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## Original Contribution

# The Cross-Sectional Association of Sleep Disturbance and Sleep Apnea With Complex Multimorbidity Among Chinese and Korean Americans

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A new concept called complex multimorbidity provides a more reliable measure of disease burden than multimorbidity based on a simple count of diseases, by categorizing diseases according to the body system they affect. This study examined associations between sleep measures and complex multimorbidity among Chinese and Korean Americans in the Baltimore–Washington DC Metropolitan Area, using cross-sectional data ( $n = 400$ ) from the Screening to Prevent Colorectal Cancer study (2018–2020). Sleep disturbance was measured using the 8-item Patient Reported Outcomes Measurement Information System Sleep Disturbance scale and sleep apnea risk was assessed using the Berlin questionnaire. Complex multimorbidity was defined as the coexistence of 3 or more of body system disorders assessed by self-report of physician-diagnosed diseases. Poisson regression models with adjustments indicated that individuals with sleep disturbance had 2.15 times the prevalence of having complex multimorbidity (95% confidence interval (CI): 1.07, 4.29). Individuals with a high risk of sleep apnea had 1.19 times the prevalence of having complex multimorbidity (95% CI: 0.47, 3.01). These findings suggest a need for interventions to increase awareness of the importance of sleep among health-care providers and the public and to educate them about causes, signs, and treatment of sleep disturbance and sleep apnea.

Asian Americans; complex multimorbidity; emigrants and immigrants; sleep

Abbreviations: CI, confidence interval; CMM, complex multimorbidity; OSA, obstructive sleep apnea; PR, prevalence ratios.

While research on disparities in chronic conditions has typically taken a single-disease approach, increasing attention is being given to understanding the impact of having more than one chronic condition at a time—most often referred to as “multimorbidity” (1–3). Multimorbidity is more common as patients age and chronic conditions co-occur, resulting in more frequent health-care visits, multiple medications, and overall lower quality of life (4, 5). Therefore, detecting and preventing multimorbidity can help lower health-care costs. Studies on multiple chronic diseases have commonly used conventional multimorbidity based on a simple count of diseases (6, 7). However, a new approach called complex multimorbidity (CMM) provides a better measure of disease burden, especially for self-reported data, by categorizing diseases according to the body system they affect rather than looking at diseases individually (6, 8). Compared with a simple count of diseases, CMM identifies patients with more complex and greater needs because it is

likely that chronic conditions in different body systems compete for treatment, while the treatments of chronic conditions within the same system are complementary (8–10). Thus, CMM is helpful for health-care planners to identify services which should be colocated for optimal care of patients by identifying patients who need help in coordinating care between multiple health-care providers (8, 11, 12).

Development of multiple chronic disease is directly linked with modifiable lifestyle factors such as tobacco use (13, 14), alcohol/drug misuse (14–16), poor nutrition (17), obesity (14), low physical activity (14, 18), and inadequate sleep duration (19). Notably, extensive research associates various indicators of poor sleep health, including short sleep duration, insomnia, and sleep-disordered breathing, with the development of a wide range of individual chronic conditions such as obesity (20–24), heart disease (25–31), diabetes (28, 32–35), stroke (36–38), and psychiatric symptomatology (39, 40).

This study aimed to focus on the relationship between sleep disturbance, sleep apnea, and CMM among Chinese and Korean Americans. To our knowledge, none of the previous studies examined the relationship between sleep and CMM. Instead, there are some international studies examining the association between sleep and multimorbidity, which found that poor sleep (i.e., sleep disturbance, short sleep, dissatisfaction with sleep) was closely related to developing multimorbidity in Sweden, Canada, and Germany (1–3). These studies, however, were conducted in majority White populations and did not examine specific communities of color.

