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Clinical Investigation

Prevalence of Cardiometabolic Risk Factors in Women: Insights From the Houston HeartReach Study

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Abstract

Background: Cardiovascular disease is the leading cause of death among women in the United States. Past research has highlighted the importance of the relationship between female-specific demographics and traditional risk factors. The present analysis aimed to identify the prevalence of modifiable risk factors in women attending a community cardiovascular health screening.

Methods: Data collected between 2011 and 2019 were obtained from the Houston HeartReach Registry. Participants were classified as having or not having each of 4 traditional cardiometabolic risk factors: hypertension, diabetes, body mass index indicating overweight or obesity, and dyslipidemia. Differences in prevalence were compared using the Pearson χ^2 test.

Results: Most participants had hypertension, overweight or obesity, and dyslipidemia. Older women (≥65 years) had the highest prevalence of all cardiometabolic risk factors. Black participants had a higher prevalence of hypertension (P = .006) and a lower prevalence of dyslipidemia (P = .009) than non-Black participants. Hispanic participants had a lower prevalence of hypertension (P < .001) and a higher prevalence of overweight or obesity (P = .03) than non-Hispanic participants. Participants in the lowest household income bracket (<$25,000) were more likely to have diabetes (P = .001) and overweight or obesity (P = .004) than participants in the highest income bracket (≥$50,000). Unemployed participants had a higher prevalence of diabetes (P < .001), overweight or obesity (P = .004), and dyslipidemia (P < .001) than employed participants. Comorbidity analysis revealed clustering of multiple cardiometabolic risk factors. Moreover, risk factor hot spots were identified by zip code, which could help select future sites for targeted screening.

Conclusion: The analysis found that cardiometabolic risk factor prevalence varies with demographic and socioeconomic status. Geographic areas where cardiometabolic risk factor prevalence was highest were also identified. Further participant recruitment and analysis are required to create predictive models of cardiovascular disease risk in women.

Keywords: Cardiometabolic risk factors; cardiovascular diseases; women's health; cross-sectional studies; social class

Introduction

It is well established that heart disease is the leading cause of death for women living in the United States.[1] Although many studies have pointed to sex-based differences in cardiovascular disease (CVD) risk profiles,[2-5] only a few have highlighted the heterogeneity of cardiometabolic risk factors and their prevalence in women.[6] Cardiometabolic risk factors is an umbrella term used to describe factors associated with the development of CVD, including hypertension, diabetes, a body mass index (BMI) indicating overweight or obesity, and dyslipidemia. Researchers have found the prevalence of traditional cardiometabolic risk factors to be a valuable metric

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for predicting CVD outcomes, but studies indicate that these factors do not fully capture the complexity of women's cardiovascular health.[1] In a statement published by the American Heart Association (AHA), some traditional cardiometabolic risk factors, such as BMI, show poor sensitivity because female patients from certain racial and ethnic groups are historically underrepresented in sample populations.[1] In addition, many CVD risk models that use traditional cardiometabolic risk factor variables as predictors fail to account for female-specific risk factors, such as pregnancy complications, hormone history, and medical conditions and interventions.[7,8] For these reasons, nontraditional risk factors have been suggested as supplementary predictors of CVD risk in women.[1,9,10]

Although studies have shown that predictive models can more accurately predict CVD outcomes when nontraditional risk factors are used in conjunction with traditional risk factors,[9,10] only limited research has focused directly on predicting these outcomes in women.[11,12] Female-specific nontraditional CVD risk factors that the AHA has identified include mental health conditions, access to medical care, and socioeconomic status (SES).[1] Although the AHA suggests that lower SES is a risk factor for CVD in women,[1] few studies have identified such associations in a women's health cohort. The objective of this work, therefore, was to perform a holistic, cross-sectional analysis of the prevalence of cardiometabolic risk factors in women in the Houston HeartReach Registry.

Key Points

- Risk of CVD in women is understudied. A cross-sectional analysis of the Houston HeartReach women's health cohort revealed heterogeneity in women's cardiometabolic risk factor profiles.
- Black participants were more likely than their non-Black counterparts to have hypertension but less likely to have dyslipidemia.
- Hispanic participants were less likely than their non-Hispanic counterparts to be hypertensive but more likely to have overweight or obesity.
- Participants with a lower SES were more likely than their higher-SES counterparts to have diabetes, overweight or obesity, or dyslipidemia.
- Geographic analysis revealed a cluster of participants with cardiometabolic risk factors residing in southeastern Houston.

Abbreviations and Acronyms

AHA, American Heart Association
BMI, body mass index
CVD, cardiovascular disease
SDOH, social determinants of health
SES, socioeconomic status

Participants and Methods

Houston HeartReach Registry

The Houston HeartReach Registry is an ongoing research initiative conducted in Houston, Texas, by the Center for Women's Heart & Vascular Health at The Texas Heart Institute. The registry aims to gather baseline information about the overall cardiovascular health status of women residing in urban Houston communities. Since the study's inception in 2011, The Texas Heart Institute has collaborated with community health organizations such as BakerRipley, the Lesbian Health Initiative of Houston, and the Elnita McClain Women's Center to recruit and screen participants at local health fairs. In addition, some participants were directly recruited during private visits with Texas Heart Institute physicians.

