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Disparities in the Prevalence of Excess Heart Age Among Women with a Recent Live Birth

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Abstract

Background: Understanding and addressing cardiovascular disease (CVD) risk has implications for maternal and child health outcomes. Heart age, the modeled age of an individual's cardiovascular system based on risk level, and excess heart age, the difference between a person's heart age and chronological age, are alternative simplified ways to communicate CVD risk. Among women with a recent live birth, we predicted heart age, calculated prevalence of excess heart age (≥5 years), and examined factors associated with excess heart age.

Materials and Methods: Data were analyzed in 2017 from 2009 to 2014 Pregnancy Risk Assessment Monitoring System (PRAMS). To calculate heart age we used maternal age, prepregnancy body mass index, systolic blood pressure, smoking status, and diabetic status. Weighted prevalence and prevalence ratios compared the likelihood of excess heart age across racial/ethnic groups by selected factors.

Results: Prevalence of excess heart age was higher in non-Hispanic black women (11.8%) than non-Hispanic white women (7.3%, prevalence ratio [PR], 95% confidence interval [CI]: 1.62, 1.49–1.76) and Hispanic women (4.9%, PR, 95% CI: 2.39, 2.10–2.72). Prevalence of excess heart age was highest among women who were without health insurance, obese or overweight, engaged

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Supplementary Material
Supplementary Table S1

in physical activity less than thrice per week, or were smokers in the prepregnancy period. Among women with less than high school education, non-Hispanic black women had a higher prevalence of excess heart age than Hispanic women (PR, 95% CI: 4.01, 3.15–5.10).

Conclusions: Excess heart age may be an important tool for decreasing disparities and encouraging CVD risk reduction among certain groups of women.

Keywords

maternal and child health; cardiovascular health; reproductive health; heart age

Introduction

Cardiovascular disease (CVD), including coronary heart disease, heart failure, stroke, and hypertension, is increasing among younger women[1-3] and is a leading cause of maternal morbidity and mortality in the United States.[4-9] CVD prevalence among women ages 20–39 years was 11.5% from 2011 to 2014 compared to 10.0% from 2009 to 2012 and 10.1% from 2007 to 2010.[1-3] A recent report on maternal mortality found that roughly 30% of all pregnancy-related mortality resulted from conditions related to CVD.[9] Several studies have documented associations between CVD risk factors, elevated CVD risk in pregnancy, and adverse perinatal outcomes.[10-15] In addition, studies have found associations between hypertensive disorders of pregnancy, adverse perinatal outcomes, and future maternal CVD risk.[16-19]

Heart age is used to describe the cardiovascular risk based on presence or absence of CVD risk factors.[20,21] Excess heart age is the difference between a person's heart age and chronological age.[21] Compared to chronological age, heart age predictor tools provide a patient-friendly method for informing patients of their CVD risk and highlighting those patients needing to decrease their CVD risk.[21-24] Many measurement tools estimate absolute risk of cardiovascular or coronary events over a certain time frame. Models using such predicted absolute risk measures could be challenging for the public to interpret, especially among younger adults who may not see the relevance to their daily life.[21]

Heart age and excess heart age have mainly been used by scientific and practice communities as predictor tools among the general population of adults.[21,22,24] However, heart age and excess heart age could also be alternative tools for communicating CVD risk among reproductive-aged women. Examining CVD risk factors using a summary CVD risk factor measure like heart age and excess heart age has not been conducted among women of reproductive age. Heart age was chosen because compared to other CVD risk measure tools, it is a simplified, patient friendly way of communicating CVD risk and drawing attention to women who need to decrease their CVD risk. The objectives of this study are to estimate the prevalence of excess heart age among women with a recent live birth and to examine variation by sociodemographic and behavioral factors and state of maternal residence.

Materials and Methods

Study sample

This study used data from the Pregnancy Risk Assessment Monitoring System (PRAMS).[25] PRAMS is an ongoing, population-based, state-specific surveillance system of the Centers for Disease Control and Prevention (CDC) and state health departments. PRAMS collects self-reported information about maternal experiences and behaviors before, during, and after pregnancy using a stratified random sample of women with a recent live birth, selected from birth certificate files. Data from maternal questionnaires are linked to birth certificate data for analysis. PRAMS methodology is available at https://www.cdc.gov/prams/methodology.htm[26] We used PRAMS data for years 2009 through 2014 from 30 states (Appendix Table A1) that met the established response rate threshold of ≥65% from 2009 to 2011 or ≥60% from 2012 to 2014. Analyses were conducted during 2017–2018.

Measures

We categorized maternal race/ethnicity as: non-Hispanic white, non-Hispanic black, Hispanic, and other (women reporting more than one race or any race/ethnicity not previously listed). Women in Vermont were categorized as either non-Hispanic white or other race/ethnicity; however, other race/ethnicity was excluded due to small sample numbers. Using maternal data from birth certificates, we categorized chronological age and education. PRAMS questionnaire data provided self-reported information on family income and family size, which was used to create the poverty income ratio (PIR) variable (0%–100% of the federal poverty level [FPL]; 101%–300% of the FPL; and >300% of the FPL).

