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Associations between nocturia, race/ethnicity, and chronic disease conditions: a study from
2005-2012 National Health and Nutrition Examination Surveys

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ABSTRACT

Purpose: The aim is to identify independent associations of racial and ethnic groups and nocturia among a representative sample of non-Hispanic white (NHW), non-Hispanic black (NHB), and Mexican American (MA) U.S. adults, with the secondary aim of identifying and comparing the independent associations of chronic disease conditions and multimorbidity and nocturia for each of the racial and ethnic groups.

Methods: The 2005-12 datasets of the U.S. National Health and Nutritional Examination Survey (NHANES) were used for this study. The dependent variable was the presence of nocturia defined as two or more voids per night and ascertained via NHANES interview matching validated surveys. A multivariable logistic regression model stratified by sex and controlling for age category, education, medical insurance status, smoking status, chronic disease conditions, and adiposity was used to determine the association between race/ethnicity and nocturia. A multivariable model stratified by race/ethnicity and controlling for sex, age category, education, medical insurance status, smoking status, other chronic disease conditions, and adiposity was used to determine the association between chronic disease conditions and nocturia for each group.

Results: NHB and MA men were likely to have nocturia than NHW men in the multivariable model, OR=1.82, 95% CI 1.59, 2.08 and OR=1.75, 95% CI 1.49, 2.05, respectively. NHB and MA women were more likely to have nocturia than NHW women after adjustment for demographic and clinical characteristics and chronic disease conditions, OR=2.02, 95% CI 1.80, 2.26 and OR=1.34, 95% CI 1.17, 1.53, respectively. Arthritis, depression, and hypertension were the only three chronic disease conditions statistically significantly associated with nocturia for all NHW, NHB, and MA.

Conclusion: The study indicates nocturia is independently associated with race/ethnicity among U.S. adults. Among men and women, NHB and MA will more likely have nocturia compared to NHW. The study also demonstrated the variation across races in correlates of nocturia.

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TABLE OF CONTENTS

INTRODUCTION	1
METHODS	2
RESULTS	6
DISCUSSION	11
CONCLUSION	15
REFERENCES	16
TABLES	18
FIGURES	29

INTRODUCTION

Nocturia is a common condition among men and women (1) and it is associated with increased bother, reduced quality of life, falls among the elderly, and mortality (2-6). The prevalence of nocturia varies across age and gender groups; it increases with age for both men and women (7-9), and, despite some mixed study results in terms of gender prevalence (8, 10), general trends across studies indicate that prevalence of nocturia is higher among younger women compared to younger men and higher among older men compared to older women (10, 11). Though limited studies exist that examine the prevalence of nocturia across racial and ethnic groups, nocturia is more common among non-Hispanic blacks and Hispanics compared to non-Hispanic whites, a trend which is consistent across age and gender groups (12-14).

The precise etiology of nocturia is not fully defined and, in most cases, multifactorial in nature. Nocturia has been associated with many chronic disease conditions including arthritis (9), cardiac disease (14, 15), chronic lung disease (16) benign prostatic enlargement (BPE) (6, 9, 17), hypertension (8, 9, 13, 17), diabetes (14-16), cognitive impairment (6), and depression (9, 18, 19). Other clinical characteristics, such as body mass index (BMI) and adiposity (13, 16, 20-22) and nocturnal urine production (23) are associated with increased nocturia. Studies around behavioral factors of individuals such as alcohol use, smoking, caffeine consumption, and fluid intake before bed do not have consistent, clear associations with nocturia. (17, 22). The vast number of chronic disease conditions and health and behavioral factors associated with nocturia, the differing biological mechanisms, uncertainty regarding the directionality of the associations, and the fact that many individuals with nocturia have more than one chronic disease condition, or multimorbidity, the occurrence of two or more chronic health conditions in an individual, underscore the complicated nature of the condition. Inoye et al. developed a framework for

understanding how multiple and interacting risk factors are responsible for geriatric conditions.

(24) Nocturia is similarly a symptom (and not a disease), common in older adults, multifactorial in nature, and associated with functional decline. For the provider, it is crucial to understand that nocturia is associated with multimorbidity, and this may impact the effectiveness, feasibility, and/or treatment options for nocturia.

Few studies have explored the above associations between nocturia and chronic disease conditions and multimorbidity across racial and ethnic groups. Furthermore, a limited number of studies have explored race and ethnicity as an independent predictor of nocturia, considering such a vast number of associated chronic disease conditions and potential risk factor synergism. A better understanding of the association between nocturia and chronic disease conditions and multimorbidity can help to drive more effective interventions. The aim of the current study is to identify independent associations of racial and ethnic groups and nocturia among a representative sample of non-Hispanic white, non-Hispanic black, and Mexican American U.S. adults, with the secondary aim of identifying and comparing the independent associations of chronic disease conditions and multimorbidity and nocturia for each of the racial and ethnic groups.

METHODS

Study Design

The 2005-06, 2007-08, 2009-10, and 2011-12 datasets of the U.S. National Health and Nutritional Examination Survey (NHANES) were used for this study. The cross-sectional survey is sampled to represent the demographic and health information for non-institutionalized Americans. The surveys over-sample individuals 60 and older, African Americans, Asians, and Hispanics for statistical reliability. Health information is collected via in-home surveys and health measurements and labs are performed by study teams consisting of a physician, a dentist, medical

and health technicians, and dietary and health interviewers at mobile examination centers (MEC). In the survey waves used, there were detailed, validated questions about lower urinary tract symptoms (LUTS). Detailed description of NHANES methods for health data survey and collection are available via the Centers for Disease Control and Prevention (CDC) and the National Center for Health Statistics (NCHS)(25).

Study Population

This study sample was restricted to non-Hispanic white, non-Hispanic black, and Mexican American men and women aged 20 years or older. The study sample was further restricted to individuals with information regarding nocturia. After restrictions for age, race/ethnicity, and nocturia data, the pooled analytical sample from the four NHANES datasets included 22,684 individuals.

Data Collection and Measurement

Nocturia was defined using the NHANES survey question, “During the past 30 days, how many times per night did you most typically get up to urinate, from the time you went to bed at night until the time you got up in the morning?” The NHANES nocturia question matches other validated surveys (American Urological Association 7 Symptom Index) (26) and has been previously used in reporting prevalence of LUTS (9) Nocturia was defined for these analyses as reporting two or more times per night. While this differs from The International Continence Society (27) definition, which defines nocturia as one or more times per night, it matches current research and clinical thought that two or more times of nocturia per night is more clinically meaningful (2).

Clinical and body measurements for all study participants were obtained at MECs. Clinical measurements include diastolic blood pressure (DBP), systolic blood pressure (SBP), fasting

glucose (FG), oral glucose tolerance test (OGTT), low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (LDL) cholesterol, triglycerides (TG), and total cholesterol. DBP and SBP were obtained using standardized procedures. FG, OGTT, LDL cholesterol, HDL cholesterol, TG, and total cholesterol were measured after overnight fasting. Urinary albumin and urinary creatinine were measured using random urine collected either in the participant's home. Body measurements include height and weight, which were measured using standardized procedure. BMI is calculated as weight in kilograms divided by height in meters squared. Adiposity status was classified based on BMI. Normal, overweight, and obese were classified as a BMI less than 25, 25-29.99, and greater than 30, respectively.

Demographic characteristics including race/ethnicity, marital status, education, smoking status, and medical insurance coverage were collected via survey in the participant's home. Level of educational attainment and responses were recoded into 5 level educational attainment categories, less than 9th grade, 9th to 11th grade, high school, some college, and college.

Chronic disease conditions were defined using a combination of self-reported diseases status from the NHANES questionnaire and clinical measurements from MECs. Arthritis, cancer, stroke, congestive heart failure (CHF), and coronary heart disease (CHD) were measured by self-reported disease status. Affirmative responses to the NHANES question, "Have you ever been told by a doctor or other health professional that you have" any of the above listed conditions were considered disease positive. Individuals were classified as having albuminuria given a self-reported previous diagnosis of kidney disease or a urinary albumin-creatinine ratio of 30 mg/g or greater. Albuminuria is a marker of chronic kidney disease. Individuals were classified as having chronic obstructive pulmonary disease (COPD) given a positive response to any of the following three NHANES questions, previous diagnosis by a doctor or other health professional, "do you usually cough on most days for 3 consecutive months or more during the year?", or "do you

usually bring up phlegm on most days for 3 consecutive months or more during the year?”.

