Metabolic Syndrome and Workplace Outcome

Maine Worksite Wellness Initiative

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Current Definition* of Metabolic Syndrome

- **At least 3 of the following:**
  - **Waist Circumference ≥ 40 inches men, ≥ 35 inches women**
  - **Triglycerides ≥150 mg/dl**
  - **HDL <40 mg/dl men, <50 mg/dl women or taking cholesterol medication**
  - **Blood Pressure ≥130/85 mmHg or taking BP medication**
  - **Fasting Plasma Glucose ≥100 mg/dl or taking diabetes medication**

* Grundy et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. *Current Opinion in Cardiology*. 2006;21:1-6.

Prevalence of MetS Risks (N=8,303 HRA participants in 2007 or 2008)

	Percentage of Study Population		
	Employees (N=5688)	Spouses (N=2615)	Total (N=8,303)
Triglycerides≥150	41.5%	29.1%	37.6%
Blood Pressure ≥130/85 (or BP meds)	34.0%	23.8%	30.8%
HDL<40 (male), <50 (female) (or cholesterol meds)	34.6%	34.9%	34.7%
Fasting Glucose ≥100 (or diabetes meds)	36.6%	23.5%	32.5%
Waist Circumference ≥ 40 (male), ≥ 35 (female)	26.6%	41.8%	31.4%
None of the Conditions	23.1%	28.6%	24.9%
Any One of the Conditions	24.8%	27.5%	25.6%
Any Two of the Conditions	22.9%	20.1%	22.0%
Any Three of the Conditions	17.2%	13.0%	15.8%
Any Four of the Conditions	9.0%	8.0%	8.7%
All Five of the Conditions	3.0%	2.9%	3.0%
<3 of the Conditions	70.8%	76.1%	72.5%
3+ of the Conditions (MetS)	29.2%	23.9%	27.5%

Demographics of HRA Participants With and Without MetS

	Without MetS (N=6016)	With MetS (N=2287)
Average Age	39.4 years	44.4 years*
% Male	58.1%	69.8%*
Some College or Less	68.1%	78.1%§
Household Income <$75,000	69.1%	74.0%§
Married	76.1%	80.7%§
Caucasian	89.8%	91.1%§

* t-test for age and chi-square for gender, p<.0001
§ generalized linear model controlling for age and gender, p<.05

Health Risks of Participants

	Without MetS (N=6016)	With MetS (N=2287)
Alcohol drinks >14 per week	3.6%	3.2%
Cholesterol>240 mg/dl	**8.8%**	**15.8%***
>5 Illness days in past year	**4.4%**	**7.1%***
Job dissatisfaction	10.0%	11.7%
Life dissatisfaction	**12.3%**	**14.6%***
Use relaxation medication	**12.4%**	**18.3%***
Poor or fair physical health	**6.8%**	**16.8%***
Physical inactivity	**13.6%**	**17.5%***
Safety belt use	**21.7%**	**24.6%***
Smoking	**16.6%**	**17.9%***
High stress	**20.6%**	**27.3%***
MetS Risks		
Blood pressure ≥130/85 (or meds)	**16.8%**	**67.6%***
Waist Circumference ≥ 40 (male), ≥ 35 (female)	**19.1%**	**63.8%***
Fasting glucose ≥100 (or meds)	**18.9%**	**68.2%***
HDL<40 (male), <50 (female) (or meds)	**20.8%**	**71.2%***
Triglycerides≥150	**20.6%**	**82.3%***

* generalized linear model testing difference controlling for age, gender, ethnicity, marital status, income and education p<.05

Prevalence of Health Conditions

Health Condition	Without MetS (N=6016)	With MetS (N=2287)	Adjusted OR* (95% CI)
Allergies	20.8%	19.7%	1.06 (0.93, 1.20)
Arthritis	**8.7%**	**15.2%**	**1.33 (1.13, 1.57)**
Asthma	3.1%	3.7%	1.33 (0.99, 1.78)
Back Pain	**12.5%**	**14.5%**	**1.28 (1.10, 1.49)**
Bronchitis/Emphysema	0.4%	0.7%	1.44 (0.72, 2.89)
Cancer	2.3%	2.4%	1.17 (0.47, 2.90)
Chronic Pain	**4.3%**	**6.7%**	**1.39 (1.11, 1.73)**
Depression	**4.8%**	**7.7%**	**1.75 (1.41, 2.17)**
Diabetes	**1.3%**	**10.4%**	**6.67 (5.04, 8.82)**
Heartburn	**7.9%**	**14.5%**	**1.93 (1.64, 2.27)**
Heart Disease	**1.6%**	**4.9%**	**2.35 (1.74, 3.19)**
Migraine	**4.9%**	**4.5%**	**1.30 (1.01, 1.67)**
Stroke	0.1%	0.2%	2.28 (0.33, 15.70)

*multivariate logistic regression controlling for age, gender, ethnicity, income, marital status and education.