Additional PRAMS questionnaire variables from the prepregnancy period included: health insurance (yes/no); smoking in the 3 months–2 years before becoming pregnant (current; former/never); exercise ≥3 days/week in the 12 months before pregnancy (yes/no); alcohol consumption in the 3 months before becoming pregnant (≥7 drinks/week; 4–6 drinks/week; 1–3 drinks/week; I didn't drink); and diabetes before becoming pregnant (yes/no). Prepregnancy body mass index (BMI) was calculated as (weight in kilograms)/(height in meters),[2] using self-reported height and weight data from PRAMS questionnaires and categorized according to current WHO guidelines (<18.5 kg/m^2; 18.5–24.9 kg/m^2; 25–29.9 kg/m^2; ≥30 kg/m^2).[27] Birth certificate data on prepregnancy weight and height were used to calculate BMI when questionnaire data were missing.

We calculated heart age among women in PRAMS using the nonlaboratory-based Framingham Risk Score (FRS), which is validated for men and women aged 30–74 years without prior history of CVD.[20] We estimated the 10-year risk of developing CVD using the FRS for women, which is predicted using the following variables: age, BMI, systolic blood pressure (SBP), smoking status, diabetes status, and antihypertensive medication use.[20] PRAMS lacks data on antihypertensive medication use. However, antihypertensive medications are not widely used during pregnancy (estimated prevalence of 1.1%–4.4%), and thus, we assumed no antihypertensive medication use in our model of heart age.[28,29]

PRAMS also lacks information on SBP. As a result, we used a previously reported approach involving the development of multivariable regression models to predict SBP using data collected among women ages 20–44 years within the 2009–2014 National Health and Nutrition Examination Surveys (NHANES).[30] Our SBP prediction model included the following variables: age, race/ethnicity, education, PIR, insurance status, BMI, physical activity, smoking status, alcohol consumption, diabetes, and the following interaction terms of education × alcohol, smoking × BMI, and alcohol × diabetes. The regression coefficients from this model were then applied to comparable variables among 2009–2014 PRAMS participants to predict each woman's SBP. We then used the derived predictions of SBP in the FRS calculation of 10-year CVD risk for postpartum women in PRAMS and translated the output to predicted heart age with an upper limit set at 100 years.[20]

We included 173,586 women in PRAMS to predict heart age. Respondents were excluded from the study subpopulation using the SUBPOPX statement in SUDAAN if they were <20 years old (n = 15,163) or had missing/unknown data on ≥1 of the variables used to predict SBP [age <20 years old (n = 10), race/ethnicity (n = 1,999), education (n = 1,762), PIR (n = 10,176), prepregnancy health insurance (n = 2,097), BMI (n = 2,097), physical activity level (n = 1,230), prepregnancy smoking (n = 2,451), alcohol consumption (n = 2,526), and diabetes status (n = 2,046)]. In total, 21% (n = 36,405) of respondents were excluded from the study subpopulation, resulting in a final sample of 137,181 women, representing a population estimate of 5,920,078.

Statistical analysis

We calculated weighted percentages and 95% confidence intervals (CIs) to describe our sample population by sociodemographic and behavioral factors. We then calculated weighted mean and 95% CIs for chronological age, heart age, and the prevalence of excess heart age (≥5 years), for the overall population and for each subpopulation of interest (age group, race/ethnicity, education level, PIR, prepregnancy health insurance status, BMI, physical activity level, smoking status, alcohol consumption, diabetes status, and state). Prevalence and prevalence ratios comparing the likelihood of excess heart age across racial/ethnic groups were calculated overall and for each subpopulation of interest. Women of other racial/ethnic groups were included in overall estimates, but due to the variety of racial/ethnic groups in the other category, prevalence ratios were only compared between non-Hispanic Blacks, non-Hispanic white, and Hispanic women.

All analyses were conducted with SAS v9.3 (SAS Institute, Cary, NC) and SUDAAN 11.0.0 (RTI International, Research Triangle Park, NC) to account for the PRAMS complex survey design and weighted to reflect population estimates. The CDC and local institutional review boards approved the PRAMS protocol, and all participating states approved the analysis plan for the study.

Results

More than half of women were aged 20–29 years (56.5%), were non-Hispanic white (68.6%), and had more than a high school education (66.6%); one out of three of women had a PIR of 0%–100% below FPL (33.1%). Almost half of women surveyed had a prepregnancy BMI that measured overweight (24.9%) or obese (22.9%). About half of women (46.9%) engaged in physical activity at least thrice per week before pregnancy. Also before pregnancy, a majority of women had had health insurance (80.0%), did not smoke (76.2%), had one to three alcoholic drinks per week or did not drink at all (88.9%), and did not have preexisting diabetes (97.6%) (Table 1).

