The Impact of Weight Gain or Loss on Health Care Costs for Employees at the Johnson & Johnson Family of Companies

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Objective: To quantify the impact of weight gain or weight loss on health care costs. **Methods:** Employees completing at least two health risk assessments during 2002 to 2008 were classified as adding, losing, or staying at high/low risk for each of the nine health risks including overweight and obesity. Models for each risk were used to compare cost trends by controlling for employee characteristics. **Results:** Employees who developed high risk for obesity ($n = 405$) experienced 9.9% points higher annual cost increases (95% confidence interval: 3.0%–16.8%) than those who remained at lower risk ($n = 8015$). Employees who moved from high to lower risk for obesity ($n = 384$), experienced annual cost increases that were 2.3% points lower (95% confidence interval: −7.4% to 2.8%) than those who remained high risk ($n = 1699$). **Conclusions:** Preventing weight gain through effective employee health promotion programs is likely to result in cost savings for employers.

Learning Objectives

- Review the current status of research into the cost implications of worker overweight and obesity and the cost savings resulting from weight reduction programs.
- Summarize the patterns of change in health risks observed among Johnson & Johnson employees participating in multiple health risk assessments (HRAs).
- Discuss the study implications for lowering health care costs and achieving a positive return-on-investment from obesity prevention programs.

About one-third of Americans are obese and about two-thirds are overweight or obese.[1] Obesity is related to several chronic health conditions including type 2 diabetes, heart disease, stroke, high blood pressure, high cholesterol, sleep apnea, and some types of cancers.[2–4]

The public health problem of obesity imposes a significant burden on individuals and businesses alike. In the United States, employers pay a large portion of their employees' health care costs and are therefore saddled with the additional cost burden imposed by obese workers. To support employer health promotion efforts, the Centers for Disease Control and Prevention recently released LEAN Works!, a set of on-line tools and resources to help employers understand the economic consequences of obesity in the workplace and develop effective obesity prevention programs.[5] Included on the Web site is a Return on Investment calculator, one of many tools currently available to enhance employers' understanding of the costs and benefits of weight loss programs.[6,7]

To support a business case for investment in obesity prevention programs at the workplace, several researchers have studied employer costs related to workers' obesity. These studies offer an economic justification for interventions by showing that overweight and obesity are associated with higher costs. But few studies have demonstrated that weight reduction programs can achieve cost savings or that weight gains produce an increasing cost burden for the organization.[8,9]

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Cross-sectional studies documenting the relationships between obesity and increased employer costs are plentiful.[10,11] For example, a recent analysis by Finkelstein et al[12] found that obese employees incur 42% higher medical care costs than workers with normal weight. Obese employees are more likely to be injured on the job,[13] and they experience more presenteeism (lost productive time while at work) and absenteeism compared with workers with normal weight.[14] Longitudinal research on the economic costs of weight gain or loss among workers, however, is sparse. An exception is an evaluation by Finkelstein at al[15] of an employee weight loss program in North Carolina (WAY to Health study) that found that participants achieving at least a 5% weight loss did not lower their medical expenditures or absenteeism rates during the 1 to 3 years following entry into the program. The study authors concluded that employers might not achieve short-term dollar savings and a positive return on investment from obesity prevention program, even if the program is effective in achieving weight loss.

STUDY OBJECTIVE

The objective of this study was to examine changes in health risks over time, particularly obesity risk, among workers in a large corporation and relate those changes to shifts in health care costs. We sought to determine whether employees who lost weight experienced lower medical cost growth than employees who remained obese. Similarly, we examined whether employees who maintained weight within normal and overweight categories experienced lower cost growth than employees who gained sufficient weight to place them in the obese category.

SETTING

The setting for this study is the Johnson & Johnson Family of Companies (hereinafter referred to as Johnson & Johnson), the largest and most diversified health care company in the world. The company employs approximately 100,000 employees worldwide, with about 40,000 employees based in the United States. Johnson & Johnson, a pioneer in the field of worksite health promotion, first offered its LIVE FOR LIFE program in 1979, with the expressed aim of making Johnson & Johnson employees the healthiest in the world.[16] The program has expanded in breadth and reach since its inception. With a strong commitment to a "culture of health," the corporation implemented a more comprehensive and integrated

health and wellness program in the mid-1990s so that every employee had access to a full team of health professionals who promoted and supported a healthy lifestyle. Employees are encouraged to complete health assessments on a regular basis, and they are offered a multitude of follow-up health improvement programs covering a wide array of health risks, including overweight and obesity. These programs include access to onsite fitness centers with group exercise classes and personal training; reimbursement for community-based fitness centers; on-line weight loss, nutrition education, and behavior change programs; Weight Watchers at Work; walking guides and pedometers; and seasonal fitness challenges. Rigorous evaluations in the 1980s and the late 1990s found these programs to be effective in reducing employees' health risks and costs.[17]

MATERIALS AND METHODS

Study Design

A longitudinal cohort study was conducted that linked Johnson & Johnson employees' health risk assessments (HRAs) and medical and drug insurance claims records for the period of 2002 to 2008. Employees who completed at least two health assessments in nonconsecutive years were included in the study. The rationale for requiring at least two HRAs in nonconsecutive years was that we wanted to study a sample of employees over multiple years because costs and benefits associated with risk changes may require several years of observation. Nine modifiable health risks (obesity, high blood pressure, high total cholesterol, tobacco use, excessive alcohol consumption, poor nutrition, physical inactivity, high stress, and poor emotional health) were measured using two HRA instruments administered at different times during the study period. On the basis of employees' responses to the HRA, individuals were classified as being at high risk or not at high risk (ie, lower risk) for each of the risks, for each year in which the HRA was completed.

