

The Association of Self-Reported Employee Physical Activity With Metabolic Syndrome, Health Care Costs, Absenteeism, and Presenteeism

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Objective: To examine employees' self-reported physical activity and metabolic syndrome (MetS) risks and their association with health-related workplace outcomes. **Methods:** Employees participated in a health risk appraisal in 2010. Generalized Linear Modeling was used to test the association between MetS risk factors, physical activity, and the outcome measures while controlling for confounders. **Results:** MetS was found in 30.2% of employees. Health care costs for employees with MetS who reported sufficient exercise (150 or more minutes/week) totaled \$2770 compared with \$3855 for nonsufficient exercisers. The percentage of employees with MetS who had absenteeism and presenteeism was also significantly lower for employees achieving sufficient physical activity. All risk factors for MetS were mitigated for regular exercisers. **Conclusions:** Employers should consider programs and services to support regular aerobic exercise to address the growing prevalence and costs of MetS in the workforce.

The prevalence of Metabolic Syndrome in US adults has dramatically increased over the past three decades to 34% of US adults.^{1,2} The cluster of metabolic health indicators that we now term metabolic syndrome (MetS) was first called "Syndrome X" in 1988.³ Syndrome X was described as the presence of multiple risk factors such as overweight, glucose intolerance, hyperinsulinemia, increased triglycerides, decreased high-density lipoprotein (HDL) cholesterol, and hypertension. Several definitions of MetS have been proposed by organizations such as the World Health Organization,⁴ the National Institutes of Health,⁵ and the American Heart Association,⁶ and the International Diabetes Federation.⁷

A current worldwide standard definition for MetS risk criteria requires individuals to be high risk for three of the following five criteria: waist circumference (102 cm or more in men, 88 cm or more in women, or body mass index [BMI] > 30 kg/m²); triglycerides 150 mg/dL or more or taking medication for that condition; HDL cholesterol less than 40 mg/dL for men or less than 50 mg/dL for women or taking medication for that condition; blood pressure of 130/85 mmHg or more or taking medication for that condition; and fasting glucose 100 mg/dL or more or taking medication for that condition.^{8,9}

The inclusion of those individuals who are taking medication for each of the MetS risk factors is an important step in assessing the true risks in a population. In light of the confusion caused by changing definitions, it is generally accepted that MetS is likely

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Learning Objectives

- Outline previous research on metabolic syndrome (MetS), including the evidence for a moderating effect of physical activity.
- Summarize the new findings on how MetS and physical activity are associated with health-related workplace outcomes.
- Discuss the implications for managing the prevalence and health risks of MetS in the workplace.

to be present in 20% to 25% of the world's population.¹⁰ People with MetS are two to three times as likely to have a heart attack or stroke compared with those without the syndrome.^{11,12} The MetS is thought to be one of the drivers of the growing problems of diabetes and cardiovascular disease.¹³⁻¹⁷ In addition, others, including the American Heart Association, have highlighted the importance of reducing health risks in the US population prior to the development of disease to reduce the number of deaths from cardiovascular disease and stroke.¹⁸

A large body of research indicates that physical activity moderates a number of the health risks and diseases associated with MetS¹⁹⁻²⁶ and is associated with a decreased risk of all-cause mortality.²⁷⁻³⁰ These studies have provided strong evidence that physically active adults tend to develop and maintain a higher level of metabolic fitness whereas low cardiorespiratory fitness is a strong, independent predictor of cardiovascular disease and MetS.