Workplace Outcomes Associated with MetS Risks (Employees in 2007)

	Not At Risk			At Risk		
	Annual Health Care Costs	Annual Pharmacy Costs	Annual STD Cost	Annual Health Care Costs	Annual Pharmacy Costs	Annual STD Cost
BMI	**$2175**	**$299**	**$80**	**$3060**	**$479***	**$138***
BP	**$2187**	**$264**	**$84**	**$2837**	**$501***	**$119***
Glucose	**$2201**	**$262**	**$84**	**$2776**	**$490***	**$117***
HDL	**$2441**	**$333**	**$87**	**$2377**	**$376**	**$113**
Triglycerides	**$2050**	**$243**	**$85**	**$2911***	**$489***	**$111**

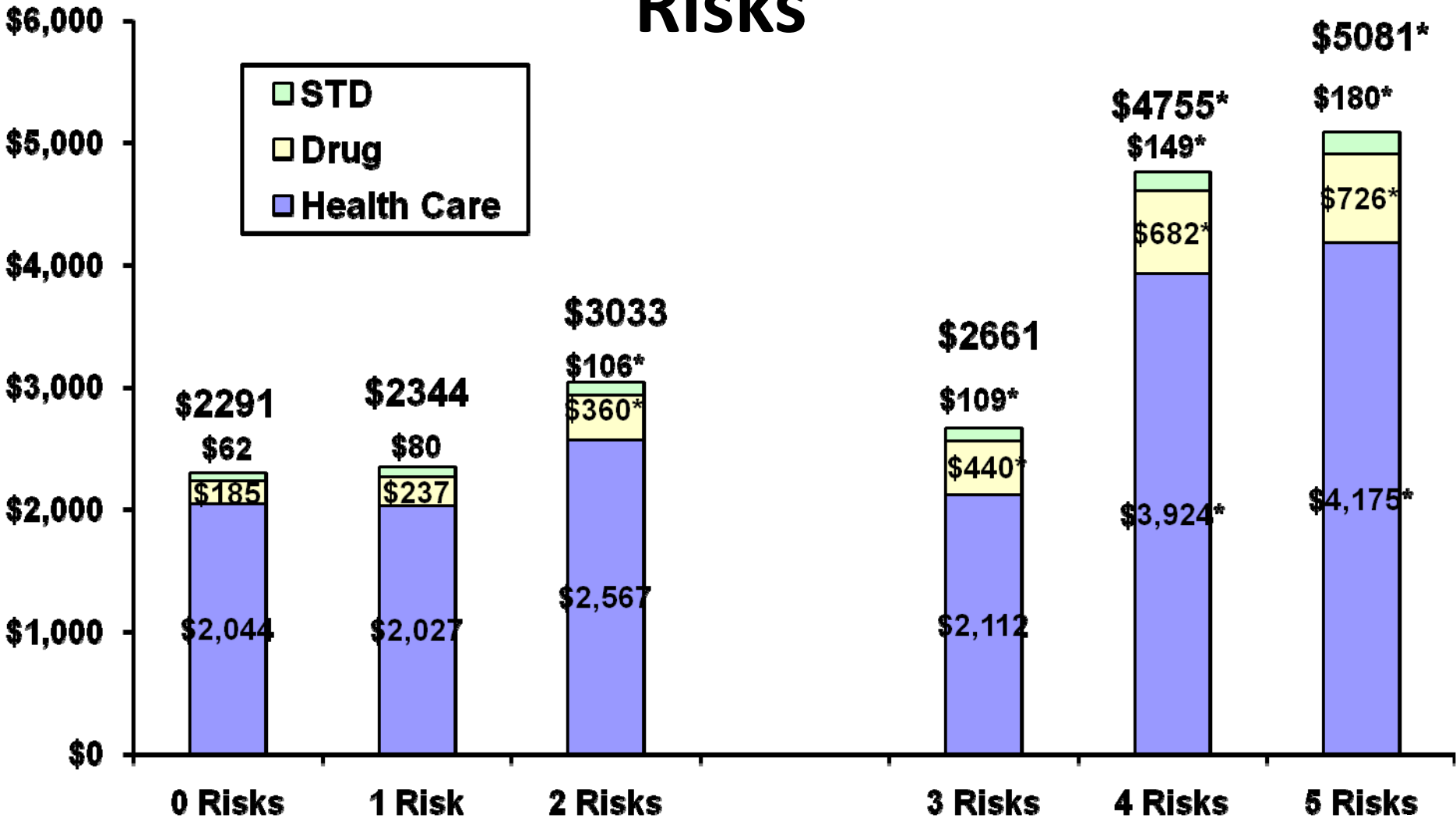
* Generalized linear model comparing those with and without the risk. $p<.05$ controlling for age, gender, marital status, education, ethnicity and income.

