diagnosis in youth. In this study, we assess if there is an association between neighborhood deprivation and anti-hypertensive therapy prescription among insured youth with a primary hypertension diagnosis.

Methods: Using a retrospective cross-sectional design, we assessed the proportion of youth with a diagnosis of primary hypertension prescribed anti-hypertensive therapy. We evaluated the proportion of youth prescribed anti-hypertensive therapy and compared prescribing patterns by area deprivation index, age, sex, obesity diagnosis, race, ethnicity, and duration of Medicaid coverage.

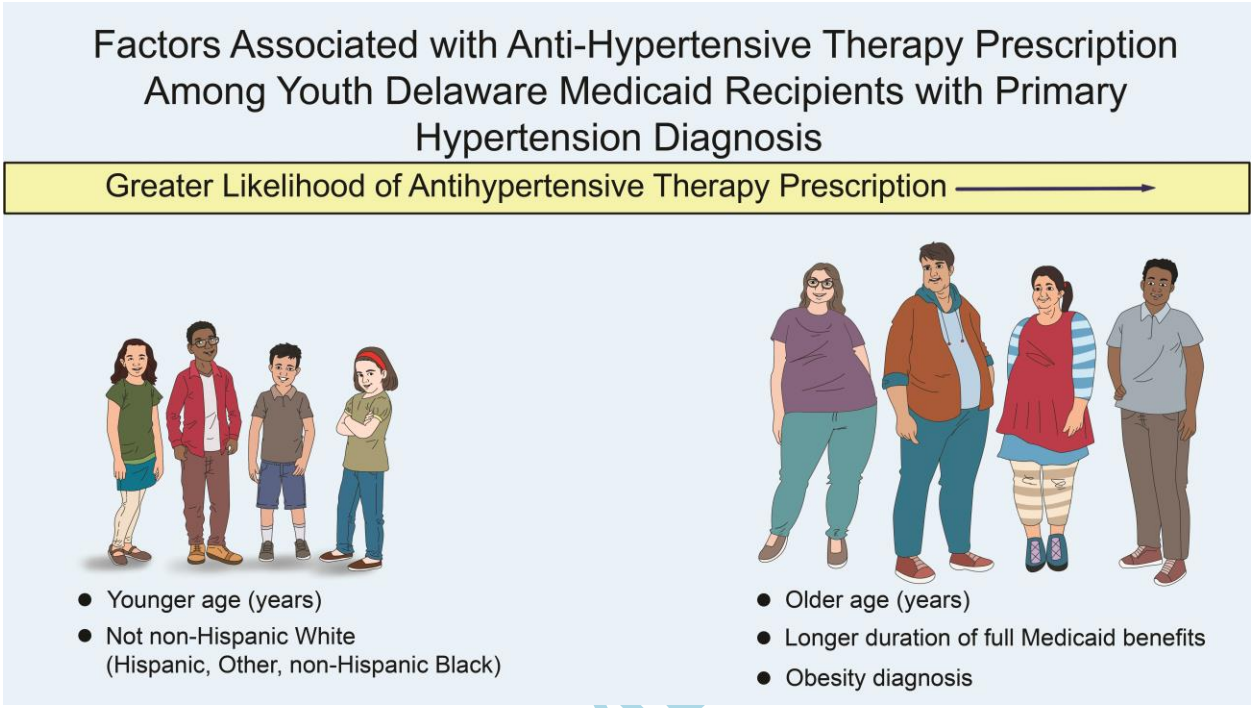
Results: Of the 65452 non-pregnant Delaware Medicaid recipients, 8 to 18 years of age, 1145 (1.7%) had an ICD-9/ICD-10 diagnosis of primary hypertension; 165 of the 1145 (14%) were prescribed anti-hypertensive therapy. Factors associated with a greater odds of prescription by multivariable logistic regression were age, obesity diagnosis, and duration of Medicaid full benefit coverage. Odds of anti-hypertensive therapy prescription did not vary by race, ethnicity or by area deprivation index.

Conclusions: Anti-hypertensive therapy prescription rates are poor despite national guideline recommendations. Among youth receiving Delaware Medicaid between 2014 and 2019, prescription proportions were highest among youth of older age, with an obesity diagnosis, and among youth with longer duration of Medicaid benefit coverage. Although high area deprivation has been shown to be associated with the diagnosis of hypertension, high vs low area deprivation was not associated with greater anti-hypertensive therapy prescription among youth with primary hypertension. Our finding of a mismatch between hypertension diagnosis and anti-hypertensive therapy prescription highlights a potential disparity in anti-hypertensive therapy prescription in youth.