Depression was measured using a 9-item Patient Health Questionnaire (PHQ-9), a tool to assess the intensity and frequency of depressive symptoms over the previous 14 days. Individuals were classified as depressed given a sub-threshold classification, PHQ-9 score between 5 and 14, and severe classification, PHQ-9 score greater than 15. These classifications are based on the severity index suggested by Kroenke et al.(28) Individuals were classified as having diabetes given a positive response to one or more of the NHANES questions, “have you ever been told by a doctor or health care professional that you have diabetes or sugar?”, “are you taking diabetic pills to lower your blood sugar?”, or an FG of 125 mg/dl and greater or an oral glucose tolerance test (OGTT) value of 200 mg/dl and greater. Individuals are classified as having dyslipidemia given a positive response to one or more of the NHANES questions, “have you ever been told by a doctor or other health professional that your blood cholesterol level was high?”, “To lower your blood cholesterol, have you ever been told by a doctor or other health professional to take prescribed medicine?” or a serum LDL-C value of 70 mg/dl. or greater. Individuals were classified as having hypertension given a DBP greater than 90 mm Hg, an SBP greater than 140 mm Hg or current treatment with prescribed anti-hypertension medication.

Chronic disease cluster variables were calculated as the sum of each of the above 12 chronic disease conditions. In circumstances where there were multiple values missing (three or more of the above chronic disease variables), the cluster variable was counted as missing.

Statistical Analysis

All analyses were performed using SAS version 9.4 (SAS Institute, Inc., Cary, North Carolina). We compared demographic and clinical characteristics of individuals with nocturia and without nocturia, of non-Hispanic white (NHW), non-Hispanic black, and Mexican American (MA) NHW, NHB, and MA men, and of NHW, NHB, and MA women. Differences were compared

using chi-square tests for categorical characteristics and one-way ANOVA for continuous characteristics.

We calculated the prevalence and 95% confidence interval of chronic disease conditions among NHW, NHB, and MA men and women with nocturia, and age stratified groups of men and women with nocturia using PROC GLM. Demographic characteristics of NHW, NHB, and MA individuals with nocturia were compared at each level of chronic disease cluster. Differences were compared using chi-square tests. We used multivariable logistic regression to calculate the prevalence odds ratio of nocturia among NHW, NHB, and MA. Model 1 is an unadjusted univariate analysis, model 2 is adjusted for sex, categorical age, education, medical insurance, smoking status, and adiposity, and model 3 is adjusted for the same variables in model 2 and other chronic disease conditions. Statistical significance was evaluated at $\alpha=0.05$ for all analysis. A multivariable logistic regression model including race and other covariates found in model 3 was used to determine the association between race/ethnicity and nocturia.

RESULTS

There were a total 22,684 eligible participants in the U.S. National Health and Nutritional Examination Survey (NHANES) between 2005-2012 with and without nocturia, 9,860 participants with nocturia and 12,824 participants without nocturia. On average, individuals with nocturia were older and heavier, and have higher BMIs, SBP, glucose levels, LDL-cholesterol levels, and triglyceride levels than individuals without nocturia ($p<0.01$). A higher proportion of those participants with nocturia was female, NHB, less educated (<9th grade or 9-11th grade

education levels), and classified as obese compared to those participants without nocturia ($p < 0.01$) [Table 1a].

Thirty-nine (39%) percent of the NHW, 53% of the NHB, and 43% of the MA sampled reported nocturia [Table 1a]. On average, NHW men with nocturia were older, more educated (some college or college graduate education levels), and more likely to have had medical insurance than NHB and MA men without nocturia ($p < 0.01$). NHB men with nocturia were heavier, less likely to be married, more likely to be classified as obese, more likely to smoke, and had a higher DBP than NHW and MA men with nocturia ($p < 0.01$). MA men with nocturia were more likely to be less educated (<9th grade or 9-11th grade education levels), and had higher glucose levels, higher LDL cholesterol, triglycerides, and total cholesterol compared to NHW and NHB men with nocturia ($p < 0.01$) [Table 1b]. Among 5,174 female participants with nocturia 2,414 (46.7%) are NHW, 1,812 (35.0%) are NHB and 948 (18.3%) are MA. On average, NHW women with nocturia were older, more likely to have had medical insurance compared to NHB and MA women with nocturia ($p < 0.01$). NHB women with nocturia were less likely to be married, more likely to smoke, heavier, more likely to be classified as obese, had higher DBP, and had lower triglycerides and cholesterol than NHW and MA women with nocturia ($p < 0.01$). MA women with nocturia were more likely to be less educated (<9th grade or 9-11th grade education levels), less likely to have had medical insurance, and had higher glucose levels than NHW and NHB women with nocturia ($p < 0.01$) [Table 1b].

Hypertension and arthritis were the top two chronic disease conditions across non-Hispanic whites, non-Hispanic blacks, and Mexican Americans for both men and women with nocturia. The highest prevalence of hypertension was observed among NHB men with nocturia (64.9%). The highest prevalence of arthritis was observed among NHW women with nocturia (59.4%). Among men with nocturia, dyslipidemia was the third most prevalent chronic condition among

NHB and MA, 20.9% and 16.9%, respectively. The third most prevalent chronic condition among NHW was cancer, 23.8%. Depression was the third most prevalent condition among NHB and MA women with nocturia, with 25.1% and 27.2% respectively. Dyslipidemia was the third most prevalent condition among NHW women with nocturia, 22.2%. Similar cancer and race prevalence trends are observed in men and women. Among women with nocturia, diabetes was most prevalent in the MA group, 15.0%, compared to 10.1% among NHW and 9.9% among NHB. Among men with nocturia, diabetes was most prevalent in the MA group, 16.4%, compared to 10.1% among NHB and 12.2% among NHW [Table 2]. Hypertension was the most prevalent condition among men with nocturia across all age groups, and among women aged 40 and older. Among women with nocturia aged less than 40 years, asthma was the most prevalent chronic condition. We observed increased prevalence of hypertension, CHD, CHF, cancer, dyslipidemia and arthritis as the age categories increased among both men and women. The greatest increases were observed for hypertension and arthritis among both men and women [Table 3, Figure 1a-b].

This highest burden of multimorbidity was observed among NHW, with 26.0% of NHW individuals with nocturia having four or more chronic disease conditions, followed by NHB and MA with 21.4% and 11.6%, respectively. Over half of MA with nocturia (53.3%) had no multimorbidity, either have 0 or 1 chronic conditions, compared to 40.9% of NHB and 31.6% of NHW (Table 4).

We compared the demographic characteristics across the number of chronic diseases (0, 1, 2, 3, 4 or more) across NHW, NHB, and MA individuals with nocturia (Table 5a-c). As the number of chronic disease conditions increased among MA, individuals were more likely to be female, whereas, there were no gender trends among NHW and NHB. Across NHW, NHB, and MA, we observed increasing age trends, decreasing levels of high education, increasing levels of low

education, and increasing levels of obesity as the number of chronic disease conditions increased (Tables 4a-c).

An unadjusted univariate analysis stratified by race/ethnicity (Model 1, Table 6a-c) showed that across NHW, NHB, and MA, all chronic disease conditions, except dyslipidemia, were associated with increased odds of nocturia. Dyslipidemia was associated with decreased odds of nocturia among NHW and NHB, but the OR is not significant for MA. Across NHB, NHW, and MA, we observed increasing odds of nocturia with increasing age, increasing adiposity, and increasing numbers of chronic disease conditions and decreasing odds of nocturia with increasing level of education.

After adjustment for sex, age, education, medical insurance, smoking status, and adiposity (Model 2, Table 6a-c), all chronic disease conditions, except for dyslipidemia, were associated with higher odds of nocturia among NHW. Among NHB, CHF and diabetes were no longer statistically significant and, among MA, COPD, cancer, CHF, CHD, and stroke were no longer statistically significant. We still observed increasing odds of nocturia with the increasing number of chronic conditions across NHW, NHB, and MA, though the magnitude of the effect was attenuated.

After adjustment for the variables from model 2 and other chronic disease conditions (Model 3, Table 6a-c), arthritis, asthma, cancer, CHD, depression, and hypertension were all significantly associated with increased odds of nocturia among NHW. We observed the strongest association between depression and nocturia (POR = 2.00, 95% CI, 1.75, 2.29). After adjustment for the variables from model 2 and other chronic disease conditions (Model 3, Table 6a-c), albuminuria, arthritis, COPD, depression, and hypertension were all significantly associated with increased odds of nocturia among NHB. We observed the strongest association between albuminuria and

nocturia (POR = 1.90, 95% CI, 1.33, 2.73). After adjustment for the variables from model 2 and other chronic disease conditions (Model 3, Table 6a-c), arthritis, asthma, depression, and hypertension were all significantly associated with increased odds of nocturia among MA. We observed the strongest association between hypertension and nocturia for MA (OR=1.58, 95% CI, 1.30-1.95). Arthritis, depression, and hypertension were the only three chronic disease conditions statistically significantly associated with nocturia for all NHW, NHB, and MA in model. Arthritis was most strongly associated with nocturia among NHB (OR = 1.39, 95% CI, 1.18-1.63) compared to NHW (OR=1.22, 95% CI 1.10-1.36) and MA (OR=1.32, 95% CI, 1.05, 1.65). Depression was most strongly associated with nocturia among NHW (OR=2.00, 95% CI, 1.75, 2.29) compared to NHB (OR=1.69, 95% CI = 1.41, 2.04) and MA (OR=1.48, 1.18, 1.86). Hypertension was most strongly associated with nocturia among MA (OR =1.58, 1.30, 1.92) compared to NHW (OR =1.30, 95% CI, 1.17, 1.45) and NHB (OR = 1.21, 95% CI 1.03, 1.42) (Model 3, Table 6a-c).

