Gender and Racial-Ethnic Differences in Cardiovascular Disease Risk Factor Treatment and Control Among Persons with Diabetes in the Multi-Ethnic Study of Atherosclerosis (MESA)

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Objective: To examine gender and racial/ethnic differences in cardiovascular risk factor treatment and control among persons with diabetes in the Multi-Ethnic Study of Atherosclerosis (MESA).

Research Design and Methods: Observational study examining mean levels of cardiovascular risk factors and proportion achieving treatment goals.

Results: The sample included 926 persons with diabetes. Compared to men, women were 9% less likely to achieve LDL cholesterol < 130 mg/dl [adjusted prevalence ratio (PR) 0.91 (0.83-0.99)] and systolic blood pressure (SBP) < 130 mmHg [adjusted PR 0.91 (0.85-0.98)]. These differences diminished over time. A lower percentage of women used aspirin (23% vs. 33%; p<0.001). African American and Hispanic women had higher mean levels of SBP and lower prevalence of aspirin use compared to non-Hispanic white women.

Conclusions: Women with diabetes had unfavorable cardiovascular risk factor profiles compared to men. African American and Hispanic women had less favorable profiles than non-Hispanic white women.
Population-based health survey data suggest that gender and racial/ethnic disparities are present in diabetes process of care measures and cardiovascular (CV) risk factor control [1-9]. Available data also indicate that gender-specific race/ethnic differences are present in CV risk factor control, but these data are limited to Medicare and Veterans’ Hospital patient populations. [5, 10-13]. We therefore performed analyses of participants with diabetes in the Multi-Ethnic Study of Atherosclerosis (MESA) to examine gender and gender-specific racial/ethnic differences in CV risk factor treatment and control.

RESEARCH DESIGN AND METHODS
MESA is a multi-center cohort study of 6,814 men and women age 45-84 years with no clinical evidence of cardiovascular disease at time of enrollment [14]. Four MESA exam periods occurred between 2000-2007. The study was approved by the Institutional Review Board at all participating institutions and all MESA participants provided informed consent. Criteria for recruitment, data collection methods and laboratory techniques have been previously described [14]. Participants were classified as having diabetes if at exam 1 they had a fasting plasma glucose \( \geq 126 \text{ mg/dl} \), or used oral hypoglycemic agents and/or insulin, or reported a physician diagnosis of diabetes.

Statistical Analysis: Multivariate models were used to calculate predicted means for lipid, blood pressure, and hemoglobin A1c levels. Prevalence ratios (PR) were calculated for percentages of participants achieving cardiovascular risk factor goals using binomial regression, with adjustment for age, MESA site, socio-economic status (SES) variables and either gender or race/ethnicity. Potential effects of selective attrition on longitudinal results were examined using t-tests to determine if participants lost to follow-up had higher mean cardiovascular risk factor levels compared to those retained in the study. Analyses were performed using SAS version 9.1.

RESULTS
Of 926 MESA participants with diabetes at exam 1 (2000-2002), 48% were women. Four racial/ethnic groups were represented (19% non-Hispanic white (NHW), 38% African American, 31% Hispanic, 12% Chinese). Compared to men, women were more likely to report gross family income <$20,000 (42% vs. 26%) and less than high school education (33% vs. 27%).

Cross-sectional Data: At exam 1, after adjustment for age, MESA site and race/ethnicity, systolic blood pressure (SBP) was 3.5 mmHg higher among women compared to men (133.7 vs. 130.2 mmHg, \( p < 0.01 \)). LDL cholesterol and hemoglobin A1c did not differ by gender. After additional adjustment for SES, there was no gender difference in mean SBP (Table 1). African American and Hispanic women had significantly higher mean SBP values compared to NHW women. A significantly lower percent of women were taking aspirin (Table 1). Hispanic women reported taking less aspirin compared to NHW women.

