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ORIGINAL ARTICLE

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Prevalence and predictors of co-occurring diabetes and hypertension in community-dwelling older adults

Omar T. Sims,[1,2,3,4] Hyejung Oh,[5] Hyunjin Noh,[6] Pamela A. Melton,[7] Samantha Sheffield,[2] Kacey Ingram[2] and Patricia Sawyer[8]

[1]Department of Social Work, College of Arts and Sciences, University of Alabama at Birmingham, Birmingham, Alabama, USA
[2]Department of Health Behavior, School of Public Health, University of Alabama at Birmingham, Birmingham, Alabama, USA
[3]Comprehensive Center for Healthy Aging, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama, USA
[4]Center for AIDS Research, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama, USA
[5]Department of Social Work, School of Social Sciences & Education, California State University Bakersfield, Bakersfield, California, USA
[6]School of Social Work, University of Alabama, Tuscaloosa, Alabama, USA
[7]Department of Social Work, Psychology and Counseling, College of Education, Humanities, and Behavioral Sciences, Alabama A&M University, Normal, Alabama, USA
[8]Department of Medicine, Division of Gerontology, Geriatrics, and Palliative Care, University of Alabama at Birmingham, Birmingham, Alabama, USA

Correspondence
Dr Omar T Sims PhD, Department of Social Work, College of Arts and Sciences, University of Alabama at Birmingham, HB 414, 1720 2nd AVE S, Birmingham, Alabama 35294-1260, USA.
Email: sims.omar@gmail.com

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Aim: The objectives of the present study were to estimate the prevalence of co-occurring diabetes and hypertension among older adults, examine predictors of co-occurring diabetes and hypertension, and ascertain whether predictors varied by race.

Methods: A retrospective analysis was carried out using a statewide survey of Alabama community-dwelling older adults (n = 1204). Measures of central tendency and frequency distributions were used for univariate analysis. Logistic regression was used to predict co-occurring diabetes and hypertension.

Results: The prevalence of co-occurring diabetes and hypertension among older adults was 17%. African American race (OR 2.28, 95% CI 1.596–3.255), body mass index ≥30 (OR 2.45, 95% CI 1.732–3.463), heart disease (OR 1.93, 95% CI 1.355–2.756) and eye disease (OR 1.44, 95% CI 1.018–2.024) were associated positively with co-occurring diabetes and hypertension.

Conclusions: The prevalence of co-occurring diabetes and hypertension among older adults was alarmingly high. The notable difference in the likelihood of co-occurring diabetes and hypertension is representative of a racial health disparity that largely disfavors African American older adults. Findings from the present study highlight a need for identification of older adults who have and who are at risk of co-occurring diabetes and hypertension in the general population and in clinical settings, and the development and implementation of suitable interventions, particularly targeting older African American adults. **Geriatr Gerontol Int 2018; ••: ••–••.**

Keywords: diabetes, hypertension, older adults, predictors, prevalence.

Introduction

According to recent estimates, the prevalence of diabetes and of hypertension among older adults in the USA is 33% and 65% respectively.[1,2] Although two distinct disease states, risk factors for diabetes and hypertension are quite similar. Consequently, diabetes and hypertension are commonly associated with each other and frequently co-occur. Commonly shared risk factors include, but are not limited to, physical inactivity, obesity, unhealthy diet, heavy alcohol use and smoking; those who live in rural areas are more likely to have diabetes and hypertension compared with those who live in urban areas.[3–6]

Among older adults, both diabetes and hypertension are independent risk factors for frailty, cardiovascular disease and chronic kidney disease;[7–9] and co-occurring diabetes and hypertension has synergistic effects on morbidity and mortality. Co-occurring diabetes and hypertension increases all-cause mortality by 38% and cardiovascular disease by 70%.[10] Furthermore, persons with co-occurrence have 3.67 higher odds of frailty.[11] Hence, the accelerated pathophysiology associated with co-occurring diabetes and hypertension has been coined "an unholy alliance.[12]

