

Research Article

Obesity And Related Cardiometabolic Risk In Young Us Hispanic Farmworkers: A Neglected Public Health Problem

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Abstract

Background

The aim was to examine cardiometabolic risk and its association with overweight/obesity among young US-Hispanic farmworkers.

Methods

This health screening-based study was conducted at the Costa-Layman Farm, Trenton, SC (2013-2016).

Results

In the entire cohort (n=303, mean age: 34.7 ± 9.6 years, 51.8% female), the prevalence of overweight/obesity was 78.5%. The prevalence of prehypertension/hypertension, and prediabetes/diabetes were 57.7% and 36.7%, respectively. The prevalence of elevated total cholesterol, elevated low-density lipoprotein cholesterol, reduced high-density lipoprotein cholesterol (HDL-cholesterol) and elevated triglycerides were 33.0%, 35.7%, 28.9%, and 39.3%, respectively. Controlling for age and sex, body mass index were significantly correlated with systolic blood pressure (r = 0.21, P = .03), diastolic blood pressure (r = 0.19, P = <.05), HbA1C (r = 0.27, P = <.01), triglycerides (r = 0.32, P = <.01), and HDL-cholesterol (r = -0.21, P = .04). Multinomial logistic regression, adjusting for age and sex, revealed that compared to individuals with normal weight, the adjusted odd ratios for prehypertension/hypertension, elevated triglycerides, and low HDL-cholesterol were 2.5 (95% CI:1.2-5.0), 2.7 (95% CI:1.3-6.0), 3.9 (95% CI:1.4-10.4), respectively, for those in the overweight/obese group. The prevalence of prehypertension/hypertension, elevated triglycerides, and low HDL-cholesterol among overweight/obese individuals when compared with normal individuals were 61.1% vs. 45.3%, 42.7% vs. 22.7%, 31.6% vs. 11.4%, respectively.

Conclusions

This suggests that young US-Hispanic farmworkers are at alarmingly high risk for development of cardiometabolic disorders, and overweight/obesity is associated with higher cardiometabolic risk.

Keywords: Cardiometabolic risk factors; US-Hispanics; Farmworkers; Overweight; Obesity

Abbreviations

AU: Augusta University;
 BMI: Body mass index;
 SBP: Systolic blood pressure,
 DBP: Diastolic blood pressure;
 FPG: Fasting plasma glucose;
 HbA1C: Glycosylated hemoglobin;
 WC: Waist circumference;
 LDL-cholesterol: Low-density lipoprotein cholesterol;
 HDL-cholesterol: high-density lipoprotein cholesterol;
 CVD: Cardiovascular disease;
 CAWHS: California Agricultural Workers Health Survey;
 OFHS: Oceana Farmworker Health Survey;
 NHANES: National Health and Nutrition Examination Survey

Introduction

According to the report of US Census Bureau, Hispanics are the largest ethnic minority group in the nation. Moreover, the US Hispanic population is projected to grow to 128.8 million in 2060, raising them up to nearly 31% of the US population[1]. Limited data suggest a high prevalence of cardiometabolic risk factors in Hispanics[2-6]. Overweight and obesity are serious and epidemic problems globally, and more concerning in US Hispanics. US Hispanics have the second highest prevalence of adult obesity among different ethnic group, and the Office of Minority Health reported that US Hispanic adults had higher risk of being obese by 1.2 times compared to white adults[7,8]. The Hispanic population is involved in farming which is consistently ranked among the most dangerous occupations in the US[9]. According to Occupational Safety and Health Administration, almost 6,000 farmworkers died from work-related injuries from 2003 to 2011, and the mortality rate for farmworkers was 7 times higher than that mortality rate for all workers in private industry[10]. More than 80% of the US farmworkers are Hispanic, and most of them are relatively young and uneducated[7]. Although US Hispanics have higher cardiometabolic risk factors, being a US Hispanic farmworkers could increase this risk. Data from the national Agricultural Workers Survey 2001-2002 showed that farmworkers have language barrier, low education level, lack of health insurance, and lack of authorization to work in the US[8]. All of these reasons could explain the poor access to the health care system which might be the main cause of this risk. A report by the National Center for Farmworker Health showed that 75% of agricultural workers were below poverty levels, which increases the health burden of this population[9,11,12]. However, only few studies inves-

tigated the cardiometabolic risk in this population[13,1]. Also, their contribution is critical to the productivity and stability of the nation's agriculture system. Hence, studying the health disparities of this population is a public health priority.

