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Research Article

Evaluation of Two Screening Methods for Cardiometabolic Syndrome among Hispanic Adults from NHANES 2011 - 2012

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Abstract

Background: Ethnic minorities have a higher percentage of Cardiometabolic Syndrome (CMS) than the general population, but they are often under-diagnosed. Identification and diagnosis is influenced by screening methods which may not adequately capture CMS among ethnic groups, particularly adult Hispanics. This study compared the National Cholesterol Education Program Adult Treatment Panel (ATP III) and the American Association of Clinical Endocrinologists (AACE) screening guidelines for CMS among Hispanic adults.

Methods: A convenience sample of adult Hispanics from the National Health and Nutrition Examination Survey (NHANES) 2011 - 2012 was used. Selection included 100 males and females age 35 - 65 years old, self-reported Hispanic, and who met CMS components by the ATP III, and impaired glucose tolerance or impaired fasting glucose plus any number of components by the AACE. Statistics for categorical and continuous variables were used where appropriate. A $p = \leq 0.05$ was considered statistically significant. Kappa statistic was used to compare agreement between the two methods. The primary outcome criterion was a diagnosis of CMS.

Results: The ATP III method yielded a higher percentage of CMS diagnosis (87%) compared with the AACE screening method (77%). The ATP III also detected a higher percent of CMS in both genders. The number of CMS diagnosis by both methods overall was higher in females (168 vs 161). Kappa statistic indicated a moderate agreement between the AACE and ATP III criteria for CMS diagnosis ($\kappa = 0.454$, 95% confidence interval 0.347 - 0.561).

Implications for Practice: Primary care practitioners need evidenced based screening tools that will provide the most accurate information for evaluating CMS and its severity. Sensitive measures for CMS are needed for differing ethnicities and gender in clinical practice.

Introduction

Cardiometabolic Syndrome (CMS) is a cluster of factors that include central obesity, hyperglycemia, insulin resistance, hypertension, and dyslipidemia [1]. CMS affects approximately one-fourth of the population in the United States (U.S.) with ethnic minorities such as Hispanics having higher percentages than other populations [2]. Hispanic is defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture

or origin regardless of race. Thirty-six percent of Hispanic women and 34% of Hispanic men have CMS [3]. CMS carries significant health implications for Cardiovascular Disease (CVD) and Type 2 Diabetes Mellitus (T2DM), which is among the leading causes of mortality and morbidity worldwide [2]. CMS increases the risk of CVD by 12-17%, and T2DM by 30-52% [4]. Moreover, the cost burden of these diseases is tremendous. Costs associated with T2DM exceeded \$174 billion in 2007 [5]. Similarly, the total cost associated with CVD in the U.S. is expected to rise to an alarming

\$818 billion dollars by 2030 [6].

The diagnosis of CMS is often dependent upon the diagnostic method used for the specific group. Although much of the research over the past five years has focused on diagnosis of CMS among minorities, it remains unclear whether current scientific evidence is conclusive enough to support changes in screening requirements in minority populations. Consequently, there is a practice dilemma caused by screening guidelines that may not capture CMS and the actual presentation of minority populations such as Hispanics in the U.S. who may be under-diagnosed. It is estimated that the number of under-diagnosed Hispanics with CMS is as much as 50% more than whites [7]. The lack of CMS recognition can lead to postponement of the treatment of individual components of the syndrome that are all independent risk factors for cardiovascular disease and pre-term mortality. Additionally, CMS is a continuum of risk and current methods do not address the severity of CMS.

Current Screening Methods

The two most widely used and accepted CMS screening methods are the National Cholesterol Education Program Adult Treatment Panel (ATP III) and the American Association of Clinical Endocrinologists (AACE). However, these methods have shown to be ambiguous in some instances, and may lack generalizability and applicability in certain populations [8]. Therefore, primary care

practitioners need evidenced based screening tools that will provide the most accurate information for evaluating ethnic minorities at risk for CV and T2DM. These types of screening tools are vital to practitioners who are obligated to provide culturally competent care to minority groups.