Both NHB and MA men were likely to have nocturia than NHW men after adjustment for demographic and clinical characteristics and chronic disease conditions, OR=1.82, 95% CI 1.59, 2.08 and OR=1.75, 95% CI 1.49, 2.05, respectively (Table 7a). The same trend was observed among women. Both NHB and MA women were more likely to have nocturia than NHW women after adjustment for demographic and clinical characteristics and chronic disease conditions, OR=2.02, 95% CI 1.80, 2.26 and OR=1.34, 95% CI 1.17, 1.53, respectively (Table 7b). For both, men and women, adjustments for clinical and demographic characteristics and chronic disease conditions increased the magnitude of the association between race/ethnicity and nocturia, except in the case of NHB women, where the magnitude of the association remained the same after adjustments for covariates.

DISCUSSION

The results of this study demonstrate that NHB and MA women and men were more likely to have nocturia after adjusting for the presence of other chronic disease conditions, as well as other clinical and demographic characteristics. The results are consistent with previous studies that have shown that NHB and Hispanic race/ethnicity was associated with increased nocturia (9, 12-14). Similar to other studies, we included measures of socioeconomic status and comorbid disease conditions. This study was the first to include twelve chronic disease conditions to evaluate their association with nocturia, whereas in other studies only a handful were included, such as diabetes, hypertension, obesity, and cardiovascular disease (9, 13, 14), and in some others, none were included (12). We did not include income in the current model, although it may be important to do so in future studies(12). Finally, like in other studies that include dichotomous variables for chronic disease conditions, we were not able to account for the severity of chronic disease such as uncontrolled diabetes.

We found a high burden of chronic disease conditions and multimorbidity among NHW, NHB, and MA men and women with nocturia. Notably, hypertension and arthritis were the first and second most prevalent chronic disease conditions, respectively, among NHW, NHB, MA men and women. Among men with nocturia, the highest prevalence of hypertension was observed for NHB (66%) followed by NHW (61.2%) and MA (47.9%). A similar trend between racial/ethnic groups was observed for NHB, NHW, and MA women with nocturia with hypertension prevalence of 59.4%, 64.4% and 51.5%, respectively [Table 2]. The high prevalence of hypertension among individuals with nocturia aligns with a number of other studies, which found hypertension to be significantly associated with nocturia in the NHANES sample (9) and other community-based populations (13, 17). The association of hypertension with nocturia rate was

statistically significant for all racial/ethnic groups after adjustment for demographic characteristics and other chronic disease conditions [Table 6a-c].

Among men with nocturia, the highest prevalence of arthritis was observed for NHW (44.0%) followed by NHB (35.9%) and MA (22.4%). A similar trend between racial/ethnic groups was observed for NHW, NHB, and MA women with nocturia with arthritis prevalence of 53.2%, 44.6%, and 36.6%, respectively [Table 2]. Arthritis was statistically significantly associated with increased nocturia across all three racial/ethnic groups after adjustment for demographic characteristics, including age, and other chronic disease conditions. The strength of association was attenuated after the adjustment in model 3, but still statistically significant [Table 6a-c]. Previous studies have shown a positive association between nocturia and arthritis(29), yet since this is such a common condition in aging, it would be valuable to further explore elsewhere this relationship in older adults with and without nocturia.

Depression was statistically significantly associated with increased odds of nocturia among all racial/ethnic groups after adjustment for demographic characteristics and other chronic disease conditions [Table 6a-c]. Among NHW, NHB, and MA, depression was associated with a 100%, 70% and 50% increase in the odds of nocturia, respectively, compared with those individuals without depression [Table 6a-c]. We observe that, among men, depression was most prevalent among NHW (20.5%), and that, among women, depression was most prevalent among MA (27.2%) [Table 2]. The strong, cross-sectional association between depression and increased nocturia was well-documented in previous studies on the topic. Sleep disturbance associated with depression and anxiety may be the associated with increased nocturia frequency (9, 18, 19, 30, 31), and the directionality of this has not been completely resolved.

Among NHB, the strongest association was observed for albuminuria with a 90% increase in the odds of having nocturia (OR=1.90, 95% CI 1.33-2.73), in contrast no statistically significant association was found between albuminuria and nocturia among NHW and MA. Some previous studies have failed to demonstrate an association(17).

We also observed mixed results in terms of coronary heart disease. CHD was associated with a 40% increase in the odds of nocturia among NHW (OR = 1.40, 95% CI 1.17, 2.29), whereas no statistically significant associations were observed between CHD and nocturia for NHB and MA [Table 6a-c]. Previous studies have also demonstrated mixed results in terms of the association between cardiac diseases and nocturia(9, 14, 15, 17). In some studies, cardiac diseases were defined more broadly than the definitions included in the current study, including self-reported physician diagnosis of either CHF, coronary artery bypass, myocardial infarction, or angina, and differences in the definitions used could be the cause of some of the inconsistencies across studies.

Both cancer (non-dermatologic) and asthma were associated with increased odds of nocturia among NHW, whereas no statistically significant association was observed among NHB or MA. Asthma and cancer was associated with a 14% increase in the odds of nocturia (OR = 1.14, 95% CI 1.01, 1.31) and nearly 40% increase in the odds of nocturia (OR = 1.38, 95% 1.21-1.58) among NHW [Table 6a-c]. There is little information on the association between nocturia and asthma. Cancer, particularly prostate cancer, has been linked to increased nocturia in previous studies(9). COPD was only statistically significantly associated with increased odd of nocturia among NHB (OR = 1.61, 95% CI 1.23, 2.10), whereas no association was observed for NHW or MA. Previous studies have demonstrated no associations between COPD and increased nocturia(9, 17). Finally, diabetes was only statistically significantly associated with increased odd of nocturia among MA (OR = 1.51, 95% CI 1.15, 1.99), whereas no association was observed for

NHW or NHB. Previous studies have reported mixed results in terms of associations between diabetes and increased nocturia (9, 14, 17). Diabetes was determined by both objective measures and self-report, which may account for some of the differences between studies. In the current study, as in previous studies, diabetes is dichotomized, and therefore does not account for varying disease severity.

Strengths and Limitations

The number of chronic disease conditions included in the current study have allowed us to investigate the association between race/ethnicity and nocturia while accounting for chronic disease conditions and multimorbidity in a more robust manner than previous studies that have only controlled for three to four chronic disease conditions. The study also included MA, which has not been included in all investigations of the association between nocturia and race/ethnicity(9). NHANES is a large sample representative of the US population, so are findings have strong generalizability. The question used to identify individuals with nocturia is consistent with conventions within the literature and standards papers(26). Another strength of utilizing NHANES to capture nocturia is that nocturia is a symptom, and not adequately captured in databases generated from billing information, as it is not associated with a discrete diagnosis code. Furthermore, disease status for hypertension, COPD, albuminuria, and dyslipidemia were based, in part, on objective measures of disease status rather than self-report only.

The current study is limited by the cross-sectional design of NHANES, therefore it is not possible to draw conclusions about the directionality of the relationship between chronic disease conditions; reverse causality is possible. NHANES samples only community dwelling individuals in the United States and does not provide information on the institutionalized individuals (i.e. living in nursing homes). Given that nocturia is highly prevalent among the oldest populations, and associated with chronic diseases and multimorbidity, it may be important to explore this

population in further studies. While adjustment for disease status was robust in the multivariable model, it could have better adjusted for demographic factors and behavioral risk factors for nocturia. The multivariable models did not control for income, a measure of socioeconomic status, given that it was not available at the time of the current analysis. The multivariable analysis did not adjust for caffeine use given that we were unable to account for the time of consumption throughout the day. It also did not adjust for alcohol consumption given that the definition was too broad (12 or more alcoholic beverages per year) to be associated in a meaningful way with nocturia. Disease status was also determined by self-report for arthritis, cancer, stroke, congestive heart failure, and coronary heart disease. Self-report of disease status may introduce bias into the current study. Finally, all disease status variables are dichotomous and does not account for severity or duration of the chronic disease conditions.

CONCLUSION

The current study indicated that nocturia is independently associated with race/ethnicity among U.S. adults included in the NHANES study, and that among both men and women, NHB and MA will more likely have nocturia compared to NHW. The study also demonstrated the variation across races in correlates of nocturia. These findings underscore the complex nature of nocturia and the need for interventions that consider the multifactorial etiology of the condition.