To address the public health needs for this vulnerable population, we hypothesized that the young US farmworkers of Hispanic origin are at risk of obesity and related cardiometabolic diseases. Also, we tested the hypothesis that overweight/obese farmworkers have higher cardiometabolic risk than normal weight individuals.

Materials and Methods

Participants

This community outreach project was performed by the university and community partnership between Augusta University and Costa-Layman Farm during the summers from 2013 to 2016. The Costa-Layman nursery is wholesale supplier for perennials, located in Trenton, South Carolina. It was established in 1990, and it consists of three farms. The average size of each farm about 229 acres. Fliers were distributed among the employees and were posted on the noticeboards throughout the farms. All the employees working at the Costa-Layman Farms were invited to participate in this health-screenings, and Hispanic participants accounted for approximately 65% of the entire population. The consent form was translated in Spanish. Study information and consent process were conducted during the farm business hours with help of certified Spanish interpreters. Written informed consent was obtained from 303 participants. The protocol was approved by the Institutional Review Board at Augusta University. All measurements were performed in the morning at the plant nursery at Costa-Layman Farm.

Sociodemographics

Questionnaires including country of origin (Mexico, Guatemala, or other), education level (<high school vs. ≥high school), marital status (married, never married, or other), and years of residency (<10 years vs. ≥10 years) were translated in Spanish and were completed with help from interpreters.

Anthropometry and blood pressure

Height and weight were obtained according to standard procedures, using a wall-mounted stadiometer (Tanita Corporation of American, Arlington Heights, IL) and calibrated electronic scale (model CN20L; Cardinal Detecto, Webb City, MO). Body mass index (BMI) was calculated using CDC formula, weight (kg)/height (m²) for which we used for body weight classification: < 25 kg/m² (normal weight), 25 -29.9 kg/m² (overweight), or ≥ 30 kg/m² (obese)[12]. Waist circumferences (centimeter) were measured with minimal clothing at the approximate midpoint between the lower margin of the last

palpable rib and the top of the iliac crest at the level of umbilicus[11]. Elevated waist circumference was defined as > 102 cm for males, and > 88 cm for females[14]. After 5 minutes of rest, systolic (SBP) and diastolic blood pressures (DBP) were measured twice, each at least 1 minute apart, in sitting position using manual mercury sphygmomanometer by trained research staff. The averages of two measurements were reported and used for analyses. Prehypertension was defined as SBP \geq 120 and < 140 or DBP \geq 80 and < 90 mmHg based on the American Heart Association (AHA) definition, while hypertension was defined as SBP \geq 140 or DBP \geq 90 mmHg[15].

Biochemical Variables

Venous blood was collected after an overnight fast, and all blood samples were centrifuged immediately and stored at -80°C for analysis. Fasting plasma glucose (FPG), glycosylated hemoglobin (HbA1C), and lipid profile (total cholesterol, low-density lipoprotein cholesterol (LDL-cholesterol), high-density lipoprotein cholesterol (HDL-cholesterol), and triglycerides) were assessed by standard clinical laboratory methods at Premier Medical Laboratory Services (Greenville, SC). Fasting glucose was measured using hexokinase and glucose-6-phosphate dehydrogenase enzymatic method, while HbA1C was determined based on turbidimetric inhibition immunoassay. Lipid parameters were measured by an enzymatic colorimetric method, using automated analyzer (Cobas c 311/501 and Cobas c 502) and Cobas enzymatic reagents.

Prediabetes was defined as fasting glucose 100-125 mg/dL, or HbA1C 5.7-6.4% , while diabetes was defined as fasting glucose \geq 126 mg/dL, or HbA1C \geq 6.5% based on the American Diabetes Association guidelines[16]. Dyslipidemia were defined based on National Cholesterol Education Program/Adult Treatment Panel III (NCEP/ATP III) guidelines as follows: elevated total cholesterol \geq 200 mg/dL, elevated LDL-cholesterol \geq 130 mg/dL, elevated triglycerides \geq 150 mg/dL, and reduced HDL-cholesterol < 40 mg/dL[14].