Definition of AACE Guidelines for CMS

According to the AACE, CMS is diagnosed when individuals have either impaired glucose tolerance (IGT, plus any of the following criteria: (1) body mass index (BMI) $\geq 25 \text{ kg/m}^2$, (2) triglycerides (TR) $\geq 150 \text{ mg/dL}$, (3) High Density Lipoprotein Cholesterol (HDL-C) $< 40 \text{ mg/dL}$ in men and $< 50 \text{ mg/dL}$ in women, (4) Systolic Blood Pressure (SBP) $\geq 130 \text{ mmHg}$ or Diastolic Blood Pressure (DBP) $\geq 85 \text{ mmHg}$ [9]. Table 1 summarizes these criteria. The AACE presented its screening guideline in 2003 to account for insulin resistance as a core criterion of CMS, referring to it as "Insulin Resistance Syndrome" [9]. Moreover, the Insulin Resistance Atherosclerosis Study (IRAS) found that obesity was a causal risk factor of the syndrome, as opposed to a consequence of the syndrome, and gave preference to BMI rather than WC as a measure of obesity. Other important distinctions with the AACE guidelines are that T2DM is an exclusion criterion, IGT is a major criterion, and there is no specific number of criteria required for diagnosis [10].

Risk Factor Components	Defining Criteria	
	AACE IGT or IFG, plus any number of these criteria	ATP III Any three of these criteria
Overweight or Obesity	BMI $\geq 25 \text{ kg/m}^2$	WC $> 102 \text{ cm}$ in men or 88 cm women
Elevated Triglycerides (TG)	TG $\geq 150 \text{ mg/dL}$	TG $\geq 150 \text{ mg/dL}$
Low HDL	HDL-C $< 40 \text{ mg/dL}$ in men, and $< 50 \text{ mg/dL}$ in women	HDL-C $< 40 \text{ mg/dL}$ in men, and $< 50 \text{ mg/dL}$ in women
Elevated Blood pressure	Systolic ≥ 130 and Diastolic $\geq 85 \text{ mmHg}$	Systolic BP ≥ 130 and diastolic BP $\geq 85 \text{ mmHg}$
Fasting glucose	≥ 100 and $\leq 126 \text{ mg/dL}$	$\geq 100 \text{ mg/dL}$ or history of T2DM or taking anti-diabetic medications
2-Hour Post-glucose (OGT)	$\geq 140 \text{ mg/dL}$	Not a criteria of this method

Table 1: ATP III Criteria for CMS.

Definition of ATP III Guidelines for CMS

According to ATP III, CMS is diagnosed when any three or more of the following criteria exists: (1) WC $> 102 \text{ cm}$ in men or 88 cm in women, (2) triglycerides $\geq 150 \text{ mg/dL}$, (3) HDL-C $< 40 \text{ mg/dL}$ in men and $< 50 \text{ mg/dL}$ in women, (4) systolic blood pressure $\geq 130 \text{ mm Hg}$ or diastolic blood pressure $\geq 85 \text{ mm Hg}$ or history of hypertension, (5) fasting blood glucose $\geq 100 \text{ mg/dL}$ or history of T2DM or taking anti-diabetic medications [11]. Table 1 summarizes these criteria. The ATP III is different from AACE as it allows for diagnosis of CMS in persons with T2DM. The importance of this distinction is that the high risk for Atherosclerotic Cardiovascular Disease (ASCVD) and multiple-risk factors among individuals with T2DM [12].

Problem with CMS Guidelines for Hispanics

For Hispanics, the diagnostic utility of CMS screening is in question since CMS diagnosis varies based on race and ethnicity. Further, race/ethnicity-specific analysis of individual CMS components in this population is limited. This limitation is due to the lack of adjustment for factors specific to this population group. Consequently, misdiagnosis and under-diagnosis remains prevalent among adult Hispanics.

Purpose

The purpose of this study was to compare the ATP III and AACE screening methods for CMS among Hispanic adults. The objectives of this study were three-fold:

- Examine the cardiometabolic risk profiles using the ATP III and AACE cardiometabolic screening methods among Hispanic adults from NHANES 2011 - 2012.
- Compare cardiometabolic risk profiles utilizing the two cardiometabolic screening methods among Hispanic adults.
- Quantify the prevalence of CMS diagnosis between the two methods among Hispanic adults.