Key Words: area deprivation, pediatrics, hypertension, anti-hypertensive medication, Medicaid

Accepted Manuscript
Version of Record at: https://doi.org/10.1093/ajh/hpad098

Graphical abstract



Introduction:

Reducing the burden of hypertension is a multi-step process that requires diagnosis followed by equitable initiation of guideline directed therapy.[1] Lifestyle intervention is the first recommended step for managing hypertension in youth and adoption of a healthier lifestyle can result in a decrease in measured blood pressure.[2-4] However, lifestyle intervention alone is not effective in all persons. In a large retrospective cohort study of 7 health care organizations, 5.6% of hypertensive youth had persistent hypertension and met criteria for antihypertensive therapy prescription despite attempted lifestyle intervention.[5]

Reported factors associated with antihypertensive therapy prescription in youth include White race, older age and obesity.[6] However, we know that social determinants of health (SDoH) drive 80% of population health outcomes[7] and yet no studies to date have examined the relationship between SDoH in youth and antihypertensive therapy prescription.

In our recently published study, we found that, in addition to factors such as age, sex, obesity diagnosis, and duration of Medicaid benefit coverage, higher area deprivation (area deprivation index at or above the state's upper quartile) was associated with hypertension diagnosis among Delaware Medicaid recipients 8 to 18 years of age.[8] Higher neighborhood level deprivation may therefore contribute to a higher burden of hypertension in youth. Effective treatment is needed to reduce the immediate and potential long-term complications of hypertension beginning in youth. In this study, we assess the relationship between area deprivation at the Census block group level and anti-hypertensive therapy prescription. We also assess the relationship between age, sex, obesity status, and duration of Medicaid benefit coverage and antihypertensive therapy prescription among youth Delaware Medicaid recipients with provider diagnosed primary hypertension.

Materials and Methods:

We performed a cross-sectional analysis of data from Delaware Medicaid recipients, collected between 2014 and 2019. The Nemours Children's and University of Delaware (UD) institutional review boards approved study activities. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline.

Cohort: We analyzed medical claims, eligibility, and client data. The Delaware Division of Medicaid and Medical Assistance (DMMA) supplies weekly data updates to the UD Center for Community Research and Service (CCRS).

The CCRS accesses data for research and uses internal procedures to safeguard the data. CCRS policy scientists (EN, MJM) coded and supplied aggregate data to the primary investigator (C.M.B.-S.).

Study Population: Age of the patients included age at the end of the Medicaid enrollment year. We selected youth 8 to 18 years similar to a previously published study,[9] due to reports of higher prevalence of HTN among 8 and 9 year old youth.[10] We included youth with at least one provider visit (inpatient, outpatient, or emergency department) and at least 1 month of full Medicaid insurance coverage between 2014 and 2019. We excluded pregnant youth using 388 pregnancy codes specified by the Office of Population Affairs.[11]

We did not include provider counts because providers are sometimes identified by their own unique provider ID and sometimes by a practice ID. Therefore, due to the nature of the source data, we were unable to accurately determine the number of providers or practices prescribing antihypertensive therapy. We were also unable to assess whether provider practice area deprivation was associated with antihypertensive therapy prescription.

Outcomes: The primary outcome was receipt of an antihypertensive agent. Antihypertensive agents were described by class, including angiotensin receptor blockers (ARBs), angiotensin-converting enzyme inhibitors (ACEI), beta blockers (BBs), calcium channel blockers (CCBs), and diuretics. Antihypertensive therapy prescribing patterns were characterized as single-agent class (e.g., a prescribed medication from a single antihypertension medication class), multiple classes (e.g., receipt of multiple single-agent class medications) and combined-class agent (e.g., multiple antihypertensive classes in a single prescribed agent).

Independent Variables:

Primary hypertension was defined as a diagnosis of hypertension by ICD-9/-10 exclusive of a secondary hypertension diagnosis. We excluded secondary diagnoses as these conditions tend be less common[12] and present before the age of 6 years.[1] We also excluded secondary causes (e.g., chronic kidney disease) since indications for treatment of secondary hypertension often vary from indications for the treatment of primary hypertension.[1] For a detailed description of the ICD-9/-10 codes used to identify youth with primary hypertension, please see our prior publication.[8]

Area Deprivation Index (ADI): Each patient's primary enrollment address, at the time of first health care visit between 2014-2019, was geocoded using ArcGIS 10.8.1. This Census block group geocode was then used to link each participant with their 2014-2019 American Community survey national ADI value by Census block group.[13, 14]

Updated every 5 years, the ADI is a composite index of 17 variables used to describe the socioeconomic status (SES) of the community in which one lives. It is based upon weighted US Census data and is not determined by race, ethnicity, or individual SES. It provides a *geo-spatial* description of neighborhood deprivation and ranks area deprivation at the Census block group level (e.g., neighborhood) from 1 to 100 where ADI=100 represents the most deprived communities.