Overall, average chronological age for women in the sample was 28.8 years with an average heart age of 27.6 years. Among women in the sample, 7.5% or 11,393 had an excess heart age of ≥5 years (Table 2). Prevalence of excess heart age of ≥5 years varied by sociodemographic and behavioral factors. Excess heart age was observed among 6.2% of women aged 20–29 compared to 9.2% of women aged ≥30 years. Prevalence varied by race/ethnicity and was higher among non-Hispanic black women (11.8%) versus non-Hispanic white (7.3%) and Hispanic women (4.9%). Prevalence of excess heart age decreased for women as the FPL increased from 10.7% for 0%–100% below FPL to 7.8% for 101%–300% FPL and 4.2% for ≥300% FPL.

Women without prepregnancy health insurance had a higher prevalence of excess heart age (8.8%) than those who did (7.2%). Prevalence of excess heart age varied by prepregnancy BMI and was higher both among women with obesity (23.8%) or who were overweight (5.7%) compared to women who were normal (1.2%) or underweight (0.8%). Women who did not engage in physical activity at least thrice per week had a higher prevalence of excess heart age (8.6%) than those who did (6.3%). Approximately a quarter (25.6%) of women who smoked before pregnancy had an excess heart age compared to those who did not (1.9%). Almost 80% of women with prepregnancy diabetes had an excess heart age, compared to 5.7% of women who did not have prepregnancy diabetes (Table 2).

Prevalence ratios showed higher excess heart age among the overall population of non-Hispanic black compared to non-Hispanic white (prevalence ratio [PR], 95% CI: 1.6, 1.5–1.8) and Hispanic women (PR, 95% CI: 2.4, 2.1–2.7) (Table 3). Prevalence ratios comparing non-Hispanic black to non-Hispanic white women were significant for all subsets of characteristics except those not having health insurance before pregnancy and being underweight or obese before pregnancy. Similarly, prevalence ratios comparing non-Hispanic black to Hispanic women were significant for all subsets of characteristics except those aged 40 years and older and being underweight before pregnancy. The largest disparities were observed when comparing non-Hispanic black to Hispanic women among those with an education of less than high school (PR, 95% CI: 4.0, 3.2–5.1) and those without diabetes before pregnancy (PR, 95% CI: 4.1, 3.5–4.8).

Overall, the prevalence of excess heart age was significantly lower for Hispanic compared to non-Hispanic white women (PR, 95% CI: 0.7, 0.6–0.8). In addition, among most subpopulations of interest, prevalence of excess heart age was either lower or not significant for Hispanic compared to non-Hispanic white women. Prevalence of excess heart age was significantly higher in Hispanic compared to non-Hispanic white women among those that did not smoke before pregnancy (PR, 95% CI: 1.8, 1.5–2.2) or those that had diabetes before pregnancy (PR, 95% CI: 1.1, 1.0–1.2). Prevalence of excess heart age was highest in West Virginia (11.2%), followed by Ohio (10.5%) and Tennessee (9.9%) (Table 4). The lowest prevalence was in Utah (2.9%), Colorado (5.1%), and Hawaii (5.5%).

Discussion

In the PRAMS state- and population-based sample of women who recently delivered a live birth, we found that, overall, mean heart age was lower than chronological age, indicating that women in our sample had CVD risk profiles that were generally healthy. Prevalence of excess heart age increased with increasing age and varied significantly by race/ethnicity. In addition, women with obesity, diabetes, or who were smokers before pregnancy had higher prevalence of excess heart age.

Prevalence of excess heart age was highest for non-Hispanic black compared to Hispanic women and non-Hispanic white women and varied significantly across race/ethnicity by several sociodemographic and behavioral factors. Specifically, at all levels of education and PIR, non-Hispanic black women had a significantly higher prevalence of excess heart age compared to Hispanic women and non-Hispanic white women. It is important to note that variation in prevalence of excess heart age across race/ethnicity may be driven by differences in risk factor prevalence.

The elevated prevalence of excess heart age among women with obesity, diabetes, or who were smokers is not surprising given that all three are risk factors for CVD.[31,32] Obesity and diabetes specifically are increasing among young women, including those of reproductive age,[33,34] and are of higher prevalence among non-Hispanic black women compared to non-Hispanic white women and Hispanic women.[1,35] The disparities observed for non-Hispanic black women in our analysis are also consistent with an earlier report of heart age among U.S. adults aged ≥30 years.[21] Using data from the Behavioral Risk Factor Surveillance System from 2011 to 2013, Yang et al. found racial and ethnic differences in heart age among women aged 30–74 years; the prevalence of excess heart age was highest among non-Hispanic black women, followed by Hispanic women and then non-Hispanic white women.[21] This pattern of disparities calls for reduction in CVD risk that may benefit from a health equity approach.[36]

Achieving reductions in prevalence of excess heart age is also important given the higher risk for adverse perinatal outcomes and pregnancy related morbidity and mortality among non-Hispanic black women.[37-40] Pregnancy-related mortality among non-Hispanic black women has been reported at rates three to four times that of non-Hispanic white women.[9] Cardiovascular conditions, in particular, compose higher percentages of maternal morbidity and mortality for non-Hispanic black compared to non-Hispanic white women.[9,41] In addition, compared to non-Hispanic white women, non-Hispanic black women had more variation in cause of pregnancy-related mortality,[9] suggesting the need for a broader approach for identifying and addressing ways to decrease morbidity and mortality.