Workplace Outcomes Associated with Number of MetS Risks (Employees in 2007)

	N	Annual Health Care	Annual Pharmacy	Annual STD
None of the Risks	1050	$2044	$185	$62
Any One of the Risks	1209	$2027	$237	$80
Any Two of the Risks	1117	$2567	$360*	$106*
Any Three of the Risks	873	$2112	$440*	$109*
Any Four of the Risks	463	$3924*	$682*	$149*
All Five of the Risks	154	$4175*	$726*	$180*
No MetS (<3 risk factors)	3376	$2211	$261	$82
MetS (3+ risk factors)	1490	$2888**	$545**	$129**

* Generalized linear model p<.05 compared to those with zero risks, controlling for age, gender, marital status, education, ethnicity and income.
** Generalized linear model p<.05 compared to those without MetS, controlling for age, gender, marital status, education, ethnicity and income.

Annual Costs by Number of MetS Risks



* Significantly different from 0 risk category, p<.01 GLM adjusting for age, gender, ethnicity, education, income and marital status.

Odds of Reducing Individual Risks associated with Overall Change in MetS from 2007 to 2008

Odds of	MetS in 2007 → No MetS in 2008 (High to Low) (N=552) compared to MetS in both 2004 and 2006 (High to High) (N=1286)	
	OR	95% CI
Reduced Risk for Waist Circumference	15.28	(10.51, 22.21)
Reduced Risk for HDL	10.15	(6.67, 15.43)
Reduced Risk for Triglycerides	18.88	(12.66, 28.15)
Reduced Risk for Glucose	18.11	(12.32, 26.61)
Reduced Risk for Hypertension	15.24	(10.46, 22.21)
Sex	0.98	(0.97, 1.00)
Age	1.26	(0.92, 1.72)

Odds of Individual Risk Increases associated with Overall Change in MetS from 2007 to 2008