Definition of Terms

Self-Reported: Provide details about one's circumstances, typically one's medical or psychological condition, and is often used for ethnicity.

Cardiometabolic Risk (CMR): A construct that comprises a cluster of risk factors that indicate a patient's overall risk for T2DM and cardiovascular disease.

Oral Glucose Tolerance (OGT): A standard dose of glucose is ingested by mouth and blood levels are checked after two hours.

Insulin Resistance (IR): A condition in which the body produces insulin but does not use it effectively, causing glucose to build up in the blood, leading to T2DM.

Methods

Institutional Review Board

This study met the University of Alabama's Institutional Review Board criteria for waiver of consent since a public database was used and there was no interaction with participants.

Sample

This cross-sectional, descriptive study utilized a convenience sample from the NHANES 2011 - 2012. A systematic consecutive sample of 100 males and 100 female self-reported Hispanics age 35 - 65 years old, and who met CMS components were included in

this study. Exclusion criteria include pregnancy, and age less than 35 or greater than 65 years old. The study included the following components:

- Subject characteristics: self-reported ethnicity, age, and gender.
- Anthropometric measurements: WC, BMI, and BP.
- Laboratory results: fasting serum glucose, HDL, and TR levels.

Selection of subjects was performed using the screening criteria and querying the database until the required number of participants was obtained. The NHANES is designed to collect information on the health and nutrition status of the U.S. household population. The survey supports examination of public health issues that can best be addressed through physical examinations and laboratory tests. The NHANES has a consistent core set of tests (e.g. height, weight, blood cholesterol) that are designed to assess the overall health and nutritional status of the subjects and evaluate certain variables that affect health. Data were gathered through personal interviews and standardized assessments of physical examinations and laboratory tests. All NHANES questionnaires are translated into Spanish and can be administered in either English or Spanish based on the preference of the respondent. Interpreters were used for non-English/non-Spanish speaking participants [13]. NHANES protocol and assessment techniques are described elsewhere [14].

Data collection method included the following:

- The NHANES 2011 - 2012 public database was downloaded to a computer.
- The database was queried based on screening parameters for selection of 100 females and 100 males.
- Variables were entered into an excel spreadsheet and then electronically transferred to SPSS software. Any combination of three or more CMS criteria components using the two methods was entered into the database.
- The data was analyzed utilizing Excel 2010 and SPSS version 22.0 [15].

Statistical Analysis

Descriptive statistics were used for characteristics of the participants and risk factor variables for CMS. Chi Square was used for categorical variables and two tailed t-tests were used for continuous variables. The sample size calculation was based on anticipated effect size (Cohen's d) of 0.2, power level of 80%, and 0.05 significance level (two tailed). Kappa statistic was used to calculate level of agreement between the two CMS methods.

Results

The overall sample included 100 males and 100 females. Of the 200 participants, 77% (n=155) of participants were diagnosed with CMS based on the AACE method, and 87% (n=174) of participants were diagnosed based on the ATP III method. There was no significant difference in number of participants diagnosed between methods ($p = 0.401$).

Characteristics of Sample

For the overall group, the mean age was 51 years (± 8.94). For the overall group, the male mean age was 49 years (± 9.12) and the female mean age was 52 years (± 8.64). There was no significant difference between gender age in the overall group ($p = 0.053$). For the AACE group, the overall mean age was 51 years (± 9.12). For the AACE group, the male mean age was 50 years (± 9.54) and the female mean age was 52 years (± 8.64). There was no significant difference between gender age in the AACE group ($p = 0.121$). For the ATP III group, the overall mean age was 50 years (± 8.97). For the ATP III group, the male mean age was 49 years (± 9.17) and the female mean age was 52 years (± 8.57). There was significant difference between gender age in the ATP III group ($p = 0.035$). There was no significant difference in male mean age between the AACE and ATP III groups ($p = 0.603$). There was no significant difference in female mean age between the AACE and ATP III groups ($p = 0.911$). Table 2 summarizes the characteristics of the sample.