Some studies of MetS prevalence have been conducted at individual corporations and results indicate that the prevalence varies by occupation type. Shift workers have been identified as a group with higher MetS prevalence than others,³¹ and a study of a Midwestern manufacturing corporation found that 30.2% of employees met the criteria for MetS. Those with MetS were also significantly more likely to have a variety of additional health risks and health conditions than those without MetS.³²

The prevalence of MetS was examined in a sample of employees who participated in a cardiovascular screening program at a defense, security, and aerospace corporation located in the Northeastern United States.³³ Workers were primarily engineers, accountants, and other white-collar workers. Approximately 27% of the screening participants met the criteria for MetS, with a higher rate among men (30.2%) compared with women (19.7%; $P < 0.005$). A study of 203 employees of a leading global energy company reported an MetS prevalence of 23.6% based on laboratory and medical claims data.³⁴ The prevalence of MetS in a global financial services corporation was 22.6% and was associated with increased illness days and increased trend of short-term disability (STD) absence claims. No significant association was found with presenteeism or STD incidence.³⁵

Because corporations are often the primary payer of health care costs, they have an interest in optimizing the health of their

employees. In this study, a large global financial services organization based in the United States began an employee wellness program in 2009. The company wellness program had many components, one of which was the availability of on-site fitness centers or activity rooms at major work locations. Furthermore, an annual health risk appraisal (HRA) and biometric screening were offered to employees as a way of identifying health risks and helping employees maximize their health. The purpose of this study was to identify the prevalence of MetS in this employee population and to determine its association with a variety of work-related outcome measures including on-the-job productivity (presenteeism), STD absences, medical claims, and pharmacy claims. Moreover, self-reported physical activity was investigated to determine whether or not it had a mitigating effect on MetS risk factors.

METHODS

The Worksite and Study Population

This retrospective observational study was conducted at a US-based Fortune 100 company, with employees in more than 20 countries and at multiple worksites in the United States. In 2010, the average age of the US employee population was 42.3 years and 65% of the workforce was female. By offering a variety of employee benefits such as wellness programs, incentive campaigns for behavior change, on-site health clinics, nutritional counseling, weight-reduction programs, and worksite fitness center services, it provides an ideal opportunity to engage large numbers of individuals in an efficient manner.

In 2010, as part of the corporation's worksite health and wellness program, an HRA and biometric screening were offered to 27,000 employees who voluntarily chose to participate in the survey. This employer implemented a full replacement Consumer Directed Health Plan in 2009 for all employees. The questionnaire includes biometric measurements as well as a variety of other health-related questions. In addition, it includes an eight-item Work Limitations Questionnaire (WLQ), which is based on the original 25-question version developed by Lerner et al.³⁶ The eight-question WLQ has well documented reliability and validity for the purpose of determining work limitations.³⁷⁻⁴⁰ The objective biometric measurements were conducted either in this employer's workplace clinics or by a vendor at several locations across the United States. A total of 5218 individuals who participated in the HRA and biometric screening in 2010 were employed by the company for that entire year, and they participated in the company's medical plan. A variety of exclusion criteria were then applied to the study population. They included exclusions due to pregnancy, self-report, or medical claims, indicating severe chronic conditions such as transplants, stroke, or renal failure, medical claims greater than \$100,000 in 2010, or incomplete responses on the HRA regarding physical activity. In all, 873 employee responses were excluded because of these criteria, which left a final study population of $n = 4345$. The study population had an average age of 41.6 years and comprised 65.9% females. These demographics were not statistically different from the entire workforce in 2010.

Measures

This study utilizes the AHA/NHLBI⁸ criteria for MetS, which are listed previously. For investigating the association of physical activity and MetS, we used a three-level risk classification, which is used by the US Department of Health and Human Services to classify individuals as sufficiently active (acquiring 150 minutes of moderate-intensity activity per week), insufficiently active (1 to 149 minutes of moderate-intensity activity per week), and inactive (0 minutes of moderate-intensity activity per week).⁴¹ The current study's HRA asks employees about the number of days per week and minutes per session they did moderate-intensity physical activity in the past

month as well as the number of days per week and minutes per session they did heavy or vigorous physical activity in the past month. For the physical activity risk determination, vigorous activity minutes are doubled and then added to the moderate minutes to calculate the minutes per week. For example, an employee who reported 2 days per week of vigorous activity with each session lasting 30 minutes as well as 2 days per week of moderate activity with each session lasting 60 minutes has accumulated $[(2 \times 30 \times 2) + (2 \times 60)] = 240$ minutes of activity per week.