Data for the ADI is obtained from the American Community Survey.[14] Delaware's median national ADI is 38, the lower quartile is 25 and upper quartile is 52.[15] In this analysis we characterized ADI as a continuous variable but also separately analyzed the relationship between antihypertensive therapy prescription and ADI as a categorical outcome variable. We selected a dichotomous predictor variable of ADI $\geq$ 50 (=1) vs ADI < 50 (=0). ADI of 50 was selected as a representation of the national ADI at and above the state's upper quartile.

Obesity diagnosis was ascertained using ICD-9 278.00, 278.01, and ICD-10 codes E66* (obesity). All youth with obesity had a Z-code for BMI greater than the 95th percentile or Z-code for BMI 30 and above (Z68.30-45). Any child with a Z-code for BMI greater than the 95th percentile also had an ICD-9 or ICD-10 code for obesity.

Patient demographic characteristics (sex, race/ethnicity, and age) as described in the pooled Medicaid dataset were included in the analysis. Self-reported race/ethnicity was categorized as non-Hispanic Black (NHB), non-Hispanic White (NHW), Hispanic and Other. Due to small individual subgroup sample size, youth with race/ethnicity described as "Hawaiian," "Indian or Alaskan," "Native American," "Other, not Hispanic," or "Pacific Islander" were categorized as "Other."

Given that the source of data for this analysis was Medicaid data, we added a variable for duration of full Medicaid benefit coverage. Our hypothesis was that clients who were not in receipt of Medicaid for the entire study period would have less of a chance to be treated for their hypertension. This potential impact is called the "churn"impact.[16]

Statistical Analysis: We evaluated demographic variables using chi-squared tests for comparison of categorical variables and Wilcoxon Rank sum for comparison of medians (2-sided null hypothesis at a priori significance level

of $p<.05$). In accordance with Centers or Medicare and Medicaid Services (CMS), no cell containing a value of 1 to 10 or cell that allows a value of 1 to 10 be derived from other reported cells was reported.[17] We modeled all first order independent variables and second-order terms using a forward selection approach. Cases with missing values were excluded from the logistic regression model. We ensured model fit using Goodness of Fit tests (Deviance, Pearson, and Hosmer and Lemeshow). All statistical analyses were carried out using SAS 9.4 (Chapel Hill, NC). Receiver operator characteristic curve analysis was performed and area under the ROC curve calculated for the final model.

Results:

Youth with Hypertension Prescribed Anti-Hypertensive Therapy: Of 65452 non-pregnant 8–18-year-old Delaware Medicaid recipient youth with geocoded addresses, 1145 (1.7%) received a diagnosis of primary hypertension. Among the 1145 youth with primary HTN, 165 (14%) were prescribed at least 1 anti-hypertensive therapy while 980 (86%) were not. Youth who received at least 1 anti-hypertensive therapy had a median age of 15 years (IQR: 13,17), 102 (62%) were male, 112 (68%) had obesity diagnosis, 22 (13%) were of Hispanic ethnicity, 72 (44%) were non-Hispanic-White, the median ADI was 51 (IQR: 38, 61), and the median duration of Medicaid coverage was 70 (IQR 56,72). Among youth with primary HTN diagnosis who did not receive antihypertensive therapy, the median age was 13 years (IQR: 11, 15), 579 (59%) were male, 593 (61%) had obesity diagnosis, 249 (25%) were of Hispanic ethnicity, 324 (33%) were non-Hispanic White, the median ADI was 51 (39, 65) and the median duration of Medicaid coverage was 69 months (IQR: 53,72) (Table 1). Subgroup analyses revealed a younger age (12 years (IQR: 10,14) vs 14 years (IQR: 11, 16); $p<0.0001$) among Hispanic youth vs non-Hispanic youth who were not prescribed antihypertensive therapy (Supplemental Table 1). Non-Hispanic-White youth who were not prescribed antihypertensive therapy were slightly older than the remaining population of hypertensive youth who were not prescribed antihypertensive therapy (median 14 years (IQR: 11.5, 16) vs median 13 years (IQR: 11,15), $p=0.0009$). When we compared the proportion of Hispanic youth with and without obesity who did not receive antihypertensive therapy, Hispanic youth with obesity (vs without obesity) were more likely not to receive antihypertensive therapy prescription (71% vs 29%, $p<0.0001$) with an odds ratio of 1.6 (95% CI: 1.2-2.0) (Supplemental Table 2). Similarly, when we compared the proportion of Non-Hispanic White youth vs non- Non-Hispanic White youth, with and without obesity, who did not receive antihypertensive therapy, a greater proportion of the non-Non-Hispanic White (e.g., Black, other, Hispanic) with obesity were likely not to receive antihypertensive therapy (64% vs 36%,

p=0.0035) with an odds ratio of 1.15 (95% CI: 1.04-1.26) while the odds ratio was 0.77 (95%CI: 0.64-0.91) among non-Hispanic White youth with obesity (Supplemental Table 2). Additional figures demonstrating the association between race, ethnicity, obesity status and ADI can be found in Supplemental Figures 1-4.

