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Socioeconomic, Mental Health, and Healthcare Access Determinants of Prescription Antibiotic Use in U.S. Adults: Evidence from NHANES 2017-March 2020

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Abstract. Antimicrobial resistance is a major public health challenge, and understanding patterns of antibiotic use is important for improving stewardship strategies. This study examined socioeconomic, mental health, and healthcare access determinants of prescription antibiotic use among U.S. adults using publicly available data from the National Health and Nutrition Examination Survey (NHANES) 2017 March to 2020 pre-pandemic cycle. Adults aged 18 years and older were included. Prescription antibiotic use during the previous 30 days was identified from the NHANES prescription medication file. Independent variables included age, sex, race/ethnicity, education, household income, health insurance coverage, primary source of healthcare, self-rated health, and depressive disorders and symptoms measured by the PHQ-9. Descriptive statistics and bivariate analyses were conducted using Pearson's chi-square tests and independent-samples t-tests. Among 9,693 adults, 355 (3.7%) reported recent prescription antibiotic use. Antibiotic use was significantly associated with sex, race/ethnicity, health insurance, usual source of healthcare, self-rated health, depression category, and PHQ-9 score. Age, education, and household income were not significantly associated with antibiotic use. These exploratory findings suggest that healthcare access and mental health may be important correlates of prescription antibiotic use.

Keywords: antibiotic use, NHANES, healthcare access, depressive symptoms, antimicrobial resistance

1. Introduction

Antimicrobial resistance (AMR) has become one of the most urgent global public health challenges of the twenty-first century, with inappropriate antibiotic use as a central driver of this crisis [1, 2]. Although antibiotics remain one of the most transformative medical breakthroughs, their effectiveness is increasingly undermined by patterns of overuse, underuse, and misuse across the world. Importantly, antibiotic use is not determined solely by clinical need. Growing evidence suggests that demographic, socioeconomic, behavioral, and healthcare-related factors also influence patterns of antibiotic use. As a result, antibiotic use should be examined as a complex phenomenon embedded in the public health system.

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Existing research has identified numerous factors associated with antibiotic use. At the individual level, demographic characteristics such as age, sex, race and ethnicity, educational attainment, and household income have been associated with differences in healthcare utilization and prescription medication use [3, 4]. Previous studies have also suggested that mental health status may influence healthcare-seeking behaviors, treatment adherence, and medication use. In addition, healthcare access, including insurance coverage, having a usual source of care, and access to healthcare services, plays an important role in determining whether individuals receive prescription medications, including antibiotics.

Although previous studies have examined individual socioeconomic characteristics, mental health, or healthcare access separately, relatively few studies have evaluated these determinants simultaneously within a single analytical framework. Consequently, it remains unclear which factors contribute most strongly to differences in prescription antibiotic use when multiple domains of influence are considered together. A more comprehensive understanding of these determinants may help identify population groups that are more likely to receive antibiotics and inform future antibiotic stewardship efforts.

Building on these observations, this study adopts a multi-domain framework to examine prescription antibiotic use among U.S. adults using data from the National Health and Nutrition Examination Survey (NHANES) [5]. Specifically, this study evaluates three groups of determinants: (1) socioeconomic characteristics, including age, sex, race/ethnicity, education, and household income; (2) mental health status, measured using depressive symptoms; and (3) healthcare access, including health insurance coverage and access to routine healthcare services. The study aims to investigate which of these factors are associated with prescription antibiotic use. By integrating these domains within a single analytical framework, this study seeks to provide a more comprehensive understanding of population-level determinants of antibiotic use and to inform future public health strategies promoting appropriate antibiotic stewardship.

2. Methods

2.1. Study design

This study employed a cross-sectional study design using publicly available data from the National Health and Nutrition Examination Survey (NHANES). NHANES is a nationally representative health survey conducted by the National Center for Health Statistics (NCHS) of the US Centers for Disease Control and Prevention (CDC) [5]. The survey combines household interviews with standardized health examinations to collect information on demographic characteristics, health status, healthcare access, prescription medication use, and other health-related variables. This study analyzed data from the NHANES 2017-March 2020 pre-pandemic cycle.