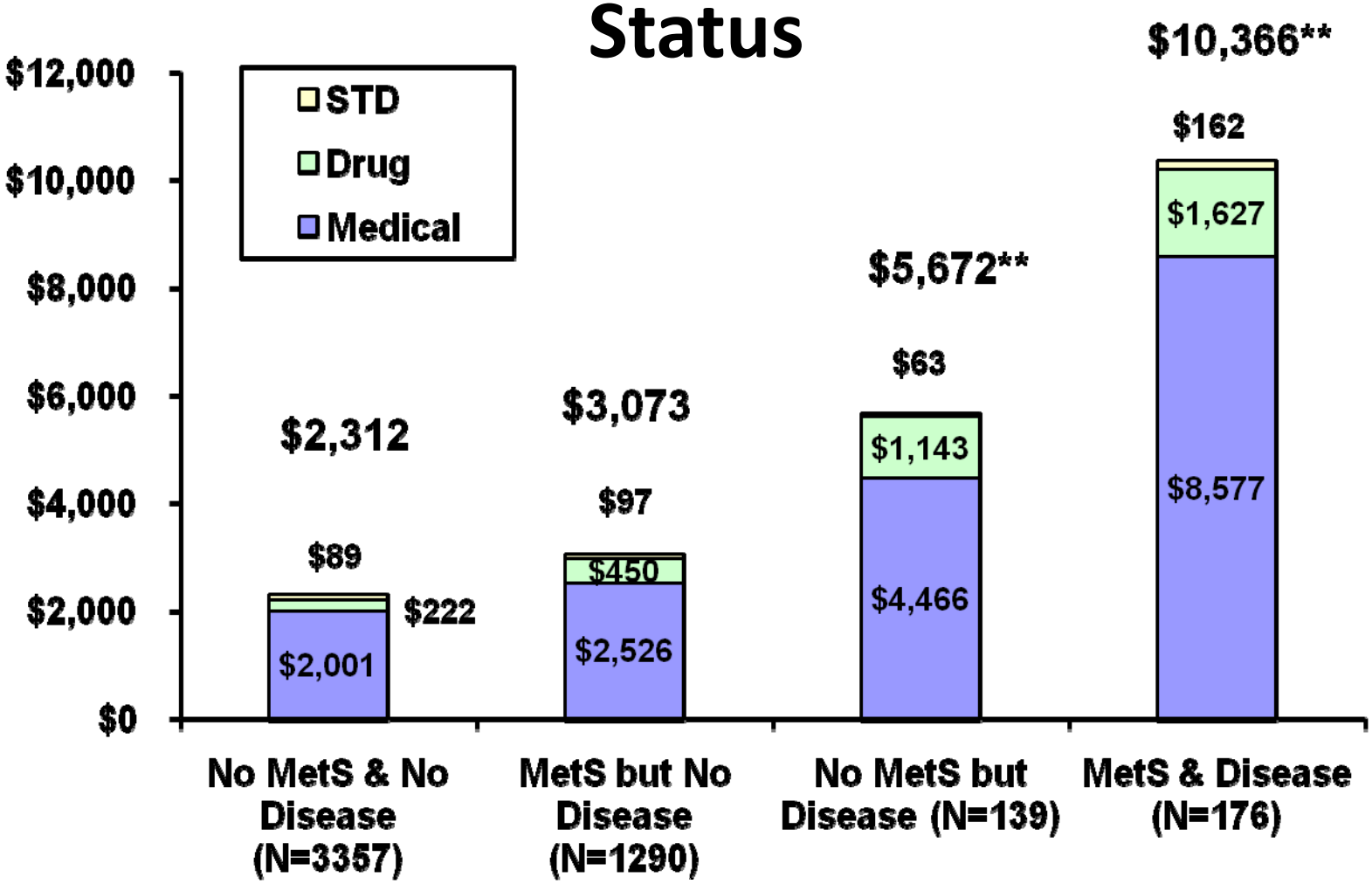
Odds of	No MetS in 2007 → MetS in 2008 (Low to High) (N=588) compared to No MetS in both 2007 and 2008 (Low to Low) (N=4120)	
	OR	95% CI
Increased Risk for Glucose	16.49	(12.38, 21.98)
Increased Risk for HDL	15.31	(11.35, 20.66)
Increased Risk for Hypertension	14.27	(10.65, 19.10)
Increased Risk for Triglycerides	13.64	(10.22, 18.18)
Increased Risk for Waist Circumference	12.91	(8.74, 19.07)
Sex	1.04	(1.03, 1.05)
Age	0.48	(0.37, 0.62)

Odds of Newly Reporting Disease* in 2008 for those with each MetS Risk Factor in 2007

Risk Factor in 2007	Odds of Newly Reporting Arthritis in 2008 OR (95%CI)	Odds of Newly Reporting Chronic Pain in 2008 OR (95% CI)	Odds of Newly Reporting Diabetes in 2008 OR (95% CI)	Odds of Newly Reporting Heart Disease in 2008 OR (95% CI)
Waist	**1.637 (1.247, 2.150)**	1.117 (0.792, 1.575)	**4.914 (2.607, 9.281)**	1.338 (0.841, 2.129)
Hypertension	0.966 (0.418, 1.299	**1.659 (1.156, 2.381)**	**3.488 (1.895, 6.421)**	**2.110 (1.292, 3.446)**
Glucose	1.148 (0.860, 1.532)	1.169 (0.814, 1.680)	**16.046 (6.727, 38.274)**	1.518 (0.940, 2.450)
HDL	1.157 (0.867, 1.544)	1.326 (0.939, 1.873)	**2.937 (1.698, 5.078)**	1.551 (0.967, 2.486)
Triglycerides	1.100 (0.831, 1.457)	**1.632 (1.158, 2.299)**	**3.084 (1.720, 5.531)**	**2.820 (1.731, 4.592)**
MetS	1.223 (0.915, 1.636)	**1.797 (1.266, 2.551)**	**9.832 (4.877, 19.822)**	**2.842 (1.767, 4.574)**

* Logistic regression controlling for age, gender, gender, ethnicity, income, education and marital status.

