



3rd Edition

Corporate health & well-being management

A compendium of research evidence

vielife





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Acknowledgments

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Research country of origin



Medical care costs



Absence from work



Productivity at work



Health promotion programmes

Choosing health & performance

The proof is in the numbers

What started as a niche discipline among a few pioneering organisations has rapidly grown into a major strategic HR initiative. When we first published this Compendium into the benefits and return on investment of workplace and public health promotion programmes, very few organisations invested in integrated health & well-being programmes. Today, there are many employers who have created roles specifically tasked with managing employee well-being. Global organisations like Pepsi, Cisco and Vodafone are developing and executing global health & productivity strategies. Public sector bodies in Australia, Singapore, Europe and North America are increasing budgets for 'Public Health Promotion' and Governments around the globe are making the connection between good health, productivity, vitality and happy citizens.



Effective health management requires accurate measurement, so we are delighted that our commitment to 'monetising' the value of investment in 'Health Promotion' programmes has proven so valuable.

vielife has always been committed to providing research-based thought leadership in the area of health & human performance. We hope that this latest contribution provides you with one more tool in your tool box to position integrated health management as a critical element of your people management strategy. The macro and micro economic arguments for employers taking an active role in the health of the nation are undeniable:

- From a demographic point of view we are at full employment, facing an ageing work force and an absolute decline in the number of 35-45 year olds.
- From a health perspective we are seeing:
 - o Health care costs rising rapidly (estimated to be 10% of GDP by 2010 in the UK, and 17% of GDP by 2010 in the U.S.) with corresponding double-digit growth in insurance premiums.
 - o The cost of obesity and overweight in England is approximately £7.4 billion per year⁽¹⁾. In Australia obesity costs AU\$1,721 million per year⁽²⁾ and in the U.S. obesity costs US\$93 billion⁽³⁾.
 - o In the UK stress is the no.1 reason for absence for non-manual employees⁽⁴⁾ and the average cost of absence is £598 per employee per year, and £680 in the public sector⁽⁴⁾.
 - o Over 50% of all Australians⁽⁵⁾, 65% of all Americans⁽⁶⁾ and well over 50% of Britons are either overweight or obese⁽⁷⁾.
- People in 'good health' are up to 20% more productive than those in 'poor health'. Improvements in employee health deliver a corresponding reduction in absence and improvement in productivity and deliver a

healthy ROI of 6.2 to 1 (IHPM/vielife Research). An incremental two hours per employee, per month, through reduced absence and improved energy/alertness would deliver an additional 97.7 million work days per year to the UK economy.

Our Connect 4 Life (C4L) project, piloted in the general population with Tameside & Glossop Primary Care Trust (Tameside, UK), proved that health improvement programmes are a highly cost effective use of NHS resources. The programme significantly improved the quality of life and life expectancy of participants. The incremental cost effectiveness ratio of C4L per quality adjusted life year (QALY) gained was £1,000 (\$2,000), significantly better than other more commonly used treatments such as antihypertensive treatment (£12,000/\$24,000 cost per QALY).

For these reasons, and not least because taking collective responsibility for the good health of the communities we work in is socially responsible, we need to make the investment case for health promotion. Now, when CEOs, CFOs, Insurers and Governments ask us to justify our requests for greater investment in integrated health management programmes, we have the facts and case studies to hand. We can, in the immortal words of Jerry Maguire, "Show them the money!"

The irony is that at a time when employers want people who are healthier, thinner, faster, younger and less stressed, the general population is becoming less healthy, fatter, slower, older and more stressed.

Unless organisations start to deal with this issue, the impact of poor health on vitality, productivity and absence will only get worse.

We hope the facts presented in this compendium help you make the case for greater investment in health management in your own organisation. You will find yourself in a healthy company if you do.

Clive Pinder
CEO, vielife

1. UK Government White Paper on Public Health 2004. 2. A cost benefit analysis of weight management strategies. Yates J, Murphy C. Asia Pacific Journal of Clinical Nutrition 2006. 3. National Medical Spending Attributable to Overweight and Obesity. Finkelstein EA et al. Health Affairs 2003. 4. CIPD Annual Survey Report, Absence Management, 2006. 5. National Health Survey 2001, Australia. 6. National Health and Nutrition Examination Survey 1999-2002. 7. UK Department of Health, Policy and Guidance, 2007.

A compendium of research evidence

Corporate health & well-being management

It is a pleasure to introduce this, the third edition of the Compendium of Research Evidence, to you. It is more than three years since we started compiling the first edition of the Compendium, with the aim of providing an easy to digest summary of key published research in the area of health and performance management. During this time the discipline has advanced tremendously. We now have a far greater understanding of how health issues impact not only health care delivery costs but also employee performance and productivity. Central to this understanding is the work that has been done on productivity measurement, with a number of well-validated self-reported productivity measures now available to help quantify the area of presenteeism.

What seems to be emerging from this work is that the indirect costs associated with on-the-job productivity loss are significantly higher than the associated health care delivery costs, but in a similar fashion to health care costs, appear to be just as amenable to reduction through health risk modification.