The measurement of self-reported work limitation due to health was established by the responses to the WLQ in the HRA. The eight-item WLQ asks participants: "In the past 2 weeks, how much of the time did your physical health/emotional problems make it difficult to." Then participants report a percentage limitation ranging from 0% to 100% of the time for eight items in four domains (time, mental/interpersonal, output, and physical). Participants could also indicate whether any question "does not apply to my job."

STD and Workers' Compensation (WC) absences were combined and linked with the employee's individual HRA responses. In the same way, medical and pharmacy claims were summed for each individual employee for 2010 and then linked with the employee's individual HRA data. All data were de-identified before transmission to the University of Michigan Health Management Research Center (Ann Arbor) where they were analyzed. This study was conducted in accordance with the University of Michigan's institutional review board.

Statistical Methods

The data collected from the questionnaire were analyzed by demographic and biometric characteristics. The BMI, calculated from weight and height, was used as a measure of central obesity because many participants did not report their waist circumference and because the MetS criteria state that if BMI is more than 30 then waist circumference can be assumed as high-risk.⁴² The MetS guidelines include individuals taking medication for their HDL cholesterol. The HRA used in this study asked individuals about cholesterol medications but did not specify medications used to improve HDL cholesterol specifically, so we did not include medication for HDL in that risk factor. The prevalence of each MetS risk factor was calculated for each of the three physical activity classifications (sufficiently active, insufficiently active, inactive) to calculate the relative risk.

Work limitations were scored for each of the four WLQ domains by taking the average of nonmissing items in each subscale (0 to 4), and one for scoring overall presenteeism (0 to 4), which was the average of at least 3 nonmissing individual items. The responses were assigned points between 0 and 4, where 4 represented 100% work limitation and 0 represented 0% work limitation. For example, a score for "all of the time (100%)" for the question: I can get going easily at the beginning of the workday and the response "some of the time (about 50%)" for the question I start my job as soon as I have arrived, would translate to a score of $(4+2)/2 = 3$ on the time management domain.

Demographic variables were tested using *t* test for the continuous variable age and chi-square test for the categorical variables to determine whether those with MetS were different from those without MetS. After identifying those differences, all further analyses comparing those with and without MetS and those with and without sufficient physical activity were conducted using Generalized Linear Modeling (PROC GLM) while controlling for age, gender, geographical region, and job type.

RESULTS

Table 1 presents the demographic factors of employees with and without MetS. As stated earlier, individuals must meet three or more of the five MetS criteria to qualify as having MetS. Therefore, we divided the employees into those who do not have MetS

TABLE 1. Demographic Factors in Employees With and Without MetS

	Total (N = 4345)		No MetS (0–2 MetS Risk Factors) (N = 3031)		MetS (3+ MetS Risk Factors) (N = 1314)		Chi-Square or <i>t</i> -Test P Values
	N	%	N	%	N	%	
Gender							0.0031
Female	2,862	65.9	2,039	67.3	823	62.6	
Male	1,483	34.1	992	32.7	491	37.4	
Average age in 2010	41.6 yrs		40.6 yrs		44.0 yrs		<0.0001
Geographic area							<0.0001
Midwest	175	4.0	129	4.3	46	3.5	
Northeast	538	12.4	469	15.5	69	5.3	
South	1,900	43.7	1,227	40.5	673	51.2	
West	1,732	39.9	1,206	39.8	526	40.0	
Job type							<0.0001
Hourly	3,145	72.4	2,077	68.5	1,068	81.3	
Salaried	1,200	27.6	954	31.5	246	18.7	
Metabolic syndrome risks							
Waist circumference (≥102 cm in men, ≥88 cm in women, or BMI > 30 kg/m ²)	1,588	36.5	588	19.4	1,000	76.1	<0.0001
Triglycerides (≥150 mg/dL or taking medication for hyperlipidemia)	1,538	35.4	567	18.7	971	73.9	<0.0001
HDL cholesterol (<40 mg/dL for men or <50 mg/dL for women)	2,083	47.9	999	33.0	1,048	82.5	<0.0001
Blood pressure (≥130/85 mmHg or taking medication for hypertension)	1,513	34.8	620	20.5	893	68.0	<0.0001
Fasting glucose (≥100 mg/dL or taking medication for diabetes)	1,041	24.0	343	11.3	698	53.1	<0.0001

HDL, high-density lipoprotein.