2.2. Study population

Participants were selected from adults aged 18 years and older who participated in the NHANES 2017 March to 2020 survey. Individuals with missing information on prescription medication use or key demographic variables were excluded from the analysis. Because NHANES is a publicly available database, no additional participant recruitment or informed consent was required for this secondary data analysis.

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2.3. Variables

The outcome variable was prescription antibiotic use during the previous 30 days. Information was obtained from the NHANES Prescription Medication Questionnaire (RXQ) [6]. Participants who reported using at least one prescription antibiotic during the previous 30 days were classified as antibiotic users, while all other participants were classified as non-users. Independent variables included age, sex, race/ethnicity, educational attainment, household income measured by the poverty-income ratio, health insurance coverage, routine source of healthcare, self-rated health, and depressive symptoms measured by the Patient Health Questionnaire-9 (PHQ-9).

2.4. Data management

Data from the Demographics (DEMO), Prescription Medication (RXQ_RX), Depression Questionnaire (DPQ), Health Insurance Questionnaire (HIQ), and Healthcare Utilization Questionnaire (HUQ) files were downloaded from the NHANES website and merged using the unique participant identification number (SEQN). Participants with missing values for variables included in the analysis were excluded where appropriate.

2.5. Statistical analysis

All statistical analyses were conducted using R (version 4.6.1). Descriptive statistics were used to summarize participant characteristics. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized using means and standard deviations. Bivariate analyses were performed to examine the association between prescription antibiotic use and each independent variable. Cross-tabulation and Pearson's chi-square tests were used for categorical variables. Differences in PHQ-9 scores between antibiotic users and non-users were evaluated using independent-samples t-tests. As this study was designed as an exploratory analysis for educational research purposes, unweighted analyses were performed to examine bivariate associations without applying the complex NHANES survey design or sampling weights. Therefore, the findings should be interpreted as exploratory rather than nationally representative. Values with two-sided significance level of less than 0.05 ($p < 0.05$) were considered statistically significant.

3. Results

3.1. Participant characteristics

A total of 9,693 adults were included in the analysis, of whom 355 (3.7%) reported using at least one prescription antibiotic during the previous 30 days. Overall, 51% of participants were female, 35% were non-Hispanic White, and 84% reported having health insurance. Most participants also reported having a usual place for healthcare (83%). Participant characteristics are summarized in Table 1.

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Table 1. Participant characteristics according to prescription antibiotic use among U.S. adults in NHANES 2017-March 2020. Continuous variables are presented as mean (SD), and categorical variables are presented as n (%). P values were calculated using Pearson's chi-square tests for categorical variables and Welch's two-sample t-test for continuous variables

Characteristic	Overall N = 9,693	No antibiotic N = 9,338	Antibiotic N = 355	p-value
Age group:				0.4
18-29	1,839 (19%)	1,767 (19%)	72 (20%)	
30-44	2,154 (22%)	2,086 (22%)	68 (19%)	
45-64	3,289 (34%)	3,171 (34%)	118 (33%)	
65+	2,411 (25%)	2,314 (25%)	97 (27%)	
Sex:				0.021
Male	4,718 (49%)	4,567 (49%)	151 (43%)	
Female	4,975 (51%)	4,771 (51%)	204 (57%)	
Race/ethnicity:				0.009
Mexican American	1,131 (12%)	1,102 (12%)	29 (8.2%)	
Other Hispanic	991 (10%)	960 (10%)	31 (8.7%)	
Non-Hispanic White	3,370 (35%)	3,219 (34%)	151 (43%)	
Non-Hispanic Black	2,555 (26%)	2,463 (26%)	92 (26%)	
Non-Hispanic Asian	1,172 (12%)	1,141 (12%)	31 (8.7%)	
Other/Multi-racial	474 (4.9%)	453 (4.9%)	21 (5.9%)	
Education:				0.7
Less than 9th grade	719 (7.8%)	696 (7.8%)	23 (6.9%)	
9-11th grade	1,041 (11%)	1,004 (11%)	37 (11%)	
High school/GED	2,225 (24%)	2,153 (24%)	72 (22%)	
Some college/AA	2,975 (32%)	2,859 (32%)	116 (35%)	
College graduate or above	2,257 (24%)	2,174 (24%)	83 (25%)	
Income group:				0.7
Low income	2,382 (29%)	2,296 (29%)	86 (28%)	
Middle income	3,210 (39%)	3,083 (39%)	127 (41%)	
High income	2,620 (32%)	2,525 (32%)	95 (31%)	
Insurance:				<0.001
Insured	8,112 (84%)	7,783 (84%)	329 (93%)	
Uninsured	1,554 (16%)	1,528 (16%)	26 (7.3%)	
Routine place:				<0.001