Statistical Analysis

Statistical analyses were performed using SPSS software (version 23, IBM SPSS Statistics, Chicago, IL). A P-value < .05 was considered statistically significant for all analyses. Normal distribution and homogeneity of variances were confirmed by Shapiro-Wilks *W* and Leven's tests, respectively. Continuous variables were summarized by means and standard deviation. Categorical variables were summarized by relative frequencies. Partial Pearson's correlation coefficients were used to examine the associations of BMI with cardiometabolic risk factors, with control for age and sex. We further examined the BMI-cardiometabolic risk factor relationship by comparing markers of cardiometabolic risk between normal weight (BMI < 25 kg/m²) and overweight/obese (BMI \geq 25 kg/m²) groups. For comparison of the dependent variables (i.e., SBP,

DBP, fasting glucose, HbA1C, total cholesterol, triglycerides, LDL-cholesterol, and HDL-cholesterol), an F test was performed to test the assumption of homogeneity of regression slopes for the interactions between the independent variable (BMI groups) and the covariates (age and sex). Because there were no interactions, analysis of covariance was used to compare the differences in dependent variables between normal weight and overweight/obese groups after adjusting for age and sex. Multinomial logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI) for the presence of prehypertension/hypertension, prediabetes/diabetes, elevated total cholesterol, elevated triglycerides, elevated LDL-cholesterol, and low HDL-cholesterol according to the normal weight and overweight/obese groups after adjusting for age and sex.

Results

Participant characteristics of the total sample are presented in Table 1. The sample was composed of 303 US Hispanic farmworkers (51.8% female) and the mean \pm SD age was 34.7 \pm 9.6 (19 – 71) years. Among the population, 63%, 30% and 7% considered Mexico, Guatemala, and others as their country of origin, respectively. Regarding the education level of the farmworkers, the rate of high school graduation was 33%. With respect to the marital status, 40.9% were married, while 45.2% were never married. Regarding their residency in US, 58% of total population have resided \geq 10 years, while 42% have resided < 10 years. Overall, 44.8% were overweight, and 33.7% obese; 42.7% had elevated waist circumference; 43.5% had prehypertension and 14.2% had hypertension; 28.9% had prediabetes and 7.8% diabetes; 33.0% had elevated total cholesterol; 39.3% had elevated triglycerides; and 35.7% had elevated LDL-cholesterol as well as 28.9% had low HDL-cholesterol. Table 2 reports partial correlations (adjusting for age and sex) of BMI with markers of cardiometabolic risk. Significant positive associations were found between BMI and systolic BP, diastolic BP, HbA1C, and triglycerides (all P < .05). Similarly, there was a trend toward a significant, positive association between BMI and fasting glucose (P = .06). Conversely, HDL-cholesterol was negatively associated with BMI (P = .04).

When markers of cardiometabolic risk were compared between BMI groups adjusting for age and sex (Table 3), the overweight/obese group vs. normal weight group had significantly higher systolic BP, diastolic BP, fasting glucose, HbA1C, triglycerides and LDL-cholesterol levels and lower HDL-cholesterol levels (all P < .05). No significant differences in total cholesterol levels were observed between groups.

The prevalence and adjusted odds ratios for cardiometabolic risk factors in normal weight and overweight/obese US Hispanic farmworkers are presented in Table 4. There was a higher percentage of US Hispanic farmworkers with prehypertension/hypertension, elevated triglycerides, and low

HDL-cholesterol in the overweight/obese group compared with the normal weight group (all $P < .05$). Multinomial logistic regression, adjusting for the covariates, revealed that compared to individuals with the normal weight, the adjusted odds ratios for prehypertension/hypertension, elevated triglycerides, and low HDL-cholesterol were 2.5 (95% CI: 1.2-5.0), 2.7 (95% CI: 1.3-6.0), and 3.9 (95% CI: 1.4-10.4), for those in the overweight/obese group, respectively. No association was observed between the two groups of BMI for prediabetes/diabetes, elevated total cholesterol, or elevated LDL-cholesterol (all $P > .05$).

