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Original article

Use of Antihypertensive Medications and Diagnostic Tests Among Privately Insured Adolescents and Young Adults With Primary Versus Secondary Hypertension

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A B S T R A C T

Purpose: To compare the use of antihypertensive medications and diagnostic tests among adolescents and young adults with primary versus secondary hypertension.
Methods: We conducted retrospective cohort analysis of claims data for adolescents and young adults (12–21 years of age) with ≥3 years of insurance coverage (≥11 months/year) in a large private managed care plan during 2003–2009 with diagnosis of primary hypertension or secondary hypertension. We examined their use of antihypertensive medications and identified demographic characteristics and the presence of obesity-related comorbidities. For the subset receiving antihypertensive medications, we examined their diagnostic test use (echocardiograms, renal ultrasounds, and electrocardiograms).
Results: The study sample included 1,232 adolescents and young adults; 84% had primary hypertension and 16% had secondary hypertension. The overall prevalence rate of hypertension was 2.6%. One quarter (28%) with primary hypertension had one or more antihypertensive medications, whereas 65% with secondary hypertension had one or more antihypertensive medications. Leading prescribers of antihypertensives for subjects with primary hypertension were primary care physicians (80%), whereas antihypertensive medications were equally prescribed by primary care physicians (43%) and sub-specialists (37%) for subjects with secondary hypertension.
Conclusions: The predominant hypertension diagnosis among adolescents and young adults is primary hypertension. Antihypertensive medication use was higher among those with secondary hypertension compared with those with primary hypertension. Further study is needed to determine treatment effectiveness and patient outcomes associated with differential treatment patterns used for adolescents and young adults with primary versus secondary hypertension.

IMPLICATIONS AND CONTRIBUTION

Primary hypertension is the predominant hypertension diagnosis in adolescents and young adults. However, only one quarter of subjects with primary hypertension received antihypertensive pharmacotherapy, compared with 65% with secondary hypertension. How these differential treatment patterns affect patient outcomes such as the level of blood pressure control warrants further study.

Hypertension in adolescents and young adults may be result from renal, cardiac, or other etiologies, or have no known cause (primary hypertension). Primary hypertension among adolescents and young adults is a growing concern owing to high rates of obesity among United States youth [1–3]. Previous studies have shown that about one half of pediatric hypertension patients ≤18 years of age had primary hypertension [4–9]; 17% of

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young children (<6 years of age) compared with ≥60% of 6- to 11-year-olds and adolescents 12–16 years of age have primary hypertension [5]. Although these were relatively smaller studies conducted mostly at single referral centers and one multicenter study, the studies suggest an important epidemiologic shift in pediatric hypertension from largely secondary to primary hypertension with increasing patient age. Despite this changing epidemiology, the diagnosis, workup, and treatment of hypertension in children and adolescents still remain largely in the pediatric subspecialty domain, whereas the treatment of hypertension in adults largely occurs in the primary care setting.

Hypertension management for adolescents and young adults may vary depending on the specialty of their providers (pediatric vs. adult; primary care vs. subspecialty), particularly given the differences in pediatric versus adult hypertension guidelines. Previous studies have described unexpected antihypertensive prescribing patterns for adolescents with primary hypertension with Medicaid coverage in which primary care physicians who provided care for both adults and children—primarily family practitioners—were leading prescribers of antihypertensive medications [10]. Moreover, previous studies demonstrated the common use of adult hypertension guideline-recommended diagnostic tests [11] such as electrocardiograms (EKG) for adolescents with primary hypertension with Medicaid coverage, whereas pediatric hypertension guideline-recommended [12] diagnostic tests (echocardiograms and renal ultrasounds) were not commonly used [13]. Prior work in adults suggests that physician prescribing patterns are influenced by limited availability and/or cost of medications (higher tiers) offered by insurance plan formularies [14–17]. Because insurance coverage could affect both the use of medications and diagnostic tests for adolescents and young adults with hypertension, we set out to characterize the use of antihypertensive medications and diagnostic tests among privately insured adolescents with primary hypertension versus secondary hypertension.

Methods

Study design

We conducted a retrospective cohort analysis of claims and pharmacy data from a large private managed care plan in Michigan for adolescents and young adults 12–21 years of age during 2003–2009. The private managed care plan in Michigan is a nonprofit organization serving nearly 700,000 members across various geographic regions of Michigan, including southeastern, mid, and Upper Peninsula. Its network includes more than 5,000 primary care physicians, over 15,000 specialists, and most of the state's leading hospitals. We identified subjects with primary hypertension and secondary hypertension and examined their use of antihypertensive medications. For the subset that received antihypertensive medications, we examined their use of diagnostic tests (echocardiograms, renal ultrasounds, and EKGs). The Institutional Review Board of the University of Michigan Medical School approved this study.

Study population

Our study population was defined as those who were aged 12–18 years on December 31, 2003, who had medical and prescription coverage for at least 3 of 7 years (≥11 months per year) at any time during January 1, 2003 to December 31, 2009. We excluded years in which they had other insurance coverage or were >21 years of age. If subjects had one or more visits with an *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) code for secondary hypertension (402.x, 403.x, 404.x, or 405.x) or a common pediatric cause of secondary hypertension such as renal disease at any time during the study period, we considered them to have secondary hypertension. We considered subjects to have primary hypertension if they had one or more visits with the ICD-9-CM code for hypertension (401.x) and no secondary hypertension. Appendix 1 provides a full list of inclusion and exclusion codes.

Variables of interest

Antihypertensive pharmacotherapy. Using pharmacy claims and National Drug Codes, we identified adolescents and young adults who had one or more claims for the following antihypertensive drug classes: angiotensin-converting enzyme (ACE) inhibitors (including angiotensin receptor blockers [ARB]), β-blockers, calcium channel blockers, diuretics, and centrally acting agents (including clonidine and guanfacine) [12]. Prescriber identification numbers on pharmacy claims were linked to physician specialty data. From this analytic file, we created the following variables:

- Receipt of one or more antihypertensive medication during the study period.
- Class of antihypertensive medication.
- Monotherapy versus combination therapy: Monotherapy was defined as having prescription claims for only one antihypertensive medication per day. Subjects with multiple antihypertensive single drugs were categorized as the drug class of the last antihypertensive prescription claim, to allow mutually exclusive groups. Combination therapy was defined as prescription claims for two different drug classes on the same day ± 1 day or one or more claims for a combination medication (i.e., one medication formulated with two antihypertensive drugs, such as benazepril/hydrochlorothiazide—oral). Subjects who received combination therapy at any time during the study period were classified as having combination therapy, even if they had periods of monotherapy.
- Median number of hypertension visits per year of eligibility
- Years of insurance coverage (3–4 years vs. 5–7 years)
- Specialty of the physician who first prescribed the antihypertensive drug class determined for the study period was categorized as primary care physicians (PCP) (family physicians, general practitioners, internists, medicine–pediatrics, and general pediatricians), sub-specialists, and unknown specialty.

Diagnostic tests. We considered subjects to have had an echocardiogram if they had one or more claims with current procedural terminology (CPT) codes 93303, 93304, 93307, 93308, 93320, 93321, 93325, or 93350, or ICD-9-CM procedure code 88.72 or 37.28 or revenue code 0483.

We considered subjects to have had a renal ultrasound if they had one or more claims with CPT code 76770 or 76775, or ICD-9-CM procedure code 88.76.

We considered subjects to have had an EKG if they had one or more with CPT codes 93000, 93005, 93010, 93040, 93041, or 93042 or ICD-9-CM procedure code 89.51 or 89.52. Although EKGs are not recommended in the evaluation of pediatric