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TABLES

Table 1a. Basic Demographic and Clinical Characteristics of 22,684 Adults with and without Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	Nocturia (9,860)		No Nocturia (12,824)		P-Value
	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)	
<i>Demographic Characteristics</i>					
Age, years	9,860	58.4 (16.8)	12,824	48.2 (17.7)	<0.0001
Sex	9,860		12,824		0.0028
Male		4,686 (42.5)		6,351 (57.5)	
Female		5,174 (44.4)		6,473 (55.6)	
Race/Ethnicity	9,860		12,824		<0.0001
Non-Hispanic White		4,818 (39.3)		7,457 (60.8)	
Non-Hispanic Black		3,238 (52.5)		2,932 (47.5)	
Mexican Americans		1,804 (42.6)		2,435 (57.4)	
Married	9,852	4,890 (57.8)	12,818	6,704 (42.2)	<0.0001
Education	9,848		12,813		<0.0001
<9 th Grade		1,482 (15.1)		1,148 (9.0)	
9-11 th Grade		2,018 (20.5)		1,815 (14.2)	
High School		2,520 (25.6)		3,067 (23.9)	
Some College		2,452 (24.9)		3,898 (30.4)	
College Graduate		1,376 (14.0)		2,885 (22.52)	
Smoke	9,860	1,842 (8.12)	12,823	2,463 (10.86)	0.3165
Medical Insurance	9,854	7,852 (79.68)	12,815	9,784 (76.4)	<0.0001
<i>Clinical Characteristics</i>					
Weight, kg	9,860	84.8 (22.2)	12,824	82.2 (21.2)	<0.0001
BMI, kg/m ²	9,860	30.4 (7.32)	12,824	28.9 (6.7)	<0.0001
Adiposity	9,860		12,824		<0.0001
Normal		2,250 (22.8)		3,778 (29.5)	
Overweight		3,092 (31.4)		4,401 (34.3)	
Obese		4,518 (45.2)		4,645 (36.2)	
DBP, mmHg	8,812	69.4 (14.3)	11,516	69.6 (12.6)	0.1471
SBP, mmHg	8,812	128.2 (20.3)	11,516	122.2 (17.4)	<0.0001
FG, mg/dL	4,528	116.1 (43.6)	6,020	106.5 (32.0)	<0.0001
OGTT, mg/dL	3,148	133.7 (60.5)	4,823	118.9 (51.0)	<0.0001
LDL, mg/dL	4,376	113.3 (36.5)	5,856	115.7 (35.3)	0.0012
HDL, mg/dL	9,336	53.1 (16.6)	12,283	52.9 (16.0)	0.3768
TG, mg/dL	4,492	143.8 (132.8)	5,971	130.6 (103.9)	<0.0001
T-Cholesterol, mg/dL	9,336	196.0 (43.7)	12,283	196.0 (40.8)	0.9596

Notes: All p-values were calculated using one-way ANOVA and the overall F test for continuous variables and a Chi-Square test for categorical variables. Abbreviations: BMI (Body Mass Index), DBP (Diastolic Blood Pressure), SBP (Systolic Blood Pressure), FG (Fasting Glucose), OGTT (Oral Glucose Tolerance Test), LDL (Low-Density Lipoprotein Cholesterol), HDL (High-Density Lipoprotein Cholesterol), TG (Triglyceride), T-Cholesterol (Total Cholesterol)

Table 1b. Basic Demographic and Clinical Characteristics of 4,686 Adult Males with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Race/Ethnicity, 2005-2012

	Non-Hispanic White 2,404			Non-Hispanic Black 1,426			Mexican American 856			P-Value*
	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)				
<i>Demographic Characteristics</i>										
Age, years	2,404	64.2 (15.7)	1,426	56.2 (15.7)	856	54.9 (15.8)	<0.0001			
Married	2,402	1564 (65.1)	1424	630 (44.2)	856	558 (65.2)	<0.0001			
Education	2,404		1424		854		<0.0001			
<9 th Grade		250 (10.4)		150 (10.5)		388 (45.4)				
9-11 th Grade		384 (16.0)		384 (27.0)		140 (16.4)				
High School		644 (26.8)		412 (29.0)		154 (18.0)				
Some College		274 (23.9)		334 (23.5)		126 (14.8)				
College Graduate		552 (23.0)		114 (10.1)		46 (5.4)				
Smoke	2,404	458 (19.1)	1,426	366 (25.7)	856	138 (16.1)	<0.0001			
Medical Insurance	2,400	2,108 (87.8)	1,426	1,104 (77.4)	856	528 (61.7)	<0.0001			
<i>Clinical Characteristics</i>										
Weight, kg	2,404	89.3 (20.5)	1,426	91.4 (24.5)	856	84.1 (18.1)	<0.0001			
BMI, kg/m ²	2,404	29.3 (6.1)	1,426	29.6 (7.3)	856	29.4 (5.5)	0.2139			
Adiposity	2,404		1,426		856		<0.0001			
Normal		584 (24.3)		390 (27.4)		176 (20.6)				
Overweight		918 (38.2)		440 (30.9)		344 (40.2)				
Obese		902 (37.5)		596 (41.8)		336 (39.3)				
DBP, mmHg	2,170	68.7 (13.7)	1,258	73.0 (15.8)	794	71.2 (13.9)	<0.0001			
SBP, mmHg	2,170	127.9 (19.0)	1,258	132.1 (20.2)	794	128.1 (19.2)	<0.0001			
FG, mg/dL	1,132	114.4 (32.8)	608	120.1 (49.9)	418	131.3 (60.4)	<0.0001			
OGTT, mg/dL	844	139.4 (63.1)	394	125.0 (53.3)	274	142.4 (84.1)	0.0003			
LDL, mg/dL	1,084	106.6 (35.0)	590	109.3 (34.6)	392	118.8 (36.1)	<0.0001			
HDL, mg/dL	2,322	47.7 (14.2)	1,310	52.8 (16.5)	816	45.9 (14.5)	<0.0001			
TG, mg/dL	1,122	153.3 (164.8)	602	123.2 (117.4)	416	183.1 (151.6)	<0.0001			
T-Cholesterol, mg/dL	2,322	185.7 (42.7)	1,310	188.2 (41.0)	816	203.0 (45.8)	<0.0001			

Notes: All p-values were calculated using one-way ANOVA and the overall F test for continuous variables and a Chi-Square test for categorical variables. Abbreviations: BMI (Body Mass Index), DBP (Diastolic Blood Pressure), SBP (Systolic Blood Pressure), FG (Fasting Glucose), OGTT (Oral Glucose Tolerance Test), LDL (Low-Density Lipoprotein Cholesterol), HDL (High-Density Lipoprotein Cholesterol), TG (Triglyceride), T-Cholesterol (Total Cholesterol)

Table 1c. Basic Demographic and Clinical Characteristics of 5,174 Adult Females with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Race/Ethnicity, 2005-2012

	Non-Hispanic White 2,414			Non-Hispanic Black 1,812			Mexican American 948			P-Value*
	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)	N	Mean (SD) or n (%)		
<i>Demographic Characteristics</i>										
Age, years	2414	60.4 (17.1)	1812	53.4 (16.0)	948	54.4 (15.5)	948	54.4 (15.5)	948	<0.0001
Married	2414	1170 (48.8)	1808	506 (28.0)	948	462 (48.7)	948	462 (48.7)	948	<0.0001
Education	2412		1810		944		944		944	<0.0001
<9 th Grade		158 (6.6)		106 (5.7)		430 (45.6)		430 (45.6)		
9-11 th Grade		456 (18.9)		476 (26.3)		178 (18.9)		178 (18.9)		
High School		696 (28.9)		450 (24.9)		164 (17.4)		164 (17.4)		
Some College		716 (29.7)		572 (31.6)		130 (13.8)		130 (13.8)		
College Graduate		386 (16.0)		206 (11.4)		42 (4.5)		42 (4.5)		
Smoke	2,414	478 (9.8)	1,812	314 (17.3)	948	88 (9.3)	948	88 (9.3)	948	<0.0001
Medical Insurance	2,412	2,088 (86.6)	1,812	1,476 (81.5)	948	548 (57.8)	948	548 (57.8)	948	<0.0001
<i>Clinical Characteristics</i>										
Weight, kg	2414	78.5 (20.7)	1812	87.8 (24.2)	948	74.6 (17.3)	948	74.6 (17.3)	948	<0.0001
BMI, kg/m ²	2414	30.1 (7.5)	1812	33.3 (8.7)	948	30.9 (6.7)	948	30.9 (6.7)	948	<0.0001
Adiposity	2414		1812		948		948		948	<0.0001
Normal		654 (27.1)		278 (15.3)		168 (17.7)		168 (17.7)		
Overweight		692 (28.7)		418 (23.1)		280 (29.5)		280 (29.5)		
Obese		1068 (44.2)		1116 (61.6)		500 (52.7)		500 (52.7)		
DBP, mmHg	2120	67.4 (13.6)	1614	70.5 (14.7)	856	66.7 (12.6)	856	66.7 (12.6)	856	<0.0001
SBP, mmHg	2120	126.6 (20.9)	1614	128.8 (21.3)	856	125.8 (20.6)	856	125.8 (20.6)	856	0.0008
FG, mg/dL	1150	108.5 (32.9)	774	115.9 (47.5)	446	121.1 (51.4)	446	121.1 (51.4)	446	<0.0001
OGTT, mg/dL	868	132.0 (54.5)	498	121.5 (44.1)	270	147.9 (71.4)	270	147.9 (71.4)	270	<0.0001
LDL, mg/dL	1118	116.9 (37.1)	752	116.8 (40.0)	440	115.5 (32.7)	440	115.5 (32.7)	440	0.7983
HDL, mg/dL	2320	56.7 (16.8)	1642	58.7 (17.8)	962	54.2 (14.2)	962	54.2 (14.2)	962	<0.0001
TG, mg/dL	1146	152.2 (142.9)	758	109.2 (62.8)	448	148.6 (77.8)	448	148.6 (77.8)	448	<0.0001
T-Cholesterol, mg/dL	2320	204.9 (43.8)	1642	197.7 (44.6)	926	201.3 (38.7)	926	201.3 (38.7)	926	<0.0001