(*n* = 3031) and those who do (*n* = 1314). This represents a prevalence of 30.2% in this population. Employees in this corporation who meet the criteria for MetS are statistically significantly older (44.0 years vs 40.6 years), more likely to be male (37.4% vs 32.7%), and more likely to live in the south (51.2% vs 40.5%) than those without MetS. Hourly employees composed 72.4% of the study population but comprised 81.3% of the employees with MetS.

Among the employees with MetS, 76.1% are at risk for waist circumference/BMI, 73.9% for triglycerides, 82.5% for HDL cholesterol, 68.0% for blood pressure, and 53.1% for glucose. These numbers compare with 19.4% waist circumference/BMI, 18.7% triglycerides, 33.0% HDL cholesterol, 20.5% blood pressure, and 11.3% glucose for the employees who do not meet the criteria for MetS.

The MetS is often associated with other health risk factors and conditions. Table 2 shows the health risk factors and self-reported medical conditions measured by the HRA for those with and without MetS, controlling for the confounding demographic variables age, gender, geographical region, and job category. This analysis shows that employees who meet the criteria for MetS are significantly more likely to also be at high risk for self-reported illness absence days, perceived health, physical activity, safety belt use, smoking, and stress than those without MetS. Moreover, they are significantly more likely to report having depression, high cholesterol, and osteoporosis than those without MetS.

Because past research has indicated that physical activity may be a crucial link in the MetS risk cluster due to its association with many, if not all, of the MetS risks,^{19–26} it was of interest to examine the self-reported physical activity levels of this study population. Using the US Department of Health and Human Services definition

of sufficient physical activity levels, we divided the employees into those who are sufficiently active (150+ minutes of activity per week; *n* = 46.9% of subjects), insufficiently active (1 to 149 minutes of activity per week; 39.8% of subjects), and those who are inactive (0 minutes of activity per week; 13.3% of subjects). The results can be found in Table 3. Employees who self-report being sufficiently active were the benchmark, then the relative risk of meeting the MetS criteria were calculated for those who were insufficiently active and inactive. The analysis controlled for age, gender, geographic location, and job type.

As shown in Table 3, the insufficiently active and inactive employees were significantly more likely to have each of the five MetS risk factors and MetS as a whole than those meeting the physical activity criteria. A total of 24.1% of the sufficiently active employees met the criteria for MetS compared with 33.8% of the insufficiently active (*P* < 0.05) and 41.5% of the inactive (*P* < 0.05) employees. Similar results are found for waist circumference/BMI (28.9%, 41.5%, and 48.9%), triglycerides (32.0%, 37.8%, and 40.4%), HDL cholesterol (42.0%, 51.8%, and 57.3%), blood pressure (31.6%, 36.0%, and 42.8%), and fasting glucose (20.1%, 26.4%, and 30.2%), respectively. The inactive employees had a significantly higher relative risk of MetS for the risks of waist circumference/BMI, blood pressure, and MetS as a whole than the insufficiently active group. These results show a dose–response relationship between lower levels of physical activity and higher prevalence of MetS risk factors.