Health care providers can play a role in CVD risk factor reduction earlier in the life course of women of reproductive age. This is particularly true for obstetricians and gynecologists, who often serve as the primary physicians for women during childbearing years and have contact with women at yearly medical appointments, health screenings, and during the "stress test"[42,43] of pregnancy. As suggested in the new American Heart Association/ American College of Obstetricians and Gynecologists Presidential Advisory, obstetricians and gynecologists are in a unique position to counsel women on CVD risk reduction initiatives,[43] which could include using the heart age tool to communicate CVD risk during office visits.

Ultimately, achieving reductions in CVD risk factors for young non-Hispanic black women, including those of reproductive age, may require system-level change and coordination between clinical and public health settings.[35] The benefits of targeted approaches may also yield reductions in CVD risk and outcomes among women as they age.[44]

One example of an integrative and targeted approach may be the Centering Pregnancy model that is typically implemented in both prenatal and postpartum care settings and focuses on providing coordinated care between providers and patients in group settings according to gestational age.[45] Many Centering Pregnancy models target racial/ethnic minority or underserved women at risk for adverse maternal or infant birth outcomes. Centering pregnancy groups provide an opportunity for providers to counsel a larger number of women with more time to address questions, concerns, and barriers to care for patients, as well as encourage sharing of experiences, increase confidence, and community building.[45] Centering Pregnancy models may be a good arena for providers to discuss and build self-efficacy of racial/ethnic minority or underserved patients around health concerns that may impact current and future pregnancies such as using the Heart Age tool to encourage reduction in CVD risk factors.

We also found considerable variation by state in prevalence of excess heart age. West Virginia had the highest prevalence of excess heart age, while women in Utah had the lowest. The higher prevalence of excess heart age among women in states included in our analysis reflects a higher prevalence of CVD risk factors among women in the state. For example, a PRAMS analysis of prepregnancy smoking among women ages 20–40 years found that West Virginia was the highest out of 40 states examined with a significant increase from 36.2% to 46.2% from 2000 to 2010.[46]

Limitations

This study has several limitations. First, the FRS, from which heart age is derived, was validated with a predominantly non-Hispanic white sample, and the accuracy of heart age prediction for other racial and ethnic groups is unclear.[20] In addition, the FRS was originally developed for adults ≥30 years. While a few studies have assessed the utility of the FRS in predicting later risk CVD events among younger adults, results are mixed.[47,48]

Second, SBP, needed for heart age calculation, is not provided in PRAMS and thus was predicted using model-estimation techniques for women of similar sociodemographic and behavioral profiles in NHANES. Using prediction models to obtain SBP is a technique shown to produce very similar CVD risk scores using indicators other than heart age.[30] In our study, Supplementary Table S1 shows the measured versus predicted SBP by selected characteristics for NHANES and PRAMS 2009–2014. The pattern of differences in model predicted that SBP in PRAMS is consistent with differences in measured SBP in NHANES by the selected characteristics. Specifically, the Supplementary Table S1 shows that mean estimated SBP was consistent between NHANES and PRAMS with respect to age group but were underestimated by race, education, income, and insurance status. The consistent pattern of measured and model-predicted mean SBP provides some assurance that the predicted SBP was not likely to introduce additional bias on disparities in excess heart age at population level. These results indicate, however, that prediction of heart age and excess heart age may systematically underestimate SBP by race, education, income, and insurance. Therefore actual excess heart age might be slightly underestimated among women of reproductive age.

Third, women included in the study were from states who met the required PRAMS threshold participation rates. Therefore, results may be generalizable to only the states included in the analyses. Fourth, several characteristics of women participating in PRAMS may make them less generalizable to women of similar age in the general population. Women in the PRAMS sample were healthy enough to have had a recent live birth and the majority of women in the analytical sample after exclusions had greater than a high school education, were non-Hispanic white, had health insurance, and were of normal body weight. Finally, we used self-report data for maternal health behaviors, family income, and individual weight and height, which may be subject to under or overestimation based on social desirability. A large number of women refused to answer questions on self-reported family income contributing to a large number of missing data for the PIR variable. In addition, due to possible underestimating of self-reported weight data, BMI may be underestimated,[49] contributing to underestimation of heart age for some women.

Conclusions

Despite these limitations, this study has a number of strengths. It uses large, population-based data from 30 states in geographically distinct regions of the country, allowing for excess heart age estimates for state-level information and action. Public health activities that address behaviors contributing to excess heart age (*e.g.*, smoking and diabetes control) may consider highlighting women of reproductive age as a special population to prevent future chronic disease burden along with preconception and perinatal care.

Utilizing heart age to establish and communicate CVD risk before pregnancy may be an effective way to achieve reductions in prepregnancy CVD risk factors, yield decreased CVD risk in pregnancy, and improve perinatal and health outcomes. This may be especially important for improving the cardiovascular health of non-Hispanic black women due to their higher prevalence of excess heart age.

Appendix

Appendix Table A1.