Notes: All p-values were calculated using one-way ANOVA and the overall F test for continuous variables and a Chi-Square test for categorical variables. Abbreviations: BMI (Body Mass Index), DBP (Diastolic Blood Pressure), SBP (Systolic Blood Pressure), FG (Fasting Glucose), OGTT (Oral Glucose Tolerance Test), LDL (Low-Density Lipoprotein Cholesterol), HDL (High-Density Lipoprotein Cholesterol), TG (Triglyceride), T-Cholesterol (Total Cholesterol)

Table 2. Prevalence of Chronic Diseases among 9,860 Adults with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Race/Ethnicity and Sex, 2005-2012

	Males					
	Non-Hispanic White		Non-Hispanic Black		Mexican American	
	%	95% CI	%	95% CI	%	95% CI
Albuminuria	4.1	3.4, 5.0	5.7	4.6, 7.0	4.7	3.5, 6.4
Arthritis	44.0	42.1, 46.1	35.9	33.5, 38.5	22.4	19.8, 25.4
Asthma	13.4	12.1, 14.8	15.7	13.9, 17.7	6.3	4.9, 8.2
COPD	14.4	13.1, 15.9	8.0	6.7, 9.5	4.0	2.9, 5.5
Cancer	23.8	22.2, 25.6	11.9	10.4, 13.4	3.7	2.6, 5.3
Congestive Heart Failure	8.7	7.6, 9.9	7.3	6.1, 8.8	3.8	2.7, 5.4
Coronary Heart Disease	24.5	22.9, 26.3	14.3	12.6, 16.2	11.2	9.3, 13.5
Depression	20.5	18.6, 22.5	17.4	15.1, 20.1	14.1	11.5, 17.3
Diabetes	12.2	10.1, 13.5	10.1	8.6, 11.8	16.4	14.1, 19.0
Dyslipidemia	22.5	20.1, 24.2	20.1	19.0, 23.2	16.9	14.5, 19.5
Hypertension	61.2	60.1, 64.0	65.9	63.5, 68.4	47.9	44.7, 51.4
Stroke	8.2	7.2, 9.4	7.4	6.2, 8.9	3.3	2.3, 4.7
	Females					
Albuminuria	4.4	3.6, 5.3	6.1	5.0, 7.3	5.3	4.1, 7.0
Arthritis	53.2	51.2, 55.2	44.6	42.4, 46.9	36.6	33.4, 39.5
Asthma	19.5	18.0, 21.1	20.6	18.9, 22.6	11.2	9.3, 13.4
COPD	14.8	13.4, 16.2	12.1	10.7, 13.7	4.2	3.1, 5.7
Cancer	21.7	20.1, 23.4	7.6	6.5, 8.9	5.9	4.6, 7.6
Congestive Heart Failure	6.3	5.4, 7.4	5.0	4.1, 6.1	2.3	1.5, 3.5
Coronary Heart Disease	14.3	12.9, 15.7	10.8	9.5, 12.4	6.8	5.4, 8.6
Depression	21.3	19.6, 23.2	25.1	22.9, 27.6	27.2	24.1, 30.7
Diabetes	10.1	9.0, 11.4	9.9	8.6, 11.4	15.0	12.9, 17.4
Dyslipidemia	22.2	20.6, 23.9	19.5	17.7, 21.4	17.5	15.3, 20.1
Hypertension	59.4	57.5, 61.4	64.4	62.2, 66.6	51.5	48.4, 54.8
Stroke	7.1	6.2, 8.2	6.7	5.7, 8.0	4.0	2.9, 5.5

Table 3. Prevalence of Chronic Diseases among 9,860 Adults with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Age and Sex, 2005-2012

	20-29		30-39		40-49		50-59		60-69		70-79		>80	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	Male													
Albuminuria	.72	18, 2.9	2.9	1.6, 5.3	2.5	1.5, 4.3	4.7	3.4, 6.5	5.8	4.6, 7.3	6.6	5.2, 8.4	4.5	3.2, 6.5
Arthritis	5.0	3.0, 8.4	10.7	8.0, 14.6	23.5	20.2, 27.3	35.5	32.3, 39.1	45.7	42.9, 48.6	49.4	46.3, 52.7	49.2	45.5, 53.3
Asthma	15.1	11.4, 20.0	14.9	11.6, 19.1	13.4	10.8, 16.5	15.7	13.3, 18.5	13.8	12.0, 16.0	9.9	8.2, 12.0	9.2	7.2, 11.8
COPD	3.6	2.0, 6.6	9.1	6.6, 12.7	7.6	5.7, 10.1	11.8	9.7, 14.3	11.4	9.7, 13.4	13.2	11.3, 15.6	9.8	7.8, 12.5
Cancer	2.2	1.0, 4.8	1.7	0.8, 3.8	3.2	2.1, 5.1	9.1	7.3, 11.4	16.3	14.3, 18.5	28.2	25.4, 31.2	34.6	31.1, 38.5
CHF	-	-	1.7	0.8, 3.8	4.3	2.9, 6.4	6.8	5.2, 8.8	8.9	7.4, 10.7	8.8	7.2, 10.8	12.3	10.0, 15.2
CHD	1.4	0.5, 3.8	4.0	2.4, 6.7	9.0	6.9, 11.8	14.4	12.1, 17.1	20.2	18.1, 22.7	25.4	22.8, 28.3	37.5	33.9, 41.4
Depression	16.3	11.9, 22.4	24.4	19.6, 30.4	21.9	18.3, 26.1	26.8	23.4, 30.7	14.8	12.5, 17.7	14.7	12.9, 19.2	9.3	6.8, 12.9
Diabetes	3.6	2.0, 6.6	5.7	3.7, 8.7	9.4	7.2, 12.2	11.2	9.2, 13.7	13.8	12.0, 16.0	17.9	15.6, 20.5	12.4	10.1, 15.2
Dyslipidemia	3.2	1.7, 6.2	12.3	9.3, 16.3	17.3	14.5, 20.8	20.5	17.8, 23.6	25.3	22.9, 28.9	26.6	23.9, 29.5	21.1	18.2, 24.6
Hypertension	18.7	14.6, 23.9	33.1	28.6, 38.5	48.0	44.0, 51.4	60.1	56.7, 63.6	69.9	67.3, 72.6	73.5	70.8, 76.4	69.5	66.0, 73.2
Stroke	1.4	0.5, 3.8	1.7	0.7, 3.8	3.2	2.1, 5.1	4.4	3.2, 6.2	7.1	5.8, 8.7	12.0	10.1, 14.2	11.8	9.5, 14.6
	Female													
Albuminuria	2.2	1.1, 4.4	3.9	2.6, 5.9	5.2	3.8, 7.0	3.6	2.6, 5.0	5.7	4.5, 7.3	7.2	5.7, 9.2	6.5	4.8, 8.9
Arthritis	5.9	3.9, 8.9	14.6	12.0, 17.8	32.7	29.5, 36.1	46.6	43.6, 49.9	59.9	57.0, 62.9	68.3	65.3, 71.5	69.8	66.2, 73.7
Asthma	25.8	21.7, 30.7	18.5	15.6, 22.0	21.1	18.4, 24.2	21.9	19.4, 24.6	17.9	15.7, 20.4	15.5	13.3, 18.1	9.1	7.0, 11.8
COPD	9.1	6.6, 12.6	8.2	6.2, 10.8	15.4	13.1, 18.2	13.9	11.8, 16.2	13.4	11.5, 15.6	10.3	8.4, 12.5	9.1	7.0, 11.8
Cancer	4.3	2.7, 6.9	7.1	5.3, 9.6	6.9	5.4, 9.0	12.0	10.1, 14.2	13.9	12.0, 16.2	20.1	18.4, 23.8	28.4	25.0, 32.4
CHF	-	-	0.4	0.0, 1.4	2.3	1.5, 3.7	3.2	2.2, 4.5	7.2	5.8, 8.9	7.1	5.6, 9.0	13.5	11.0, 16.7
CHD	2.2	1.1, 4.3	1.1	0.5, 0.03	5.7	4.3, 7.5	9.9	8.2, 12.0	13.8	11.8, 16.0	18.5	16.1, 21.2	25.3	21.9, 29.1
Depression	21.8	17.7, 26.9	33.9	29.9, 38.5	27.4	24.2, 31.1	31.1	27.9, 34.5	22.0	19.4, 25.1	13.2	10.8, 16.1	11.8	8.9, 15.6
Diabetes	2.7	1.5, 5.0	4.6	3.2, 6.7	8.2	6.5, 10.4	10.7	8.9, 12.9	15.6	13.6, 18.0	13.2	11.1, 15.7	14.4	11.8, 17.6
Dyslipidemia	5.6	3.7, 8.6	9.6	7.5, 12.4	15.2	12.8, 17.9	22.4	19.9, 25.2	25.1	22.6, 27.8	28.0	25.2, 31.2	24.0	20.8, 27.8
Hypertension	10.8	8.0, 14.4	33.5	29.8, 37.6	41.7	38.3, 45.3	58.8	55.8, 62.0	75.7	73.2, 78.3	80.6	78.7, 83.3	81.4	78.3, 84.7
Stroke	1.6	0.7, 3.6	1.8	1.0, 3.3	4.9	3.6, 6.7	5.5	4.2, 7.1	6.6	5.3, 8.3	9.1	7.4, 11.2	13.3	10.8, 16.4