Our study population also has several important outcome measures typically of interest to corporations that provide health promotion programs to employees. Figures 1 and 2 compare four categories of employees: (1) without MetS who are sufficiently active;

TABLE 2. Health Risk Factors in Employees With and Without MetS

	Total (N = 4345)		No MetS (0–2 MetS Risk Factors) (N = 3031)		MetS (3+ MetS Risk Factors) (N = 1314)	
	N	%	N	%	N	%
Alcohol (> 14 drinks/wk male; > 7 drinks/wk female)	168	3.9	127	4.2	41	3.1
Cholesterol (\geq 240 or taking cholesterol meds)	202	4.6	127	4.2	75	5.7
Illness days (> 5 days/yr)*	475	10.9	270	8.9	205	15.6
Job satisfaction (very or somewhat dissatisfied)	892	20.5	622	20.5	270	20.5
Life satisfaction (very or somewhat dissatisfied)	730	16.8	487	16.1	243	18.5
Perceived health (fair or poor)*	417	9.6	160	5.3	257	19.6
Physical activity (inactive or insufficient < 150 min/wk of moderate physical activity per week)*	2308	53.1	1484	49.0	824	62.7
Safety Belt Use (< 100%)*	440	10.1	283	9.3	157	11.9
Smoking (current)*	306	7.0	177	5.8	129	9.8
Stress (often, heavily or excessively stressed, or trouble coping at times, often, or unable to cope)*	757	17.4	478	15.8	279	21.2
Self-reported medical conditions						
Allergies	1493	34.4	1070	35.3	423	32.2
Arthritis	95	2.2	60	2.0	35	2.7
Asthma	493	11.3	331	10.9	162	12.3
Back pain	258	5.9	163	5.4	95	7.2
Cancer	96	2.2	62	2.0	34	2.6
Depression*	454	10.4	283	9.3	171	13.0
High cholesterol*	855	19.7	462	15.2	393	29.9
Migraine headaches	388	8.9	273	9.0	115	8.8
Osteoporosis*	129	3.0	93	3.1	36	2.7

* $P < 0.05$, generalized linear model testing the difference between those with and without MetS, controlling for age, gender, geographic location, and job type.

TABLE 3. The Association of Health Risk Factors and Relative Risks of MetS Factors and Relative Physical Activity Level*

Factor	Sufficiently Physically Active (150+ min of Activity) (n = 2037)		Insufficiently Physically Active (1–149 min of Activity) (n = 1729)		Inactive (0 min of Activity) (n = 579)	
	%	RR	%	RR	%	RR
MetS (3+ of the below risk factors)	24.1% ^a	1.00	33.8% ^b	1.40	41.5% ^c	1.72
Waist circumference (\geq 102 cm in men, \geq 88 cm in women, or BMI > 30 kg/m ²)	28.9% ^a	1.00	41.5% ^b	1.44	48.9% ^c	1.69
Triglycerides (\geq 150 mg/dL or taking medication for hyperlipidemia)	32.0% ^a	1.00	37.8% ^b	1.18	40.4% ^b	1.26
HDL cholesterol (< 40 mg/dL for men or < 50 mg/dL for women)	42.0% ^a	1.00	51.8% ^b	1.23	57.3% ^b	1.37
Blood pressure (\geq 130/85 mmHg or taking medication for hypertension)	31.6% ^a	1.00	36.0% ^b	1.14	42.8% ^c	1.36
Fasting glucose (\geq 100 mg/dL or taking medication for diabetes)	20.1% ^a	1.00	26.4% ^b	1.31	30.2% ^b	1.50

*Alphabetical letters (a,b,c) in each row with differing letters are $P < 0.05$, generalized linear model adjusting for gender, age, geographic location, and job type. For example, groups with a “b” are significantly different from the “a” group in that row and groups with a “c” are significantly different from both “a” and “b” groups in that row.
HDL, high-density lipoprotein.