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Table 1. (continued)

Yes	8,022 (83%)	7,697 (82%)	325 (92%)	
There is no place	1,607 (17%)	1,580 (17%)	27 (7.6%)	
There is more than one place	60 (0.6%)	57 (0.6%)	3 (0.8%)	
Self-rated health:				0.049
Excellent	1,126 (12%)	1,087 (12%)	39 (11%)	
Very good	2,639 (27%)	2,556 (27%)	83 (23%)	
Good	3,556 (37%)	3,433 (37%)	123 (35%)	
Fair	1,957 (20%)	1,870 (20%)	87 (25%)	
Poor	405 (4.2%)	383 (4.1%)	22 (6.2%)	
Depression category:				<0.001
None/minimal	6,109 (74%)	5,910 (74%)	199 (64%)	
Mild	1,400 (17%)	1,337 (17%)	63 (20%)	
Moderate/severe	767 (9.3%)	720 (9.0%)	47 (15%)	
PHQ-9 score, mean (SD)	3.3 (4.3)	3.3 (4.2)	4.3 (5.3)	<0.001

Note: Values are n (%) unless otherwise specified. P-values were calculated using Pearson's chi-square tests for categorical variables and Welch two-sample t-tests for PHQ-9 score.

3.2. Bivariate associations

Bivariate analyses demonstrated that several participant characteristics were significantly associated with prescription antibiotic use (Table 1). Female participants were more likely than males to report recent antibiotic use. Significant differences were also observed across racial and ethnic groups, with antibiotic use varying among different populations. Participants with health insurance and those reporting a usual source of healthcare had a higher prevalence of prescription antibiotic use than those without regular access to healthcare services. Self-rated health status was also associated with antibiotic use, with participants reporting poorer health generally showing a higher prevalence of recent antibiotic use. Detailed statistical results are summarized in Table 2, while the distribution of participant characteristics is presented in Table 1.

Table 2. Bivariate associations between participant characteristics and prescription antibiotic use among U.S. adults in NHANES 2017-March 2020. Pearson's chi-square tests were performed for all categorical variables. Variables with $p < 0.05$ were considered statistically significant

Variable	Chi-square	df	p-value	Significant
Age group	2.8346	3	0.4178	No
Sex	5.3070	1	0.0212	Yes
Race/ethnicity	15.3220	5	0.0091	Yes
Education	1.9982	4	0.7361	No
Income group	0.6190	2	0.7338	No

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Table 2. (continued)

Insurance	20.2591	1	<0.001	Yes
Routine place	21.6318	2	<0.001	Yes
Self-rated health	9.5569	4	0.0486	Yes
Depression category	18.3725	2	0.0001	Yes

Note: Chi-square statistics, degrees of freedom (df), p-values, and statistical significance are presented for each categorical variable. Variables with $p < 0.05$ were considered statistically significant.

Mental health was significantly associated with prescription antibiotic use. Participants with more severe depressive symptoms reported higher rates of antibiotic use than those with fewer or no depressive symptoms. The prevalence of antibiotic use increased progressively across depression categories, rising from approximately 3.3% among participants with no or minimal depressive symptoms to approximately 4.5% among those with mild depressive symptoms and over 6.0% among those with moderate or severe depressive symptoms (Figure 1). Similarly, participants who reported antibiotic use had significantly higher mean PHQ-9 scores than those who did not use antibiotics (Table 1).