Each participant underwent third-party medical screenings and completed a health survey, which incorporated questions from other established surveys.[13-15] Biometric screening consisted of baseline clinical measurements and a standard lipid panel. The health survey examined personal history, including demographic information and SES. Of the 1,476 participants recruited as of 2019, 1,217 were biologically female at birth. Institutional review board approval was received, and signed consent forms were obtained from all participants in this study.

Traditional Cardiometabolic Risk Factors

The 4 cardiometabolic risk factors of interest were hypertension, diabetes, a BMI indicating overweight or obesity, and dyslipidemia. Participants were categorized as hypertensive if they used blood pressure–lowering medication, reported having hypertension, or had a blood pressure cuff reading that exceeded American College of Cardiology/AHA guidelines (≥130 mm Hg systolic or ≥80 mm Hg diastolic).[16] For participants with multiple blood pressure readings, systolic and diastolic pressures were averaged separately before clinical cutoffs were applied. Participants were categorized as having diabetes if they were receiving medical treatment for diabetes, reported having diabetes, or had a fasting blood glucose value of at least 6.99 mmol/L (126 mg/dL).[17] Participants were classified as having overweight or obesity if their BMI was 25 or higher. Finally, participants were categorized as having dyslipidemia if they used cholesterol-lowering medication or had serum lipid panel measurements exceeding clinical cutoffs suggested by the AHA (total cholesterol >5.17 mmol/L [>200 mg/dL] or triglycerides >1.70 mmol/L [>150 mg/dL]).[18]

Demographic Cardiometabolic Risk Factors

Three demographic variables of interest were collected: age (categorized as 18-39, 40-64, and ≥65 years), race (Black vs non-Black), and ethnicity (Hispanic vs non-Hispanic). Participants who reported being multiracial (by selecting “Black” and 1 or more other races in the answer choices) were classified as Black. Participants who selected both “Hispanic” and other ethnicities were similarly classified as Hispanic. Because this study aimed to target racially and ethnically underrepresented groups with high CVD risk, its classification schema was tailored to specifically focus on these 2 demographic groups.

Nontraditional Cardiometabolic Risk Factors

This study analyzed 2 nontraditional risk factors related to SES: annual household income and employment status. Annual household income was self-reported and stratified into quartiles (<$25,000; $25,000-$34,999; $35,000-$49,999; ≥$50,000). Annual household income was included in this analysis because during the study’s survey, participants were asked to consider different sources of monthly household income to create an accurate estimate of their annual income. Participants also reported whether they were employed or unemployed.

Statistical Analysis

The prevalence of the 4 traditional cardiometabolic risk factors was examined in the overall cohort, as shown in Table I, and was stratified by demographic variables (age, race, and ethnicity) and SES variables (income and employment status), as shown in Table II. The *P* values in Table II were derived from a Pearson χ^2 test for differences in the prevalence of each risk factor across demographic or SES subgroups. All analyses were performed in R, version 4.3.1, software (R Foundation for Statistical Computing); 2-tailed $P < .05$ was considered statistically significant.

Post hoc comparisons with Bonferroni corrections were used to compare proportional differences in cardiometabolic risk factors across age groups and annual household

TABLE I. Baseline Cohort Characteristics

Characteristic[a]	All participants, No. (%) (N = 1217)[b]
Cardiometabolic risk factor	
Hypertension	
Yes	670 (55.1)
No	541 (44.5)
Unknown	6 (0.5)
Diabetes	
Yes	173 (14.2)
No	1,040 (85.5)
Unknown	4 (0.3)
Overweight or obesity	
Yes	961 (79.0)
No	210 (17.3)
Unknown	46 (3.8)
Dyslipidemia	
Yes	680 (55.9)
No	517 (42.5)
Unknown	20 (1.6)
Demographics	
Age, y	
18-39	466 (38.3)
40-64	613 (50.4)
≥65	128 (10.5)
Unknown	10 (0.8)
Race	
Black	139 (11.4)
Non-Black	1,078 (88.6)
Ethnicity	
Hispanic	856 (70.3)
Non-Hispanic	361 (29.7)
Socioeconomic status	
Annual household income	
<$25,000	580 (47.7)
$25,000-$34,999	200 (16.4)
$35,000-$49,999	134 (11.0)
≥$50,000	108 (8.9)
Unknown	195 (16.0)
Employment status	
Employed	413 (33.9)
Unemployed	766 (62.9)
Unknown	38 (3.1)

[a] Missing values for each variable, where present, are denoted as “unknown.”

[b] Some percentage values may not total 100.0% due to rounding.