Research to date suggests that elevated chronic-condition morbidity burden in minoritized groups—including Asian, Black, and Hispanic Americans—is likely due to factors including racism (41, 42), socioeconomic disadvantage (43), and physical and social environment (44). Nonetheless, most prior studies on racial and ethnic disparities have focused on single diseases, and they have not examined multiple chronic diseases, nor have they studied sleep as a risk factor for developing chronic diseases (45, 46). In particular, there is a paucity of research addressing Asian Americans. A few studies have suggested that the prevalence of multimorbidity was slightly lower in Asian adults compared with White and Black adults (47, 48), but assessing the prevalence and burden of chronic condition morbidity has been difficult among Asian Americans due to variation across Asian subgroups and underutilization of medical treatment (49). Although data on multimorbidity or CMM according to Asian subgroup does not currently exist, Chinese and Korean Americans in particular have been reported to have poorer health outcomes in terms of general health, physical and social functioning, and mental health compared with national norms (50). Emerging evidence suggests that Asian Americans experience sleep disparities as well: They have shorter sleep duration than White Americans, and Chinese men experience higher rates of sleep apnea compared with White men of similar age and body mass index (51, 52).

Sleep is increasingly recognized as a risk factor for multiple chronic conditions (53, 54), and several hypotheses on the biological pathways driving the association between sleep and age-related diseases have emerged, including damage of genetic information (55), cellular injury (56), and chronic inflammation (57). One emerging hypothesis postulates that compromised sleep may cause alterations to the length of telomeres and structures on DNA needed for cellular replication (58–61). Shorter telomere length, in turn, has been extensively implicated in the pathogenesis of multiple chronic conditions, including heart disease (62–64), cancer (65–67), and stroke (68–70). Moreover, poor sleep health is also associated with a multitude of poor health behaviors including smoking and poor diet, which increase the risk of various chronic diseases (71, 72).

The present study fills a gap in sleep-health disparities research by focusing on the association of sleep measures and CMM among Chinese and Korean Americans, helping to address the paucity of research on risk factors of multiple chronic disease in the United States and among Asian American groups. Moreover, out of the major indicators of compromised sleep, sleep apnea, in particular, is well

established with the development of singular major chronic conditions including cardiovascular disease (73–75), diabetes (76, 77), and cancer (78, 79). To our knowledge, our study is the first to explore the relationship between sleep apnea risk and the development of chronic conditions through the lens of CMM. For our study, we hypothesized that sleep disturbance is positively associated with CMM (hypothesis 1). In addition, we expected sleep apnea risk to be positively associated with CMM (hypothesis 2).

## METHODS

### Study sample

The present study used baseline data from a randomized controlled trial to increase colorectal cancer screening among 400 Chinese and Korean Americans (200 Chinese and 200 Korean Americans) living in the Baltimore–Washington DC Metropolitan Area. Participants were between the ages of 50 and 75 years, and they were recruited from primary care physicians' clinics in Maryland and Northern Virginia. The baseline survey data were collected from August 2018 to June 2020. After giving informed consent, participants completed a self-administered questionnaire (for in-person data collection) or a research assistant-led phone survey (for phone-based data collection) in their preferred language (Mandarin, Korean, or English). Eighty-nine percent of data collection was completed in person (155 Chinese and 200 Korean Americans), and the remaining 11% was collected by phone (45 Chinese Americans) because of the outbreak of coronavirus disease 2019 (COVID-19) in March 2020. The study was approved by the institutional review boards of the University of Maryland, College Park, and University of California, Irvine.

### Variables

*Dependent variables.* Our dependent variable was CMM. We asked participants if they had ever been told by a doctor or health-care provider in the past year that they had any of the following 10 conditions: 1) high blood pressure, 2) high cholesterol, 3) heart attack or any other heart disease, 4) cancer, 5) stroke, 6) diabetes, 7) anxiety or depression, 8) obesity, 9) breathing problem (asthma or emphysema), and 10) any other health problems. Using this question, we created a binary variable to assess CMM. CMM was defined as the coexistence of 3 or more of the following body system disorders: 1) circulation disorder (high blood pressure, stroke, heart attack, or any other heart disease), 2) endocrine-metabolic disorder (diabetes, obesity, or high cholesterol), 3) cancer, 4) anxiety or depression, 5) breathing problem (asthma or emphysema), and 6) any other health problems (7).