To date, the majority of studies on older adults characterize and examine diabetes or hypertension alone, or highlight ways in which one is associated with the other,[13–17] whereas only Balogun and Salako 2011 have sought to characterize and examine co-occurrence.[18] However, this examination was limited to clinical and metabolic differences between hypertensive patients who developed diabetes and patients with diabetes who developed hypertension. Thus, the prevalence of co-occurring diabetes and hypertension among older adults has not been well-established, and predictors of co-occurring diabetes and hypertension have been largely unexamined. This is an important public health and clinical consideration given the adverse effects of co-occurring diabetes and hypertension on the survival and well-being of older adults. To fill this knowledge gap, using a sample of community-dwelling older adults living in the state of Alabama, the present study estimated the prevalence of co-occurring diabetes and hypertension among older adults, examined predictors of co-occurring diabetes and hypertension, and ascertained whether predictors varied by race.

Methods

The present study analyzed data from an Alabama Medicaid Agency-funded long-term care needs assessment carried out by the Comprehensive Center for Healthy Aging at the University of Alabama at Birmingham known as "Charting the Course." The purpose of Charting the Course was to assess current and emerging medical conditions and social needs of older Alabama residents. To recruit a sample representative of the state of Alabama, counties were selected based on the size of the county and geographic distribution, and it was determined a sample size of 1200 would give adequate power to detect differences by age, race, sex and area of residence. A stratified random sampling design was used to ensure that the proportion of participants would represent the state population aged >55 years.

Of residents randomly selected for participation, a letter was mailed to inform and recruit potential participants for in-home interview assessments. A toll free number was provided for persons to inquire about the study. In-home face-to-face interviews were scheduled for respondents confirmed to be aged ≥55 years, able to communicate with an interviewer and living in the community.

The survey questionnaire was developed and approved by the State of Alabama Long-Term Care Task Force and the University of Alabama at Birmingham's Comprehensive Center for Healthy Aging. Survey questions included, but were not limited to, sociodemographics, general health, health services utilization, medical history, cognitive functioning and emotional health, spirituality, social care, retirement planning, and long-term care planning. Interviewers for Charting the Course interviewed 1204 community-dwelling older adults. All participants provided signed informed consent before being interviewed. The analysis for the present study included the total sample of participants. The current study was approved by the institutional review boards of the University of Alabama at Birmingham and the University of Alabama.

Outcomes

Co-occurring diabetes and hypertension

The main outcomes were prevalence and predictors of co-occurring diabetes and hypertension. Co-occurring diabetes and hypertension was defined for participants who reported having medical diagnoses of diabetes and hypertension.

Predictors

Demographics

Demographic data included sex, race (African American and white), age, education (reported in years of education), income (reported categorically as ≤$19 999, $20 000–$49 999, ≥$50 000) and residence (urban *vs* non-urban).

Self-rated general health and physical activity

Self-rated general health was assessed by a single-item Likert scale question that assessed overall health, "In general, how would you say your health is?": 1 = poor, 2 = fair, 3 = good, 4 = very good and 5 = excellent. Self-rated physical activity was a single-item Likert scale question that assessed physical activity, "How would you describe your level of physical activity?": 1 = not active, 2 = minimally active, 3 = moderately active and 4 = active.

Obesity

Body Mass Index (BMI) was calculated using self-reported weight and height. Obesity was defined as BMI ≥30.

Tobacco use

Participants who reported current cigarette use were defined as current cigarette smokers.

Medical conditions

Medical conditions included heart disease and eye disease.

Depression

Scores from the Geriatric Depression Scale (Short Form), a 15-item self-report assessment of depression, were used to identify older adults with depressive symptomatology (a score >5).[19]

Statistical analysis

Measures of central tendency and frequency distributions were used for univariate analysis. Student's *t*-tests and the χ^2-test were used to