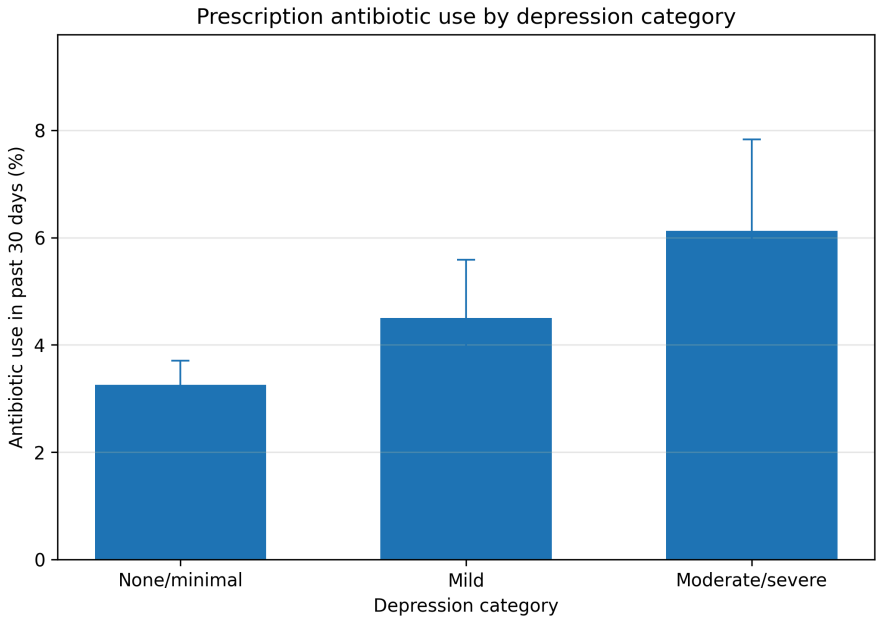


Figure 1. Prevalence of prescription antibiotic use according to depression severity among U.S. adults, NHANES 2017–March 2020. Error bars indicate 95% confidence intervals. Participants with moderate or severe depressive symptoms had the highest prevalence of prescription antibiotic use, followed by those with mild depressive symptoms and those with no or minimal depressive symptoms. The association between depression category and prescription antibiotic use was statistically significant (Pearson's χ^2 test, $p < 0.001$)

Healthcare access variables, including health insurance coverage and having a usual source of healthcare, were both significantly associated with prescription antibiotic use (Table 1; Figure 2). Participants with health insurance demonstrated a higher prevalence of antibiotic use than uninsured participants, indicating that healthcare access may influence opportunities to receive prescription

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medications (Figure 2). In contrast, no statistically significant differences in prescription antibiotic use were observed across age groups, educational attainment, or household income (Table 1).

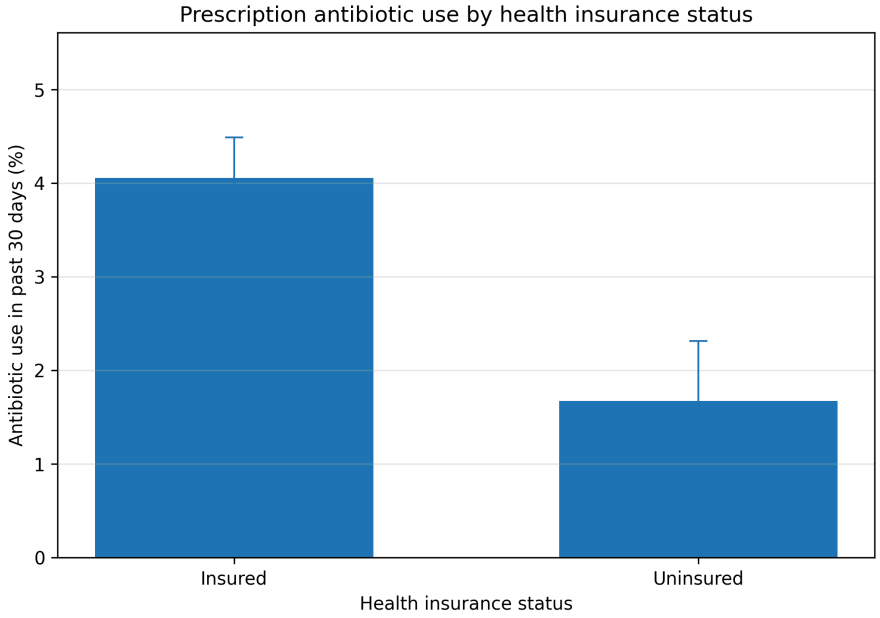


Figure 2. Prevalence of prescription antibiotic use according to health insurance status among U.S. adults, NHANES 2017–March 2020. Error bars indicate 95% confidence intervals. Participants with health insurance reported a significantly higher prevalence of prescription antibiotic use than uninsured participants (Pearson's χ^2 test, $p < 0.001$)