TABLE II. Demographic and SES Characteristics, by Cardiometabolic Risk Factor

	Hypertension, No. (%)[a]			Diabetes, No. (%)[a]			Overweight or obesity, No. (%)[a]			Dyslipidemia, No. (%)[a]		
Characteristic	**Yes**	**No**	***P* value**	**Yes**	**No**	***P* value**	**Yes**	**No**	***P* value**	**Yes**	**No**	***P* value**
Demographic characteristics												
Age, y												
18-39	168 (36.1)	297 (63.9)	<.001[b]	23 (4.9)	443 (95.1)	<.001[b]	338 (76.0)	107 (24.0)	<.001[b]	178 (39.0)	278 (61.0)	<.001[b]
40-64	383 (62.9)	226 (37.1)		104 (17.1)	505 (82.9)		502 (84.8)	90 (15.2)		403 (66.7)	201 (33.3)	
≥65	115 (90.6)	12 (9.4)		45 (35.2)	83 (64.8)		112 (90.3)	12 (9.7)		95 (74.8)	32 (25.2)	
Race												
Black	92 (66.2)	47 (33.8)	.006	27 (19.4)	112 (80.6)	.06	113 (85.0)	20 (15.0)	.40	63 (46.3)	73 (53.7)	.009
Non-Black	578 (53.9)	494 (46.1)		146 (13.6)	928 (86.4)		848 (81.7)	190 (18.3)		617 (58.2)	444 (41.8)	
Ethnicity												
Hispanic	432 (50.7)	420 (49.3)	<.001	122 (14.3)	731 (85.7)	.95	688 (83.7)	134 (16.3)	.03	485 (57.7)	355 (42.3)	.32
Non-Hispanic	238 (66.3)	121 (33.7)		51 (14.2)	309 (85.8)		273 (78.2)	76 (21.8)		195 (54.6)	162 (45.4)	
SES characteristics												
Income												
<$25,000	319 (55.3)	258 (44.7)	.37	104 (18.0)	475 (82.0)	<.001[b]	460 (82.7)	96 (17.3)	.01[b]	312 (54.8)	257 (45.2)	.86
$25,000-$34,999	100 (50.3)	99 (49.7)		24 (12.0)	176 (88.0)		165 (85.5)	28 (14.5)		114 (57.9)	83 (42.1)	
$35,000-$49,999	76 (56.7)	58 (43.3)		9 (6.7)	125 (93.3)		101 (78.9)	27 (21.1)		74 (55.6)	59 (44.4)	
≥$50,000	65 (60.2)	43 (39.8)		6 (5.6)	102 (94.4)		75 (70.8)	31 (29.2)		62 (57.9)	45 (42.1)	
Employment status												
Employed	221 (53.6)	191 (46.4)	.30	33 (8.0)	379 (92.0)	<.001	305 (77.4)	89 (22.6)	.004	203 (50.0)	203 (50.0)	<.001
Unemployed	433 (56.8)	329 (43.2)		133 (17.4)	631 (82.6)		626 (84.4)	116 (15.6)		460 (60.8)	297 (39.2)	

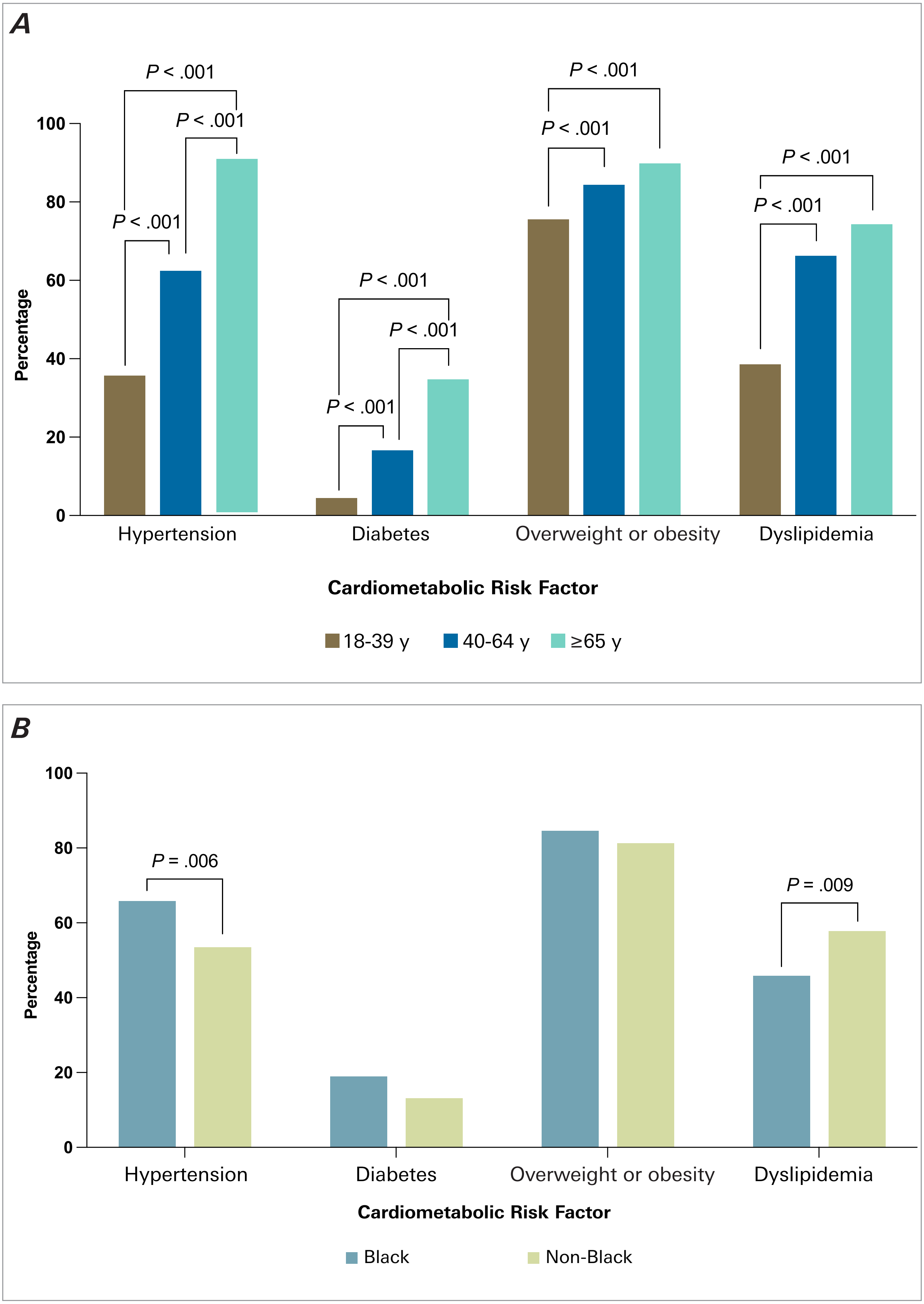
SES, socioeconomic status.