*Independent variables.* Independent variables were self-reported sleep disturbance and sleep apnea risk. To evaluate sleep disturbance, we used the adult 8-item version of The National Institutes of Health Patient Reported Outcomes Measurement Information System (PROMIS) sleep

disturbance measure (80). The measure was originally created using literature searches of well-established, existing measures, expert content review, qualitative research with patients, and pilot testing (81). PROMIS sleep disturbance measures the perceptions of sleep quality, depth, and restoration within the past 7 days. This includes perceived difficulties falling asleep and staying asleep, as well as sleep satisfaction (81, 82). Each item was rated using a 5-point Likert scale, and the ratings on the 8 items were summed to create a total raw score ranging from 8 to 40. The raw score was converted to a standardized T-score using conversion tables published on the PROMIS website (<http://nihpromis.org/>), with higher scores reflecting more sleep disturbances (81). The T-score has 4 categories (none to slight, mild, moderate, and severe), according to the suggestion by the PROMIS website. Among 400 participants, 327 (81.2%) were classified into “none to slight” category, 41 (10%) were “mild,” 30 (8%) were “moderate,” and 2 (0.5%) were in the “severe” category. We recoded the categories into a binary variable (0 = none to slight, 1 = mild, moderate, or severe). In our study, we referred to respondents as having sleep disturbance (mild, moderate, or severe) or not (none to slight).

To identify the risk of sleep apnea, we used the Berlin questionnaire (83), which is a useful and valid clinical screening test and epidemiologic tool in the sleep clinic and diverse populations (83–85). As the Berlin sleep apnea scale includes questions about obesity and hypertension, which are components of CMM, we used a modified sleep apnea score (86). Three subcategories were used from the questionnaire: Subcategory 1, snoring patterns (i.e., snoring intensity (louder than talking) and snoring frequency (3–4 times a week or almost every day)) provided a positive score when the snoring intensity and/or frequency were positive; subcategory 2, breathing pauses, provided a positive score when the response was “3–4 times a week” or “almost every day”; and subcategory 3, feeling tired or fatigued in the morning or daytime, provided a positive score when the response was “3–4 times a week” or “almost every day.” Participants were classified as being at high risk of obstructive sleep apnea (OSA) when they scored positive on 2 or more subcategories, and the participants who did not score positive in any or only 1 subcategory were categorized as being at low risk of OSA. The risk of having sleep apnea was used as a binary variable (high risk or low risk) in the analysis.

**Covariates.** We included several sociodemographic characteristics: age, gender, Asian subgroup, marital status, education, household income, employment status, and health insurance status. Age was a continuous variable in years, and gender was categorized as male or female. Marital status was recoded into a binary variable: married or cohabiting, and not currently married or cohabiting. Asian subgroup was categorized as Korean or Chinese. We recoded education as up to high-school graduate/General Educational Development certificate, some college/vocational school/college graduate, and graduate/professional school. Household income was categorized as less than \$40,000, \$40,000 to \$79,999, or \$80,000 or more. Employment status was categorized as

full-time, part-time, or not employed. Health insurance status was recoded into private insurance, Medicare/Medicaid, and no health insurance.

**Potential effect modifiers.** We tested gender, Asian subgroup, and acculturation as potential effect modifiers for the associations between sleep measures and CMM. The effect modifiers were decided based on prior research. First, there was a sex-specific pattern in the relationship between short sleep and multimorbidity, with only women reporting a significant positive relationship (2). Comparative studies found heterogeneity in health status and prevalence of chronic diseases across Asian subgroups (87, 88). Last, more acculturated Asian immigrants were found to have more sleep complaints (89) as well as higher prevalence of chronic conditions (90, 91), possibly because of poorer health behaviors and health risks that reflect Americanized lifestyles (92). For a measure of acculturation, we used median years living in the United States, coded as a binary variable ( $\leq 22$  years and  $> 22$  years).