4. Discussion

This study examined socioeconomic characteristics, mental health, and healthcare access in relation to prescription antibiotic use among U.S. adults using NHANES data. The findings suggest that healthcare access and mental health were more strongly associated with prescription antibiotic use than several traditional socioeconomic indicators. Specifically, health insurance coverage, having a usual source of healthcare, self-rated health, and depressive symptoms were significantly associated with recent antibiotic use, whereas age, educational attainment, and household income were not.

Our findings are broadly consistent with previous systematic reviews showing that antibiotic use is influenced by multiple patient-related factors rather than by clinical need alone. Zanichelli et al. [3] reported that demographic characteristics, socioeconomic status, patient attitudes, and interactions with healthcare providers collectively influence responsible antibiotic use, although the strength of individual determinants varies across settings. Similarly, Sun et al. [4] concluded that non-biomedical factors—including socioeconomic characteristics, healthcare access, cultural context, and individual beliefs—play important roles in shaping antibiotic use behaviors worldwide. The present study extends these observations by demonstrating that several of these determinants remain associated with prescription antibiotic use in a sample of U.S. adults.

Healthcare access emerged as one of the strongest determinants of prescription antibiotic use. Participants with health insurance and a usual source of healthcare were more likely to report recent antibiotic use. This finding may reflect greater opportunities to seek medical care and receive prescriptions rather than inappropriate prescribing. Kasse et al. [7] similarly reported that healthcare system characteristics—including access to services, clinical guidelines, healthcare organization,

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physician experience, and healthcare infrastructure—substantially influence antibiotic prescribing practices. Together, these findings suggest that antibiotic use should be interpreted within the broader context of healthcare accessibility rather than solely as an indicator of inappropriate use.

An interesting finding of this study was the positive association between depressive symptoms and prescription antibiotic use. Individuals with higher PHQ-9 scores and more severe depressive symptoms were more likely to report recent antibiotic use. Although previous systematic reviews have primarily focused on socioeconomic characteristics and antibiotic-related knowledge, psychological well-being may also influence healthcare-seeking behaviors and medication use. Individuals experiencing depressive symptoms may have more frequent contact with healthcare services because of poorer overall health or increased healthcare utilization. Future studies should further investigate the potential relationship between mental health and antibiotic prescribing using longitudinal study designs.

The findings of this study support the growing recognition that antibiotic use is shaped by multiple interacting determinants beyond biological factors alone. Kunin et al. [8] emphasized that effective antibiotic stewardship requires consideration of social, behavioral, and healthcare system factors, while Allel et al. [9] further demonstrated that antimicrobial resistance is influenced by broader socioeconomic, governance, and environmental conditions at the population level. Although the present study focused on prescription antibiotic use rather than inappropriate use or antimicrobial resistance, identifying population groups with different patterns of antibiotic use may contribute to future antibiotic stewardship efforts.

Several limitations were acknowledged and noted. First, this was a cross-sectional study and causal relationships cannot be established. Second, NHANES records prescription antibiotic use but does not distinguish between appropriate and inappropriate prescribing. Third, unweighted analyses were performed without incorporating the complex NHANES sampling design; therefore, the findings should be interpreted as exploratory rather than nationally representative. Finally, important determinants such as physician prescribing behavior, patient knowledge, and cultural beliefs were not available in NHANES and should be examined in future research.

5. Conclusion

This exploratory cross-sectional analysis found that prescription antibiotic use among U.S. adults was associated with healthcare access, self-rated health, depressive symptoms, sex, and race/ethnicity. In contrast, age, educational attainment, and household income were not significantly associated with recent antibiotic use. These findings suggest that antibiotic use patterns should be understood within broader healthcare access and mental health contexts. Future research using weighted analyses and multivariable models should further examine these relationships and distinguish appropriate from inappropriate antibiotic prescribing.

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