[a] Percentages are calculated out of the row frequency total for each level of a demographic or SES subgroup. $P < .05$ was considered statistically significant.

[b] Further post hoc testing was performed on these groups, as shown in Fig. 1A and 1D.

income groupings (Fig. 1). For these comparisons, $P < .017$ was considered statistically significant for differences across the 3 age groups, and $P < .008$ was considered statistically significant for differences across the 4 income groups.

In addition, the number of each participant's distinct cardiometabolic risk factors was examined in a pie chart (Fig. 2). The geographic distribution of risk factors at a zip code level (Fig. 3) was examined by generating a choropleth map in Tableau, version 2023.3.1, software (Salesforce, Inc).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Percentage
Hypertension
Diabetes
Overweight or obesity
Dyslipidemia
Cardiometabolic Risk Factor
18-39 y
40-64 y
≥65 y
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Cardiometabolic Risk Factor
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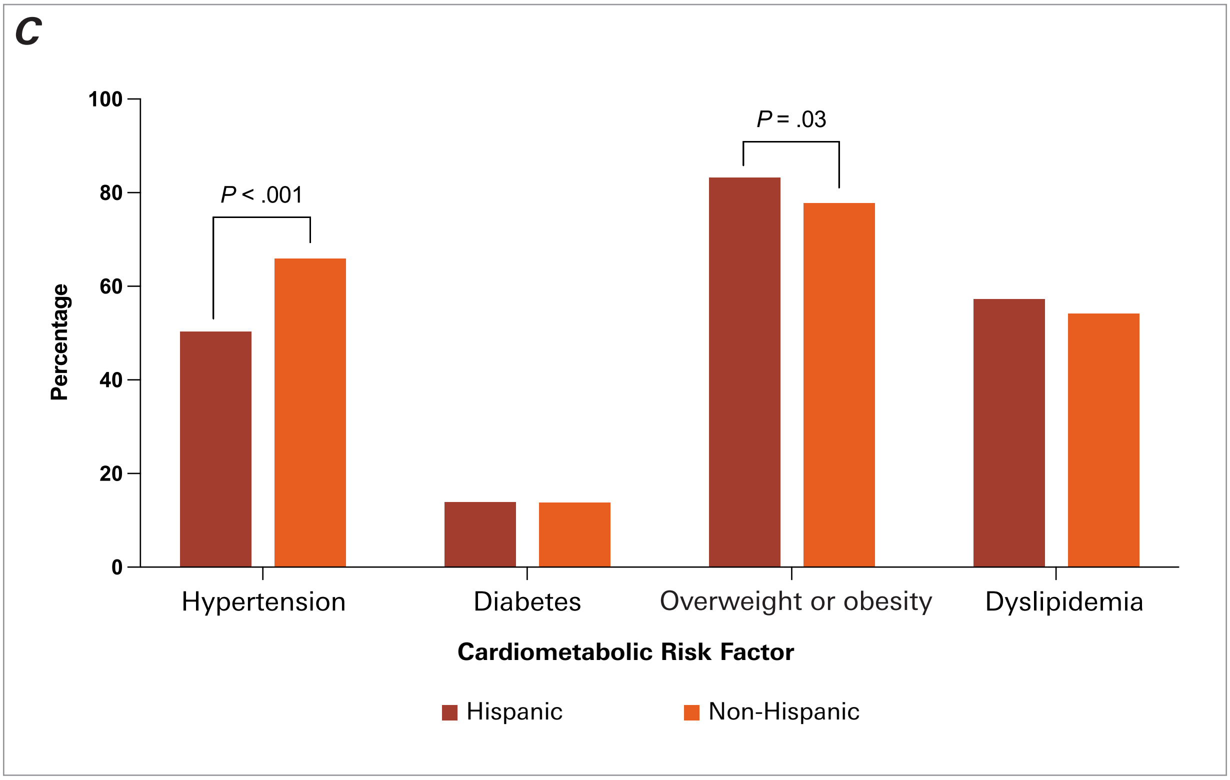
Non-Black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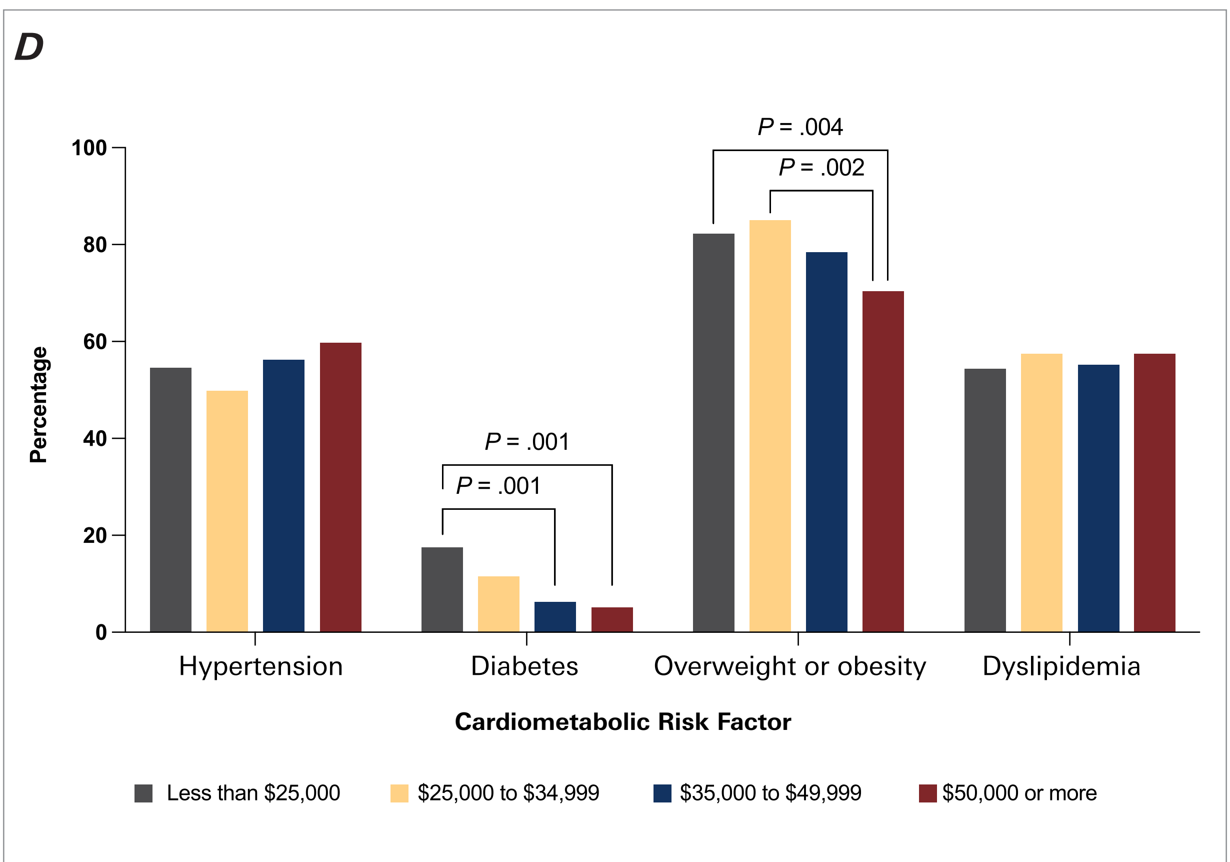
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Cardiometabolic Risk Factor
Less than $25,000
$25,000 to $34,999
$35,000 to $49,999
$50,000 or more