2007 Cost by 2007 MetS and Disease* Status



*Disease = self-reported heart disease or diabetes. ** p<.0001 significantly different from all other groups.

Conclusions

- **MetS is prevalent in working populations: 29% among at this manufacturing corporation and 24% among their spouses.**
- **Those with MetS are significantly more likely to have:**
  - **A variety of additional health risks**
  - **A variety of health conditions**
  - **Higher health care, pharmacy and STD costs**
- **All of the risks contribute to changes in overall MetS status (no one single risk is responsible for changes)**

Conclusions continued

- **Employees with MetS but no disease in 2007 were more likely to newly report chronic pain, diabetes and heart disease in 2008 compared to those without MetS**
- **Those with MetS and a health condition had significantly higher costs than other employees**
  - **The vast majority of employees with MetS had not yet developed a health condition and their costs were not significantly greater than those without MetS**
    - **This is encouraging to organizations investing in keeping employees healthy.**

Conclusions continued

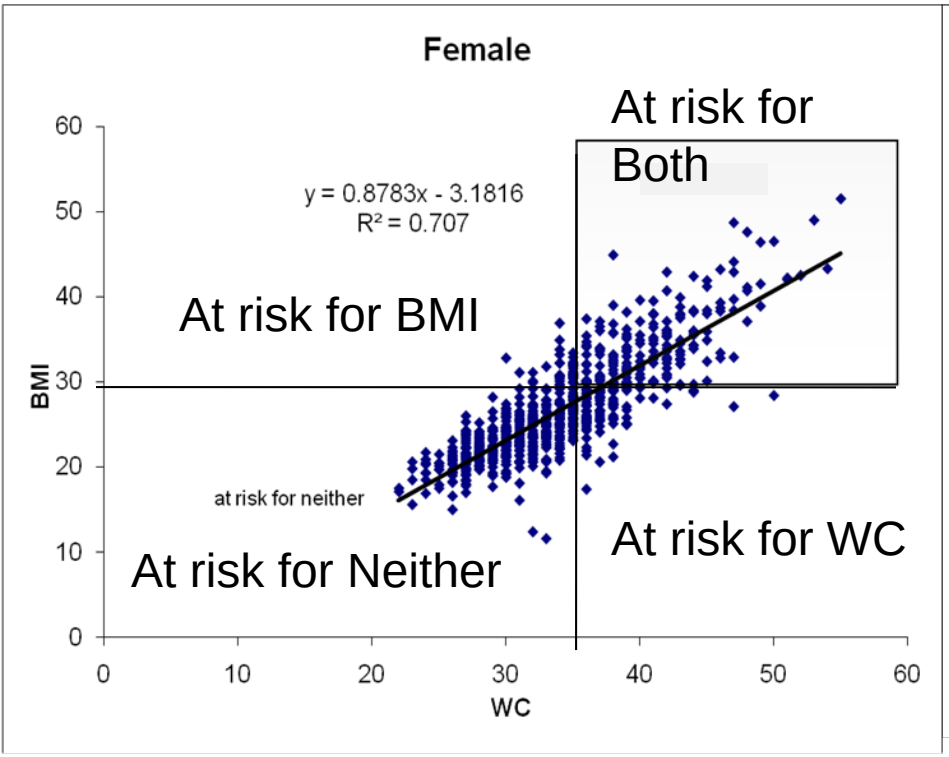
- **MetS is an important issue for corporate medical departments and worksite health promotion practitioners**
- **Employees with MetS have higher costs**
  - **Those with MetS have a total cost (health care + pharmacy + STD) about 1.4 times higher than those without MetS, ($3562 vs. $2554, $p<.05$)**
    - **Similar to other conditions such as rheumatoid arthritis (1.9 times higher costs), irritable bowel syndrome (1.5 times higher costs)**