Employing multivariable logistic regression analysis, a best fit logistic regression model with receiver operative characteristic curve (ROC) C-statistic of 0.71 was selected. According to this adjusted model, age, obesity diagnosis, and duration of Medicaid coverage were the only factors associated with a greater odds of antihypertensive therapy prescription. Second-order terms were not significant (e.g., age*Hispanic ethnicity, etc.). For each additional year of age there was a 31% greater odds of antihypertensive therapy prescription (OR 1.31, 95% CI 1.21, 1.41; *P<0.0001*). Similarly, obesity diagnosis was associated with a 56% greater odds (OR 1.56, 95% CI 1.08, 2.25; *p=0.019*) and for each added month of Medicaid benefit coverage there was 2% greater odds (OR 1.02, 95% CI 1.01, 1.03; *p= 0.0039*) of antihypertensive therapy prescription (Table 2). ADI was not associated with antihypertensive therapy prescription (data not shown).

Youth were predominantly prescribed a single-agent class antihypertensive (N=157, 95%). The most common class of antihypertensive therapy prescribed was an ACEI (N=95), followed by diuretic (N=67), BB (N=43), or ARB (N=29). Due to the small cell count, we were unable to report the number of recipients who received CCBs. While most youth received a single-agent class pill, some received multiple single-agent class pills (N=57) and an even smaller number received a combined-class-agent pill (N=27) (e.g., lisinopril-hydrochlorothiazide) (Figure 1).

Discussion:

Our findings are unique in that this is the first study to assess the relationship between neighborhood deprivation and antihypertensive therapy prescription among youth with a diagnosis of primary hypertension. Currently, there are limited published studies evaluating the relationship between area deprivation and anti-hypertensive therapy prescription. The authors located a single study that found that adults living within areas of highest deprivation within Hungary were more likely to receive prescription anti-hypertensive therapy.[18] Our findings suggest the opposite and highlight potential differences in the relationship between community deprivation and antihypertensive therapy prescription in youth vs in adults. Findings from our work are important because they highlight that while youth who live within higher deprivation neighborhoods are more likely to be diagnosed with primary

hypertension,[8] higher neighborhood deprivation is not associated with a greater odds of antihypertensive therapy prescription. Antihypertensive therapy prescription was associated with older age, obesity diagnosis and duration of full Medicaid benefit coverage (Central Illustration).

National guidelines recommend lifestyle intervention as an initial treatment for most youth with hypertension.[1] However, youth living within high deprivation communities may have less opportunity to reduce their blood pressures via lifestyle intervention. Higher neighborhood level deprivation has been associated with poorer access to healthy food options and safe places to exercise.[19, 20] While no studies have specifically assessed the relationship between uptake of healthy diet and exercise among hypertensive youth living within higher deprivation communities, it is likely that poorer access to higher quality foods and safe places to exercise pose a limitation to the effective uptake of a healthy lifestyle to reduce blood pressure; thus making prescription of antihypertensive therapy a necessary next step.

Rates of antihypertensive therapy prescription were low in our study, supporting previously published findings.[5, 6] Within the state of Michigan, only 23% of sampled youth with primary hypertension were prescribed 1 or more antihypertensive agents.[6] Similar to this previously published study, we identified low rates of antihypertensive therapy prescription amongst all youth, including amongst those with a greater likelihood of hypertension, living within more deprived neighborhoods. Given the potential ineffective response to lifestyle intervention, low overall reported rates of antihypertensive prescription and lack of increased odds of antihypertensive therapy prescription among youth residing within high deprivation neighborhoods, our study suggests that there is a mismatch between hypertension diagnosis and antihypertensive therapy prescription, particularly among youth living within high deprivation communities.

However, not all youth in our study were less likely to receive antihypertensive therapy. Like previously published studies,[6] we found that greater duration of Medicaid benefit coverage (e.g., insurance coverage) was associated with an increased odds of antihypertensive therapy prescription. According to National Health and Nutrition Examination Survey (NHANES) 2003 to 2012 data, a study of 8796 hypertensive adults found that individuals were more likely to receive antihypertensive therapy if insured and were at a much lower odds of receiving anti-hypertensive

pharmacologic therapy if uninsured.[21] Given that Medicaid continuous coverage ended March 31, 2023,[22] future studies may want to assess the relationship between continuous Medicaid coverage and antihypertensive therapy prescription rates, including prescription rates in youth.