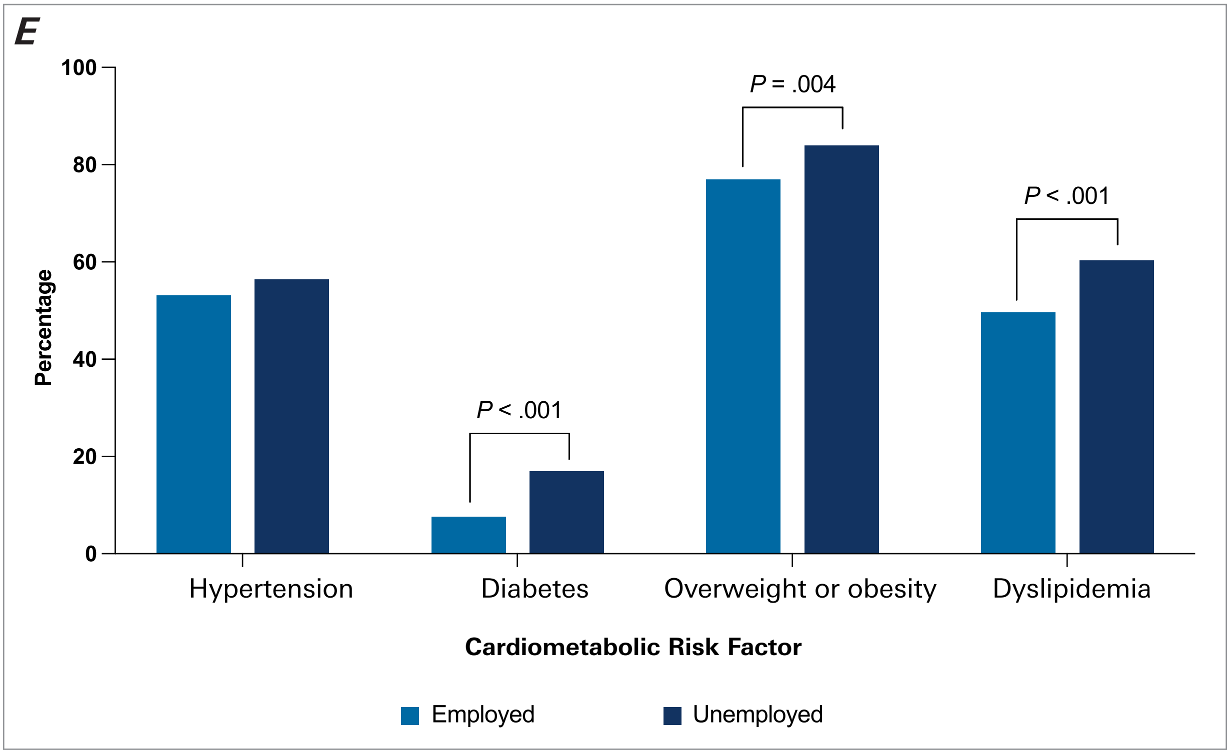

Fig. 1 Prevalence of cardiometabolic risk factors is shown, stratified by (**A**) age group, (**B**) race, (**C**) ethnicity, (**D**) annual household income quartile, and (**E**) employment status.

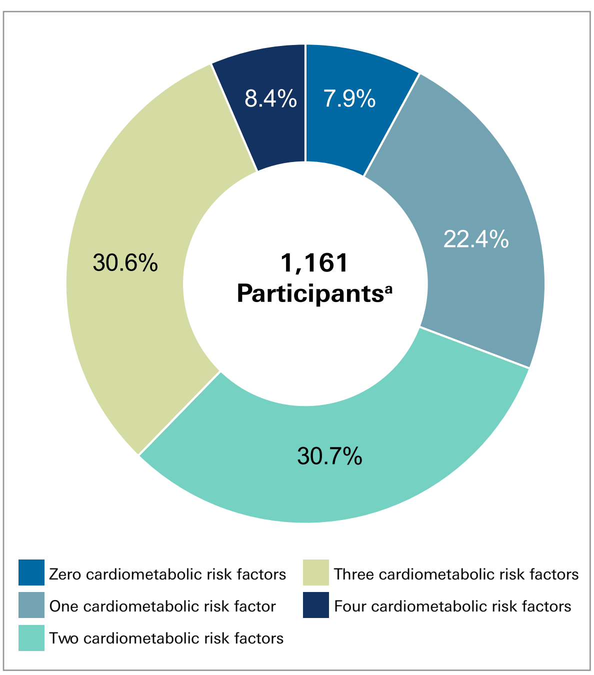

Fig. 2 Pie chart shows cardiometabolic risk factor prevalence and clustering in the study cohort.

[a] A total of 56 participants were excluded because of missing data in at least 1 of the 4 cardiometabolic risk factor categories.

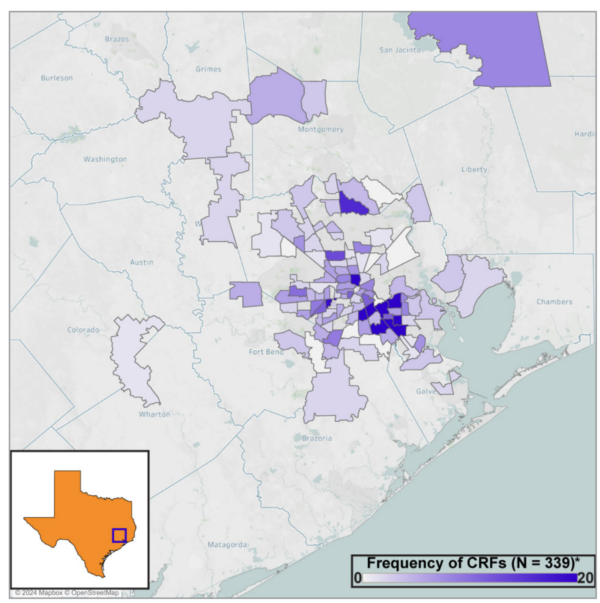

Fig. 3 Choropleth map shows geospatial clustering (by zip code) of cardiometabolic risk factors in the study cohort. Data are presented as frequencies.