As with previous editions, this is not intended to be an exhaustive review or meta-analysis of the research in this area, rather an easy to digest summary of some of the important, and sometimes seminal, articles that have shaped, and continue to shape, the discipline of health and performance management.

We have focused upon articles that quantify the impact of health risks or interventions on 'the bottom line', in order to make this as practical a publication as possible for business leaders and those needing justification for

health and performance management investment.

We have kept in many of the older articles to help the reader understand how this area has advanced over the last two decades and how, piece by piece, the puzzle is gradually fitting together. Having said this there is still much we don't know that requires further research effort. Little is understood about the relative efficacy of different types of health promotion intervention, both in the short term, but more importantly, in the longer term.

Also, how health promotion programmes impact longer term functioning and life expectancy is an important area that needs further investigation. We have started looking at this area in more detail with an analysis of the Connect 4 Life health promotion project that took place in Manchester in the North

West of England in 2006. Using established health economic approaches it has been estimated that improvements seen in the areas of smoking, nutritional balance, physical activity and stress management could have a significant impact upon not just life expectancy but also providing good quality additional life years. The cost per QALY (quality adjusted life year) was estimated at £1,000 (\$2,000), which compares very favourably with the costs of other treatments such as the use of cholesterol-lowering drugs in the prevention of heart disease and stroke.

More work is also needed in the area of defining the optimal type of intervention for different populations based upon their age, gender and ethnicity. However, if the pace of investigation continues as it has done over the last few years, I have little doubt that at least some of these questions will be answered by the time we come to compile the next edition of this publication.

Peter Mills
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* For further information on the Connect 4 Life project, please contact **Julia Herbert** at j.herbert@vielife.com



The impact of health risks on medical care costs

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Yen LT, Edington DW, Witting P.

Associations between health risk appraisal scores and employee medical claims costs in a manufacturing company.

Am J Health Promot 1991; vol 6; pages 46-54.

This was one of the first studies to specifically investigate the relationship between health risk factors and medical claims costs in an employee population.

A total of 1,838 employees at a steel manufacturing company completed a health risk appraisal (HRA) in 1985. Each respondent was classified as either high or low risk for 18 health risk factors. Average medical claims costs from 1985 to 1987 were mapped to HRA data.

Average annual medical costs for the high-risk group were higher than for the low-risk group for all of the health risk factors. The difference ranged from \$67 to \$778, depending upon the risk factor.

A high health risk status for 11 of the 18 measures was shown to significantly predict 'high-cost' status. These 11 factors were (i) five days or more absence in the previous year, (ii) regular use of any medication, (iii) excess alcohol consumption, (iv) smoking, (v) presence of serious medical problems, (vi) self perception of physical health being poor, (vii) poor life satisfaction, (viii) high levels of stress, (ix) poor job satisfaction, (x) chronic bronchitis or emphysema, and (xi) being unmarried.

It was found that the average costs incurred by individuals increased as the total number of health risk factors increased (\$190 for no health risk factors, rising to \$1,550 for those with six or more). In addition, the chances of an employee incurring high costs increased dramatically from less than 8% in the group with no health risk factors to 56% in the group with six or more health risk factors.

The study also demonstrated that 66% of health care costs were incurred by only 10% of the employee population.

Notes



The impact of health risks on medical care costs

Yen L, Schultz A, Schnueringer E, Edington DW.

Financial costs due to excess health risk among active employees of a utility company.

J Occup Environ Med 2006: vol 48; pages 896-905.

The aim of this study was to determine the excess medical costs associated with employees with numerous health risk factors, compared with those with none or few, in a Midwest utility company in the U.S.

The study population consisted of 4,266 employees who had complete financial records for 2001 and 2002. Of these, 49% (2,082) completed a health risk appraisal (HRA), which collected information on 15 health risk factors known to have an impact upon costs.

Four financial measures were used to define costs: (i) medical claims, (ii) pharmacy claims, (iii) time away from work (absenteeism), and (iv) the overall sum for these three costs.

Three levels of risk status were defined for HRA participants: (i) low risk (0-2 health risk factors), (ii) medium risk (3-4 health risk factors), and (iii) high risk (5 or more health risk factors).

Excess costs were calculated as the difference in average annual costs between HRA participants with low-risk status and those with medium or high-risk status, as well as non-participants.

The total cost for the overall population was \$29.4 million over the two-year study period. The total excess costs were \$9.4 million (32% of the total costs) per year. Two-thirds (\$6.2 million) of the excess costs were attributable to HRA non-participants, equivalent to \$2,829 per employee per year.

The total excess costs for HRA participants amounted to \$3.2 million. Of these, 56% (\$1.8 million) were attributable to medium and high-risk individuals and 44% (\$1.4 million) were attributable to HRA participants classified as high risk (see table).

This study brought together data on health risk status and direct and indirect employer costs. Excess health risks are significantly related to excess costs due to absenteeism, medical and pharmacy claims.