	Overall N = 200	AACE N = 155	ATP III N = 174	p value
Male, N (%)	100 (100%)	73 (47%)	88 (50%)	0.301
Female, N (%)	100 (100%)	82 (53%)	86 (49%)	0.375
Age, M (SD)	51.1 (± 8.94)	51.4 (± 9.12)	50.8 (± 8.97)	0.867
BMI, M (SD)	31.2 (± 5.32)	31.3 (± 5.44)	31.6 (± 5.38)	0.018
WC, M (SD)	103.7 (± 11.59)	103.4 (± 11.60)	104.9 (± 11.63)	0.055
SBP, M (SD)	129.2 (± 18.72)	127.3 (± 17.59)	129.7 (± 18.05)	0.109
DBP, M (SD)	74.4 (± 10.33)	74.4 (± 10.08)	74.8 (± 10.37)	0.455
FPG, M (SD)	128.6 (± 46.67)	110.1 (± 11.16)	132.0 (± 49.03)	0
OGT,	163.4 (± 69.85)	149.0 (± 45.92)	166.9 (± 74.05)	0
TR,M (SD)	211.4 (± 132.02)	197.2 (± 119.70)	221.1 (± 136.40)	0.555

HDL, M (SD)	44.0 (± 11.18)	44.5 (± 11.13)	43.15 (± 11.10)	0.308
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Table 2: Sample Characteristics and Risk Factor Profiles.

Risk Factor Profiles

BMI: For the overall group, the mean BMI was 31.2 kg/m² (± 5.32). For the overall group, the male mean BMI was 30.6 kg/m² (± 4.49) and the female mean BMI was 31.8 kg/m² (± 5.99). There was no significant difference between gender BMI in the overall group ($p = 0.108$). For the AACE group, the overall mean BMI was 31.3 kg/m² (± 5.44). For the AACE group, the male mean BMI was 30.9 kg/m² (± 4.44) and the female mean BMI was 31.6 (± 6.20). There was no significant difference between gender BMI in the AACE group ($p = 0.452$). For the ATP III group, the mean BMI was 31.6 kg/m² (± 5.38). For the ATP III group, the male mean BMI was 31.1 kg/m² (± 4.59) and the female mean BMI was 32.2 kg/m² (± 6.05). There was no significant difference between gender BMI in the ATP III group ($p = 0.154$). There was significant difference in male mean BMI between the AACE and ATP III groups ($p = 0.003$). There was no significant difference in female mean BMI between the AACE and ATP III groups ($p = 0.540$).

WC: For the overall group, the mean WC was 103.7 cm (± 11.59). For the overall group, the male mean WC was 105.8 cm (± 10.90) and the female mean WC was 101.6 cm (± 11.94). There was significant difference between gender WC in the overall group ($p = 0.013$). For the AACE group, the overall mean WC was 103.4 cm (± 11.60). For the AACE group, the male mean WC was 106.4 cm (± 10.82) and the female mean WC was 100.6 cm (± 11.68). There was significant difference between gender WC in the AACE group ($p = 0.002$). For the ATP III group, the overall mean WC was 104.9 cm (± 11.63). For the ATP III group, the male mean WC was 107.0 cm (± 11.02) and the female mean WC was 102.6 cm (± 11.81). There was significant difference between gender WC in the ATP III group ($p = 0.014$). There was significant difference in male mean WC between the AACE & ATP III groups ($p = 0.002$). There was no significant difference in female mean WC between the AACE & ATP III groups ($p = 0.939$).

SBP: For the overall group, the mean SBP was 129.2 mmHg (± 18.72). For the overall group, the male mean SBP was 131.2 mmHg (± 17.89) and the female mean SBP was 127.0 mmHg (± 19.44). There was no significant difference between gender SBP in the overall group ($p = 0.126$). For the AACE group, the overall mean SBP was 127.3 mmHg (± 17.59). For the AACE group, the male mean SBP was 129.8 mmHg (± 17.02) and the female mean SBP was 124.8 mmHg (± 17.93). There was significant difference between gender SBP in the AACE group ($p = 0.001$). For the ATP III group, the overall mean SBP was 129.7 mmHg (± 18.05). For the ATP III group, the male mean SBP was 131.2 mmHg (± 16.44)

and the female mean SBP was 127.9 mmHg (± 19.68). There was no significant difference between gender SBP in the ATP group ($p = 0.240$). There was no significant difference in male mean SBP between the AACE & ATP III groups ($p = 0.245$). There was no significant difference in female mean SBP between the AACE & ATP III groups ($p = 0.302$).