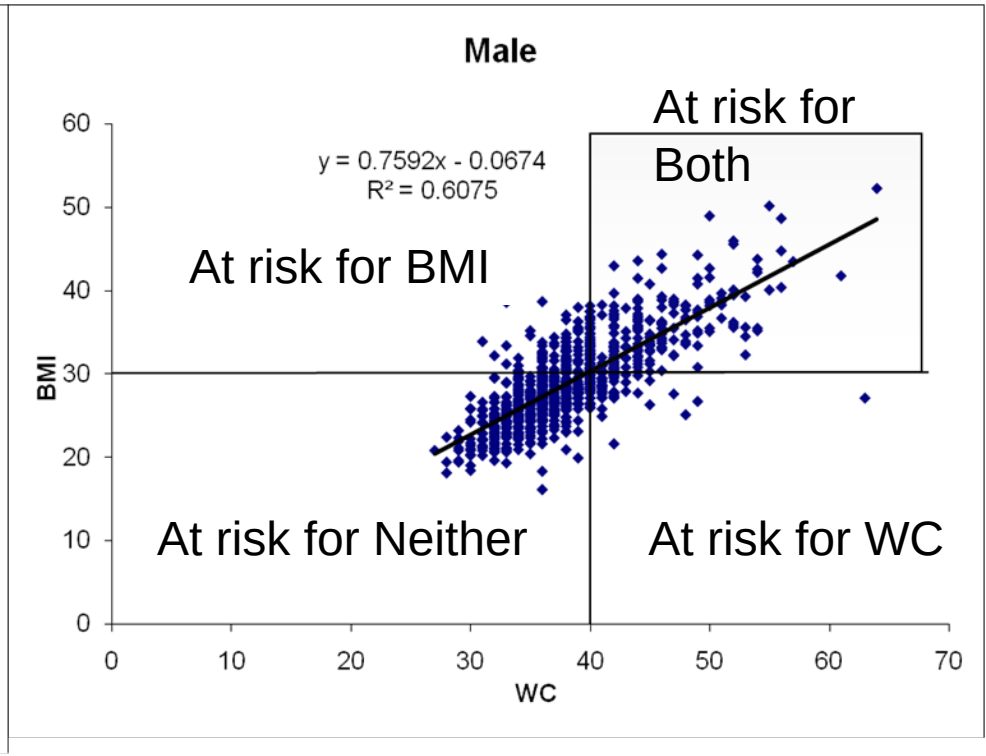
Conclusions continued

- **Since most employees are low-risk for MetS (70% in this company), programs and benefit designs should be geared to low-risk maintenance as well as risk reduction**
- **Even in employed populations, MetS has predictive power for new cases of chronic pain, diabetes and heart disease**
- **Current guidelines for MetS focus on lifestyle changes as first line of treatment followed by pharmacotherapy**
- **Physical activity can yield improvements in weight, BP and glucose utilization and is an important component**

Scatter plots of BMI vs. WC for Females and Males

Employees who are at risk for BMI (>30 kg/m^2), Waist Circumference (>=40 in. for men and >=35 in. for women), both or neither. Correlation is stronger for women than men.





Agreement between the Classifications
Kappa agreement statistic = 0.8666

MetS using BMI	MetS using WC		Total
	No MetS	MetS	
No MetS	3240 (67.1%)	141 (2.9%)	3381 (70.0%)
MetS	130 (2.7%)	1318 (27.3%)	1448 (30.0%)
Total	3370 (69.8%)	1459 (30.2%)	4829 (100.0%)

Employees who are at risk for Metabolic Syndrome using BMI (>30 kg/m^2) compared to Waist Circumference (>=40 in. for men and >=35 in. for women). Agreement between classifications is very strong.

References

1. Schultz, Alyssa, Dee W. Edington. Metabolic Syndrome in a Workplace: Prevalence, Co-Morbidities, and Economic Impact. Metabolic Syndrome Related Disorders. 7(5):459-468, 2009.

2. Schultz, Alyssa, Dee W. Edington. The Association Between Changes in Metabolic Syndrome and Changes in Cost in a Workplace Population. Journal of Occupational and Environmental Medicine. 51(7):771-779, 2009.

3. Schultz, Alyssa B., Dee W. Edington. Analysis of the Association between Metabolic Syndrome and Disease in a Worksite Population over Time. Value in Health. 12(1):1-7, 2009.