Comparing changes in measures for each employee in the sample, individuals were placed into one of the following four groups for each health risks: (1) stayed at high risk, (2) moved from high risk to low risk, (3) stayed at low risk, and (4) moved from low risk to high risk. In addition, each employee's medical and drug cost experience was tracked over the same time period. Risk and cost trends were then compared for each of the nine health risks using multivariate models that controlled for employee demographics, health plan characteristics, and year in which the risk and cost data were calculated. Specifically, we compared the cost trends of employees who moved from lower risk to higher risk with that of employees who remained at lower risk for each of the nine risks. We also compared cost trends for employees who moved from high risk to low risk in contrast with those who remained high risk, again separately for each of the nine risks. We hypothesized that employees who move from high risk to low risk would experience a favorable cost trend (ie, have lower increases in costs) compared with employees who remained at high risk. Similarly, we hypothesized that employees who moved into a higher risk category during the course of the study would experience steeper cost growth than employees who remained at lower risk.

Data and Study Sample

Medical and drug cost data for Johnson & Johnson employees were derived from the Thomson Reuters MarketScan Commercial Claims and Encounters database (Ann Arbor, Michigan) for 2002 to 2008. Information on health risks for each employee was obtained from HRAs administered by Johnson & Johnson during the study period. For the period of 2002 to 2005, an HRA from Summex, Inc (WebMD, Indianapolis, Indiana), was employed, and during the period of 2006 to 2008, an HRA from HealthCalc (Health Fitness Corporation, Minneapolis, Minnesota) was used. Employees were given the opportunity to complete an HRA every other year.

The study included Johnson & Johnson employees aged 18 to 64 years who completed at least two HRAs during the period of 2002 to 2008 in nonconsecutive years, and were enrolled in one of the company's health plans for at least 320 days during the study years. Employees enrolled in capitated plans (health maintenance organization or capitated point-of-service plans) were excluded because payments made under those plan arrangements may not fully capture all of the costs of medical care for these employees.

Health Risks and Risk Changes

Nine health risks (obesity, high blood pressure, high total cholesterol, tobacco use, excessive alcohol consumption, poor nutrition, physical inactivity, high stress, and poor emotional health) were measured on the basis of a series of questions on the HRA. For each risk, employees were classified as being at high risk, not at high risk, or missing if they did not complete the questions needed to define the risks. In general, operational definitions for high risk were consistent across the two HRAs employed with the exceptions noted below.

Employees were classified as having a weight risk (ie, obesity) if their body mass index (BMI) was 30 kg/m^2 or greater, on the basis of their height and weight. Blood pressure risk was defined as having a systolic blood pressure greater than or equal to 140 mm Hg or diastolic blood pressure greater than or equal to 90 mm Hg. Employees who reported total cholesterol values greater than or equal to 240 mg/dL were classified as being at high risk for total cholesterol.

Employees who reported that they currently used any form of tobacco were coded as having tobacco risk. For alcohol, being at high risk was defined for men as having reported drinking more than 14 alcoholic drinks per week and for women as having reported drinking more than 7 drinks per week.

Risk definitions did differ for the two HRA instruments in the categories of nutrition, physical activity, and mental health. Before 2006 (Summex HRA), employees were coded as having nutrition risk if they consumed fewer than five servings of fruit and vegetables each week. In 2006 and later years (HealthCalc HRA), the definition was changed to not consuming five servings of fruits and vegetables per day. Surprisingly, responses did not vary much from one instrument to another implying that employees understood the question to mean the average daily consumption during a typical week.

Employees were coded as being at risk for physical inactivity if they reported less than three days a week of 30 minutes of physical activity. The 30 minutes of physical activity did not need to be continuous and could include exercise, housework, yard work, walking, stair climbing, and recreational sports. In 2006, the wording of the question was changed to specify that the 30 minutes of physical activity was of moderate intensity.

The stress risk questions also changed when Johnson & Johnson shifted to the HealthCalc HRA in 2006. Before 2006, employees who reported an "overwhelming amount of stress" related to work or family, and were trying to manage their stress but still often felt stressed, were coded as being at risk for stress. In 2006 and later years, employees were coded as being at high risk for stress if they were "often, heavily, or excessively" stressed.

Before 2006, employees were classified as having emotional health risk if they reported during the last month that they "rarely felt that life was filled with things that were interesting and challenging," or felt "downhearted/blue, or sad" often or most of the time. In 2006 and later, employees were classified as having emotional health risk if they reported "feeling down, depressed, or hopeless" in the *past two weeks* and had "little interest or pleasure in doing things."