Table 1 Characteristics of older adults

Variables (Categories)	Frequency (*n*)	Percent (%)	Mean (SD)
Demographics			
Sex			
Male	514	42.7	
Female	690	57.3	
Race			
White	877	72.8	
African American	327	27.2	
Age (range 55–90)			68.52 (8.70)
Education			
1–11 years	306	25.4	
High school	365	30.3	
College or Higher	532	44.2	
Income			
Less than $19 999	460	44.0	
$20 000–$49 999	360	34.4	
$50 000 or more	225	21.5	
Residence			
Urban	720	59.8	
Non-urban	484	40.2	
Self-rated Health and Physical Activity			
General health (range 1–5)			2.89 (1.19)
Physical activity level (range 1–4)			2.01 (0.97)
Obesity			
No (BMI < 30)	803	68.9	
Yes (BMI ≥ 30)	363	31.1	
Tobacco Use			
Smoke cigarettes			
No	1035	86.0	
Yes	169	14.0	
Medical Conditions			
Diabetes			
No	950	78.9	
Yes	254	21.1	
Hypertension			
No	452	37.5	
Yes	752	62.5	
Heart disease			
No	774	64.3	
Yes	430	35.7	
Eye disease			
No	613	50.9	
Yes	591	49.1	
Depression			
No	565	46.9	
Yes	639	53.1	

compare numerical and dichotomous variables between those with and without co-occurring diabetes and hypertension. Logistic regression was used to determine which predictors were associated with co-occurring diabetes and hypertension. The correlations ($-0.003 \leq r \leq 0.193$) and variance inflation factor statistics (≥1.256) were checked during preliminary analysis. No multicollinearity problem was observed in the multivariate analysis. SPSS Statistics 23 (IBM Corporation, Armonk, NY, USA) was used for all statistical analyses.

Results

More than half of the sample was female (58%) and white (73%; Table 1). The average age was 69 years (range 55–90 years). Nearly half of the sample (44%) had an income of <$19 999, and the majority resided in an urban area (60%). Self-rated general health was fair (2.89, SD 1.19), and physical activity was minimally active (2.01, SD 0.97). One-third of participants were obese, and 14% smoked cigarettes. A total of 49% reported eye disease, 36% reported heart disease and 53% reported depressive symptomatology.

The prevalence of co-occurring diabetes and hypertension among older adults was 17% (Table 2). Compared with older adults without co-occurring diabetes and hypertension, a higher proportion of older adults with co-occurring diabetes and hypertension had BMI ≥30 ($\chi^2 = 50.96$, $P = 0.000$), heart disease ($\chi^2 = 46.45$, $P = 0.000$), eye disease ($\chi^2 = 14.33$, $P = 0.000$) and depression ($\chi^2 = 10.75$, $P = 0.001$), and lower levels of self-rated general health ($t = 13.26$, $P = 0.000$) and physical activity ($t = 5.17$, $P = 0.000$). Those with and without co-occurring diabetes and hypertension did not differ in sex, age, residence or smoking status.

In the logistic regression analysis (Table 3), African American race (OR 2.28, 95% CI 1.596–3.255), BMI ≥30 (OR 2.45, 95% CI 1.732–3.463), heart disease (OR 1.93, 95% CI 1.355–2.756), and eye disease (OR 1.44, 95% CI 1.018–2.024) were associated positively with co-occurring diabetes and hypertension. Low levels of self-rated general health were associated negatively with co-occurring diabetes and hypertension (OR 0.50, 95% CI 0.415–0.610).

Predictors of co-occurring diabetes and hypertension did not vary by race (Table 4). Obesity and heart problems were associated positively with co-occurring diabetes and hypertension for both African American and white participants, and low levels of self-rated general health were associated negatively with co-occurring diabetes and hypertension for both racial groups.

Table 2 Comparison of older adults with and without co-occurring diabetes and hypertension