Future studies will also need to assess barriers to anti-hypertensive therapy prescription. Potential barriers such as loss of follow-up between the diagnosing and prescribing visits, negative parental response to recommendations for antihypertensive therapy prescription and provider reluctance to prescribe antihypertensive therapies all represent potential barriers. It is possible that providers may be unsure of when to prescribe and parents unsure of when to accept pharmacologic therapies in children with hypertension. Knowledge regarding how to prescribe such therapies represent an additional barrier. A randomized multisite controlled trial that included interviews of 8 community health center pediatric providers offers useful insight into the potential barriers impacting antihypertensive therapy prescription. Providers said: "*I do not feel comfortable at all in managing it (HTN) in terms of medication management, so I have never started a child on any ACE [angiotensin-converting enzyme] inhibitor or any other antihypertensive agent on my own. I typically talk to families about weight reduction. I talk about exercise and kind of nonpharmacologic measures to treat the hypertension."* [23] Greater knowledge of the many FDA approved anti-hypertensive therapeutic options for the management of hypertension in youth may be needed.[24-26]

Obesity diagnosis, like duration of Medicaid coverage, was associated with a greater likelihood of antihypertensive therapy prescription. This finding was consistent with previously published studies[6] and suggests a possible persistence in blood pressure elevation among youth with obesity despite attempted lifestyle intervention. The finding of an association between obesity diagnosis and greater odds of antihypertensive therapy may reflect higher attrition rates among youth with obesity recommended for lifestyle intervention.[27] Greater provider recognition of the presence of hypertension among youth with obesity may also explain the association between obesity diagnosis and antihypertensive therapy prescription in our study.[28]

Rates of multi-antihypertensive therapy prescription were slightly lower than the lead author's previously published findings.[29] Ninety-five percent of the 165-youth prescribed antihypertensive therapy were prescribed a single-class anti-hypertensive agent and only (N=57) 35% were prescribed 2 or more single-class antihypertensive agents

(Figure 1). However, like previously published findings, prescribed antihypertensive agents were predominantly inhibitors of the renin angiotensin-aldosterone system (e.g., ACE inhibitors). Twenty-seven patients were prescribed a combination pill in this study.

Finally, it is important to note that we did find that ethnicity and race were associated with differences in anti-hypertensive therapy prescribing practices within our population of Medicaid recipients. Subgroup analyses revealed that associations between Hispanic ethnicity and Non-Hispanic White race and antihypertensive therapy prescription were explained by differences in age. We found that Non-Hispanic White youth who were not prescribed antihypertensive therapy were slightly older. The reason for this association is unknown and deserves further consideration. One possibility is greater reluctance to begin antihypertensive therapy in this group. We also found that the proportion of Hispanic and non-Non-Hispanic White youth (Hispanic, Other, Non-Hispanic Black) with obesity who were not prescribed antihypertensive therapy was significantly greater (Supplemental Table 2). Hispanic youth with obesity had a 60% greater odds of not receiving antihypertensive therapy compared to Hispanic youth without obesity while non-Non-Hispanic-White youth with obesity had a 15% greater odds of not receiving antihypertensive therapy compared to non-Non-Hispanic-White youth without obesity. Our findings suggest under-prescribing of antihypertensive therapy amongst higher risk groups (e.g., Hispanic and non-Non-White youth with obesity).

In conclusion, attenuating the burden of cardiovascular disease in later life begins with addressing risk and treating disease during childhood and adolescence. In our study, we found that antihypertensive prescription among Medicaid recipient youth is poo. Further studies are needed to understand the barriers to antihypertensive therapy prescription, especially within high-risk populations.

Limitations: Our study has several important limitations. First, only 1.7% of the population was diagnosed with hypertension, however more recent estimates of the prevalence of HTN in youth cite a prevalence of primary hypertension of as low as 2%. Second, we did not determine how many providers prescribed antihypertensive therapy. We agree that information about the number of providers or practices prescribing antihypertensive therapy in youth might inform individual provider level comfort with antihypertensive therapy prescription and potentially

reflect practice policy. However, addresses of providers in the Medicaid dataset are not always linked to a facility and regardless of location of the practice or provider specialty, greater understanding of the factors associated with higher vs lower rates of antihypertensive therapy prescription in youth is needed. Third, we report anti-hypertensive prescription but not anti-hypertensive therapy use. The goal of the study was not to assess adherence to treatment but potential barriers to treatment initiation. An additional limitation of this study is that it is unclear the percentage of patients who responded to lifestyle intervention, who truly had white coat hypertension, measurement error, refused pharmacologic intervention or were not yet prescribed anti-hypertensive therapy. Finally, data for this study was acquired from a Medicaid dataset. There may be inherent concerns about use of an administrative dataset to identify youth with hypertension. However, it has been shown that administrative datasets can be used to identify patients with hypertension.[30] Despite its limitations, our study is an important step in understanding disparities in hypertension management in youth.