After employees' health risk levels were determined, they were compared over time by the following groups for each of the nine risks: those who (1) stayed at high risk, (2) lowered risk (lost risk),

(3) stayed at lower risk, or (4) increased risk. For example, employees who consistently had a BMI lower than 30 kg/m^2 throughout the study period were classified as staying at lower risk for weight. Employees whose BMI increased from less than 30 kg/m^2 to 30 kg/m^2 or greater were classified as adding the weight risk.

Employees who did not have complete information about their risk status for at least two HRAs (because they did not answer the questions) were classified as "unknown risk change" for that risk. Employees who completed three or more HRAs and reported that they both added and lost the risk during the study period were also classified as unknown risk change for that risk.

Outcomes

The dependent variable was average annual total allowed health care costs, measured as employee and company payments for medical and prescription drug claims. All payments, including copayments and deductibles paid by the employee and Johnson & Johnson, were used in calculating total costs. Health care costs were adjusted to 2007 dollars using the Medical Care Consumer Price Index.[22] For each employee, all years of health care cost data from 2002 to 2008 were considered in the analysis, where the employee was continuously enrolled in a noncapitated medical plan for at least 320 days. All employees in the sample needed to have at least three years of cost data (the years in which they completed their pre- and post-HRAs as well as a year in between). Employees could be followed from three to seven years.

Explanatory Variables

To control for confounders when analyzing cost changes for employees who changed their risk status or remained at either low or high risk, we considered demographic, health plan, and health status characteristics as possible independent influencers on health care costs. We measured employee age and gender when they first entered the sample. Concurrently with the year of available cost data, we measured employees' region of residence, type of health plan in which they were enrolled, their wage classification (salaried or other), and calendar year. Health status was measured using the Deyo Charlson Comorbidity Index (CCI) and a count of the number of psychiatric diagnosis groups (PDGs). The CCI summarizes risk of death or serious disability in the coming year, on the basis of whether diagnosis codes for 18 conditions are observed. Charlson Comorbidity Index values that exceed 6 indicated a high risk of death or major disability, values ranging from 2 to 6 indicate moderate risk, and values less than 2 indicate low health risk.[23,24] As for the PDG measure, there are 11 possible PDGs, which are aggregated from International Classification of Diseases, 9th Revision–Clinical Modification diagnosis codes associated with mental health problems. Psychiatric diagnosis groups included alcohol use disorders, other substance use disorders, depression, bipolar disorder, posttraumatic stress disorders, and schizophrenia.[25]

Analysis

For the descriptive analysis, we compared annual average health care costs in the first and last year for each employee tracked during the study period. We then calculated the average annual change in costs over time, by risk, for each of the four groups of employees (ie, those who added risk, lost risk, stayed at risk, and stayed not at risk). We tested for statistical significance comparing employees who changed risk (added or lost) with those who did not (stayed not at risk or stayed at risk) at 95% confidence levels using two-sample *t* tests with unequal variances. We also examined trends in health status by graphing CCI and PDG scores over time.

The multivariate models included all years of cost data and controlled for employee demographics and plan characteristics. Separate models were estimated for each of the nine health risks and implemented using a generalized linear model with log-link and gamma distribution. Health status was described to help interpret results but was not included as a control variable in the models because health status can be viewed as auto correlating with changes in risk and cost. The time trend was modeled linearly with a variable that was set to zero for 2002 and increased to six for 2008. Because age and time are perfectly collinear, this time trend also controlled for advancing age. We used a linear time trend because many employees had only three years of data, and more flexible trends require a longer time series to accurately select the appropriate shape of the trend. We visually examined graphs of the unadjusted cost data to assess whether another specification of time was appropriate but concluded that linear was the best approximation.

Indicator variables for the risk change group (added, lost, stayed at risk, stayed not at risk, and unknown) were included in the models, which allowed the intercepts of the time trends to be different for each risk change group. The time trend and the indicators for the risk groups were interacted, which allowed each risk group to have a different time trend. We tested our hypotheses by comparing the percent change in regression-adjusted health care costs for employees who added risk with those who stayed not at risk. Similarly, we compared employees who lost risk with those who stayed at risk. Regression-adjusted costs were calculated using the method of recycled predictions, which generates estimates from the model for each group and time period, holding all other variables constant.[26,27] We tested for statistically significant differences between the two cost trends and differences in the starting cost levels by bootstrapping the standard error of the difference between the groups with 1000 repetitions and calculating the 95% confidence interval (CI) (normal-based) using STATA® MP 11.1 (StataCorp, College Station, TX).[28]

RESULTS

Study Sample

There were 10,601 employees who met our inclusion criteria. Each employee completed from two to four HRAs during the

TABLE 1. Employee Characteristics

Characteristic	Percentage of employees (n = 10,601)
Age of employee when enter sample, y	
Average	40.2
18–34	28.9
35–44	37.1
45–54	28.3
55–64	33.9
Gender	
Female	43.6
Region of residence	
Northeast	46.8
North Central	17.4
South	22.7
West	13.2
Type of health plan when enter sample	
Preferred provider organization	67.1
Point of service	13.7
Comprehensive	17.9
Other	1.33
Wage group	
Salaried	92.4
Hourly	7.6

time frame, with an average of 2.3 HRAs completed per employee. Employees contributed a minimum of three years and a maximum of seven years of claims experience, with an average of 4.8 years. Almost all employees (86%) contributed four or more years of claims experience. Employee characteristics are shown in Table 1. Employees were on average 40.2 years of age, slightly less likely to be women (43.6% women), residing in the Northeast (46.8%), and mostly enrolled in preferred provider organization health plans. Most employees in the study were salaried (92.4%).