[a] In total, 878 participants were excluded for missing data in at least 1 of the 4 cardiometabolic risk factor categories or because of missing or invalid zip codes. Map data from OpenStreetMap.org. CRF, cardiometabolic risk factor.

Missing Data

Participants with multiple cardiometabolic risk factors were counted for each individual risk factor they had. For comparisons between demographic or SES characteristics and cardiometabolic risk factors (Table II, Fig. 1), only patients with complete data were included. For analysis of risk factor clustering (Fig. 2), participants with missing data in any of the 4 risk factors of interest (n = 56) were excluded. For geographic mapping of cardiometabolic risk factor clustering (Fig. 3), participants with missing data in any of the 4 risk factors or with missing or invalid zip codes (n = 878) were excluded.

Results

Baseline Characteristics

The baseline characteristics of Houston HeartReach participants with verified biometric and health survey data are shown in Table I. The majority (50.4%) of participants were 40 to 64 years of age. The study cohort was predominantly Hispanic (70.3%), and 11.4% of participants identified as Black. Most participants were unemployed (62.9%) and had an annual household income less than $35,000 (64.1%). Regarding the 4 traditional cardiometabolic risk factors analyzed, 55.1% of participants were hypertensive, 14.2% had diabetes, 79.0% had overweight or obesity, and 55.9% had dyslipidemia. Six participants had missing data for hypertension, 4 for diabetes, 46 for overweight or obesity, and 20 for dyslipidemia; a total of 56 participants had missing data for 1 or more traditional cardiometabolic risk factors.

Traditional CVD Predictors: Demographics-Based Results

Participants aged 65 years and older had the highest prevalence of hypertension (90.6%), diabetes (35.2%), overweight or obesity (90.3%), and dyslipidemia (74.8%) (Table II). Post hoc comparisons across the 3 age groups (Fig. 1A) revealed that older participants (≥65 years) had a higher prevalence of all cardiometabolic risk factors than younger participants (18-39 years; $P < .001$).

Black and non-Black participants had different risk factor profiles (Fig. 1B). Black participants had a higher prevalence of hypertension (66.2% vs 53.9%; $P = .006$), whereas non-Black participants had a higher prevalence of dyslipidemia (46.3% vs 58.2%; $P = .009$).

Differences were observed between ethnically Hispanic and non-Hispanic participants in the rates of hypertension and of overweight and obesity (Fig. 1C). Whereas overweight and obesity were more common in Hispanic participants (83.7% vs 78.2%; $P = .03$), hypertension was more common in non-Hispanic participants (50.7% vs 66.3%; $P < .001$).

Nontraditional CVD Predictors: SES-Based Results

When the cohort was stratified by income and employment status, differences were found in cardiometabolic risk factor prevalence between lower and higher SES strata. Participants in the 2 lowest annual household income quartiles had higher prevalence rates of diabetes and of overweight and obesity than participants from the higher income strata (Table II). Post hoc analyses (Fig. 1D) revealed that participants with a household income below $25,000 had a higher prevalence of diabetes than those in the $35,000 to $49,999 group (18.0% vs 6.7%; $P = .001$) and the $50,000 or more group (18.0% vs 5.6%; $P = .001$). Similarly, participants with a household income less than $25,000 were more likely to have a BMI associated with overweight or obesity than participants in the $50,000 or more group (82.7% vs 70.8%; $P = .004$), and participants in the $25,000 to $34,999 group had a higher prevalence of overweight or obesity than participants in the $50,000 or more group (85.5% vs 70.8%; $P = .002$).

In addition, unemployed participants had a higher prevalence of diabetes than employed participants did (17.4% vs 8.0%; $P < .001$), BMI indicating overweight or obesity (84.4% vs 77.4%; $P = .004$), and dyslipidemia (60.8% vs 50.0%; $P < .001$) (Fig. 1E).

Cumulative Comorbidities and Geographic Trends in Cardiometabolic Risk Factors

In the overall cohort, diabetes was less prevalent (14.2%) than the other cardiometabolic risk factors (55.1%-79.0%). To better understand the distribution of comorbid cardiometabolic risk factors within the cohort, the present study investigated the number of distinct risk factors each participant had (Fig. 2) and found that the majority of participants (61.3%) had 2 or 3 cardiometabolic risk factors. Geospatial mapping also identified a distinct cluster of women with high risk factor prevalence in the southeastern region of Houston (Fig. 3).

Discussion

This study assessed the overall prevalence of cardiometabolic risk factors and examined variations in the risk factor profiles of female participants in various demographic groups and SES classifications. Three of the 4 cardiometabolic risk factors examined (hypertension, BMI indicating overweight or obesity, and dyslipidemia) were particularly prevalent in the overall cohort. Consistent with previously reported trends,[19] demographic analysis showed higher cardiometabolic risk factor prevalence in older participants. Hispanic participants were less likely to be hypertensive but more likely to have a BMI indicating overweight or obesity, while Black participants more often had hypertension but less often had dyslipidemia. Consistent with previous research suggesting a link between lower SES and higher cardiometabolic risk,[20] this study's SES analysis indicated that individuals in the 2 lowest household income quartiles had the highest prevalence of diabetes and overweight or obesity. In addition, unemployed participants had higher rates of diabetes, overweight or obesity, and dyslipidemia than employed participants.