Acknowledgements: The authors would like to thank the Delaware INBRE Medicaid program and the Delaware Division of Medicaid and Medical Assistance.

FUNDING: *"Access to health care claims data was supported by an award from the Institutional Development Award (IDeA) from the National Institute of Health's National Institute of General Medical Sciences under grant number P20GM103446"* Delaware INBRE Core Access Awardee (PI: Baker-Smith)

DISCLOSURE: Dr. Baker-Smith was the epidemiologist and a lead author of the 2017 American Academy of Pediatrics Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. The authors have no other disclosures.

DECLARATIONS

Availability of data and material: Individual data cannot be shared as data is protected by the Division of Medicaid and Medical Assistance (DMMA).

Code available upon request.

Authors' contributions:

Mss. McDuffie and Nescott had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Baker-Smith

Acquisition, analysis, or interpretation of data: Baker-Smith, McDuffie, Nescott, Akins

Drafting of the manuscript: Baker-Smith

Critical revision of the manuscript for important intellectual content: Baker-Smith, McDuffie, Nescott, Akins

Statistical analysis: McDuffie, Nescott

Obtained funding: Baker-Smith

Administrative, technical, or material support: Baker-Smith, McDuffie, Nescott, Akins.

Supervision: Baker-Smith, Akins

Ethics approval. The Nemours Children's and University of Delaware (UD) institutional review boards approved study activities.

Consent to take part not applicable due to use of deidentified data.

REFERENCES:

1. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, de Ferranti SD, Dionne JM, Falkner B, Flinn SK, Gidding SS, Goodwin C, Leu MG, Powers ME, Rea C, Samuels J, Simasek M, Thaker VV and Urbina EM. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017;140.
2. Couch SC, Saelens BE, Khoury PR, Dart KB, Hinn K, Mitsnefes MM, Daniels SR and Urbina EM. Dietary Approaches to Stop Hypertension Dietary Intervention Improves Blood Pressure and Vascular Health in Youth With Elevated Blood Pressure. *Hypertension*. 2021;77:241-251.
3. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, Bray GA, Vogt TM, Cutler JA, Windhauser MM, Lin PH and Karanja N. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *N Engl J Med*. 1997;336:1117-24.
4. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, Obarzanek E, Conlin PR, Miller ER, 3rd, Simons-Morton DG, Karanja N and Lin PH. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med*. 2001;344:3-10.
5. Kaelber DC, Liu W, Ross M, Localio AR, Leon JB, Pace WD, Wasserman RC and Fiks AG. Diagnosis and Medication Treatment of Pediatric Hypertension: A Retrospective Cohort Study. *Pediatrics*. 2016;138.
6. Yoon EY, Cohn L, Rocchini A, Kershaw D, Freed G, Ascione F and Clark S. Antihypertensive prescribing patterns for adolescents with primary hypertension. *Pediatrics*. 2012;129:e1-8.
7. Medicaid's Role in Addressing Social Determinants of Health. 2019.
8. Baker-Smith CM, Yang W, McDuffie MJ, Nescott EP, Wolf BJ, Wu CH, Zhang Z and Akins RE. Association of Area Deprivation With Primary Hypertension Diagnosis Among Youth Medicaid Recipients in Delaware. *JAMA Netw Open*. 2023;6:e233012.
9. Hardy ST, Sakhuja S, Jaeger BC, Urbina EM, Suglia SF, Feig DI and Muntner P. Trends in Blood Pressure and Hypertension Among US Children and Adolescents, 1999-2018. *JAMA Netw Open*. 2021;4:e213917.
10. Goulding M, Goldberg R and Lemon SC. Differences in Blood Pressure Levels Among Children by Sociodemographic Status. *Prev Chronic Dis*. 2021;18:E88.
11. Services USDoHH.
12. Nugent JT, Young C, Funaro MC, Jiang K, Saran I, Ghazi L, Wilson FP and Greenberg JH. Prevalence of Secondary Hypertension in Otherwise Healthy Youths with a New Diagnosis of Hypertension: A Meta-Analysis. *J Pediatr*. 2022;244:30-37.e10.
13. Kind AJH and Buckingham WR. Making Neighborhood-Disadvantage Metrics Accessible - The Neighborhood Atlas. *N Engl J Med*. 2018;378:2456-2458.
14. Singh GK. Area deprivation and widening inequalities in US mortality, 1969-1998. *Am J Public Health*. 2003;93:1137-43.
15. Delaware.gov. My Healthy Community Delaware Environmental Public Health Tracking Network. 2023.
16. Cholera R, Anderson D, Raman SR, Hammill BG, DiPrete B, Breskin A, Wiener C, Rathnayaka N, Landi S, Brookhart MA, Whitaker RG, Bettger JP and Wong CA. Medicaid Coverage Disruptions Among Children Enrolled in North Carolina Medicaid From 2016 to 2018. *JAMA Health Forum*. 2021;2:e214283.
17. (CMS) CfMaMS. CMS Cell Suppression Policy. 2020;2023:Guidance Portal.
18. Boruzs K, Juhász A, Nagy C, Szabó Z, Jakovljevic M, Bíró K and Ádány R. High Inequalities Associated With Socioeconomic Deprivation in Cardiovascular Disease Burden and Antihypertensive Medication in Hungary. *Front Pharmacol*. 2018;9:839.