Risks and Risk Changes

The percentage of employees who changed their risk status during the study was relatively low; generally, less than 10% changed risk, with the exception of exercise and nutrition habits. From baseline to follow-up, 76% of the employees stayed at lower at risk (not obese) for weight (Table 2) and equal percentages added or lost weight risk during the study (4%). The vast majority of employees also stayed at lower risk for blood pressure (78%), cholesterol (86%), alcohol (94%), tobacco (92%), depression (86%), and stress (65%). About half of the employees remained at lower risk for exercise (46%) and only 17% remained at lower risk for nutrition. More employees moved to lower risk for blood pressure and cholesterol (7% and 6%, respectively) than those who moved into a higher risk category (4%). There was very little movement in the alcohol and tobacco risks. About 2% of employees became at higher risk for alcohol and 1% moved into lower risk. Only 1% of the employees reported adding tobacco risk but 4% reported losing the risk (ie, quitting tobacco use) during the study period. Slightly more employees became at risk for depression or stress, although changes in the wording of the HRA questions in 2006 likely affected these responses. A small percentage of employees were classified as having unknown risk change status (0%–8%) for each of the risks except for stress where 21% of employees were classified as having an unknown change in risk status, likely due to nonresponse on these survey items.

To illustrate the relationships among risks, we created Table 3, which shows the correlations among each of the health risks. All of the risk factors were positively correlated with weight risk, except for alcohol risk. The risks that were most strongly related to weight risk were blood pressure, lack of exercise, and poor diet.

TABLE 2. Frequency of Risk and Risk Changes

Risk	Add Risk, %	Lose Risk, %	Stay at Risk, %	Stay Not at Risk, %	Unknown,* %
Weight	4	4	16	76	1
Blood pressure	4	7	2	78	8
Cholesterol	4	6	3	86	1
Alcohol	2	1	1	94	2
Tobacco	1	4	3	92	0
Exercise	13	19	18	46	4
Nutrition	11	18	50	17	5
Emotional health	6	4	1	86	3
Stress	7	5	3	65	21

$n = 10{,}601$ employees.
*Unknown includes employees who have added and lost the risk during the study and employees who did not have complete information about their risk status for at least two health risk assessments.

Health Care Costs

Table 4 shows the unadjusted changes in health care costs for employees in each risk group without controlling for confounders. Employees who added weight risk (moved from BMI < 30 kg/m^2 to BMI ≥ 30 kg/m^2) increased their average annual medical costs to $1267, about $982 (95% CI: $255–$1710) more than employees who remained at lower risk, whose costs increased an average of $285 each year. Employees who added weight risk also started out with higher costs than those who remained lower risk ($3742 compared with $3154, $P = 0.1330$), suggesting that employees who added the risk may have had more baseline medical problems. Employees who lost weight risk experienced annual cost growth that was $101 lower than that of employees who remained at higher risk, although this difference was not statistically significant. Employees who lost weight risk also started with about $100 lower costs than employees who remain at high weight risk ($4256 compared with $4358, $P = 0.8268$).

Statistically significant differences were also found for employees who added blood pressure risk. Annual costs for employees who added blood pressure risk increased by $297 (95% CI: $9–$585) per year compared with those for employees who remained at low risk for blood pressure.

Table 5 shows the regression-adjusted impact of adding or losing each risk. After adjusting for employee characteristics (age, gender, and geographic region, all of which were strongly predictive of costs), we found that adding weight risk, losing tobacco risk, and losing alcohol risk were associated with significant cost increases, relative to employees whose risk status did not change. Employees adding weight risk experienced 9.9% point higher cost growth (95% CI: 3.0%–16.8%) compared with those who stayed not at risk. Contro-lling for confounders, both groups started at similar baseline cost levels ($2978 and $2920 in 2002).

TABLE 3. Correlation Between Each Risk at Baseline (Employee's First Year of Data)

	Risks								
	Weight	Blood Pressure	Cholesterol	Tobacco	Alcohol	Stress	Exercise	Emotional Health	Nutrition
Weight	1								
Blood pressure	0.4286	1							
Cholesterol	0.2594	0.2877	1						
Tobacco	0.2587	0.2322	0.1972	1					
Alcohol	–0.0221	0.1391	0.0545	0.3947	1				
Stress	0.2066	0.1014	0.0944	0.0275	0.0936	1			
Exercise	0.4428	0.3089	0.273	0.2372	0.1974	0.2167	1		
Emotional health	0.2733	0.2123	0.1611	0.2047	0.0959	0.5746	0.282	1	
Nutrition	0.428	0.3632	0.3443	0.4133	0.2933	0.2739	0.5514	0.3627	1

Tetrachoric correlation coefficients (for binary variables). Risk was coded as zero if missing or not at risk.