DBP: For the overall group, the mean DBP was 129.2 mmHg (± 18.72). For the overall group, the male mean DBP was 76.5 mmHg (± 9.00) and the female mean DBP was 72.1 mmHg (± 11.21). There was a significant difference between gender DBP in the overall group ($p = 0.003$). For the AACE group, the overall mean DBP was 127.3 mmHg (± 17.59). For the AACE group, the male mean DBP was 76.9 mmHg (± 9.06) and the female mean DBP was 71.9 mmHg (± 10.49). There was a significant difference between gender DBP in the AACE group ($p = 0.003$). For the ATP III group, the mean overall SBP was 129.7 mmHg (± 18.05). For the ATP III group, the male mean DBP was 77.0 mmHg (± 8.73) and the female mean DBP was 72.2 mmHg (± 11.49). There was a significant difference between gender DBP in the ATP III group ($p = 0.003$). There was no significant difference in male mean DBP between the AACE & ATP III groups ($p = 0.141$). There was no significant difference in female mean DBP between the AACE & ATP III groups ($p = 0.907$).

FPG: For the overall group, the mean FPG was 128.6 mg/dL (± 46.67). For the overall group, the male mean FPG was 137.8 mg/dL (± 52.99) and the female mean FPG was 119.5 mg/dL (± 37.43). There was a significant difference between gender FPG in the overall group ($p = 0.005$). For the AACE group, the overall mean FPG was 110.1 mg/dL (± 11.16). For the AACE group, the male mean FPG was 114.2 mg/dL (± 11.24) and the female mean FPG was 106.5 mg/dL (± 9.83). There was a significant difference between gender FPG in the AACE group ($p = 0.000$). For the ATP III group, the overall mean FPG was 132.0 mg/dL (± 49.03). For the ATP III group, the male mean FPG was 141.4 mg/dL (± 55.45) and the female mean FPG was 122.3 mg/dL (± 39.49). There was a significant difference between gender FPG in the ATP III group ($p = 0.010$). There was a significant difference in male mean FPG between the AACE & ATP III groups ($p = 0.000$). There was a significant difference in female mean FPG between the AACE & ATP III groups ($p = 0.000$).

OGT: For the overall group, the mean OGT was 163.4 (± 69.85). For the overall group, the male mean OGT was 168.6 mg/dL (± 84.77) and the female mean OGT was 158.7 mg/dL (± 53.50). There was no significant difference between gender OGT in the overall group ($p = 0.401$). For the AACE group, the mean overall OGT was 149.0 (± 45.92). For the AACE group, the male mean OGT was 145.7 mg/dL (± 50.41) and the female mean OGT was 152.2 mg/dL (± 41.89). There was no significant difference between gender OGT in the AACE group ($p = 0.426$). For the ATP

III group, the mean overall OGT was 166.9 (± 74.05). For the ATP III group, the male mean OGT was 174.8 mg/dL (± 89.37) and the female mean OGT was 159.8 mg/dL (± 56.88). There was no significant difference between gender OGT in the ATP III group ($p = 0.269$). There was a significant difference in male mean OGT between the AACE & ATP III groups ($p = 0.001$). There was a significant difference in female mean OGT between the AACE & ATP III groups ($p = 0.043$).