Total and excess costs by financial measures and participant status (in millions of dollars)

Financial measures	Total cost (all eligible employees n = 4,266)	Excess cost (all eligible employees n = 4,266)	Total cost HRA participants (n = 2,082)	Excess cost HRA participants (n = 2,082)	Total cost HRA non-participants (n = 2,184)	Excess cost HRA non-participants (n = 2,184)
Time away from work	\$11.8	\$3.7	\$5.1	\$1.1	\$6.7	\$2.6
Medical claims	\$15.3	\$4.9	\$6.8	\$1.7	\$8.5	\$3.2
Pharmacy claims	\$2.3	\$0.8	\$1.1	\$0.4	\$1.2	\$0.4
Total costs	\$29.4	\$9.4	\$13.0	\$3.2	\$16.4	\$6.2

Notes



The impact of health risks on medical care costs

Bertera RL.

The effects of behavioral risks on absenteeism and health care costs in the workplace.

J Occup Med 1991: vol 33; pages 1119-1124.

The aim of this study was to quantify the impact that health risk factors have upon absence from work and health care costs within a large employee population at the Du Pont Company.

Health risk appraisal, physical examination, and illness data, were collected for 45,976 employees between 1984 to 1988. Employees were categorised into either a high-risk group (3 or more health risks) or a low-risk group (0-2 health risks).

In all, 50% of employees were in the high-risk category. Annual excess costs for employees in this group compared with the low-risk group for each risk factor were calculated as:

Smoking	\$960
Overweight	\$401
Excess alcohol	\$389
Elevated cholesterol	\$370
High blood pressure	\$343
Seatbelt use	\$272
Lack of exercise	\$130

The total annual cost to the whole company for excess health risk was conservatively estimated at \$70.8 million.

Notes



The impact of health risks on medical care costs

Goetzel RZ, Anderson DR, Whitmer RW, Ozminkowski RJ, Dunn RL, Wasserman J.

The relationship between modifiable health risks and health care expenditures. An analysis of the multi-employer HERO health risk and cost database.

J Occup Environ Med 1998; vol 40; pages 843-854.

This study was conducted by the Health Enhancement Research Organisation (HERO) with the aim of quantifying the impact of 10 modifiable health risk factors upon health care expenditures.

In total, 46,026 employees from six large employers completed a health risk appraisal (HRA) between 1990 and 1995. The HRA assessed future risk of heart disease, stroke and psychosocial problems through questions relating to (i) physical activity, (ii) nutrition, (iii) alcohol consumption, (iv) tobacco use, (v) depression, (vi) stress, (vii) obesity, (viii) blood pressure, (ix) cholesterol and (x) blood glucose. Health care expenditures for each individual were tracked for up to three years after completion of the HRA.

Respondents were classified as low or high risk for each of the health measures assessed.

In all, 33,237 employees (72% of the study sample) incurred medical costs during the study period. Employees classified as high risk for depression, stress, blood glucose, blood pressure, weight, smoking and physical activity had significantly more health care expenditures than employees classified as low risk for these factors.

Average annual medical costs for individual health risks were:

	High risk	Low risk
Stress	\$2,287	\$1,578
Physical activity	\$2,011	\$1,567
Body weight	\$2,317	\$1,570
Depression	\$3,189	\$1,679
Tobacco use	\$1,949	\$1,503
Blood pressure	\$2,122	\$1,715
Blood glucose	\$2,597	\$1,690
Cholesterol	\$1,962	\$1,678

Employees with multiple health risk factors for heart disease, psychological ill health and stroke incurred 228%, 147% and 85% higher costs than low-risk individuals, respectively.

Notes



The impact of health risks on medical care costs

Anderson DR, Whitmer RW, Goetzel RZ, Ozminkowski RJ, Dunn RL, Wasserman J, *et al.*

The relationship between modifiable health risks and group-level health care expenditures (HERO-2).

Am J Health Promot 2000: vol 18; pages 45-52.

This study was an extension of the original HERO study (see page 13) and used the same employee population to quantify the relative contribution of modifiable health risk factors on total health care expenditure.

Health risk appraisal data from 46,026 employees were paired with health care expenditure data. Each individual was classified as being high or low risk for each of the following health risk factors: (i) sedentary lifestyle, (ii) alcohol use, (iii) nutrition, (iv) former tobacco use, (v) current tobacco use, (vi) depression, (vii) stress, (viii) high blood pressure, (ix) high cholesterol, (x) body weight, and (xi) high blood glucose.

The most common risk factors within the population were sedentary lifestyle (32.4%), tobacco use (31.1%), poor nutritional balance (20.2%), and excess body weight (20.0%).

The analysis revealed that 25% of total health care expenditures during the study period were directly attributable to modifiable health risk factors.

Notes



The impact of health risks on medical care costs

Jee SH, O'Donnell MP, Suh I, Kim IS.

The relationship between modifiable health risks and future medical care expenditures: the Korea Medical Insurance Corporation (KMIC) Study.

Am J Health Promot 2001: vol 15; pages 244-255.

The purpose of this study was to determine whether the presence of modifiable lifestyle factors can predict future medical care costs.