	Co-occurring diabetes and hypertension		Significance
	No (n = 994)	Yes (n = 210)	
Demographics			
Sex, *n* (%)			χ^2 (1)=2.19, (P = 0.138)
Male	434 (43.7%)	80 (38.1%)	
Female	560 (56.3%)	130 (61.9%)	
Race, *n* (%)			**χ^2(1) = 39.83, (P = 0.000)***
White	761 (76.6%)	116 (55.2%)	
African American	233 (23.4%)	94 (44.8%)	
Mean age, years (SD)	68.52 (8.86)	68.51 (7.95)	t = −0.017, (P = 0.986)
Education			**χ^2(2) = 25.30, (P = 0.000)***
1–11 years	230 (23.2%)	76 (36.2%)	
High school	293 (29.5%)	72 (34.3%)	
College or higher	470 47.3%)	62 (29.5%)	
Income			**χ^2(2) = 25.93, (P = 0.000)***
<$19 999	349 (40.7%)	111 (59.4%)	
$20 000–49 999	304 (35.4%)	56 (29.9%)	
≥$50 000	205 (23.9%)	20 (10.7%)	
Residence, *n* (%)			χ^2(1) = 3.21, (P = 0.073)
Urban	606 (61.0%)	114 (54.3%)	
Non-urban	388 (39.0%)	96 (45.7%)	
Self-rated health and physical activity			
Mean general health (SD)	3.06 (1.17)	2.09 (0.916)	**t = −13.26, (P = 0.000)***
Mean physical activity level (SD)	2.08 (0.953)	1.70 (0.998)	**t = −5.17, (P = 0.000)***
Obesity, *n* (%)			**χ^2(1) = 50.96, (P = 0.000)***
No (BMI <30)	706 (73.3%)	97 (47.8%)	
Yes (BMI ≥30)	257 (26.7%)	106 (52.2%)	
Tobacco use			
Smoke cigarettes, *n* (%)			χ^2(1)=0.98, (P = 0.328)
No	850 (85.5%)	185 (88.1%)	
Yes	144 (14.5%)	25 (11.9%)	
Medical and psychiatric conditions			
Heart disease, *n* (%)			**χ^2(1) = 46.45, (P = 0.000)***
No	682 (68.6%)	92 (43.8%)	
Yes	312 (31.4%)	118 (56.2%)	
Eye disease, *n* (%)			**χ^2(1) = 14.33, (P = 0.000)***
No	531 (53.4%)	82 (39.0%)	
Yes	463 (46.6%)	128 (61.1%)	
Depression, *n* (%)			**χ^2(1) = 10.75, (P = 0.001)**
No	488 (49.1%)	77 (36.7%)	
Yes	506 (50.9%)	133 (63.3%)	

*P < 0.05. Age range 55–90 years. Bold indicates statistical significance.

Table 3 Logistic regression predicting co-occurring diabetes and hypertension

Variables	Categories	OR	95% CI	*P*-values
Race	White	1		
	African American	2.279	1.596–3.255	0.000*
Sex	Male	1		
	Female	1.171	0.828–1.656	0.372
Residence	Urban	1		
	Rural	1.078	0.766–1.518	0.666
General health		0.503	0.415–0.610	0.000*
Physical activity level		1.178	0.974–1.425	0.092
Obesity	No (BMI <30)	1		
	Yes (BMI ≥30)	2.449	1.732–3.463	0.000*
Smoke cigarettes	No	1		
	Yes	0.733	0.445–1.206	0.221
Heart disease	No	1		
	Yes	1.932	1.355–2.756	0.000*
Eye disease	No	1		
	Yes	1.435	1.018–2.024	0.039*
Depression	No	1		
	Yes	1.247	0.873–1.781	0.225

*$P < 0.05$. CI, confidence interval; OR, odds ratio.

Table 4 Logistic regression predicting co-occurring diabetes and hypertension by race

Variables	Categories	White OR (95% CI)	African American OR (95% CI)
Sex	Male	1	1
	Female	1.236 (0.787–1.940)	1.136 (0.652–1.979)
Residence	Urban	1	
	Rural	1.350 (0.869–2.097)	0.725 (0.411–1.279)
General health		**0.504 (0.395–0.644)**	**0.507 (0.366–0.702)**
Physical activity level		1.125 (0.878–1.442)	1.256 (0.929–1.697)
Obesity	No (BMI <30)	1	
	Yes (BMI ≥30)	**3.092 (1.979–4.829)**	**1.744 (1.001–3.040)**
Smoke cigarettes	No	1	
	Yes	0.785 (0.397–1.549)	0.692 (0.333–1.438)
Heart disease	No	1	
	Yes	**1.994 (1.255–3.169)**	**1.925 (1.094–3.388)**
Eye disease	No	1	
	Yes	1.314 (0.835–2.067)	1.714 (1.000–2.937)
Depression	No	1	
	Yes	1.267 (0.800–2.007)	1.178 (0.666–2.084)

*$P < 0.05$. CI, confidence interval; OR, odds ratio. Bold indicates statistical significance.