## Statistical analyses

We first conducted a descriptive analysis for the prevalence of singular chronic disease and body system affected in CMM as well as characteristics of the entire sample and by subgroups of the levels of sleep disturbance. We report the mean and standard error for continuous variables and frequencies and percentages for categorical variables. Then, Poisson regression models with robust error variance were fitted to examine the associations between sleep measures and CMM. For each sleep measure, 3 regression models were fitted. The first model estimated associations between sleep measures and CMM without any covariates. The second model added age, gender, Asian subgroup, and marital status to the first model, while the third model added education, household income, employment status, and health insurance status to the second model. Finally, we examined interaction terms to test for potential effect modification by gender, Asian subgroup, and acculturation for the association between sleep measures and CMM. All statistical analyses were performed using Stata, version 15.1 (StataCorp LLC, College Station, Texas).

## RESULTS

**Table 1** reports the prevalence of singular chronic diseases and body systems affected in the sample. Among singular chronic diseases, high cholesterol ( $n = 166$ , 41.5%), high blood pressure ( $n = 136$ , 34.0%), and diabetes ( $n = 80$ , 20.0%) were the most common. Body systems affected were prevalent in the following order: endocrine-metabolic disorder ( $n = 204$ , 51.0%), circulation disorder ( $n = 142$ , 35.5%), other health problems ( $n = 47$ , 11.8%), anxiety or depression ( $n = 23$ , 5.8%), breathing problem ( $n = 18$ , 4.5%), and cancer ( $n = 10$ , 2.5%).

**Table 2** presents the distribution of CMM, sleep apnea, and sociodemographic characteristics for the entire sample and the sample stratified by level of sleep disturbance. Out of

**Table 1.** Prevalence of Singular Chronic Diseases and Body Systems Affected ( $n = 400$ ), Screening to Prevent Colorectal Cancer Study, Baltimore–Washington DC Metropolitan Area, 2018–2020

Disease or Body System	No.	%
Singular chronic disease <sup>a</sup>		
High cholesterol	166	41.5
High blood pressure	136	34.0
Diabetes	80	20.0
Obesity	57	14.3
Any other health problems	47	11.8
Heart attack or any other heart disease	24	6.0
Anxiety or depression	23	5.8
Breathing problem (asthma or emphysema)	18	4.5
Cancer	10	2.5
Stroke	7	1.8
Body system affected <sup>b</sup>		
Endocrine-metabolic disorder	204	51.0
Circulation disorder	142	35.5
Other health problems	47	11.8
Anxiety or depression	23	5.8
Breathing problem	18	4.5
Cancer	10	2.5

<sup>a</sup> Prevalence was based on participants' multiple choices.

<sup>b</sup> Body system was categorized as follows: 1) circulation disorder (high blood pressure, stroke, heart attack, or any other heart disease); 2) endocrine-metabolic disorder (diabetes, obesity, or high cholesterol); 3) cancer; 4) anxiety or depression; 5) breathing problem (asthma or emphysema); and 6) any other health problems.

400 participants, 327 (81.8%) respondents were classified as having no sleep disturbance, while 73 (18.2%) were classified as having sleep disturbance. There were significant differences between the 2 sleep disturbance groups for CMM, sleep apnea risk, gender, Asian subgroup, and marital status. Among participants who had sleep disturbance, a higher proportion had CMM (15.1%) compared with those who did not have sleep disturbance (6.7%). Among individuals in the sleep disturbance group, there was a higher proportion of individuals classified as at high risk of OSA (24.7%) than among those who did not have sleep disturbance (9.8%). Among respondents with sleep disturbance, a higher proportion of participants were female (65.8%), Korean (63.0%), and not married/cohabiting (24.7%) compared with those without sleep disturbance (female: 49.9%, Korean: 47.1%, not married/cohabiting: 12.5%).