19. Whybrow S, Hollis JL and Macdiarmid JI. Social deprivation is associated with poorer adherence to healthy eating dietary goals: analysis of household food purchases. *J Public Health (Oxf)*. 2018;40:e8-e15.
20. Clennin MN, Lian M, Colabianchi N, Kaczynski A, Dowda M and Pate RR. Associations among Neighborhood Socioeconomic Deprivation, Physical Activity Facilities, and Physical Activity in Youth during the Transition from Childhood to Adolescence. *Int J Environ Res Public Health*. 2019;16.
21. Gu A, Yue Y, Desai RP and Argulian E. Racial and Ethnic Differences in Antihypertensive Medication Use and Blood Pressure Control Among US Adults With Hypertension: The National Health and Nutrition Examination Survey, 2003 to 2012. *Circ Cardiovasc Qual Outcomes*. 2017;10.
22. Rudowitz RB, A; Hinton, E; Guth, M; Tolbert, J. Medicaid: What to Watch in 2023. 2023;2023.
23. Bello JK, Mohanty N, Bauer V, Rittner SS and Rao G. Pediatric Hypertension: Provider Perspectives. *Glob Pediatr Health*. 2017;4:2333794x17712637.
24. Baker-Smith CM, Benjamin DK, Jr., Grabowski HG, Reid ED, Mangum B, Goldsmith JV, Murphy MD, Edwards R, Eisenstein EL, Sun J, Califf RM and Li JS. The economic returns of pediatric clinical trials of antihypertensive drugs. *Am Heart J*. 2008;156:682-8.
25. Roberts R, Rodriguez W, Murphy D and Crescenzi T. Pediatric drug labeling: improving the safety and efficacy of pediatric therapies. *Jama*. 2003;290:905-11.
26. Taylor-Zapata P, Baker-Smith CM, Burckart G, Daniels SR, Flynn JT, Giacoia G, Green D, Kelly AS, Khurana M, Li JS, Pratt C, Urbina EM and Zajicek A. Research Gaps in Primary Pediatric Hypertension. *Pediatrics*. 2019;143.
27. Jelalian E, Hart CN, Mehlenbeck RS, Lloyd-Richardson EE, Kaplan JD, Flynn-O'Brien KT and Wing RR. Predictors of attrition and weight loss in an adolescent weight control program. *Obesity (Silver Spring)*. 2008;16:1318-23.
28. Hansen ML, Gunn PW and Kaelber DC. Underdiagnosis of hypertension in children and adolescents. *Jama*. 2007;298:874-9.
29. Binka E, Mendley S, Gaskin P, Himes C, Jinadu L and Baker-Smith CM. Description of Antihypertensive Medication Use in a Pediatric Practice: Single and Multiple Antihypertensive Medication Therapy. *J Clin Hypertens (Greenwich)*. 2017;19:90-97.
30. Quan H, Khan N, Hemmelgarn BR, Tu K, Chen G, Campbell N, Hill MD, Ghali WA and McAlister FA. Validation of a case definition to define hypertension using administrative data. *Hypertension*. 2009;54:1423-8.

Figure Legends

Table 1: Demographic Table: Youth Prescribed vs Not Prescribed Anti-Hypertensive Therapy

Legend: Among youth with hypertension, 165 (14%) were prescribed antihypertensive therapy. Median ADI of youth with hypertension prescribed antihypertensive therapy vs not prescribed antihypertensive therapy was no different (p=0.25).