Table 4 - Prevalence of multimorbidity among 9,860 individuals with nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

# of Chronic Disease Conditions	Non-Hispanic White	Non-Hispanic Black	Mexican Americans
	(%)	(%)	(%)
0	11.5	16.1	25.2
1	20.1	24.8	28.1
2	23.5	22.4	22.3
3	18.9	15.4	12.8
4+	26	21.4	11.6

Table 5a. Clustering of Chronic Disease Conditions in Non-Hispanic White Adults with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	0	1	2	3	4+	p-value
	%	%	%	%	%	
Sex						0.1786
Male	45.67	50.10	52.12	50.00	49.52	
Female	54.33	49.90	47.88	50.00	50.48	
Age Group						<0.0001
20-29	16.06	6.20	2.47	1.43	0.64	
30-39	21.12	11.88	7.23	3.30	3.51	
40-49	21.48	14.26	11.11	6.70	8.31	
50-59	18.23	16.12	16.40	13.74	13.90	
60-69	11.37	19.32	17.02	16.81	19.01	
70-79	6.86	17.15	26.54	31.32	27.96	
80+	4.87	15.08	19.22	26.70	26.68	
Education						<0.0001
<9 th Grade	4.71	5.99	6.79	8.57	13.50	
9-11 th Grade	17.93	16.43	17.81	14.18	20.05	
High School	25.72	27.07	26.72	32.31	27.08	
Some College	28.44	26.65	27.43	26.92	25.48	
College	23.19	23.86	21.25	18.02	13.90	
Adiposity						<0.0001
Normal Weight	39.17	30.89	24.87	24.51	17.33	
Overweight	31.41	35.33	34.48	33.30	31.95	
Obese	29.42	33.78	40.65	42.20	50.72	

Table 5b. Clustering of Chronic Disease Conditions in Non-Hispanic Black Adults with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	0	1	2	3	4	p-value
	%	%	%	%	%	
Sex						0.2489
Male	47.31	45.77	42.96	41.97	42.20	
Female	52.69	54.23	57.04	58.03	57.80	
Age Group						<0.0001
20-29	26.35	13.68	6.08	1.81	0.87	
30-39	17.69	13.18	8.15	6.02	3.61	
40-49	22.69	19.78	13.95	14.06	10.40	
50-59	20.58	17.16	20.30	19.68	20.81	
60-69	7.69	22.64	30.25	34.94	28.65	
70-79	4.04	10.20	13.95	18.67	34.87	
80+	0.96	3.36	7.32	4.82	5.64	
Education						<0.0001
<9 th Grade	2.31	5.24	8.86	10.44	12.43	
9-11 th Grade	19.23	22.57	30.47	30.12	30.20	
High School	33.65	30.42	25.62	21.89	21.53	
Some College	32.50	29.05	26.04	25.10	27.60	
College	12.31	12.72	9.00	12.45	8.24	
Adiposity						<0.0001
Normal Weight	31.15	23.13	20.30	16.06	13.44	
Overweight	32.50	25.37	27.35	25.30	23.27	
Obese	36.35	51.49	52.35	58.63	63.29	

Table 5c. Clustering of Chronic Disease Conditions in Mexican Adults with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	0	1	2	3	4	p-value
	%	%	%	%	%	
Sex						0.0004
Male	52.09	51.68	45.52	42.17	36.67	
Female	47.91	48.32	54.48	57.83	63.33	
Age Group						<0.0001
20-29	18.02	10.45	2.24	0.87	0.00	
30-39	26.15	13.61	5.22	0.87	0.48	
40-49	24.62	14.79	11.19	9.13	5.24	
50-59	14.73	17.36	23.63	23.48	18.10	
60-69	9.67	30.77	35.82	35.65	45.71	
70-79	4.18	9.86	16.67	21.30	23.33	
80+	2.64	3.16	5.22	8.70	7.14	
Education						<0.0001
<9 th Grade	38.46	44.47	49.87	43.86	56.67	
9-11 th Grade	25.27	16.01	16.29	14.91	10.95	
High School	18.90	19.17	16.29	16.23	15.71	
Some College	12.97	14.43	11.53	20.61	14.76	
College	4.40	5.93	6.02	4.39	1.90	
Adiposity						<0.0001
Normal Weight	22.64	19.72	16.42	17.39	16.67	
Overweight	45.49	34.52	31.09	24.78	28.57	
Obese	31.87	45.76	52.49	57.83	54.76	

Table 6a. Association between demographic characteristics, chronic disease conditions, and chronic disease clusters and nocturia among non-Hispanic white individuals from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Sex						
Female	0.95	0.88, 1.02				
Age Group						
20-29	ref.					
30-39	1.80	1.49, 2.17				
40-49	2.43	2.03, 2.91				
50-59	3.88	3.25, 4.64				
60-69	4.57	3.83, 5.44				
70-79	7.13	5.99, 8.48				
80+	9.59	8.0, 11.5				
Education						
<9 th Grade	ref.					
9-11 th Grade	0.80	0.67, 0.95				
High School	0.54	0.46, 0.63				
Some College	0.41	0.34, 0.48				
College	0.33	0.28, 0.39				
Medical Insurance	0.79	0.71, 0.88				
Chronic Disease Conditions						
Albuminuria	1.90	1.54, 2.34	1.37	1.10, 1.71	1.13	0.88, 1.46
Arthritis	2.24	2.08, 2.41	1.42	1.30, 1.54	1.22	1.10, 1.36
Asthma	1.15	1.04, 1.27	1.33	1.19, 1.48	1.15	1.01, 1.31
COPD	1.77	1.58, 2.00	1.48	1.31, 1.67	1.12	0.96, 1.30
Cancer	2.07	1.88, 2.28	1.32	1.19, 1.46	1.38	1.21, 1.58
Congestive Heart Failure	2.84	2.38, 3.38	1.60	1.33, 1.92	1.20	0.91, 1.58
Coronary Heart Disease	2.63	2.36, 2.93	1.47	1.31, 1.66	1.40	1.17, 2.29
Depression	1.98	1.76, 2.24	2.23	1.96, 2.53	2.00	1.75, 2.29
Diabetes	1.87	1.64, 2.13	1.17	1.02, 1.34	1.08	0.92, 1.29
Dyslipidemia	0.74	0.68, 0.80	0.52	0.48, 0.57	0.50	0.45, 0.56
Hypertension	2.47	2.29, 2.66	1.41	1.30, 1.54	1.30	1.17, 1.45
Stroke	2.38	2.02, 2.80	1.41	1.19, 1.68	1.07	0.86, 1.32
Adiposity						
Normal Weight	ref.					
Overweight	1.27	1.15, 1.39				
Obese	1.61	1.47, 1.76				
Number of Chronic Conditions						
0	ref.		ref.			
1	1.88	1.67, 2.13	1.34	1.18, 1.52		
2	3.02	2.68, 3.41	1.65	1.44, 1.89		
3	3.68	3.23, 4.19	1.74	1.50, 2.01		
4+	5.27	4.64, 5.98	2.26	1.96, 2.61		