Table 3 reports the prevalence ratios (PRs) and 95% confidence intervals (CIs) for Poisson regression models to estimate associations between sleep disturbance and CMM or between sleep apnea risk and CMM. In model 1, without any potential confounders, individuals who had sleep disturbance had 2.24 times the prevalence of having CMM (95% CI: 1.14, 4.42) compared with those who did not have sleep disturbance. The association was maintained in model 2 (adjusted PR = 2.14; 95% CI: 1.08, 4.22), which adjusted for age, gender, Asian subgroup, and marital status, and also in model 3 (PR = 2.15; 95% CI: 1.07, 4.29), which added

covariates of education, household income, employment status, and health insurance status to model 2. For sleep apnea, the individuals at high risk of OSA were also more likely to have CMM (PR = 1.25; 95% CI: 0.51, 3.09) than those at low risk of OSA, without adjusting for any potential confounders (model 1). The positive association was maintained in model 2 (PR = 1.25; 95% CI: 0.50, 3.11) and in model 3 (PR = 1.19; 95% CI: 0.47, 3.01).

As potential effect modifiers, we tested gender, Asian subgroup, and acculturation for the associations between sleep measures and CMM. Web Table 1 presents the results of stratified analyses and interaction terms. Even though the differences were not large enough for interaction terms to be significant at  $P < 0.1$ , our data suggest that male participants, Korean Americans, and people who have lived in the United States 22 years or less might have a stronger association between sleep disturbance and CMM.

## DISCUSSION

To the best of our knowledge, this study is the first to examine the association between sleep measures and CMM, and the first to analyze this association among Asian Americans. Given that Asian Americans have shorter sleep duration and higher odds of sleep apnea and poor sleep quality compared with White Americans (93–95), research

**Table 2.** Characteristics of the Study Participants ( $n = 400$ ), Screening to Prevent Colorectal Cancer Study, Baltimore–Washington DC Metropolitan Area, 2018–2020

Characteristic	P Value	Sleep Disturbance					
		Total		No ( $n = 327$ ; 81.8%)		Yes ( $n = 73$ ; 18.2%)	
		No.	%	No.	%	No.	%
CMM <sup>a</sup>	0.019						
Yes		33	8.3	22	6.7	11	15.1
No		367	91.8	305	93.3	62	84.9
OSA risk	0.001						
High		50	12.5	32	9.8	18	24.7
Low		350	87.5	295	90.2	55	75.3
Age, years <sup>b</sup>	0.930	58.39 (0.32)		58.38 (0.36)		58.45 (0.67)	
Gender	0.014						
Male		189	47.3	164	50.2	25	34.3
Female		211	52.8	163	49.9	48	65.8
Asian subgroup	0.014						
Korean		200	50	154	47.1	46	63.0
Chinese		200	50	173	52.9	27	37.0
Marital status	0.008						
Married/cohabiting		341	85.3	286	87.5	55	75.3
Not married/cohabiting		59	14.8	41	12.5	18	24.7
Education	0.360						
Less than HS, HS grad/GED		134	33.5	108	33.0	26	35.6
Some college/vocational school/college grad		169	42.3	135	41.3	34	46.6
Graduate/professional school		97	24.3	84	25.7	1	17.8
Household income, \$	0.451						
<40,000		126	31.5	100	30.6	26	35.6
40,000–79,999		134	33.5	108	33.0	26	35.6
≥80,000		140	35.0	119	36.4	21	28.8
Employment status	0.674						
Full-time		231	57.8	190	58.1	41	56.2
Part-time		84	21.0	66	20.2	18	24.7
Not employed		85	21.3	71	21.7	14	19.2
Health insurance status	0.953						
Private insurance		242	60.5	199	60.9	43	58.9
Medicare/Medicaid		74	18.5	60	18.4	14	19.2
None		84	21.0	68	20.8	16	21.9

Abbreviations: CMM, complex comorbidity; GED, General Educational Development certificate; HS, high school; OSA, obstructive sleep apnea.