Characteristics	Value
<i>N</i>	303
Age, y	34.7 ± 9.6
Females, %	51.8
Anthropometrics	
BMI, kg/m ²	28.6 ± 5.0
Overweight status, % ¹	44.8
Obese status, %	33.7
Waist circumference, cm	93.1 ± 12.2
Elevated waist circumference, % ²	42.7
Blood pressure	
Systolic BP, mm Hg	120.6 ± 14.3
Diastolic BP, mm Hg	76.6 ± 10.1
Prehypertension, % ³	43.5
Hypertension, %	14.2
Diabetes-related measures	
Fasting glucose, mg/dL	100.2 ± 37.1
HbA _{1c} , %	5.9 ± 1.3
Prediabetes, % ⁴	28.9
Diabetes, %	7.8
Lipids	
Total cholesterol, mg/dL	183.9 ± 35.9
Elevated Total cholesterol, % ⁵	33
Triglycerides, mg/dL	160.6 ± 97.1
Elevated triglycerides, % ⁶	39.3
LDL-cholesterol, mg/dL	118.9 ± 31.2
Elevated LDL-cholesterol, % ⁷	35.7
HDL-cholesterol, mg/dL	47.7 ± 12.2
Low HDL-cholesterol, % ⁸	28.9

¹BMI of 25 to 29.9 is considered overweight, while BMI ≥30 is considered obese.

²Defined as waist circumference >102 cm for men and >88 cm for women.

³Prehypertension defined as systolic BP 120-139 mm Hg and/or diastolic BP ≥ 80-89 mm Hg, while hypertension defined as systolic BP ≥140 mm Hg and/or diastolic BP ≥90.

⁴ Prediabetes defined as a fasting blood glucose 100-125 mg/dl and/or HbA_{1c} test 5.7-6.4%, while diabetes defined as fasting blood glucose ≥126 mg/dl and/or HbA_{1c} test ≥6.5%.

⁵Defined as Total cholesterol ≥200 mg/dL.

⁶Defined as triglycerides ≥150 mg/dL.

⁷Defined as LDL-cholesterol ≥130 mg/dL.

⁸Defined as HDL-cholesterol <40 mg/dL.

Table 1. Characteristics of the US Hispanic farmworkers participants.

Variable	<i>r</i>	<i>P</i> value
Systolic BP	0.21	0.03
Diastolic BP	0.19	<.05
Fasting glucose	0.18	0.06
HbA _{1c}	0.27	<.01
Total cholesterol	-0.01	0.89
Triglycerides	0.32	<.01
LDL-cholesterol	0.04	0.67
HDL-cholesterol	-0.21	0.04

Abbreviations: BMI, body mass index; BP, blood pressure; HbA_{1c}, hemoglobin A1c; LDL, low density lipoprotein; HDL, high density lipoprotein.

¹Relationships are adjusted for age and sex. *N* = 303

Table 2. Correlations of body mass index with cardiometabolic risk factors¹.

	Normal weight	Overweight/obese	<i>P</i>
	(BMI < 25)	(BMI ≥ 25)	
Systolic BP, mm Hg	116.9 ± 13.2	121.7 ± 14.4	<.01
Diastolic BP, mm Hg	71.9 ± 9.4	77.5 ± 9.9	<.01
Fasting glucose, mg/dL	89.7 ± 15.8	105.2 ± 44.7	0.04
HbA _{1c} , %	5.5 ± 0.6	6.1 ± 1.5	<.05
Total cholesterol	180.1 ± 36.8	187.5 ± 35.9	0.2
Triglycerides, mg/dL	127.8 ± 53.8	166.6 ± 98.0	<.01
LDL-cholesterol, mg/dL	111.3 ± 31.5	123.7 ± 30.8	0.01
HDL-cholesterol, mg/dL	53.6 ± 12.9	46.8 ± 12.0	<.01

Abbreviations: BMI, body mass index; BP, blood pressure; HbA_{1c}, hemoglobin A1c; LDL, low density lipoprotein; HDL, high density lipoprotein.

¹Values are mean ± SEM.

²Data are adjusted for age and sex.

Table 3. Cardiometabolic risk factors in normal weight and overweight/obese US Hispanic farmworkers^{1,2}.