This six-year study (1992 to 1998) at the Korea Medical Insurance Corporation involved 78,728 men and 50,414 women enrolled in a health insurance plan. Health risk appraisal data and biometric measurements collected in 1992 were merged with medical claims records for the following six years.

Perceived health status, smoking, body mass index, physical activity, cholesterol levels, blood pressure and blood glucose levels were all important individual predictors of medical care costs incurred. Observed excess costs were between 2.4% and 16% higher for high-risk individuals compared with low-risk individuals, depending on the risk factor. The presence of multiple risk factors accounted for up to 55% higher medical care costs.

In all, modifiable health risk factors accounted for 23.1% of medical care costs over the study period.

Notes



The impact of health risks on medical care costs

Pronk NP, Goodman MJ, O'Connor PJ, Martinson BC.

Relationship between modifiable health risks and short-term health care charges.

JAMA 1999; vol 282; pages 2235-2239.

The aim of this study was to quantify the impact of three modifiable health risk factors (smoking, physical inactivity and overweight/obesity) on medical care costs.

A total of 5,649 individuals over 40 years of age, who were insured by Health Partners (a large Minnesota-based health plan), completed a comprehensive health risk appraisal (HRA) in 1995. Medical care costs were monitored for an 18-month period after completion of the HRA. Data was adjusted for age, race, gender and chronic disease status.

Observed medical care costs were higher for individuals at high risk for each of the three health risk factors studied. Individuals who were physically inactive incurred an average of 4.7% higher medical care costs than those who were active one day per week. Each one unit increase in body mass index above the healthy range resulted in a 1.9% increase in medical costs. Smokers had medical care costs 18% higher than those who had never smoked, whereas former smokers had 25.8% higher charges than those who had never smoked.

Notes



The impact of health risks on medical care costs

Finkelstein E, Fiebelkorn C, Wang G.

The cost of obesity among full-time employees.

Am J Health Promot 2005: vol 20; pages 45-51.

The aim of this study was to estimate annual obesity related medical costs and absenteeism costs across the U.S.

The study involved two nationally representative datasets: The National Health Interview Survey (NHIS) and the Medical Expenditure Panel Survey (MEPS). The NHIS data comprised 25,427 individuals and the MEPS comprised 20,329 individuals. Data was collected between 2001 and 2002.

NHIS data was used for the absenteeism analysis and MEPS data was used for the medical cost analysis.

Participants were categorised into five body mass index (BMI) groups:

- (i) BMI = 18.5 to 24.9 kg/m² (normal),
- (ii) BMI = 25 to 29.9 kg/m² (overweight),
- (iii) BMI = 30 to 34.9 kg/m² (grade I obesity),
- (iv) BMI = 35 to 39.9 kg/m² (grade II obesity),
- (v) BMI ≥40 kg/m² (grade III obesity).

Nearly half (46%) of men were classified as overweight and a further 23% were classified as obese. Of the full-time employed women, 28% were classified as overweight and 23% were obese.

Obesity resulted in a significant increase in absenteeism for women; this was not significant for men.

BMI group	Absenteeism days per year (females)
Normal weight	3.4
Overweight	3.9
Grade I obesity	5.2
Grade II obesity	6.4
Grade III obesity	8.2

The combined costs (absenteeism plus medical) for individuals classified as overweight, or as grades I, II or III obesity, were significantly greater than for normal-weight individuals, for both males and females.

BMI group	Combined excess costs (male)	Combined excess costs (female)
Overweight	\$175	\$588
Grade I obesity	\$462	\$1,372
Grade II obesity	\$1,212	\$2,485
Grade III obesity	\$2,027	\$2,164

The study estimated that the costs of obesity alone (excluding those in the overweight category) at a firm with 1,000 employees would be \$285,000 per year; with approximately 30% (\$85,500) of this total resulting from increased absenteeism.

The study demonstrated two important facts; (i) obesity related costs were significantly higher for females than males, (ii) obesity resulted in significant increases in medical costs among all full-time employees.

Notes



The impact of health risks on medical care costs

Wang F, McDonald T, Bender J, Reffitt B, Miller A, Edington DW.

Association of health care costs with per unit body mass index increase.

J Occup Environ Med 2006: vol 48; pages 668-674.

The aim of this study was to quantify the increased health care costs associated with increased body mass index (BMI) in a large U.S. manufacturing company. The costs of two obesity related health conditions (diabetes and heart disease) were also examined.

The sample population of 35,932 employees and their partners were from General Motors Corporation and United Automobile Workers of America. They were enrolled in a medical insurance plan and had completed one health risk appraisal (HRA) between 2001 and 2002.

In all, 40.4% of the participants were classified as overweight (BMI = 25 to 29.9 kg/m²) and 33.4% were obese (BMI ≥30 kg/m²).

Analysis demonstrated that in the BMI range of 25 to 45 kg/m², annual medical costs increased by \$119.7 and drug costs increased by \$82.6 per BMI point increase.