States and Years of Data Included, Pregnancy Risk Assessment Monitoring System, 2009–2014

		Years of PRAMS data included					
State	**n[a]**	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***
Alaska	4,258	x[b]	x	o[c]	x	x	x

State	n[a]	Years of PRAMS data included					
		2009	2010	2011	2012	2013	2014
Alabama	658	o	o	O	o	o	x
Arkansas	4,428	x	x	X	x	x	o
Colorado	7,194	x	x	x	x	x	o
Delaware	3,496	x	x	x	x	o	o
Georgia	3,177	x	x	x	x	x	o
Hawaii	4,950	x	x	x	x	o	o
Illinois	5,480	x	x	x	x	x	o
Iowa	1,839	o	o	o	o	x	x
Maryland	6,740	x	x	x	x	x	x
Maine	3,878	x	x	x	x	x	o
Minnesota	5,352	x	x	x	x	x	o
Missouri	6,189	x	x	x	x	x	x
Mississippi	1,025	x	o	o	o	o	o
Nebraska	6,647	x	x	x	x	x	o
New Hampshire	1,102	o	o	o	o	x	x
New Mexico	4,198	o	o	x	x	x	x
New York (excluding New York City)	2,516	o	x	x	o	x	o
Ohio	3,550	x	x	o	x	o	o
Oklahoma	9,670	x	x	x	x	x	x
Oregon	6,049	x	x	x	x	x	o
Pennsylvania	4,952	x	x	x	x	x	x
Rhode Island	5,360	x	x	x	x	x	x
Tennessee	2,387	x	o	o	x	x	x
Utah	7,180	x	x	x	x	x	x
Vermont	4,905	x	x	x	x	x	x
Washington	6,350	x	x	x	x	x	x
Wisconsin	5,543	x	o	x	x	x	x
West Virginia	4,462	x	x	x	o	o	x
Wyoming	3,646	x	x	x	x	x	x

[a]Unweighted sample size.

[b]Data were available.

[c]Data were not collected.

PRAMS, Pregnancy Risk Assessment Monitoring System.

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Table 1.

Sample Characteristics, Women ≥20 Years of Age, Pregnancy Risk Assessment Monitoring System, 2009–2014

Characteristics	**n**[a]	**%**[b] ***(95% CI)***[c]
Total	137,181	100.0
Age (years)		
20–29	77,516	56.5 (56.1–56.9)
20–24	33,760	23.6 (23.2–24.0)
25–29	43,756	32.9 (32.5–33.3)
≥30	59,665	43.5 (43.1–44.0)
30–34	37,497	28.4 (28.0–28.8)
35–39	17,861	12.4 (12.1–12.6)
≥40	4,307	2.8 (2.6–2.9)
Race/ethnicity		
White, non-Hispanic	82,501	68.6 (68.2–69.0)
Black, non-Hispanic	16,883	11.4 (11.1–11.7)
Hispanic	17,878	11.9 (11.6–12.1)
Other, non-Hispanic	19,919	8.2 (8.0–8.4)
Education level (highest degree or level of school completed)		
<High school diploma	14,873	10.4 (10.1–10.6)
High school graduate	33,619	23.1 (22.7–23.5)
>High school	88,689	66.6 (66.2–67.0)
PIR		
0%–100% of the FPL	49,451	33.1 (32.6–33.5)
101%–300% of the FPL	43,760	31.5 (31.1–31.9)
>300% of the FPL	43,970	35.5 (35.1–35.9)
Prepregnancy health insurance		
Yes	109,352	80.0 (79.7–80.4)
No	27,829	20.0 (19.6–20.3)
Prepregnancy BMI (kg/m^2)		
Underweight, <18.5	5,522	3.6 (3.5–3.8)
Normal weight, 18.5–24.9	65,127	48.6 (48.2–49.0)
Overweight, 25.0–29.9	33,810	24.9 (24.5–25.2)
Obese, ≥30.0	32,722	22.9 (22.5–23.3)
Prepregnancy physical activity level		
Yes, ≥3 days/week	64,781	46.9 (46.5–47.4)
No, <3 days/week	72,400	53.1 (52.6–53.5)
Prepregnancy smoking status		
Yes	34,961	23.8 (23.4–24.1)
No	102,220	76.2 (75.9–76.6)
Prepregnancy alcohol consumption		
7 or more drinks/week	5,210	3.8 (3.6–4.0)

Characteristics	n[a]	%[b] (95% CI)[c]
4–6 drinks/week	9,683	7.3 (7.1–7.5)
>0 to ≤3 drinks/week	63,979	48.6 (48.2–49.1)
I didn't drink	58,309	40.3 (39.9–40.7)
Prepregnancy diabetes status		
Yes	3,695	2.4 (2.3–2.5)
No	133,486	97.6 (97.5–97.7)

[a]Unweighted sample size.

[b]Percentages may not add to 100% due to rounding.

[c]Weighted percent and 95% CI.

BMI, body mass index; CI, confidence interval; FPL, federal poverty level; PIR, poverty income ratio.

Table 2.