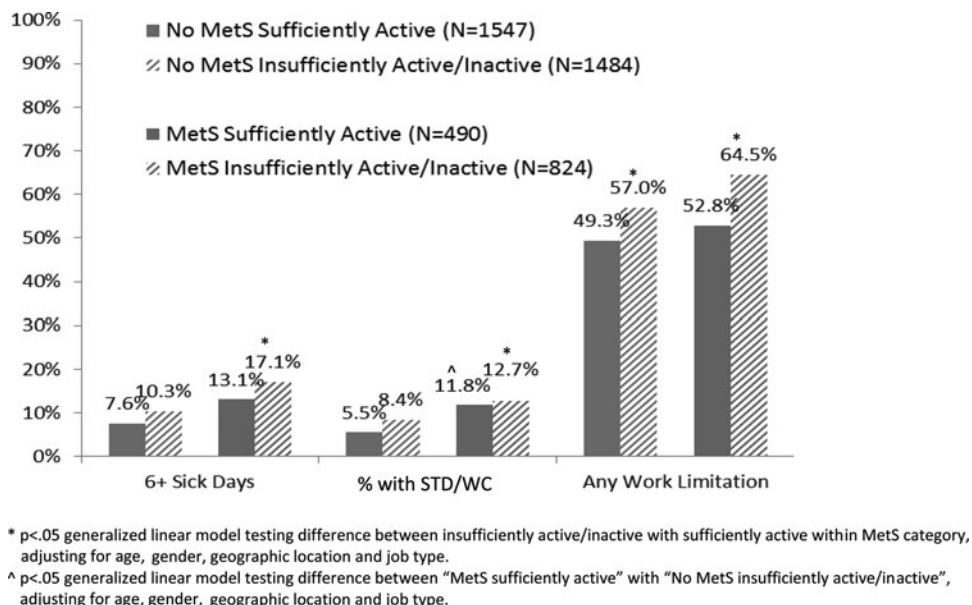


FIGURE 1. Productivity measures in employees with and without MetS and with and without sufficient physical activity (N = 4345).

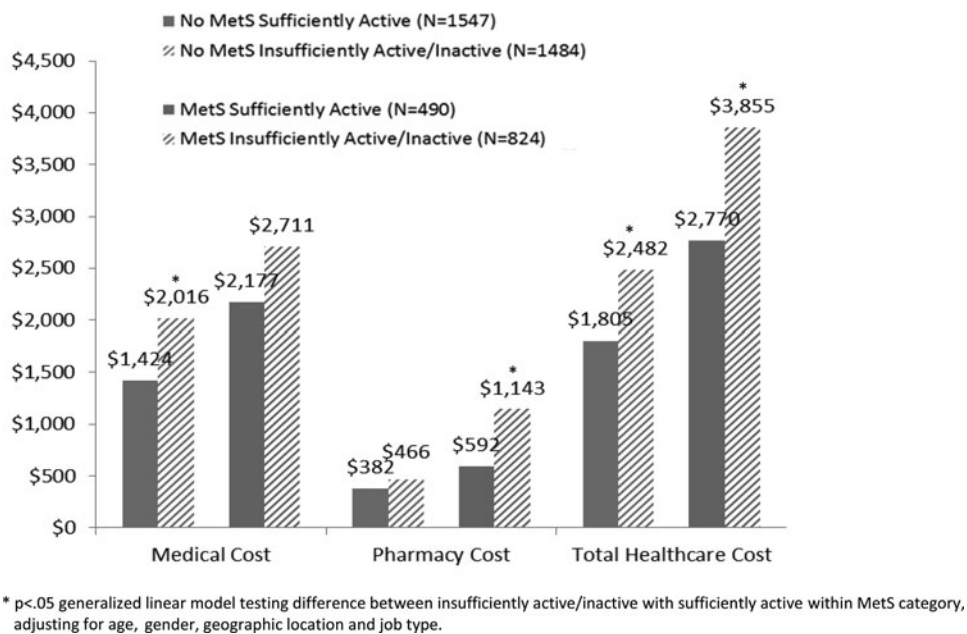


FIGURE 2. Health care cost measures in employees with and without MetS and with and without sufficient physical activity (N = 4345).

(2) without MetS and insufficiently active/inactive; (3) with MetS who are sufficiently active; and (4) with MetS and insufficiently active/inactive. Figure 1 includes the productivity outcome measures of self-reported absence days, STD and WC absences, and the percent reporting on-the-job productivity losses according to the WLQ. Figure 2 presents the cost outcomes of medical costs, pharmacy costs, and total costs (medical + pharmacy) for those four categories of employees. We chose to combine the insufficiently physically active and inactive groups for ease of comparison and presentation. The Generalized Linear Modeling used to test for significance in Figs. 1 and 2 controlled for age, gender, geographic location, and job type.