TR: For the overall group, the mean TR was 211.4 mg/dL (± 132.02). For the overall group, the male mean TR was 245.9 mg/dL (± 151.82) and the female mean TR was 176.2 mg/dL (± 96.96). There was a significant difference between gender TR in the overall group ($p = 0.000$). For the AACE group, the mean overall TR was 197.2 mg/dL (± 119.70). For the AACE group, the male mean TR was 224.8 mg/dL (± 133.94) and the female mean TR was 172.3 mg/dL (± 99.63). There was a significant difference between gender TR in the AACE group ($p = 0.006$). For the ATP III group, the mean TR overall was 221.1 (± 136.40). For the ATP III group, the male mean TR was 258.3 mg/dL (± 154.08) and the female mean TR was 182.1 mg/dL (± 102.10). There was a significant difference between gender TR in the ATP III group ($p = 0.000$). There was no significant difference in male mean TR between the AACE & ATP III groups ($p = 0.558$). There was no significant difference in female mean TR between the AACE & ATP III groups ($p = 0.714$).

HDL: For the overall group, the mean HDL mg/dL was 44.0 (± 11.18). For the overall group, the male mean HDL was 40.6 mg/dL (± 10.97) and the female mean HDL was 47.4 mg/dL (± 10.39). There was no significant difference between gender HDL in the overall group ($p = 0.143$). For the AACE group, the mean overall HDL was 44.5 (± 11.13). For the AACE group, the male mean HDL was 41.3 mg/dL (± 10.84) and the female mean HDL was 47.4 mg/dL (± 10.64). There was a significant difference between gender HDL in the AACE group ($p = 0.001$). For the ATP III group, the mean overall HDL was 43.15 mg/dL (± 11.10). For the ATP III group, the male mean HDL was 39.7 mg/dL (± 10.46) and the female mean HDL was 46.6 mg/dL (± 10.71). There was a significant difference between gender HDL in the ATP III group ($p = 0.000$). There was no significant difference in male mean HDL between the AACE & ATP III groups ($p = 0.534$). There was no significant difference in female mean HDL between the AACE & ATP III groups ($p = 0.165$). Table 2 summarizes the risk factor profiles in this sample.

CMS Diagnosis

In the AACE CMS group, 47% (n= 73) males and 53% (n=82) females were diagnosed with CMS. There was no significant difference between gender CMS diagnosis by the AACE method ($p = 0.128$). In the ATP III CMS group, 51% (n=88) males and 49%

(n=86) females were diagnosed with CMS. There was no significant difference between gender CMS diagnosis by the ATP III method ($p = 0.674$). Table 3 summarizes these results. The agreement between the two methods was found to be Kappa = 0.454, 95% confidence interval 0.347 - 0.561. There was moderate agreement between the AACE and ATP III criteria for CMS diagnosis.

AACE N (%)	ATP III N (%)	p value	Kappa value	Confidence Interval 95%
155 (77%)	174 (87%)	0.401	0.454	0.347 - 0.561

Table 3: Percent and Frequency of CMS Diagnosis.

Discussion

Subjects in this study were younger compared to the mean age of 54 years in the study by Heiss et al. which quantified the prevalence of the CMS based on the ATP III criteria among Hispanic men and women [3]. In contrast, the average age of participants diagnosed by the AACE method was higher than for those diagnosed by the ATP III method, with females being older. Since Hispanic women are diagnosed with CMS at younger ages [16], the ATP III method may be more suitable for younger age categories of females, while AACE may be more appropriate for males. The average age between genders in both the AACE and the ATP III groups also showed females to be older, with significance in the ATP III group. Thus, the burden of CMS varies by age and gender among the subjects in this study.

Risk Factor Profiles

BMI and WC: Elevated BMI (a risk factor of the AACE), and WC (a risk factor of the ATP III) were the most prominent risk factors for CMS regardless of diagnostic method. However, between methods, average BMI and WC were higher for both genders with the ATP III, but significantly higher for males only. Further, in all groups (the overall, AACE, and ATP III), females had higher average BMI, while males had higher average WC. The latter was significant in both the AACE and ATP III groups. Thus, BMI was a better predictor of obesity among females, and WC was a better predictor of obesity among males by both methods. These findings were also similar to the study by Xu et al. which estimated and compared the prevalence of CMS among native Chinese adults [17]. Chinese men were found to have significantly higher average WC.