Chronological Age, Heart Age, and Prevalence of Excess Heart Age ≥5 Years by Selected Characteristics

Characteristics	Chronological age		Heart age	Prevalence of excess heart age ≥5 years	
	n[a]	Mean[b]	Mean[b] (95% CI)	%[b] (95% CI[c])[b]	p[d]
Total	137,181	28.8	27.6 (27.5–27.6)	7.5 (7.3–7.7)	
Age (years)					
20–29	77,516	25.0	24.1 (24.0–24.1)	6.2 (5.9–6.5)	<0.0001[e]
20–24	33,760	22.2	21.7 (21.6–21.8)	5.1 (4.7–5.6)	
25–29	43,756	27.1	25.8 (25.7–25.8)	7.0 (6.6–7.4)	
≥30	59,665	33.7	32.1 (32.1–32.2)	9.2 (8.8–9.5)	
30–34	37,497	31.8	30.0 (29.9–30.0)	7.9 (7.5–8.4)	
35–39	17,861	36.5	35.2 (35.1–35.3)	11.0 (10.3–11.8)	
≥40	4,307	41.4	40.7 (40.4–41.0)	13.6 (12.1–15.4)	
Race/ethnicity					
White, non-Hispanic	82,501	29	27.7 (27.7–27.8)	7.3 (7.0–7.6)	<0.0001
Black, non-Hispanic	16,883	27.7	27.9 (27.7–28.1)	11.8 (10.9–12.7)	
Hispanic	17,878	28.3	26.4 (26.2–26.5)	4.9 (4.4–5.5)	
Other, non-Hispanic	19,919	29.5	27.6 (27.4–27.7)	7.1 (6.5–7.7)	
Education level (highest degree or level of school completed)					
<High school diploma	14,873	27	26.9 (26.7–27.0)	11.1 (10.2–12.1)	<0.0001
High school graduate	33,619	26.7	26.7 (26.6–26.8)	10.1 (9.5–10.6)	
>High school	88,689	29.8	28.0 (27.9–28.1)	6.0 (5.8–6.3)	
PIR					
0%–100% of the FPL	49,451	26.5	26.5 (26.4–26.6)	10.7 (10.2–11.2)	<0.0001
101%–300% of the FPL	43,760	28.3	27.2 (27.1–27.3)	7.8 (7.4–8.2)	
>300% of the FPL	43,970	31.5	28.9 (28.8–29.0)	4.2 (3.9–4.5)	
Prepregancy health insurance					
Yes	109,352	29.3	27.9 (27.8–27.9)	7.2 (6.9–7.4)	<0.0001
No	27,829	26.9	26.5 (26.3–26.6)	8.8 (8.2–9.3)	
Prepregnancy BMI (kg/m^2)					
Underweight, <18.5	5,522	27.3	23.0 (22.8–23.3)	0.8 (0.4–1.6)	<0.0001

Characteristics	Chronological age		Heart age	Prevalence of excess heart age ≥5 years	
	n[a]	Mean[b]	Mean[b] (95% CI)	%[b] (95% CI[c])[b]	p[d]
Normal weight, 18.5–24.9	65,127	28.8	25.9 (25.8–26.0)	1.2 (1.1–1.4)	
Overweight, 25.0–29.9	33,810	29	28.2 (28.1–28.3)	5.7 (5.3–6.1)	
Obese, ≥30.0	32,722	28.9	31.1 (31.0–31.3)	23.8 (23.0–24.6)	
Prepregnancy physical activity level					
Yes, ≥3 days/week	64,781	29.4	27.7 (27.6–27.8)	6.3 (6.0–6.6)	<0.0001
No, <3 days/week	72,400	28.3	27.5 (27.4–27.5)	8.6 (8.2–8.9)	
Prepregnancy smoking status					
Yes	34,961	27.1	30.9 (30.8–31.0)	25.6 (24.8–26.4)	<0.0001
No	102,220	29.4	26.5 (26.5–26.6)	1.9 (1.7–2.0)	
Prepregnancy alcohol consumption					
7 or more drinks/week	5,210	28.6	29.8 (29.5–30.1)	17.6 (15.9–19.4)	<0.0001
4–6 drinks/week	9,683	29.3	29.2 (29.0–29.4)	10.2 (9.3–11.2)	
>0 to ≤3 drinks/week	63,979	29	27.7 (27.7–27.8)	7.5 (7.2–7.8)	
I didn't drink	58,309	28.6	26.9 (26.8–27.0)	6.0 (5.7–6.4)	
Prepregnancy diabetes status					
Yes	3,695	29.5	40.6 (40.0–41.2)	79.8 (77.5–82.0)	<0.0001
No	133,486	28.8	27.3 (27.2–27.3)	5.7 (5.5–5.9)	

[a] Unweighted sample size.

[b] Weighted mean, weighted prevalence.

[c] Prevalence estimates with nonoverlapping 95% CIs were considered statistically significantly different from one another. This approach may fail to note differences more often than formal statistical testing and was selected to account for precision of estimates while also highlighting large differences.[50]

[d] *p*-values were obtained through chi-square tests for categorical variables.

[e] Chi-square test was calculated using the following age categories: 20–24; 25–29; 30–34; 35–39; and ≥40. The *p*-value obtained through chi-square test using age categories 20–29 and ≥30 was also <0.0001.