<sup>a</sup> CMM was defined as the coexistence of 3 or more of the following body system disorders: 1) circulation disorder (high blood pressure, stroke, heart attack, or any other heart disease); 2) endocrine-metabolic disorder (diabetes, obesity, or high cholesterol); 3) cancer; 4) anxiety or depression; 5) breathing problem (asthma or emphysema); and 6) any other health problems.

<sup>b</sup> Values are expressed as mean (standard error).

to understand the role of sleep health in chronic conditions is crucial for Asian Americans' health outcomes. We found that having sleep disturbance was significantly associated with having CMM among Chinese and Korean Americans.

Moreover, individuals at high risk of OSA were more likely to have CMM than those at low risk for OSA.

Our results align with previous research on the positive associations between sleep disturbance and multiple chronic

**Table 3.** Poisson Regression Analysis of Sleep Disturbance, Sleep Apnea, and Complex Multimorbidity ( $n = 400$ ), Screening to Prevent Colorectal Cancer Study, Baltimore–Washington DC Metropolitan Area, 2018–2020

Sleep Measure	Model 1 <sup>a</sup>		Model 2 <sup>b</sup>		Model 3 <sup>c</sup>	
	PR	95% CI	PR	95% CI	PR	95% CI
Sleep disturbance						
Yes <sup>d</sup>	2.24	1.14, 4.42	2.14	1.08, 4.22	2.15	1.07, 4.29
No	1.00	Referent	1.00	Referent	1.00	Referent
OSA risk						
High	1.25	0.51, 3.09	1.25	0.50, 3.11	1.19	0.47, 3.01
Low	1.00	Referent	1.00	Referent	1.00	Referent

Abbreviations: CI, confidence interval; CMM, complex comorbidity; OSA, obstructive sleep apnea; PR, prevalence ratio.

<sup>a</sup> Model 1 estimated associations between sleep disturbance and CMM or between sleep apnea risk and CMM.

<sup>b</sup> Model 2 is model 1 with the addition of age, gender, Asian subgroup, and marital status.

<sup>c</sup> Model 3 is model 2 with the addition of education, household income, employment status, and health insurance status.

<sup>d</sup>  $P < 0.01$ .

conditions, extending a report of sleep disturbance and multimorbidity in Swedish and German populations to Asian Americans using the CMM concept (1, 2). Using a sample of 1,189 older Swedish adults without multimorbidity at baseline, a study reported that moderate to severe sleep disturbances measured by the Comprehensive Psychiatric Rating Scale (CPRS) at baseline were associated with a higher rate of chronic disease accumulation throughout the 9-year follow-up (1). Similarly, a study in Germany ( $n = 4,127$ ) found that sleep disturbance, assessed by having insomnia, trouble in falling or staying asleep, and daytime tiredness, was associated with a higher number of chronic conditions among women (2). Additionally, although several studies examined the relationship between sleep apnea and the development of a singular chronic condition such as cardiovascular disease (73–75), diabetes (76, 77), and cancer (78, 79), our study is the first, to our knowledge, to explore the association between sleep apnea and multiple chronic conditions.

One possible mechanism underlying these associations is that sleep disturbance or sleep apnea may shorten the length of telomeres (58–61), which contributes to the pathogenesis of CMM including heart disease (62–64), cancer (65–67), and stroke (68–70). Moreover, there has been evidence that poor sleep quality has detrimental effects on cardiometabolic, endocrine, immune, and inflammatory systems. Both sleep disturbance and sleep apnea were found to activate the hypothalamic-pituitary-adrenal (HPA) axis through awakening and arousal, and increased the release of hormones that control appetite, glucose homeostasis, and cortisol levels (96–98). Poor sleep health also increases the risk of dysregulations in inflammatory disease by increasing the levels of C-reactive protein and interleukin-6 (IL-6) (57). Through these mechanisms, sleep disturbance and sleep apnea are risk factors for developing metabolic syndrome and other hypercortisolemic states, such as insomnia and depression (99). Additionally, poor sleep health may cause multiple diseases through unhealthy behaviors, such as smoking and poor diet, which are well-established as

associated with increased risk of various chronic diseases. For example, poor sleep is associated with dietary disruptions including higher caloric intake and poorer diet quality (71), which in turn has been associated with increased risk of developing multiple chronic diseases (72).