TABLE 4. Descriptive Comparison of Health Care Costs for Each Risk

	Add Risk	Stay Not at Risk	Lose Risk	Stay at Risk
Weight risk				
Number of employees	405	8,015	384	1,699
Average annual medical/Rx costs—first year	$3,742	$3,154	$4,256	$4,358
Average annual change in medical/Rx costs	$1,267	$285	$429	$530
Impact	$982		−$101	
95% Confidence interval	($255–$1710)		(−$468 to $256)	
Blood pressure risk				
Number of employees	436	8,304	773	192
Average annual medical/Rx costs—first year	$2,896	$3,349	$4,040	$4,725
Average annual change in medical/Rx costs	$682	$601	$300	−$215
Impact	$297		$515	
95% confidence interval	($9–$585)		(−$298 to $1329)	
Cholesterol risk				
Number of employees	464	9,072	650	286
Average annual medical/Rx costs—first year	$3,737	$3,401	$3,485	$3,084
Average annual change in medical/Rx costs	$436	$354	$429	$533
Impact	$82		−$104	
95% confidence interval	(−$226 to $390)		(−$1066 to $858)	
Tobacco risk				
Number of employees	79	9,722	432	328
Average annual medical/Rx costs—first year	$3,133	$3,421	$2,577	$4,401
Average annual change in medical/Rx costs	$312	$343	$856	$466
Impact	−$31		$390	
95% confidence interval	(−$416 to $354)		(−$126 to $907)	
Alcohol risk				
Number of employees	200	9,971	113	91
Average annual medical/Rx costs—first year	$3,225	$3,430	$4,497	$3,216
Average annual change in medical/Rx costs	$551	$366	−$35	$571
Impact	$185		−$233	
95% confidence interval	(−$190 to $559)		(−$1417 to $951)	
Stress risk				
Number of employees	730	6,875	487	279
Average annual medical/Rx costs—first year	$3,883	$3,412	$4,089	$4,284
Average annual change in medical/Rx costs	$362	$315	$371	$672
Impact	$47		−$300	
95% confidence interval	(−$180 to $274)		(−$756 to $155)	
Exercise risk				
Number of employees	1,336	4,989	2,049	1,895
Average annual medical/Rx costs—first year	$3,666	$3,338	$3,567	$3,266
Average annual change in medical/Rx costs	$383	$289	$405	$483
Impact	$94		−$78	
95% confidence interval	(−$157 to $344)		(−$300 to $144)	
Emotional health risk				
Number of employees	624	9,066	475	140
Average annual medical/Rx costs—first year	$3,529	$3,398	$4,059	$3,504
Average annual change in medical/Rx costs	$543	$339	$538	$469
Impact	$204		$69	
95% confidence interval	(−$38 to $445)		(−$332 to $470)	
Nutrition risk				
Number of employees	1,147	1,751	1,881	5,314
Average annual medical/Rx costs—first year	$3,560	$3,635	$3,700	$3,253
Average annual change in medical/Rx costs	$288	$274	$522	$337
Impact	$13		$185	
95% confidence interval	(−$267 to $294)		(−$13 to $383)	

Rx, prescription.

TABLE 5. Impact of Adding or Losing Risk on Costs, Regression-Adjusted Estimates

Outcome	Category	Estimated Costs 2002	Percent Growth	Impact on Cost Growth, % Points (95% Confidence Interval)
Weight				
	Lose risk ($n = 384$)	$4,204	7.1	−2.3% (−7.4% to 2.7%)
	Stay at risk ($n = 1,699$)	$3,670	9.4	
	Add risk ($n = 405$)	$2,978	17.8	9.9% (3.0% to 16.8%)
	Stay not at risk ($n = 8,015$)	$2,920	7.9	
Blood pressure				
	Lose risk ($n = 773$)	$3,452	10.9	1.8% (−11.8% to 15.4%)
	Stay at risk ($n = 192$)	$3,077	9.1	
	Add risk ($n = 436$)	$2,734	9.9	1.5% (−3.7% to 6.7%)
	Stay not at risk ($n = 8,304$)	$3,086	8.5	
Cholesterol				
	Lose risk ($n = 650$)	$2,871	13.6	0.1% (−9.3% to 9.7%)
	Stay at risk ($n = 286$)	$2,266	13.5	
	Add risk ($n = 464$)	$2,912	8.8	1.1% (−3.8% to 6.0%)
	Stay not at risk ($n = 9,072$)	$3,199	7.7	
Tobacco				
	Lose risk ($n = 432$)	$2,357	22.0	17.8% (9.1% to 26.6%)
	Stay at risk ($n = 328$)	$3,794	4.1	
	Add risk ($n = 79$)	$2,913	13.4	5.4% (−3.6% to 14.3%)
	Stay not at risk ($n = 9,722$)	$3,130	8.0	
Alcohol				
	Lose risk ($n = 113$)	$2,605	17.0	15.3% (0.3% to 30.2%)
	Stay at risk ($n = 91$)	$2,772	1.7	
	Add risk ($n = 200$)	$2,499	13.2	4.9% (−3.7% to 13.4%)
	Stay not at risk ($n = 9,971$)	$3,152	8.3	
Stress				
	Lose risk ($n = 487$)	$3,734	7.5	−3.3% (−10.6% to 4.1%)
	Stay at risk ($n = 279$)	$3,918	10.8	
	Add risk ($n = 730$)	$3,584	6.6	−1.5% (−4.9% to 1.8%)
	Stay not at risk ($n = 6,875$)	$3,024	8.2	
Exercise				
	Lose risk ($n = 2,322$)	$3,187	9.1	−0.1% (−4.0% to 3.7%)
	Stay at risk ($n = 1,662$)	$3,160	9.2	
	Add risk ($n = 1,044$)	$3,204	7.8	0.4% (−3.3% to 4.1%)
	Stay not at risk ($n = 5,268$)	$3,066	7.4	
Emotional health				
	Lose risk ($n = 475$)	$3,650	9.8	1.9% (−7.1% to 10.8%)
	Stay at risk ($n = 140$)	$3,494	7.9	
	Add risk ($n = 624$)	$3,312	12.5	4.5% (−0.3% to 9.3%)
	Stay not at risk ($n = 9,066$)	$3,079	8.0	
Nutrition				
	Lose risk (1,881)	$3,142	10.5	3.1% (−0.4% to 6.5%)
	Stay at risk ($n = 5,314$)	$3,187	7.4	
	Add risk ($n = 1,147$)	$3,035	8.1	0.7% (−3.3% to 4.7%)
	Stay not at risk ($n = 1,751$)	$3,090	7.4	