Table 3.

Prevalence and Prevalence Ratios of Excess Heart Age ≥5 Years by Selected Characteristics and Race/Ethnicity

	Prevalenc[b]			Prevalence ratio (95% CI)		
Characteristics	**White, non-Hispanic**	**Black, non-Hispanic**	**Hispanic**	**Black/white**	**Hispanic/white**	**Black/Hispanic**
Total (n^a = 117,262)	7.3	11.8	4.9	1.6 (1.5–1.8)	0.7 (0.6–0.8)	2.4 (2.1–2.7)
Age (years)						
20–29	6.2	9.0	3.4	1.4 (1.2–1.6)	0.5 (0.5–0.7)	2.7 (2.2–3.3)
20–24	5.3	6.8	2.6	1.3 (1.0–1.6)	0.5 (0.4–0.7)	2.6 (1.8–3.7)
25–29	6.8	11.3	4.0	1.7 (1.4–1.9)	0.6 (0.5–0.7)	2.8 (2.2–3.6)
≥30	8.5	17.1	7.4	2.0 (1.8–2.2)	0.9 (0.8–1.0)	2.3 (2.0–2.7)
30–34	7.1	16.4	6.1	2.3 (2.0–2.7)	0.9 (0.7–1.0)	2.7 (2.2–3.4)
35–39	10.9	18.4	8.1	1.7 (1.4–2.0)	0.8 (0.6–0.9)	2.3 (1.7–3.0)
≥40	13.2	17.9	16.1	1.4 (1.0–1.9)	1.2 (0.9–1.7)	1.1 (0.7–1.7)
Education level (highest degree/level of school completed)						
<High school diploma	13.9	19.6	4.9	1.4 (1.2–1.7)	0.4 (0.3–0.4)	4.0 (3.2–5.1)
High school graduate	10.4	12.8	5.7	1.2 (1.1–1.4)	0.6 (0.5–0.7)	2.2 (1.8–2.8)
>High school	5.8	9.4	4.3	1.6 (1.4–1.8)	0.7 (0.6–0.9)	2.2 (1.8–2.7)
PIR						
0%−100% of the FPL	12.0	13.5	5.2	1.1 (1.0–1.3)	0.4 (0.4–0.5)	2.6 (2.2–3.1)
101%−300% of the FPL	7.8	10.8	5.0	1.4 (1.2–1.6)	0.6 (0.5–0.8)	2.2 (1.7–2.8)
>300% of the FPL	4.3	5.9	3.7	1.4 (1.0–1.9)	0.9 (0.6–1.3)	1.6 (1.0–2.6)
Prepregnancy health insurance						
Yes	6.6	12.1	5.7	1.8 (1.7–2.0)	0.9 (0.8–1.0)	2.1 (1.8–2.5)
No	10.8	10.8	4.0	1.0 (0.8–1.2)	0.4 (0.3–0.5)	2.7 (2.1–3.5)
Prepregnancy BMI (kg/m^2)						
Underweight, <18.5	0.7	0.7	2.1	1.0 (0.2–4.1)	3.0 (0.4–22.0)	0.3 (0.0–3.3)
Normal weight, 18.5–24.9	1.1	2.0	1.0	1.8 (1.3–2.4)	0.9 (0.6–1.3)	1.9 (1.3–3.0)
Overweight, 25.0–29.9	5.5	8.7	3.4	1.6 (1.3–1.9)	0.6 (0.5–0.8)	2.6 (1.9–3.4)
Obese, ≥30.0	25.3	25.4	13.2	1.0 (0.9–1.1)	0.5 (0.5–0.6)	1.9 (1.7–2.2)
Prepregnancy physical activity level						
Yes, ≥3 days/week	5.7	12.1	5.2	2.1 (1.8–2.5)	0.9 (0.8–1.1)	2.3 (1.9–2.9)

Characteristics	Prevalenc[b]			Prevalence ratio (95% CI)		
	White, non-Hispanic	Black, non-Hispanic	Hispanic	Black/white	Hispanic/white	Black/Hispanic
No, <3 days/week	8.9	11.6	4.8	1.3 (1.2–1.5)	0.5 (0.5–0.6)	2.4 (2.1–2.9)
Prepregnancy smoking status						
Yes	23.4	43.1	21.9	1.8 (1.7–2.0)	0.9 (0.8–1.1)	2.0 (1.7–2.3)
No	1.4	3.1	2.6	2.2 (1.8–2.7)	1.8 (1.5–2.2)	1.2 (1.0–1.5)
Prepregnancy alcohol consumption						
7 or more drinks/week	17.2	29.6	12.0	1.7 (1.2–2.4)	0.7 (0.5–1.1)	2.5 (1.5–4.1)
4–6 drinks/week	9.5	19.2	11.2	2.0 (1.5–2.7)	1.2 (0.8–1.7)	1.7 (1.1–2.7)
>0 to ≤3 drinks/week	6.5	15.7	5.5	2.4 (2.2–2.7)	0.9 (0.7–1.0)	2.8 (2.3–3.5)
I didn't drink	6.5	7.3	4.1	1.1 (1.0–1.3)	0.6 (0.5–0.7)	1.8 (1.5–2.2)
Prepregnancy diabetes status						
Yes	75.8	94.6	82.4	1.3 (1.2–1.3)	1.1 (1.0–1.2)	1.2 (1.1–1.2)
No	5.8	9.5	2.3	1.6 (1.5–1.8)	0.4 (0.4–0.5)	4.1 (3.5^.8)

[a]Unweighted sample size, which excludes non-Hispanic other.