Table 2: Multivariable Analysis Evaluating the Odds of Anti-Hypertensive Therapy Prescription

Legend: According to multivariable analysis,age, obesity diagnosis and duration of Medicaid full benefit coverage are associated with a greater odds of antihypertensive therapy prescription. Hispanic ethnicity and non-Hispanic white race were no longer associated with anti-hypertensive therapy prescription suggesting that odds of association between race/ethnicity and antihypertensive therapy was driven by differences in the age, obesity status and duration of full Medicaid benefit coverage for youth of Hispanic ethnicity and non-Hispanic white race (see Supplemental tables 1-2). For each year of age there is a 31% greater odds of antihypertensive therapy prescription. Similarly, for each added month of Medicaid full benefit coverage, there is a 2% greater odds of antihypertensive therapy prescription. Obesity diagnosis is associated with a 56% greater odds of antihypertensive therapy prescription.

Figure 1: Youth with Hypertension, 8-18 years, Prescribed Anti-Hypertensive Therapy and Number of Medications Prescribed

Legend: Anti-hypertensive therapies prescribed include a combined-class-agent, single-class agent, multiple classes and then type of class prescribed. . Of the 1145 youth with an ICD-9/ICD-10 diagnosis of hypertension, 86% (N=980) were not prescribed therapy, while 14% (N=165) per prescribed at least 1 anti-hypertensive agent.N=27 were prescribed a combined-class-agent, N=157 were prescribed a single class agent, N=57 were prescribed multiple classes of antihypertensive therapy. The most common antihypertensive therapy prescribed was an angiotensin converting enzyme inhibitor (ACEI), N=95, diuretic, N=67; beta-blocker (BB), N=43; and angiotensin receptor blocker (ARB), N=29. Due to small cell counts, the number of calcium channel blockers could not be reported.[17]

Graphical/Visual Abstract: The primary drivers of antihypertensive therapy prescription include older age, longer duration of full Medicaid benefit coverage and obesity diagnosis.

Accepted Manuscript
Version of Record at: https://doi.org/10.1093/ajh/hpad098

Table 1

	Total	Anti-Hypertensive Therapy Prescribed (N, %)	No Anti-Hypertensive Therapy Prescribed (N, %)	p-Value
Total	1145	165 (14%)	980 (86%)	
Age (Median, IQR)	14 (11,16)	15 (13,17)	13 (11,15)	<0.0001
Sex				
Female	464 (41%)	63 (38%)	401 (41%)	0.51
Male	681 (59%)	102 (62%)	579 (59%)	
Obesity Status				
Yes	705 (62%)	112 (68%)	593 (61%)	0.072
No	440 (38%)	53 (32%)	387 (39%)	
Non-Hispanic Black (NHB)				
Yes	460 (40%)	70 (42%)	390 (40%)	0.52
No	685 (60%)	95 (58%)	590 (60%)	
Non-Hispanic White (NHW)				
Yes	396 (35%)	72 (44%)	324(33%)	0.0082
No	749 (65%)	93 (56%)	656 (67%)	
Hispanic				
Yes	271 (24%)	22 (13%)	249 (25%)	0.0007
No	874 (76%)	143 (87%)	731 (75%)	
National ADI Group (Median, IQR)	51 (39, 65)	51 (38, 61)	51 (39, 65)	0.25
ADI				
ADI 0-25	71 (6.2%)	12 (7%)	59 (6%)	0.36
ADI 26-50	477 (42%)	67 (41%)	410 (42%)	

ADI 51-75 ADI 76-100	412 (36%) 185 (16%)	66 (40%) 20 (12%)	346 (35%) 165 (17%)	
Medicaid Full Benefit Coverage, duration in months (Median, IQR)	69 (54, 72)	70 (56, 72)	69 (53, 72)	0.35

Accepted Manuscript
Version of Record at: https://doi.org/10.1093/ajh/hpad098

Table 2

	Adjusted Odds Anti-Hypertensive Therapy Prescribed OR (95% CI)	*p*-Value
Age (years)	1.31 (1.21, 1.41)	<0.0001
Obesity Diagnosis	1.56 (1.08, 2.25)	0.019
Race/Ethnicity		
Hispanic vs Not-Hispanic (NHB, NHW)	0.61 (0.36, 1.02)	0.061
Non-Hispanic White vs Not Non-Hispanic White (Hispanic, other, Non-Hispanic Black)	1.25 (0.87, 1.82)	0.23
Medicaid Full Benefit Coverage (months duration)	1.02 (1.01, 1.03)	0.0039

Accepted Manuscript
Version of Record at: https://doi.org/10.1093/ajh/hpad098

Figure 1