Furthermore, employees with higher BMI had increased rates of diabetes and heart disease, and increased costs for these diseases. The annual medical costs related to diabetes and heart disease increased by \$6.2 and \$20.3, respectively, for each unit increase of BMI above the healthy range (18.5 to 24.9 kg/m²).

This study demonstrates that medical claim costs escalate with increasing BMI, as do the risks for diabetes and heart disease.

Notes



The impact of health risks on medical care costs

Long DA, Reed R, Lehman G.

The cost of lifestyle health risks: obesity.

J Occup Environ Med 2006; vol 48; pages 244-251.

The aim of the study was to provide employers with estimated costs of lifestyle health risks; with emphasis on obesity related costs.

A total of 24.5 million full-time employees and dependants from 61 major companies across the U.S., who were enrolled in a medical plan, were assessed over a four-year period (2000 to 2004).

These companies represented several business sectors; health care, civic, utility, manufacturing, finance, consulting, retail, education and mixed business sectors.

Costs were estimated for the following lifestyle health risks:

- i. accidents/injuries,
- ii. alcohol/substance abuse,
- iii. high cholesterol,
- iv. high blood pressure,
- v. obesity (body mass index ≥ 30 kg/m²),
- vi. poor prenatal care,
- vii. lack of exercise,
- viii. smoking,
- ix. stress,
- x. poor dental hygiene.

Analysis revealed that medical claims for this group totalled \$4.75 billion between 2000 and 2004.

The results demonstrated that 14.2% of male and 25.1% of female lifestyle health risk-related claims were due to obesity. Obesity costs increased steadily with age.

In terms of business sectors, the highest obesity costs were observed for employees in the health care and retail/mixed sectors, who were 65 to 74 years of age. These were \$17.29 and \$16.49 per member per month, respectively.

Females aged between 55 and 64 years from finance/consulting, manufacturing or civic/utility sectors, and females aged between 65 and 74 years from health care or retail/mixed sectors were at greatest risk for high obesity related costs.

The study suggested that employers who are interested in wellness initiatives should first engage in weight management programmes, as the potential returns on investment are estimated to be substantial.

Notes



The impact of health risks on medical care costs

Musich S, Hook D, Barnett T, Edington DW.

The association between health risk status and health care costs among the membership of an Australian health plan.

Health Promot Intl 2003: vol 18; pages 57-65.

The purpose of this study was to evaluate the association between health risks and medical care costs in an Australian population.

A total of 11,568 members of an Australian private medical insurance plan completed a health risk appraisal (HRA) between 1995 and 1999. A group of 8,244 age and gender matched non-participants were used as a control group for the study.

The HRA assessed the presence of eight health risks factors (smoking, low levels of physical activity, excess alcohol consumption, high blood pressure, high cholesterol, body mass index, presence of certain medical conditions and excess sickness absence) and was used to stratify individuals into one of three groups: high risk (3 or more health risk factors), medium risk (2 risk factors) and low risk (0-1 risk factors).

Low-risk participants had the lowest health care costs (average total cost of AU\$377 between 1995 and 1999), compared with medium-risk (AU\$484) and high-risk participants (AU\$661), and non-participants (AU\$438).

Excess health care costs (medium and high-risk groups compared with the low-risk group) were calculated at 13.5% of total expenditures.

Notes



The impact of health risks on medical care costs

Wang F, Schultz AB, Musich S, McDonald T, Hirschland D, Edington DW.

The relationship between National Heart, Lung, and Blood Institute Weight Guidelines and concurrent medical costs in a manufacturing population.

Am J Health Promot 2003: vol 17; pages 183-189.

This study explored the relationship between body mass index (BMI) and medical costs.

A total of 177,971 employees, adult dependents and retirees of General Motors Corporation (U.S.) participated in the study. All subjects had enrolled in a health insurance plan between 1996 and 1997 and completed one health risk appraisal (HRA) in the same period.

Participants were categorised into six weight groups (according to the National Heart, Lung and Blood Institute 1998 Guidelines):

- (i) BMI <18.5 kg/m² (underweight),
- (ii) BMI = 18.5 to 24.9 kg/m² (normal),
- (iii) BMI = 25 to 29.9 kg/m² (overweight),
- (iv) BMI = 30 to 34.9 kg/m² (grade I obesity),
- (v) BMI = 35 to 39.9 kg/m² (grade II obesity),
- (vi) BMI ≥40 kg/m² (grade III obesity).

The normal-weight group cost the least and medical costs gradually increased with increasing BMI (except for the underweight group).

The annual median medical costs were \$3,184 for the underweight group, \$2,225 for the normal-weight group, \$2,388 for the overweight group, \$2,801 for grade I obesity, \$3,182 for grade II obesity, and \$3,753 for grade III obesity.

The authors suggest weight management programmes as a means of avoiding medical costs associated with obesity.

Notes



Yen L, McDonald T, Hirschland D, Edington DW.

Association between wellness score from a health risk appraisal and prospective medical claims costs.

J Occup Environ Med 2003; vol 45(10); pages 1049-1057.