SBP and DBP: Similar to the Jackson Heart Study (JHS) which was undertaken to examine factors that influence CVD development among African American men and women, HTN was not a significant risk factor [18]. However, males superseded females for having higher average systolic and diastolic BP in all groups. This finding was noted for both screening methods. Also,

both males and females in the ATP III group had higher average SBP and DBP, compared to the AACE group. Although it was not known whether participants were being treated for HTN, in practice, men should be especially targeted for HTN management to prevent CMS.

FPG: Findings for FPG were similar to the study by Rodriguez et al. (2010) that looked at risk factors associated with CMS in T2DM subjects according to different criteria for CMS diagnosis. Elevated FPG was among the major predictors of CMS regardless of gender and diagnosis method. Further, in all groups, the average FPG was significantly higher in males. Also, in the overall and ATP III groups, the male mean FPG was above the diabetes criteria cut-off of 126 mg/dL. In practice, this finding indicates that CMS can be missed in males with the AACE method because FPG parameter is specified as IFG (glucose 100 mg/dL to 126 mg/dL), and T2DM is an exclusion of the AACE method.

OGT: In all groups, male average OGT (an AACE risk factor) was higher compared to females; however, this finding was not statistically significant. In contrast, average OGT was significantly higher for the ATP III group among both genders despite OGT not being a parameter of the ATP III. Thus, adding OGT as a risk factor in ATP III may increase capture of CMS, as well as identify subjects eligible for intervention to prevent T2DM.

TR and HDL: Dyslipidemia was among the major predictors of CMS. However, it was not the strongest predictor as found by Rodriguez who reported the prevalence of CMS among Hispanic women [19]. Males had higher averages of high TR in all groups. This difference between genders was significant for the AACE and ATP III groups. Thus interventions to lower TR in males are essential. On the other hand, though the average female HDL was significantly higher than males in all groups, the average HDL was below criteria of 50 mg/dL for females. Therefore, interventions to increase HDL in females are essential.

CMS Diagnosis

Kappa statistic indicated moderate agreement between the AACE and ATP III criteria for CMS. The ATP III method diagnosed CMS in a higher number and percent of participants overall. Moreover, the number of CMS diagnosis according to the ATP III method was increased in female patients. The study by Rodriguez also found female participants to have increased diagnosis with the ATP III method [19].

Overall, this study concurs with existing research that regardless of the diagnostic criteria used, obesity and elevated glucose are the prevailing commonalities in CMS. Findings in this study also show that including BMI and OGT as risk factors for the ATP III may increase CMS capture among Hispanic adults. Similarly, including WC and FPG ≥ 100 mg/dL as risk factors for the AACE may increase CMS capture and identify individuals

eligible for intervention to prevent T2DM. The reasoning is that these risk factors are prominent in Hispanic adults who have greater incidence of obesity and T2DM. Similar studies revealed the same results among ethnic groups. Moreover, findings from this study indicate gender differences regardless of which method is used. Clearly, more sensitive measures for ethnic groups that are gender specific and which reveal severity are needed.

Limitations

A significant limitation of this study was the retrospective and cross sectional design. This limited our ability to examine the most predictive CMS definition for risk of DM, CVD, and premature death among Hispanic adults. The sample size is small. Also, a convenience sample was used as opposed to the entire Hispanic population, which would have provided more generalizable results. Further, participant medical history was not collected, so it is not known if subjects were being treated for HTN, T2DM, and dyslipidemia. Lastly, we cannot exclude selection bias for the study because only participants meeting specific criteria were included, and selection was not randomized by the investigator.

Strengths

The strength of this study was the inclusion of waist circumference. Unlike BMI, WC is not routinely included in physical exams, and as a result, some studies discussing recommendations for CMS diagnosis do not include this parameter [20]. This study adds to existing research by analyzing and describing comparison of CMS risk profile between Hispanic groups and within groups.

Conclusion

Ethnic minorities have a greater incidence of CMS than the general population, but are often under-diagnosed. Accurate identification and diagnosis are influenced by screening methods which may not adequately capture CMS among adult Hispanics in the primary care setting. Further, primary care providers are given insight into optimal methods to appropriately screen patients in the Hispanic population for CMS, and consequently provide culturally competent care. Future research is warranted to develop more sensitive measures that are ethnic and gender specific.

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