Our stratified analyses suggested that the positive association between sleep disturbance and CMM might be more pronounced among male participants, Korean Americans, and participants who have lived in the United States for 22 years or less compared with female participants, Chinese Americans, and those who have lived in the United States more than 22 years. The results suggest some differences according to Asian subgroup and gender, but we might be underpowered to show great differences. Also, although the association was significantly different by length of time in the United States, wide confidence intervals may indicate less precision (100).

The present study has limitations that need to be considered. First, we assessed sleep disturbance and sleep apnea risk using self-reported information, which is not the gold standard. Nonetheless, PROMIS sleep disturbance measures and the Berlin questionnaire for sleep apnea risk are widely used, valid, and reliable self-reported measures in diverse populations (82–85, 101). Second, due to the cross-sectional nature of our study, our findings could be susceptible to reverse causation. As our data are not longitudinal, it remains unclear whether poor sleep—as measured by the presence of self-reported sleep disturbances and sleep apnea—is causing higher CMM or whether having multiple diseases causes disturbed sleep. For example, depression could lead to insomnia and exacerbate sleep health (102), while obesity could contribute to poorer sleep and subjective fatigue due to psychological distress (103). Having several chronic conditions could also reduce sleep quality through pain. In either case, treating sleep disturbance is important as either a risk factor for or symptom of CMM. Third, there could be residual confounding. Although we adjusted for many sociodemographic variables, there could be additional potential confounding

factors affecting the relationship between sleep and CMM, such as smoking. Fourth, CMM did not include cognitive function, which is another increasing health problem among older populations. As poor sleep health was found to be associated with cognitive decline (104, 105), future studies should consider cognitive function for CMM. Fifth, due to the small sample size, our stratified analyses may be underpowered. Last, the study was limited to Chinese and Korean adults aged 50 to 75 years living and in the Washington DC Metropolitan Area. Our findings may not be generalizable to Asian Americans outside of this age range, with origins from Asian countries other than China and Korea, or who live elsewhere in the United States. Future prospective studies are needed to explore the causal mechanism using objective sleep measurements such as polysomnography or actigraphy, while including more diverse and larger Asian American populations.

Despite these limitations, our study suggests health implications. Asian Americans are the fastest growing racial group in the United States, and it is increasingly crucial to assess chronic conditions among these populations. However, previous nationwide studies on this topic in the United States have notably omitted Asian Americans due to small sample sizes and inconsistent definitions of the term “Asian American” (106–108). Even fewer studies exist for Asian subgroups, despite comparative studies suggesting heterogeneity in health status and prevalence of chronic diseases across Asian subgroups (87, 88). Our study contributes to the literature by studying the prevalence of multiple chronic conditions and CMM’s relationship with sleep disturbance and sleep apnea risk. Although sleep disturbances and sleep apnea are amenable to treatment and interventions, there is a high prevalence of unrecognized and undertreated sleep problems among Asian Americans. Some data indicate that this is particularly high in some Asian American groups (95, 109). For example, one study found that doctor-diagnosed sleep apnea was uncommon among Chinese Americans compared with White, Black, and Hispanic Americans, whereas habitual snoring and polysomnography-measured sleep disordered breathing were most common among Chinese Americans (95). Further emphasis on the importance of sleep as a risk factor for chronic disease, potentially additive to other risk factors (such as eating habits, alcohol consumption, or physical activity) may result in improved strategies for chronic disease prevention (38). Thus, public health interventions are needed to increase awareness of the importance of sleep among health-care providers and the public and to educate them about the causes, signs, and treatment of sleep disturbance and sleep apnea. Further research is needed to determine the efficacy of sleep health interventions in preventing CMM among Asian Americans and other minoritized populations in the United States

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