	Normal weight	Overweight/obese	P
	(BMI < 25)	(BMI ≥ 25)	
Prehypertension/hypertension			
Prevalence, %	45.3	61.1	0.04
Adjusted OR (95% CI) ^a	1	2.5 (1.2, 5.0) ^b	0.01
Prediabetes/diabetes			
Prevalence, %	25	40.9	0.052
Adjusted OR (95% CI) ^a	1	2.0 (0.9, 4.2) ^b	0.08
Elevated Total cholesterol			
Prevalence, %	31.8	33.3	0.85
Adjusted OR (95% CI) ^a	1	1.1 (0.5, 2.3) ^b	0.81
Elevated Triglycerides, mg/dL			
Prevalence, %	22.7	42.7	0.02
Adjusted OR (95% CI) ^a	1	2.7 (1.3, 6.0) ^b	0.01
Elevated LDL-cholesterol, mg/dL			
Prevalence, %	34.1	40	0.47
Adjusted OR (95% CI) ^a	1	1.3 (0.6, 2.8) ^b	0.43
Low HDL-cholesterol, mg/dL			
Prevalence, %	11.4	31.6	<.01
Adjusted OR (95% CI) ^a	1	3.9 (1.4, 10.4) ^b	<.01

^aData are adjusted for age and sex.

^bSignificantly different from the reference group, normal weight group (P < .05).

Table 4. Prevalence and adjusted odds ratios (95% CI) for cardiometabolic risk factors in normal weight and overweight/obese US Hispanic farmworkers.

Discussion

To our knowledge, this is the first study to comprehensively evaluate the cardiometabolic risk profile in farmworkers of Hispanic origin in Southeastern US. We observed high prevalence of a large number of cardiometabolic risk factors. Also, we found that overweight/obesity is associated with notable higher cardiometabolic risk among Hispanic farmworkers in Southeastern US. While few studies examined cardiometabolic risk of Hispanic farmworkers in US[13,1], none of those studies reported the prevalence of prehypertension, prediabetes, elevated LDL-cholesterol, reduced HDL-cholesterol, and elevated triglycerides.

The results of our study showed that the prevalence of overweight/obesity, prehypertension/hypertension, and prediabetes/diabetes among Hispanic farmworkers was 78.5%, 57.7%, and 36.7%, respectively. The prevalence of overweight/obesity in the California Agricultural Workers Health Survey (CAWHS), was 76.5%, similar to our findings[13]. The prevalence of overweight/obesity in our Hispanic farmworkers is similar to Hispanic population (78.2%) of 2011-2012 National Health

and Nutrition Examination Survey (NHANES), but higher than White and Black population, 67.0% and 75.7%, respectively[4]. Despite the demanding physical labor of our population and their young age, we found a high prevalence of cardiometabolic risk factors. Of note, this high risk could be attributed to poor access to the health care system which could be due to the following reasons. First, Spanish is the native language in 81% of the farmworkers and almost one-half of this population stated that they could not speak or read English, which indicates that language barrier is a substantial factor. Second, education level is an important determinant of health[17]. The education level of our study population was low, as the rate of high school graduation was only 33%. Third, lack of health insurance is common, where only one in five farmworkers are covered by health insurance. And fourth, half of the farmworkers lacked authorization to work in the US. Work-unauthorized farmworkers are much less likely than work-authorized farmworkers to receive unemployment insurance if they lose their jobs, and less likely to report being covered by workers compensation[8].

The prevalence of hypertension in our Hispanic farmworkers was 14.2%, while the household based survey of CAWHS study and Oceana Farmworker Health Survey (OFHS) showed prevalence of hypertension as 15.5% and 12.7%, respectively[13,1]. The prevalence of prehypertension/hypertension in 2009-2010 NHANES Hispanic participants was lower than our Hispanic farmworkers, 51.4% and 57.7% respectively[3]. Studies have found that Hispanics are less likely to be aware of their hypertension, and are less likely to have their blood pressure sufficiently controlled, compared to non-Hispanics[18]. Besides, the results of randomized clinical trials have shown that the low percentage of blood pressure control in Hispanics is not due to biological factors. In an environment providing the patient with the same access to medical care and no-cost medication, it was revealed that Hispanics had equal or superior blood pressure control compared with non-Hispanics[19]. The prevalence of diabetes in our Hispanic farmworkers was 7.8%, while CAWHS and OFHS studies reported that 4% and 8.7% of their participants were diabetic, respectively. The OFHS relied on self-reported data to define diabetes; on the other hand, we utilized clinical laboratory data to define diabetes. The prevalence of prediabetes/diabetes among our Hispanic farmworkers was lower than 2009-2012 NHANES Hispanic participants, 36.7% and 52.6%, respectively[4]. We believe that several factors might play a role in the lower prevalence of prediabetes/diabetes in our population. First, our population consists of young farmworkers, while NHANES recruited older participants. Second, studies showed that the prevalence of diabetes was positively correlated with years of dwelling in the US, and the pattern was significant among those dwelling in the US more than 10 years[20]. This finding suggests that the longer period of Hispanic farmworkers dwell in the US, the worse health they likely acquire. In general, most of our participants might have not resided in the US enough to