Employees reporting quitting tobacco use experienced faster health care cost growth (17.8% point, 95% CI: 9.1%–26.6%) than those who continued to use tobacco. Similarly, employees reporting that they lost alcohol risk experienced a 15.3% point faster cost growth rate (95% CI: 0.3%–30.2%) than employees who stayed at risk for alcohol. Nevertheless, the number of employees who lost alcohol risk was relatively small, only 113 employees. These employees had similar costs at the start of the study ($2605 for employees who lost alcohol risk and $2772 for employees who stayed at risk).

Although the impact on costs was not statistically significant for the other health risks, changes were in the hypothesized direction for employees who added risks in the following categories: blood pressure, cholesterol, tobacco, alcohol, and emotional health. On the other hand, employees who lost a risk did not experience a decrease in their cost trend during the study period, except for weight, stress, and exercise risks. For weight, stress, emotional health, and nutrition risks, employees who remained at risk were more expensive than employees who stayed not at risk, although these differences were only statistically significant for weight and stress risks.

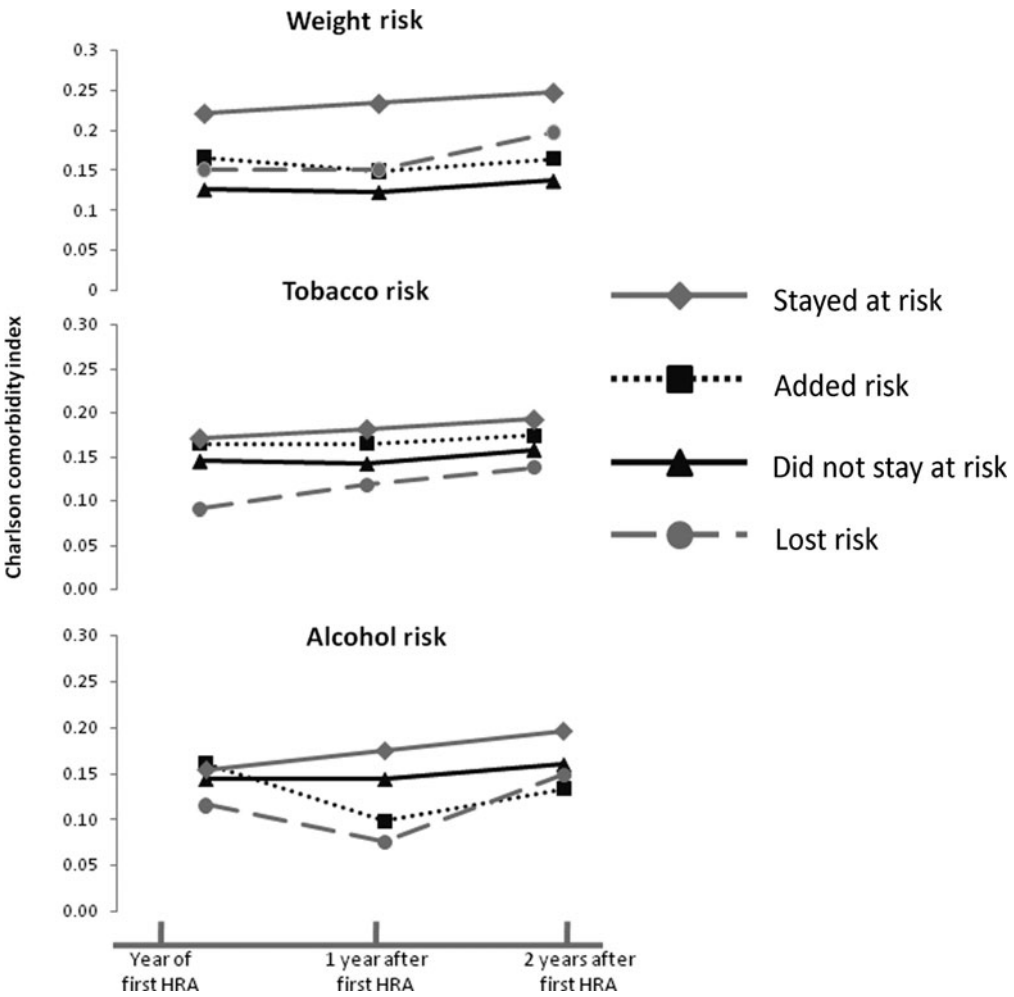

FIGURE 1. Charlson Comorbidity Index by risk group for weight, tobacco, and alcohol risks. HRA, health risk assessment.