The purpose of this study was to test whether the wellness score, derived from the University of Michigan's health risk appraisal (HRA), can be used to predict future short-term medical claims costs.

Data from 19,861 employees of General Motors Corporation and UAW (International Union, United Automobile, Aerospace and Agricultural Implement Workers of America) who were enrolled in medical insurance plans from 1996 to 1998 and who had also completed an HRA in 1996 were used for this study. The sample had an average age of 46 years and 75% were male.

The wellness score was generated from the HRA results and contained three components: (i) behavioural health risks, (ii) mortality risks and (iii) preventative services usage. Behavioural health risks consisted of 10 variables known to be associated with medical claims costs: (i) smoking status, (ii) physical activity, (iii) alcohol consumption, (iv) safety belt usage, (v) blood pressure, (vi) total cholesterol, (vii) high-density lipoprotein cholesterol, (viii) body weight, (ix) illness days, and (x) self-assessment of health.

A clear relationship existed between medical claims costs and wellness scores, with median costs ranging from \$867 to \$1,599 depending on the score. Other factors that were found to be significantly associated with cost were age, gender and presence of disease. The contribution of these factors could predict 60% of the variance in future medical claims costs. Controlling for these factors showed that each additional point on the wellness score (i.e. improvement in health) resulted in a \$56 reduction in medical claims costs.

These results show that HRA data is a valuable tool in predicting future medical claims costs.

Notes



The impact of health risks on medical care costs

Lynch WD, Chikamoto Y, Imai K, Lin TF, Kenkel DS, Ozminkowski RJ, *et al.*

The association between health risks and medical expenditures in a Japanese corporation.

Am J Health Promot 2005: vol 19(Suppl 3); pages 238-248.

The aim of this study was to investigate the relationship between health risk factors and medical care costs.

The study involved 6,543 employees from a large Japanese electronics company who were enrolled in a health insurance plan. Medical care costs were collected in 2000 and compared with data collected at company physical check-ups in 1999 and 2000 and with health risk appraisal (HRA) data.

The most commonly reported risk factors were:

Lack of exercise	52.9%
Current smoking	35%
Stress	33%
Poor nutritional habits	23.6%

Employees who had recently quit smoking incurred 76% higher medical care costs (\$289) and those with high blood pressure incurred 22.6% higher costs (\$340) than those without these risk factors. The presence of multiple cardiovascular risk factors accounted for up to 128% higher costs (\$1,204) than those with no cardiovascular risk factors.

Interestingly, smoking, poor nutrition and alcohol risks were found to be associated with lower medical care costs. Possible reasons for this finding are that the HRA was not tailored to a Japanese context and the short time span of the study limited the sensitivity of the analysis.

This study identified health risk factors in a population of Japanese employees – some of which were related to higher medical care costs.

Notes



The impact of health risks on medical care costs

Musich S, Lu C, McDonald T, Campagne LJ, Edington DW.

Association of additional health risks on medical charges and prevalence of diabetes within body mass index categories.

Am J Health Promot 2004: vol 18(3); pages 264-268.

The aim of this study was to quantify the impact of health risks on medical expenses and to determine the prevalence of diabetes in relation to body weight.

A total of 38,841 employees of General Motors Corporation (U.S.), who were enrolled in a medical plan, were assessed. Health risk appraisal data was collected and merged with medical claims records from 1996 to 2000. The sample had an average age of 46 years and 78.1% were male.

Individuals were classified according to the number of health risk factors they possessed and also by their body mass index (BMI).

The 12 health risk factors were: (i) physical activity, (ii) stress, (iii) life satisfaction, (iv) perception of health, (v) blood pressure, (vi) cholesterol, (vii) high-density lipoprotein cholesterol, (viii) smoking, (ix) alcohol use, (x) safety belt use, (xi) personal illness days, and (xii) medical conditions.

Confirming previous research findings, medical charges were found to increase significantly with BMI increases. The presence of additional health risk factors within each BMI range also led to higher costs.

BMI (kg/m²)	0 additional risk factors	4 or more additional risk factors
<18.5	\$2,689	\$7,576
18.5-24.9	\$2,655	\$6,555
25-29.9	\$3,239	\$7,118
30-34.9	\$3,579	\$7,758
≥35	\$4,151	\$8,075

Notes



The impact of health risks on medical care costs

Wang F, McDonald T, Champagne LJ, Edington DW.

Relationship of body mass index and physical activity to health care costs among employees.

J Occup Environ Med 2004; vol 46(5); pages 428-436.

The purpose of this study was to determine whether physical activity levels impact upon their health care costs, taking into account body mass index (BMI).

The study participants were 23,490 employees from General Motors Corporation and UAW (International Union, United Automobile, Aerospace and Agricultural Implement Workers of America), who were enrolled in a medical insurance plan from 1996 to 1997 and completed a health risk appraisal.

In the population as a whole, employees who were at least moderately active (exercising at least 20 minutes once or twice a week) had annual health care costs (medical and pharmaceutical) \$285 less than those of sedentary employees.