demonstrate the impact of acculturation on their health.

Dyslipidemia is another modifiable risk factor for cardiovascular disease and stroke. Our data showed that the prevalence of elevated total cholesterol, elevated LDL-cholesterol, and reduced HDL-cholesterol were 33.0%, 35.7%, and 28.9%, respectively. In addition, the prevalence of elevated triglycerides was 39.3%. In the present study we used the same cutoff 200 as the NHANES defined the elevated total cholesterol, but when using the cutoff 240 the prevalence was 7.4%, similar to the prevalence of elevated total cholesterol (≥ 240 mg/dL) in CAWHS and OFHS which was 10.5%, and 8.5%, respectively. The prevalence of high total cholesterol, high LDL-cholesterol, low HDL-cholesterol, and elevated triglycerides in the 2009-2012 NHANES was 44.8%, 35.3%, 23.3%, and 34.9%, respectively[4,5].

Hispanics have a tendency to dwell in a built environment which is relevant to higher cardiometabolic risk factors[21]. In detail, the morbid built environment has smaller food stores, less places to exercise, and unattractive or unsafe neighborhoods. This is particularly the case for rural community (Trenton) where our population resided in. Acculturation and socioeconomic status were correlated with dyslipidemia across all Hispanics. Specifically, Hispanics with Spanish-language preference, lower educational level, and lower income were associated with higher prevalence of dyslipidemia compared to Hispanics with English-language preference, higher education level, and higher income[22,23].

In our population, overweight/obese individuals have higher cardiometabolic risk. There was a higher percentage of US Hispanic farmworkers with prehypertension/hypertension, elevated triglycerides, and low HDL-cholesterol in the overweight/obese group compared with the normal weight group. This cross-sectional study showed an association between BMI, and cardiometabolic risk factors including SBP, DBP, HbA1C, triglycerides, and HDL-cholesterol. These results are in agreement with studies which reported that obesity increases cardiometabolic risk through risk factors such as dyslipidemia, elevated blood pressure, and elevated blood sugar levels[24,25]. Accumulating evidence proposes that the chronic low grade inflammation in the state of obesity plays an important role in the pathophysiology of cardiometabolic risk factors developments[26].

The limitations of the present study should be acknowledged. First, there were no available data regarding the farmworker's leisure-time physical activity or diet which might explain the health disparities. Second, pre-existing conditions such as hypertension, diabetes, and dyslipidemia were not surveyed. However, because of the lack of access to health care, our Hispanic farm workers are generally unaware of their poor health status, such that any pre-existing conditions are likely untreated or poorly controlled. Third, our study is ob-

servational study conducted at one farm site. Nonetheless, our study independently replicates the findings from the other two studies on Hispanic farmworkers in Mid-west and west coast and provides novel findings that overweight/obese Hispanics farmworkers have higher cardiometabolic risk.

Conclusions

A comprehensive profile of prevalence of overweight/obesity and cardiometabolic risk factors, and the association between overweight/obesity and cardiometabolic risk factors is reported for the first time regarding the understudied Hispanic farmworkers in Southeastern US. Hispanic young farmworkers carry a disproportionately high burden of cardiometabolic risk, which may affect their long term health and work productivity. Considering that Hispanics make above 80% of the US agricultural workforce, their health and well-being is vital to the food security of the nation. We advocate for the nation's greater attention to their health, and large-scale interventional studies are needed to reduce their cardiometabolic risk factors.

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