Discussion

Several main findings emerged from the present study. The prevalence of co-occurring diabetes and hypertension was 17%. Older adults who were African American, obese, and had heart disease or eye disease had greater odds of co-occurring diabetes and hypertension. Predictors of co-occurring diabetes and hypertension did not vary by race.

The prevalence of co-occurring diabetes and hypertension among older adults was alarmingly high. Given the multiplicative effects of co-occurrence on frailty, cardiovascular disease, renal disease and renal failure, identification and management of older adults with co-occurring diabetes and hypertension in the general population and in clinical settings are of public health importance. Public health efforts are required to educate older adults of increased health risks associated with having both disease states, and more clinical research is needed to assist clinicians with proper management of co-occurrence.

The notable difference in the likelihood of co-occurring diabetes and hypertension is representative of a racial health disparity that largely disfavors African American older adults. If suitable interventions to prevent these diseases are not designed to target this population, the potential is for an increase in annual incident cases of co-occurring diabetes and hypertension-related morbidity and mortality among the growing numbers of African American older adults.

Predictors of co-occurring diabetes and hypertension did not vary by race. Although there are no prior studies that have examined whether predictors of co-occurring diabetes and hypertension vary by race, this finding suggests that independent risk factors for co-occurring diabetes and hypertension are not race specific. More importantly, of the independent risk factors, obesity had the highest odds of predictive association with co-occurring diabetes and hypertension. This finding is not surprising, given that obesity is a leading risk factor for both diabetes and hypertension. The global prevalence of obesity has nearly doubled in the past three decades;[20] in the USA, 36% of adults have a BMI ≥30,[21] it is estimated nearly 90% of diabetes is attributable to excess weight[22] and excess weight accounts for 65–75% of the risk for hypertension.[21] This vicious synergistic combination of obesity, diabetes, and hypertension also increases the risk for cardiovascular disease and chronic kidney disease.[9] Altogether, this is an important issue for public health professionals to address for the state of Alabama, because Alabama has the second highest rate for diabetes[23] and the third highest rate for hypertension in the USA.[24]

Obesity and heart disease were risk factors across both racial groups. Health professionals and clinicians should closely monitor older adults with these conditions, and recommend strategies to prevent onset and exacerbation of both diabetes and hypertension. Physical activity as an evidence-based treatment modality for the prevention and treatment of both diabetes and hypertension has been well established.[22] In addition, lifestyle changes, such as healthy dieting, and smoking and alcohol cessation, have been shown to be therapeutic for both diabetes and hypertension.[25,26] Although understudied in co-occurring diabetes and hypertension populations, it is likely lifestyle changes will have similar, if not greater, therapeutic benefits.

The present study had some noteworthy limitations and strengths. The limitations of this study were its cross-sectional nature; the absence of sufficient data on alcohol use, anxiety and diet; and reliance on self-reported data. Given the geographic context of the study, the prevalence estimate of co-occurring diabetes and hypertension might not be generalizable to other states. Notwithstanding, the study had a relatively large number of older adults (n = 1204) and African American older adults (n = 233). The stratified random sampling strategy permitted analysis of a sample that was closely representative of community-dwelling older adults in the state of Alabama. To the authors' knowledge, this is the first study to estimate the prevalence of co-occurring diabetes and hypertension among older adults in the UAS, and to examine predictors of co-occurrence.

In summary, more research is required to prevent older adults with diabetes from developing hypertension, and hypertensive older adults from developing diabetes. Targeted public health screening and educational efforts can raise public awareness of risk factors and adverse outcomes associated with co-occurring diabetes and hypertension. The findings of the present study highlight a need for identification of older adults who have and who are at risk of co-occurring diabetes and hypertension in the general population and in clinical settings, and development and implementation of suitable interventions, particularly targeting older African American adults. Based on the findings of this study, it is advisable that intervention development purposefully includes health behavior and medical approaches to negate the pathophysiological role of obesity in co-occurring diabetes and hypertension.

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Disclosure statement

The authors declare no conflict of interest.

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