These figures illustrate that employees without MetS who accumulate sufficient amounts of physical activity in an average week have the best productivity and health care cost outcomes in this employee population. In four measures of productivity and costs (absence days, work limitations, pharmacy costs, and total health care costs), those employees with MetS but with sufficient physical activity have significantly lower productivity losses and costs than those employees with MetS who are insufficiently active or inactive. The same is true for work limitations, medical costs, and total costs among the employees without MetS. That is, the sufficiently active employees have better outcomes than the insufficiently/inactive employees.

When looking at the data in Figs. 1 and 2, there is a stepwise progression in outcomes from the “No MetS, Sufficiently Active” group to the “No MetS, Insufficiently Active/Inactive” group to the “MetS, Sufficiently Active” group to the “MetS, Insufficiently Active/Inactive” group for each of the outcome measures except work limitations. Statistical analysis controlling for confounders indicates that only one outcome (percent with STD/WC) shows a significant difference between the employees without MetS who are insufficiently active/inactive and those with MetS who are sufficiently active. For all other economic outcome measures in Figs. 1 and 2, we observe the protective nature of achieving sufficient physical activity, even in the presence of a serious combination of metabolic risk factors. That is, for self-reported illness days, work limitations, medical costs, pharmacy costs, and total costs, the employees with MetS who manage to accumulate sufficient physical activity in the average week did not have significantly worse outcomes than employees without MetS but who are insufficiently active or inactive.

In summary, for all six economic outcome measures, the best outcomes are achieved by those without MetS who are sufficiently physically active and the worst outcomes are observed for those with MetS who are insufficiently active or inactive. In 7 of the 12 comparisons, the insufficiently active/inactive have significantly more productivity loss or higher cost than the sufficiently active within their respective MetS category. In 11 of 12 comparisons, those with MetS who are sufficiently active do not have significantly different productivity loss or cost compared with those without MetS who are insufficiently active/inactive.

DISCUSSION

Relatively little is known about the prevalence of MetS risk factors and the possible impact of physical activity on MetS in employed populations in the United States. This study explored the association between self-reported MetS health risk factors, physical activity, and several workplace productivity and cost outcomes. Self-reported health risk appraisal data were analyzed on employees' metabolic health risks, additional health risks and health conditions, perceptions of how their health condition is influencing their ability to perform their job, and the amount of days missed from work due to health problems. Measured medical costs, pharmacy costs, and STD/WC absences were also examined.

This study found that employees with MetS are also more likely to have a variety of additional health risks and health conditions than employees without MetS. This finding has been reported in other employee populations as well.³²⁻³⁵ The association between self-reported disease and MetS was examined in 3285 employees of a manufacturing corporation who participated in a health risk appraisal and biometric screening in both 2004 and 2006.⁴³ In that organization, employees with MetS in 2004 were significantly more likely to self-report new cases of arthritis, chronic pain, diabetes, and heart disease in 2006. The health care, pharmacy, and STD costs of those with MetS and one of the diseases were 3.66 times greater than those without MetS and without disease. The association of MetS with other diseases and increased health care costs is a concern for organizations looking to minimize their health-related costs. Occupational health and wellness professionals have an opportunity to prevent MetS risk factors from progressing to disease status that can improve both the quality of life for individuals and the cost exposure of the corporation.

In this study, employees who were sufficiently physically active had a significantly lower prevalence of having all five MetS risk factors, as well as MetS as a whole, after controlling for demographics. Employees who were insufficiently active (1 to 149 minutes of activity per week) had a significantly lower prevalence of waist circumference, blood pressure, and MetS as a whole than the inactive group (0 minutes of activity per week). These results indicate that

some physical activity is better than none, but that meeting the physical activity guideline of 150 minutes per week is a positive and important health behavior.