Table 6b. Association between demographic characteristics, chronic disease conditions, and chronic disease clusters and nocturia among non-Hispanic black individuals from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Sex						
Female	1.34	1.21, 1.48				
Age Group						
20-29	ref.					
30-39	1.31	1.08, 1.60				
40-49	2.01	1.68, 2.42				
50-59	2.47	2.07, 2.96				
60-69	3.24	2.72, 3.85				
70-79	4.75	3.83, 5.91				
80+	4.14	3.03, 5.66				
Education						
<9 th Grade	ref.					
9-11 th Grade	0.69	0.54, 0.89				
High School	0.25	0.20, 0.33				
Some College	0.50	0.39, 0.64				
College	0.37	0.28, 0.47				
Medical Insurance	0.86	0.76, 0.98				
Chronic Disease Conditions						
Albuminuria	2.48	1.88, 3.28	1.90	1.43, 2.53	1.90	1.33, 2.73
Arthritis	2.27	2.03, 2.54	1.49	1.31, 1.69	1.39	1.18, 1.63
Asthma	1.30	1.14, 1.49	1.42	1.23, 1.64	1.19	0.99, 1.43
COPD	2.54	2.06, 3.14	2.17	1.74, 2.70	1.61	1.23, 2.10
Cancer	1.87	1.53, 2.28	1.33	1.08, 1.65	1.24	0.94, 1.64
Congestive Heart Failure	1.81	1.41, 2.31	1.28	0.99, 1.65	0.75	0.47, 1.17
Coronary Heart Disease	2.06	1.72, 2.47	1.45	1.20, 1.75	1.25	0.87, 1.75
Depression	1.85	1.56, 2.19	1.95	1.63, 2.33	1.69	1.41, 2.04
Diabetes	1.57	1.30, 1.89	1.13	0.93, 1.38	0.90	0.71, 1.15
Dyslipidemia	0.88	0.78, 1.00	0.63	0.55, 0.72	0.59	0.50, 0.70
Hypertension	2.31	2.08, 2.56	1.53	1.36, 1.73	1.21	1.03, 1.42
Stroke	1.76	1.40, 2.21	1.21	0.95, 1.53	1.03	0.87, 1.22
Adiposity						
Normal Weight	ref.					
Overweight	1.17	1.02, 1.35				
Obese	1.60	1.41, 1.81				
Number of Chronic Conditions						
0	ref.		ref.			
1	1.81	1.56, 2.09	1.43	1.23, 1.66		
2	2.55	2.18, 2.98	1.75	1.48, 2.08		
3	2.93	2.46, 3.50	1.81	1.49, 2.21		
4+	4.14	3.49, 4.91	2.41	1.98, 2.93		

Table 6c. Association between demographic characteristics, chronic disease conditions, and chronic disease clusters and nocturia among Mexican American individuals from the U.S. National Health and Nutritional Examination Surveys (NHANES), 2005-2012

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Sex						
Female	1.13	1.00, 1.28				
Age Group						
20-29	ref.					
30-39	1.75	1.38, 2.23				
40-49	2.07	1.64, 2.62				
50-59	4.14	3.28, 5.24				
60-69	6.34	5.06, 7.76				
70-79	10.32	7.64, 13.92				
80+	14.50	8.90, 23.63				
Education						
<9 th Grade	ref.					
9-11 th Grade	0.56	0.47, 0.66				
High School	0.39	0.29, 0.50				
Some College	0.59	0.50, 0.70				
College	0.47	0.39, 0.56				
Medical Insurance	0.70	0.62, 0.79				
Chronic Disease Conditions						
Albuminuria	2.32	1.65, 3.27	1.50	1.04, 2.16	1.46	0.91, 2.33
Arthritis	2.61	2.24, 3.05	1.30	1.09, 1.55	1.32	1.05, 1.65
Asthma	1.38	1.10, 1.74	1.35	1.05, 1.74	1.21	0.89, 1.64
COPD	1.72	1.22, 2.24	1.05	0.73, 1.53	0.80	0.51, 1.24
Cancer	1.53	1.12, 2.09	1.01	0.73, 1.40	0.70	0.46, 1.05
Congestive Heart Failure	2.78	1.74, 4.43	1.33	1.00, 1.77	0.62	0.23, 1.33
Coronary Heart Disease	2.54	1.944, 3.31	1.15	0.99, 1.34	1.44	0.91, 2.29
Depression	1.66	1.36, 2.03	1.57	1.26, 1.95	1.48	1.18, 1.86
Diabetes	2.41	1.97, 2.94	1.56	1.26, 1.93	1.51	1.15, 1.99
Dyslipidemia	0.90	0.77, 1.06	0.55	0.46, 0.65	0.51	0.41, 0.64
Hypertension	2.85	2.51, 3.25	1.49	1.28, 1.74	1.58	1.30, 1.92
Stroke	2.46	1.64, 3.70	1.37	0.90, 2.09	1.16	0.66, 2.05
Adiposity						
Normal Weight	ref.					
Overweight	0.94	0.79, 1.11				
Obese	1.35	1.14, 1.59				
Number of Chronic Conditions						
0	ref.		ref.			
1	1.94	1.66, 2.28	1.36	1.15, 1.62		
2	3.23	2.69, 3.87	1.63	1.32, 2.00		
3	3.54	2.82, 4.44	1.49	1.15, 1.93		
4+	4.95	3.83, 6.39	1.87	1.40, 2.50		

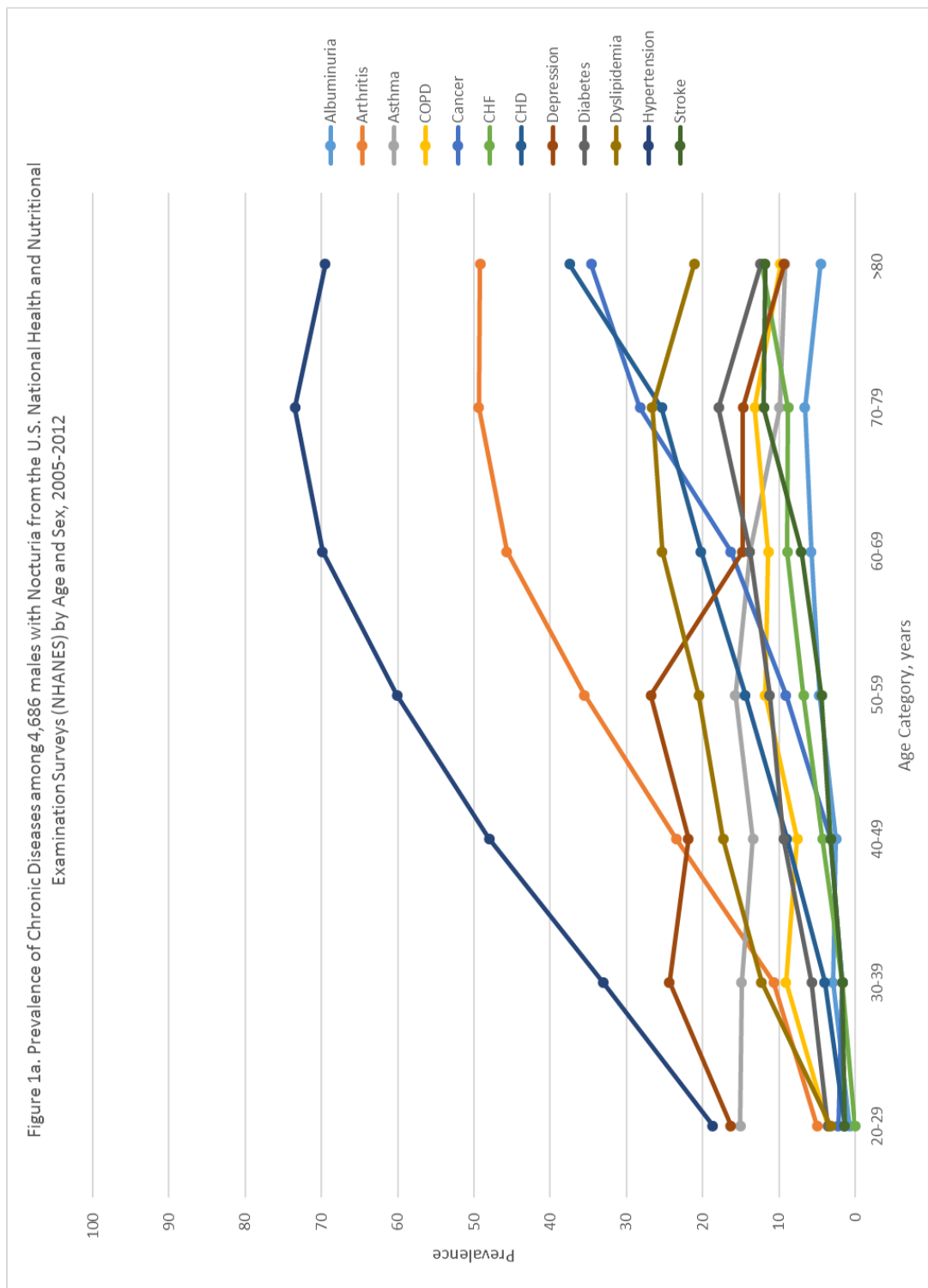
Table 7a. Association of nocturia and race/ethnicity among men from the U.S. National Health and Nutrition Survey (NHANES), 2005-2012