A lower percent of women achieved LDL < 130 mg/dl (69.4% vs. 77.1%, \( p = 0.01 \)) and SBP < 130 mmHg (42.2% vs. 57.8%, \( p = 0.002 \)) compared to men. Women were 9% less likely to achieve LDL cholesterol < 130 mg/dl compared to men [adjusted PR 0.91 (0.85-0.98)] and 9% less likely to achieve SBP < 130 mmHg [adjusted PR 0.91 (0.83-0.99)]. African American and Hispanic women were 31% [adjusted PR 0.69 (0.51-0.91)] and 30% [adjusted PR 0.70 (0.52-0.95)] less likely respectively to achieve blood pressure (BP) < 130/80 mmHg compared to NHW women.

Longitudinal Data: Of 926 subjects with diabetes at exam 1, 802 completed exam
2; 751 exam 3; and 719 exam 4. At exam 4, LDL (96.4 vs. 94.6 mg/dl, p=0.54) and SBP (130.3 vs. 127.6 mmHg, p=0.11) did not differ between women and men. At exam 4, there was no difference in the percentage of women achieving LDL < 130 mg/dl [adjusted PR 0.97 (0.91-1.04)] or SBP < 130 mmHg [adjusted PR 0.95 (0.88-1.02)] compared to men. African American women were 33% less likely to achieve BP < 130/80 mmHg (adjusted PR 0.67 [0.49-0.91]) compared to NHW women. Though women reported higher anti-hypertensive and lipid lowering medication use compared to men at exam 1, there was no difference at exam 4 in anti-hypertensive (80% vs. 75%, p = 0.20) or lipid-lowering medication (51% vs. 49%, p=0.70) use. Aspirin use increased for both genders from 2000-2007, however, women remained less likely to report aspirin use at exam 4 compared to men (44% vs. 57%, p<0.05). Aspirin use remained lower for African American and Hispanic women compared to NHW women (51% and 39% vs. 58%, respectively).

DISCUSSION

Among MESA participants with diabetes, at the baseline exam, a lower proportion of women achieved consensus treatment targets for SBP and LDL cholesterol, after adjustment for covariates. These differences were observed despite a greater reported use of BP and lipid-lowering medications among women. African American and Hispanic women had lower proportions achieving consensus treatment goals for BP, and less reported use of aspirin compared to NHW women. The gender difference in LDL and SBP control diminished over time.

Our findings are consistent with previous reports showing gender and racial/ethnic differences in cardiovascular risk factor control among persons with diabetes [2, 12, 13, 15]. Inconsistent findings have been reported regarding gender and racial/ethnic differences in use of medications for management of CV factors [3, 4, 8].

There are several potential mechanisms for the gender and racial/ethnic differences we observed. Regression adjustment for SES variables eliminated the significant gender difference in mean SBP. Socioeconomic variables may correlate with access to high quality medical care and with personal behaviors that influence risk factor levels, including medication adherence, diet and exercise. Our findings may also indicate a disparity in medication titration by physicians.

There are several limitations to our study. Information on medication use was self-reported and patient adherence was not recorded. Study participation may also have influenced treatment patterns because exam results were reported to the participants. Despite these limitations, our findings provide new information about gender and gender-specific race/ethnic differences in cardiovascular risk factor treatment and control among persons with diabetes in a contemporary multi-ethnic cohort with diverse sources of insurance.

In conclusion, we found that among subjects with diabetes in MESA, women had unfavorable cardiovascular risk factor profiles compared to men at baseline exam, however, these differences diminished over time. African American and Hispanic women had less favorable profiles than NHW women.