Health Status

To better understand results, we also examined the trend in employees' health status as measured using CCI and PDG measures. These data are shown in Figures 1 and 2. In Figure 1, CCI is the vertical axis, and time since the first HRA is the horizontal axis. Separate panels are shown for weight, tobacco, and alcohol risks. We focused on these risks because they produced significant cost changes in the multivariate analysis. For all three risks, employees who stayed at high risk also had the highest CCI scores. Employees who stayed not at risk had the lowest CCI scores for weight risk, but not the other two risks. Figure 2 displays trends in the number of PDGs for these three risk factors. As shown, employees who added tobacco risk experienced an increase in the number of PDGs.

DISCUSSION

An examination of Johnson & Johnson's employee health risk and medical claims data from 2002 to 2008 found significant risk-cost relationships for three health risks: weight, tobacco use, and alcohol consumption. Changes in costs were in the hypothesized direction for weight risk, but not for the other two risk factors. Employees who moved into high-risk status for weight during the study period experienced significantly higher cost growth than employees who did not gain sufficient weight to be put into an obese category. Conversely, employees who lost sufficient weight so that they were no longer obese experienced lower cost growth than employees who remained at risk for weight, but this finding was not statistically significant.

Our findings are consistent with previous work on those who gained weight. A previous study of adults in a managed care plan found that patients who had gained 20 lb or more experienced an annual increase of $769 (in 2008 dollars, inflated using the medical CPI) in medical costs over 3 years, compared with those who maintained weight.[29] Furthermore, patients who gained 20 lb or more and had comorbidities along with being overweight experienced a $975 (in 2008 dollars) annual increase in costs over 3 years, again compared with those who maintained weight.[29] In our study, employees who gained weight and moved into the obese category experienced annual cost increases totaling $652 more than those who maintained weight over an average of 4.8 years.

The previous study of weight loss (Finkelstein et al[15]) did not find evidence of lower medical expenditures for patients who lost at least 5% of body weight. Nevertheless, that study was limited by shorter follow-up period (3 years) and a small sample (279 subjects), where only 46 lost at least 5% of body weight. In our study, we followed employees longer (the average follow-up period was just less than 5 years). We found directional evidence of lower growth in medical expenditures for employees who lost sufficient weight to move out of the obese weight risk category, although these results were not statistically significant. Our analytic methods were also different from those of Finkelstein et al in that this study tested whether employees who lost weight experienced lower cost growth