Analysis of cost data from obese individuals revealed that although the total costs for this group were higher, active individuals incurred up to \$499 fewer costs than sedentary individuals with obesity. It was estimated that the savings in health care costs if all obese and sedentary employees became moderately active could be as much as 1.5% of the total health care costs.

The results of this study suggest that health promotion programmes aimed at improving the physical activity levels of obese employees would be cost-efficient, regardless of weight reduction initiatives.

Notes



The impact of health risks on medical care costs

White AG, Birnbaum HG, Mareva MN, Henckler AE, Grossman P, Mallett DA.

Economic burden of illness for employees with painful conditions.

J Occup Environ Med 2005: vol 47; pages 884-832.

This study sought to compare the average annual direct and indirect health care costs for employees with painful conditions with those of a random population – the 'average employee'. Direct costs included hospital inpatient costs, hospital outpatient costs, emergency room costs, doctors' office costs and total drug costs. Indirect costs included absence and disability claims.

Analysis was done on four painful conditions: (i) cancer, (ii) arthritis, (iii) back/neck disorders, and (iv) neuropathic pain.

Data from a large database of insured lives within seven large companies across the U.S. was used for the analysis over a three-year period (1998 to 2000). In total, 68,491 records were used for the analysis. These companies included a broad range of industries including: manufacturing, telecommunications, financial services, and food and beverage companies.

Analysis showed that employees with one or more of the four categories of painful conditions incurred higher costs and made more medical claims than those of the average employee.

On average, employees with cancer incurred 3.5 times greater costs compared with those of the average employee. Employees with painful conditions had 1.6 to 2.8 times as many health care claims than the average employee.

This study demonstrated a significant relationship between painful conditions and employees' costs due to medical claims and absenteeism.

Painful condition	Total costs (factor increase)	Direct costs	Indirect costs	No. of health care claims (factor increase)
None - 'average employee'	\$4,849 (n/a)	\$2,681	\$2,169	18.8 (n/a)
Cancer	\$16,874 (3.5)	\$11,002	\$5,872	53.5 (2.8)
Arthritis	\$7,369 (1.5)	\$4,212	\$3,157	30.8 (1.6)
Back/neck disorders	\$7,088 (1.5)	\$3,949	\$3,139	33.0 (1.8)
Neuropathic pain	\$9,061 (1.9)	\$5,600	\$3,462	37.4 (2.0)

Notes



The impact of health risks on medical care costs

Ozminkowski RJ, Burton WN, Goetzel RZ, Maclean R, Wang S.

The impact of rheumatoid arthritis on medical expenditures, absenteeism, and short-term disability benefits.

J Occup Environ Med 2006: vol 48; pages 135-148.

The aim of this study was to estimate medical, absenteeism and short-term disability (STD) costs for employees with rheumatoid arthritis (RA).

Medical claims data from nine companies across the U.S. was used to estimate direct (inpatient, outpatient and pharmacy expenditures) and indirect (absenteeism and STD) costs for 8,502 employees with RA. These employees were then compared with a similar population without RA.

Medical costs were higher for employees with RA than those without (\$7,337 versus \$3,250, respectively). In addition, average annual absenteeism costs and STD expenditures were \$27 and \$129 higher, respectively, for employees with RA compared with those without.

Average medical costs and estimates for absence and STD for 10 other medical conditions were compared with the average medical expenditures, absence and STD expenditures for employees with RA. The study found that the direct and indirect costs for RA were significantly higher than for the other conditions, with the exception of renal failure.

Disease	Total Costs
Heart disease	\$4,653
Bipolar disorder	\$3,374
Any cancer	\$3,415
Depression	\$2,642
Diabetes	\$2,517
Chronic obstructive pulmonary disease	\$2,099
Low back disorder	\$1,703
Hypertension	\$1,174
Asthma	\$945
Renal failure	\$18,296
RA	\$11,120

On average, employees with RA incurred significantly greater direct and indirect costs than employees without RA and the condition is more costly than a number of other medical conditions.

Notes



The impact of health risks on medical care costs

Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW.

Measuring the relationship between employees' health risk factors and corporate pharmaceutical expenditures.

J Occup Environ Med 2003; vol 45(8); pages 793-802.

This study set out to quantify the impact on pharmaceutical expenditures of different health risk factors.

A total of 3,554 employees of Bank One (U.S.) were chosen for the research as they were participants in a pharmacy benefit plan and had completed a health risk appraisal (HRA). HRA data was compared with pharmaceutical costs for the year 2000.

Specific risk factors were found to have significant effects on pharmaceutical costs, including age and gender.

Other risk factors significantly associated with higher costs were being an ex-smoker, having high blood pressure, high cholesterol, high body mass index and reporting fair or poor self-perceived health.

Some risk factors were not related to pharmaceutical costs, including lack of physical activity, heavy use of alcohol, failure to use seat belts, dissatisfaction with life, dissatisfaction with job and stress.

After controlling for age, gender and the number of self-reported diseases, each additional risk factor was associated with an average annual increase in pharmacy claims costs of \$76 per employee.