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REFERENCES
Table 1. Cardiovascular Disease Risk Factors (mean [S.E.]) and Aspirin Use (number [%]) for Participants with Diabetes, 2000-2002 (Hemoglobin A1c from exam 2)

<table>
<thead>
<tr>
<th>Gender</th>
<th>LDL cholesterol (mg/dl)</th>
<th>Systolic BP (mmHg)</th>
<th>Diastolic BP (mmHg)</th>
<th>Pulse Pressure (mmHg)</th>
<th>Hemoglobin A1c (%)</th>
<th>Aspirin (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women (n=448)</td>
<td>112.6 (2.31)</td>
<td>133.3 (1.37)</td>
<td>68.6 (0.64)***</td>
<td>64.7 (1.06)****</td>
<td>7.38 (0.12)</td>
<td>97 (23%)****</td>
</tr>
<tr>
<td>Men (n=478)</td>
<td>109.6 (2.14)</td>
<td>131.1 (1.26)</td>
<td>75.2 (0.58)</td>
<td>55.9 (0.97)</td>
<td>7.44 (0.11)</td>
<td>155 (33%)</td>
</tr>
</tbody>
</table>

Race/Ethnicity & Gender Subgroups

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Women (n=72)</th>
<th>Men (n=104)</th>
<th>Women (n=184)</th>
<th>Men (n=172)</th>
<th>Women (n=52)</th>
<th>Men (n=57)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic white</td>
<td>110.5 (3.13)</td>
<td>110.3 (3.92)</td>
<td>116.3 (3.18)</td>
<td>108.2 (3.18)</td>
<td>108.9 (5.49)</td>
<td>106.3 (5.06)</td>
</tr>
<tr>
<td>Women (n=72)</td>
<td>109.3 (4.49)</td>
<td>110.3 (3.92)</td>
<td>116.3 (3.18)</td>
<td>108.2 (3.18)</td>
<td>108.9 (5.49)</td>
<td>106.3 (5.06)</td>
</tr>
<tr>
<td>Men (n=104)</td>
<td>110.5 (3.13)</td>
<td>110.3 (3.92)</td>
<td>116.3 (3.18)</td>
<td>108.2 (3.18)</td>
<td>108.9 (5.49)</td>
<td>106.3 (5.06)</td>
</tr>
</tbody>
</table>

African American | 112.2 (2.51) | 110.3 (3.92) | 116.3 (3.18) | 108.2 (3.18) | 108.9 (5.49) | 106.3 (5.06) |
| Women (n=184)  | 112.2 (2.51) | 110.3 (3.92) | 116.3 (3.18) | 108.2 (3.18) | 108.9 (5.49) | 106.3 (5.06) |
| Men (n=172)    | 112.2 (2.51) | 110.3 (3.92) | 116.3 (3.18) | 108.2 (3.18) | 108.9 (5.49) | 106.3 (5.06) |

Hispanic | 114.1 (2.96) | 113.7 (3.67) | 114.5 (3.59) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |
| Women (n=140) | 114.1 (2.96) | 113.7 (3.67) | 114.5 (3.59) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |
| Men (n=145)   | 114.1 (2.96) | 113.7 (3.67) | 114.5 (3.59) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |

Chinese | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |
| Women (n=52) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |
| Men (n=57)    | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) | 107.6 (4.07) | 108.9 (5.49) | 106.3 (5.06) |

Abbreviations: BP, blood pressure; NHW, non-Hispanic white; S.E., standard error
Comparisons adjusted as follows: Women vs. men adjusted for age, site, race/ethnicity, income, education level and health insurance (government-sponsored vs. private vs. no insurance). African American vs. NHW adjusted for the same variables without race/ethnicity and including gender, similarly for Hispanic vs. NHW and Chinese vs. NHW. African American women vs. NHW women adjusted for same variables without gender and race/ethnicity, similarly for Hispanic women vs. NHW women and Chinese women vs. NHW women.

*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001 for comparisons of women vs. men
† p<0.05, †† p<0.01, ††† p<0.001, †††† p<0.0001 for comparisons of African American, Hispanic and Chinese vs. NHW
‡ p<0.05, ‡‡ p<0.01 for comparisons of African American, Hispanic and Chinese women vs. NHW women