Understanding how traditional and nontraditional risk factors influence women's CVD risk is a crucial step in addressing inequities in public cardiovascular health. Moreover, comprehending the cardiometabolic risk factor profiles of women is essential for developing tailored interventions and treatment plans. This cross-sectional study revealed considerable heterogeneity in the risk factor profiles of female participants in the Houston HeartReach cohort.

Numerous studies have shown that age is strongly associated with CVD risk in women as a result of a variety of hormone-driven factors.[1,21] This study confirmed an elevated prevalence of cardiometabolic risk factors among women of postmenopausal age.

Consistent with previous research,[1,22] this study found that non-Hispanic and Black women have higher rates of hypertension, while non-Black women have a higher prevalence of dyslipidemia. In addition, the current analysis confirms the greater likelihood of Hispanic women having overweight or obesity compared with non-Hispanic women.[23] Moreover, although previous studies have indicated a higher prevalence of diabetes in non-Hispanic Black women,[1] the current study did not find any statistically significant difference in diabetes prevalence by race or ethnicity. Overall, the study's findings provide insight into the demographic profiles of women who are most likely to have cardiometabolic risk factors.

The current analysis corroborates previous observations that point to the value of integrating SES factors, such as household income and employment status, into an overall cardiovascular risk assessment.[1,20] The study expands upon literature that shows an association between economically disadvantaged households and elevated risk of cardiovascular death in women.[24,25] This analysis specifically identified 2 cardiometabolic risk factors—diabetes and a BMI indicating overweight or obesity—that were most prevalent in women from lower-income households. The observation that unemployed women had a higher prevalence of cardiometabolic risk factors also supports recent findings from another cross-sectional study of female cardiovascular health,[26] which found that employed women were less likely than unemployed women to report several of the traditional cardiometabolic risk factors. These analyses therefore validate the importance of utilizing nontraditional cardiometabolic risk factors to gain a more comprehensive perspective of women's CVD risk profiles.

Broader Implications: Social Determinants of Health

Although this analysis reveals differences in cardiometabolic risk factor prevalence across traditional and nontraditional CVD risk factors, it is important to understand that these factors interact and that a much broader group of nontraditional CVD risk factors has been described—namely, social determinants of health (SDOH). Social determinants of health refers to the environmental conditions surrounding an individual's daily life.[27] The SDOH have 5 major domains[9,27]: (1) economic stability, (2) education access and quality, (3) health care access and quality, (4) neighborhood environment, and (5) social and community context. When groups are disadvantaged in any 1 of these domains, adverse health outcomes can result, including an elevated prevalence of CVD and its risk factors.[27] Whereas the current analysis targets 1 major SDOH domain, economic stability, future analyses could incorporate additional nontraditional risk factors from other SDOH domains to offer a more comprehensive perspective.

Study Limitations

This study has certain limitations. Attendees of Houston HeartReach health fairs may not reflect the overall population of women with CVD risk, thereby creating bias in the results. For instance, more than 64% of participants in the cohort reported an annual household income below $35,000 (Table I). In contrast, US Census data show that the median household income in Houston, Texas, was $42,877 in 2011 and $52,450 in 2019.[28,29] The majority of participants in the Houston HeartReach cohort therefore reside in households below the median annual income level in Houston. Furthermore, in 2011 and 2019, 29.9% and 33.7% of households in Houston, respectively, reported an annual income less than $25,000, whereas in the study cohort, 47.7% of participants reported an annual household income less than $25,000. The SES of participants in the Houston HeartReach cohort may therefore not accurately represent the SES of the larger population.

That said, the data in the current analysis represent a diverse, community-based cohort of women in a large city, with a focus on underrepresented groups. In addition, this analysis was limited by the relatively small number of participants who were initially recruited. As the study continues, more robust recruitment of participants will yield a clearer picture of cardiometabolic risk factor prevalence in diverse subgroups of women in Houston.

Conclusion

This cross-sectional analysis of data from female participants in the Houston HeartReach cohort revealed variability in their cardiometabolic risk factor profiles. First, the study highlights the nuanced distribution of cardiometabolic risk factors among demographic subgroups because not all underrepresented subgroups showed a higher prevalence of each risk factor. Second, a relationship was identified between lower SES and a greater prevalence of specific cardiometabolic risk factors. Third, the study found that cardiometabolic risk factors frequently cluster in the same individuals, emphasizing the interconnectedness of these health issues. Fourth, geographic risk factor hot spots were identified; in the future, community health initiatives and resources should be concentrated in these areas. Finally, to create predictive models that quantify women's risk of acquiring cardiometabolic risk factors based on traditional and nontraditional risk factors, an additional study with a larger sample size is required.

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