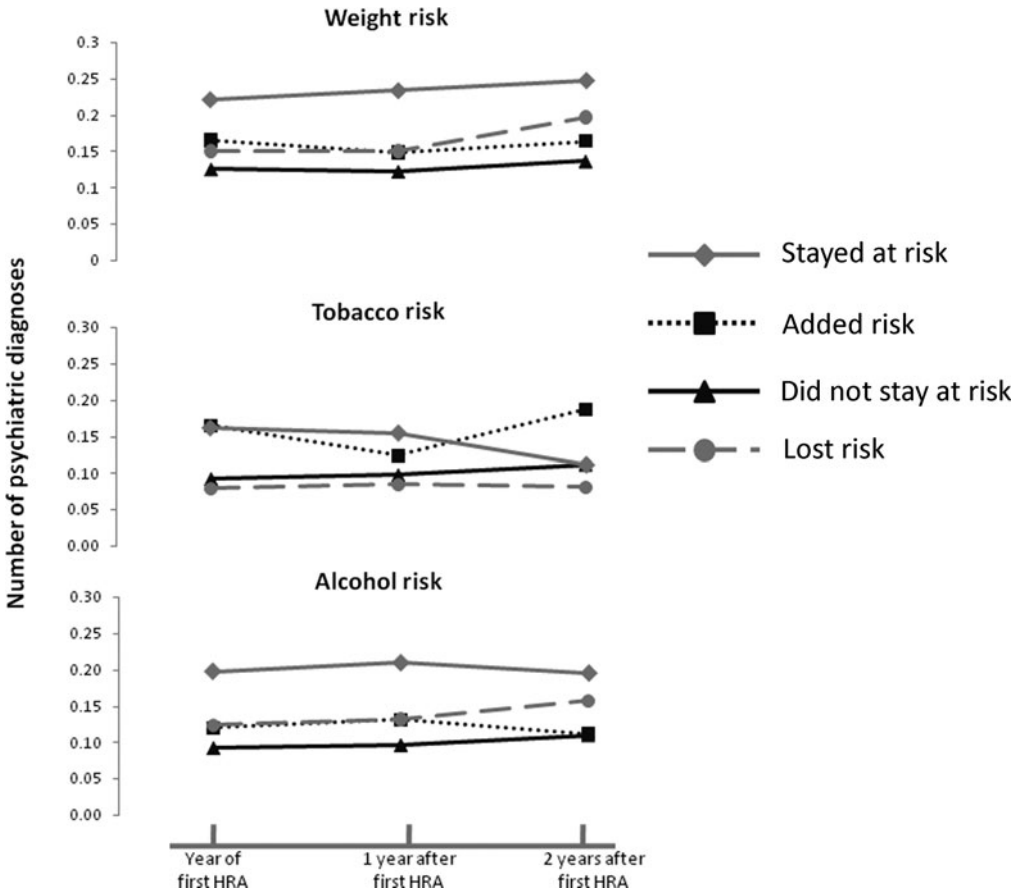

FIGURE 2. Number of psychiatric diagnosis groups by risk group for weight, tobacco, and alcohol risks. HRA, health risk assessment.

(not cost reductions), compared with employees who maintained a high weight risk.[15]

Employees who quit smoking or reduced their alcohol consumption experienced significantly higher costs. However, only a small number of employees moved into a lower alcohol risk category; so, those results may not be generalizable. Several studies have shown that those who drink heavily often avoid using health care services but become high utilizers after they quit drinking, which may explain our results. We found that employees who began at high risk for alcohol and then lowered their risk experienced higher cost growth than those who stayed at high risk for alcohol.[30–32] Similarly, studies have shown that smokers use more health care immediately after they quit, possibly because contracting a debilitating disease is what convinced them to quit smoking.[33,34] Also, damage caused by smoking and alcohol abuse may not be reversible, particularly not in the short-term. Since smoking and alcohol risks were self-reported, some biases may occur if certain types of smokers or alcohol users inaccurately report their harmful behaviors.

As shown in Table 3, health risks were not distributed randomly. Employees with weight risk were also more likely to be at high risk for blood pressure, physical inactivity, and poor diet. It stands to reason that improved eating and exercise habits lead to weight reduction, which in turn leads to improvements in biometric measures such as blood pressure, blood glucose, and high cholesterol. These relationships have been established in clinical research.[35,36] Thus, weight gain or loss may be viewed as a leading indicator of health improvements and medical care expenditures.

This study had several limitations. It examined a relatively short time frame (subjects had 4.8 years of data on average). The benefits or harms associated with losing or gaining health risks may take several years or even decades to be captured in medical claims data. Despite the large number of employees in the study (more than 10,000), only a relatively small number actually changed risks over time. Generally, fewer than 10% of the sample experienced a change in any given risk, with the exception of exercise, nutrition, and stress. Nevertheless, even small changes in the risk profile of a large population, in the case the employees at Johnson & Johnson, can produce meaningful health outcomes.

Employees were not experimentally assigned to weight loss, weight gain, or weight maintenance groups. Thus, our results are likely affected by self-selection into these groups. The advantage of this type of observational study is that results may be more representative of employee experiences in a "real-world" setting for a company-sponsored health and wellness program.

Another limitation is that we did not have enough information to control for some confounders that may induce changes in behavior and risk status. Serious health events may have been the catalyst for making lifestyle changes such as losing weight, quitting tobacco, or reducing alcohol consumption. Thus, cost savings from broader health changes that lead to a reduction in risks could be confounded by increases in costs associated with a serious health event.

Furthermore, since each risk was measured dichotomously, employees at the margins of the risk definitions may have been more likely to experience a change in risk status. This effect would

dampen the ability to detect large and meaningful changes in costs associated with changes in risk. For example, consider an employee who acquired a weight risk by moving from a BMI of 29 kg/m^2 to one where he or she was classified as obese, with a BMI of 30 kg/m^2. Although risk status had changed, from a clinical standpoint, the change in risk may not be meaningful.

CONCLUSIONS

This study is one of the few that examine changes in specific health risks, not just the number of risks, as these relate to changes in health care costs. As such, our understanding of how changes in employee health risks may alter medical expenditures is improved beyond previous research in this topic. Cross-sectional analyses of risk and cost data have provided researchers and practitioners with estimates of the cost burden of having a given health risk and the potential gains from reducing that risk. Nevertheless, few studies have carefully analyzed longitudinal data on the same individuals to determine whether, and to what extent, risk reduction programs can achieve cost savings. This study highlights the potential cost savings from preventing weight gain and bringing about weight loss in an employed population. There is also directional evidence that reducing stress may lower costs. Counterintuitive results related to a reduction in alcohol and tobacco risk (ie, reductions are linked to cost increases) may be explained by the fact that many employees may stop their bad habits when they become seriously ill or health effects of alcohol and tobacco may not be reversible, at least in the short-term.

Stepping back from the details of these findings, it appears that people with low risk generally cost less and people with high risk generally cost more. This finding has been demonstrated across many organizations and with multiple financial outcomes, and it is not new. What is new is that preventing adoption of new risks, and, to a more limited extent, reducing certain health risks, may result in cost savings. This area of investigation is still in its infancy, however. Larger databases, spanning multiple years, need to be analyzed to determine whether the patterns observed with the Johnson & Johnson population can be replicated with other employers.

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