Results of the economic outcome measures provide the most interesting findings of this study. First, employees without MetS who meet the physical activity guideline have the best workplace outcomes related to productivity and health care cost. Moreover, those with MetS who are insufficiently active or inactive have the worst outcomes. In many cases (self-reported absence days, work limitations, pharmacy costs, and total costs), those who have MetS but are acquiring sufficient physical activity have significantly better outcomes than those with MetS who are insufficiently active or inactive. These results show the importance of encouraging physical activity for all people. It has a protective or moderating effect on MetS in terms of the outcome measures studied here.

Finally, upon review of Figs. 1 and 2, a stepwise progression can be observed in the outcome measures. After statistical testing controlling for demographics, however, it reveals even more about the protective benefits of physical activity. In 11 of 12 comparisons, those with MetS who are meeting the physical activity standard do not have significantly different outcomes compared than employees without MetS who are insufficiently active or inactive. This points again to why it is important for all individuals to achieve the recommended amounts of physical activity each week, even if they already have serious combinations of health risk factors such as MetS.

With the majority of the adult population employed in industrialized countries, and most spending more than 60% of their waking time at work, employers have recognized the importance of reducing health risk factors associated with increased risk for lifestyle-related medical conditions. Numerous published research studies have now demonstrated⁴⁴⁻⁴⁶ that worksite-based health promotion programs, including worksite fitness centers, have resulted in improved health, increased employee satisfaction, and increased on-the-job productivity (presenteeism) as well as decreased absenteeism and disability.^{46,47} Brown et al⁴⁵ reported in their review on the impact on presenteeism and workplace well-being from physical activity, a positive association between physical activity and psychosocial health in employees, particularly for quality of life and emotional well-being. Schultz et al⁴⁸ reported that by reducing the health risks associated with MetS, health care expenditures for an employer could also be reduced.

Limitations

There are some limitations to this study. Participation in the HRA and screening was voluntary and therefore there may be differences between HRA participants and nonparticipants not adjusted for in our data analysis. The physical activity level and health risk information were self-reported and not directly measured. We do not know if employees who are nonexercisers were to begin exercising, if in fact their costs associated with MetS would be mitigated. Finally, financial services jobs are sedentary and further studies are needed to determine the generalizability of our conclusions in a nonsedentary employee population. For example, according to a meta-analysis on resistance training in the treatment of MetS,⁴⁹ there was no statistically significant effect of resistance training on some of the risk factors (blood lipids and diastolic blood pressure). On the contrary, several studies^{50,51} and a meta-analysis by Janiszewski and Ross¹⁹ have suggested that all components of the MetS can be reduced and prevented by cardiorespiratory exercise, with a significant effect on present risk factors after only a short bout of aerobic physical activity.

There exists disagreement on whether or not MetS is a syndrome or a collection of health risk factors associated with obesity. It has been pointed out that there is no specific medical treatment for MetS, rather it is important to treat the individual abnormal MetS risk factors. Although we used the AHA/NHLBI definition for the

MetS, the use of other definitions might result in a different outcome. Although there are variations between the definitions of MetS, BMI as an indicator of obesity might result in different outcome in a physically active population, because BMI decreases to a limited extent from physical activity. According to Stamatakis et al,⁵² waist circumference may be a better measure of adiposity for epidemiological studies examining physical activity/adiposity relationships, though BMI could be limited as a surrogate adiposity measure. Individuals with high levels of absolute muscle mass may appear to be overweight or obese when, in fact, they have relatively low body fat.

CONCLUSIONS

MetS is very common in the US workforce and accounts for significant avoidable medical expenditures and lost worker productivity. This study demonstrates how regular physical activity can significantly mitigate the effects of MetS on the costs of lost productivity and health care. Employees with MetS who participate in moderate physical activity for 150 minutes per week have lower health care costs, self-reported absence days, and work limitations than those who are insufficiently active or inactive. This study further supports the investment in worksite physical fitness and activity facilities as well as programs that promote regular physical activity.⁵³

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