[b]Weighted prevalence.

Table 4.

Chronological Age, Heart Age, and Prevalence of Excess Heart Age ≥5 Years by State

State	n[a]	*Chronological age Mean (95% CI)*	*Heart age Mean (95% CI)*	*Prevalence of excess heart age ≥5 years % (95% CI)*
Total	137,181	28.8 (28.8–28.9)	27.6 (27.5–27.6)	7.5 (7.3–7.7)
Alaska	4,258	28.3 (28.2–28.5)	27.4 (27.2–27.6)	8.3 (7.4–9.3)
Alabama	6,58	27.8 (27.5–28.2)	27.2 (26.7–27.7)	8.4 (6.5–10.8)
Arkansas	4,428	27.1 (26.9–27.3)	26.7 (26.4–27.0)	9.3 (8.0–10.7)
Colorado	7,194	29.3 (29.1–29.5)	27.4 (27.2–27.6)	5.1 (4.5–5.9)
Delaware	3,496	28.9 (28.7–29.1)	28.2 (27.9–28.4)	8.5 (7.6–9.5)
Georgia	3,177	28.5 (28.2–28.8)	27.1 (26.8–27.5)	6.2 (5.0–7.6)
Hawaii	4,950	29.0 (28.9–29.2)	27.2 (27.0–27.4)	5.5 (4.8–6.4)
Illinois	5,480	29.6 (29.5–29.8)	28.0 (27.9–28.2)	6.7 (6.0–7.4)
Iowa	1,839	28.7 (28.4–29.0)	27.6 (27.2–28.0)	8.3 (6.6–10.4)
Maryland	6,740	29.6 (29.5–29.8)	28.2 (28.0–28.3)	6.9 (6.1–7.8)
Maine	3,878	28.6 (28.4–28.8)	27.8 (27.6–28.0)	7.7 (6.8–8.8)
Minnesota	5,352	29.4 (29.3–29.6)	27.9 (27.7–28.1)	7.3 (6.5–8.1)
Missouri	6,189	28.0 (27.9–28.2)	27.5 (27.3–27.7)	9.6 (8.7–10.5)
Mississippi	1,025	26.8 (26.4–27.1)	26.5 (26.0–27.0)	9.4 (7.4–11.9)
Nebraska	6,647	28.5 (28.4–28.7)	27.4 (27.2–27.6)	8.1 (7.3–8.9)
New Hampshire	1,102	29.5 (29.2–29.9)	28.3 (27.8–28.7)	7.9 (6.2–10.1)
New Mexico	4,198	27.8 (27.7–28.0)	26.6 (26.3–26.8)	6.3 (5.6–7.2)
New York (excluding NYC)	2,516	29.8 (29.5–30.1)	28.4 (28.1–28.8)	7.6 (6.4–9.0)
Ohio	3,550	28.3 (28.1–28.6)	27.8 (27.5–28.1)	10.5 (9.2–11.9)
Oklahoma	9,670	27.5 (27.3–27.6)	26.7 (26.5–27.0)	8.5 (7.6–9.6)
Oregon	6,049	29.1 (28.9–29.3)	27.7 (27.5–28.0)	7.6 (6.6–8.7)
Pennsylvania	4,952	29.1 (28.9–29.3)	28.0 (27.8–28.2)	8.3 (7.4–9.2)
Rhode Island	5,360	29.7 (29.5–29.8)	28.1 (27.9–28.3)	6.6 (5.9–7.4)
Tennessee	2,387	28.3 (28.0–28.5)	27.8 (27.4–28.1)	9.9 (8.4–11.6)
Utah	7,180	28.3 (28.2–28.4)	25.6 (25.4–25.7)	2.9 (2.5–3.4)
Vermont	4,905	29.4 (29.2–29.5)	28.3 (28.1–28.5)	7.4 (6.7–8.2)

State	n[a]	*Chronological age Mean (95% CI)*	*Heart age Mean (95% CI)*	*Prevalence of excess heart age ≥5 years % (95% CI)*
Washington	6,350	29.2 (29.1–29.4)	27.5 (27.3–27.7)	6.3 (5.6–7.1)
Wisconsin	5,543	28.9 (28.7–29.1)	27.8 (27.5–28.0)	7.4 (6.4–8.4)
West Virginia	4,462	27.2 (27.0–27.4)	27.3 (27.1–27.6)	11.2 (10.1–12.4)
Wyoming	3,646	27.9 (27.7–28.0)	26.6 (26.3–26.8)	7.0 (6.1–8.1)

[a]Unweighted sample size.