<i>Race/Ethnicity</i>	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Non-Hispanic White	ref.	-	ref.	-
Non-Hispanic Black	1.43	1.31, 1.56	1.82	1.59, 2.08
Mexican Americans	1.05	0.95, 1.16	1.75	1.49, 2.05

Table 7b. Association of nocturia and race/ethnicity among women from the U.S. National Health and Nutrition Survey (NHANES), 2005-2012

<i>Race/Ethnicity</i>	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Non-Hispanic White	ref.	-	ref.	-
Non-Hispanic Black	2.02	1.85, 2.20	2.02	1.80, 2.26
Mexican Americans	1.25	1.13, 1.38	1.34	1.17, 1.53

FIGURES



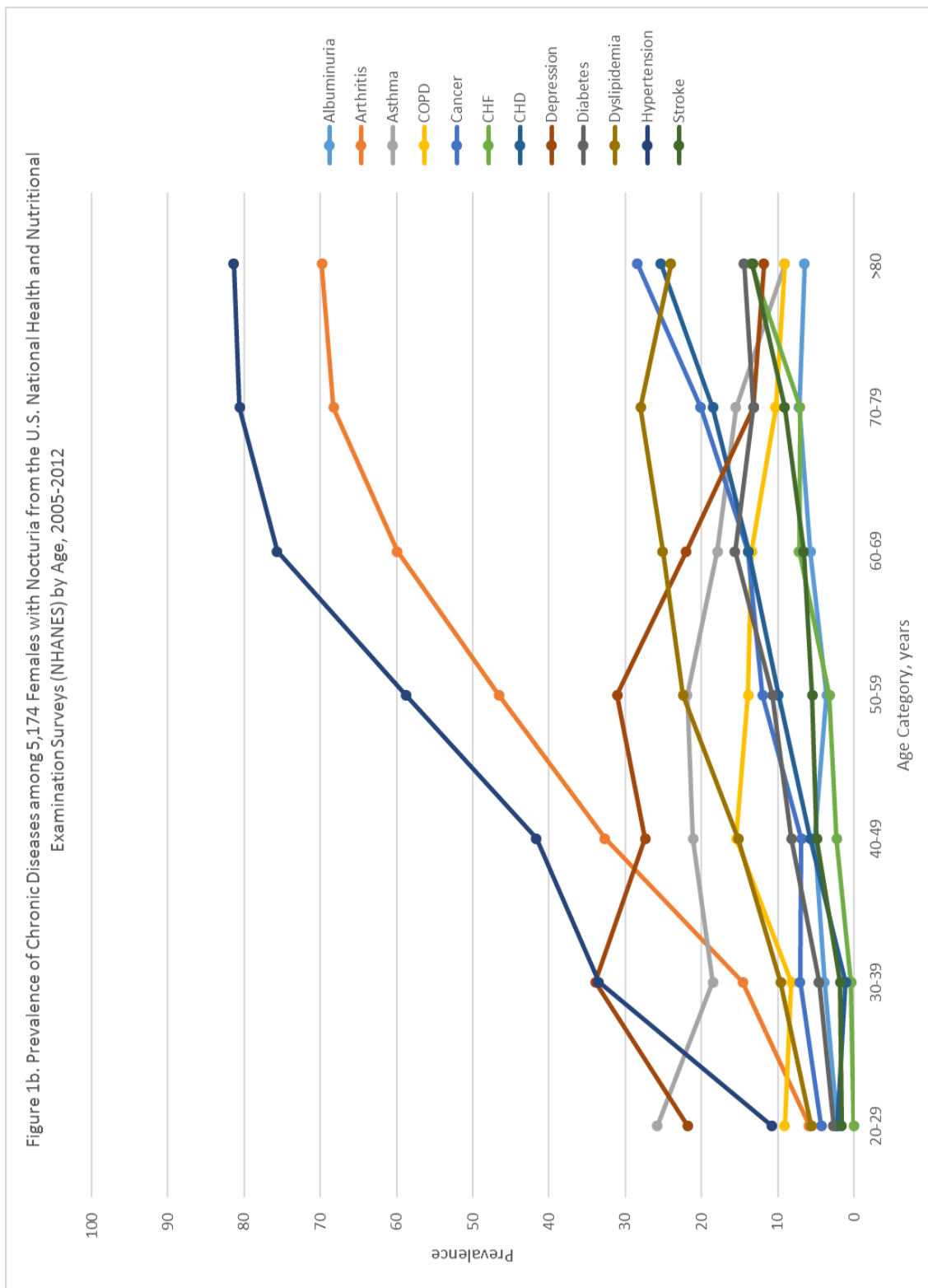


Figure 2a. Prevalence of Chronic Diseases among 4,686 men with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Race/Ethnicity and Sex, 2005-2012

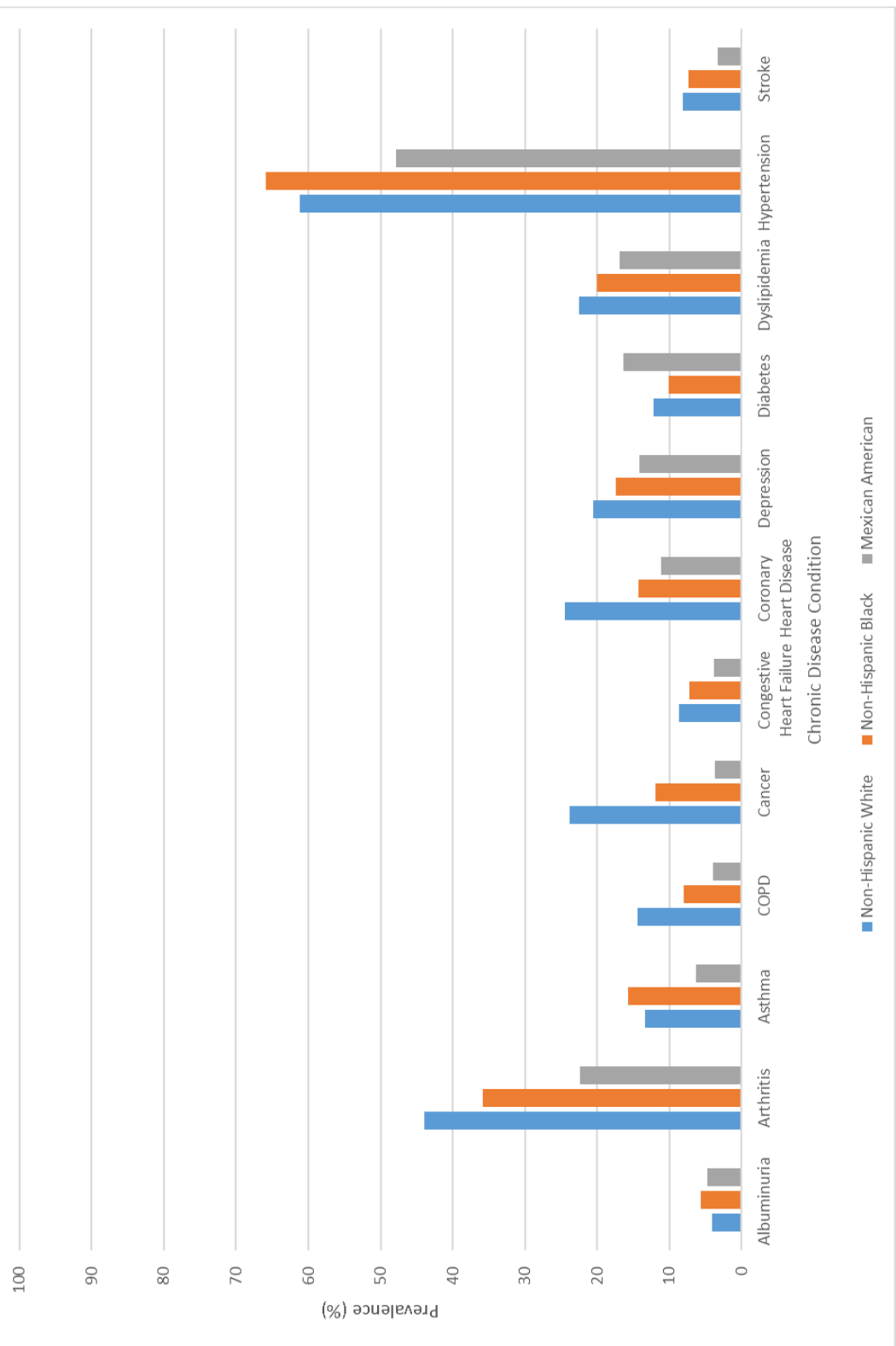


Figure 2b. Prevalence of Chronic Diseases among 5,174 women with Nocturia from the U.S. National Health and Nutritional Examination Surveys (NHANES) by Race/Ethnicity and Sex, 2005-2012