The average pharmaceutical costs were \$425 for low-risk employees (0-2 risk factors), \$591 for medium-risk employees (3-4 risk factors) and \$915 for high-risk employees (5 or more risk factors).

This study showed that the number and type of health risk factors an individual has are strongly related to pharmaceutical costs. This suggests that programmes that target modifiable risk factors might reduce pharmaceutical costs. However, it should be noted that the modification of some risk factors may lead to increased costs – for example, the treatment of high cholesterol with drugs.

Notes



The impact of health risks on medical care costs

Wright D, Adams L, Beard MJ, Burton WN, Hirschland D, McDonald T, *et al.*

Comparing excess costs across multiple corporate populations.

J Occup Environ Med 2004: vol 46(9); pages 937-945.

The aim of this study was to determine the relationship between health risk status and medical claims costs across multiple organisations.

Two years of medical claims data for employees from six corporations was merged with health risk appraisal data. The six corporations were from manufacturing, insurance and financial services sectors.

The health risk level of each individual was determined by the number of health risk factors they had. Fifteen health-related risk factors were used: (i) stress, (ii) perception of physical health, (iii) life satisfaction, (iv) job satisfaction, (v) tobacco use, (vi) alcohol use, (vii) safety belt use, (viii) drug/medication use, (ix) physical activity level, (x) illness absence days, (xi) blood pressure, (xii) cholesterol, (xiii) body mass index, (xiv) serious medical problems, and (xv) health age index.

An individual with 0-2 risk factors was classified as low risk, 3-4 risk factors as medium risk and 5 or more risk factors as high risk.

The relationship between risk level and medical costs was consistent across the six corporations: as the risk level increased from low to high, so did the medical costs.

The excess medical costs for medium and high-risk employees compared with low-risk employees ranged from 15% to 30.8%. This suggests economic benefit could be gained from the use of schemes to reduce the health risk level of employees.

Notes



The impact of health risks on absence from work and productivity

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The impact of health risks on absence from work and productivity

Burton WN, Conti DJ, Chen CY, Schultz AB, Edington DW.

The role of health risk factors and disease on worker productivity.

J Occup Environ Med 1999: vol 41; pages 863-877.

The aim of this study was to investigate the role health risk factors and specific disease states have on productivity.

A total of 564 telephone customer-service agents at Bank One in the U.S. were studied between 1994 and 1995 and completed a health risk appraisal (HRA). An objective measure of work productivity was developed (the Worker Productivity Index – WPI), which took into account call-handling statistics and absence data.

The WPI correlated with the number and type of individual health risks – as the number of health risks increased, employee productivity decreased.

Overall, 31.6% failed to maintain the productivity standard. The average worker lost 4.3 hours per week, with the majority of this loss (88%) due to on-the-job productivity deficits. The most common individual health risks were: (i) stress (average loss of 5.3 hours per week), (ii) diabetes (average loss of 11.4 hours per week), and (iii) overweight (loss of 5.7 hours per week).

Employees categorised as having high (15%) or medium (24%) health risk status had average productivity losses of 1.5 hours and 0.6 hours more per week than low-risk employees, respectively.

Conditions other than diabetes that had the most significant impact upon productivity were (i) digestive disorders (loss of 15.9 hours per week), (ii) mental illness (loss of 13 hours per week), and (iii) respiratory conditions (loss of 9.2 hours per week).

Notes



Allen H, Hubbard D, Sullivan S.

The burden of pain on employee health and productivity at a major provider of business services.

J Occup Environ Med 2005: vol 47(7); pages 658-670.

The aim of this study was to investigate the prevalence of pain in a U.S. working population and to estimate its impact on employee productivity.

A total of 1,039 employees of a Fortune 100 company were recruited to participate in the study (approximately 43.3% of eligible employees within the organisation). Each participant completed a short internet-based survey incorporating components of validated questionnaires such as the SF-36 and the Work Limitations Questionnaire. The survey included questions on health status, medical conditions, absence from work, presenteeism, health care utilisation and health risk behaviours. In addition, two specific questions on pain were included.

Of the respondents, 28.6% reported significant levels of pain. A linear relationship was observed between pain severity and productivity.

Individuals reporting the most severe pain were absent from work an average of 0.83 days more than those without pain in the four weeks prior to the survey. In addition, they had over five more days of suboptimal work performance than their healthy colleagues. On average, those with any form of pain reported 14 times more absence from work and nearly 11 times as many presenteeism-affected days as non-affected individuals. This equates to over 3.5 working days lost over a four-week period.

This study confirms the huge impact pain can have upon individual performance in the workplace. Although not specifically addressed in this study, initiatives to improve pain management could yield significant returns to employers through reduced absence and greater work performance.

Notes



Serxner SA, Gold DB, Bultman KK.

The impact of behavioral health risks on worker absenteeism.

J Occup Environ Med 2001: vol 43; pages 347-354.

The aim of this study was to examine the relationship between health risk status and the likelihood of absence from work.

A total of 35,451 employees from 28 private and public sector organisations in the U.S. took part in this study. Employees were divided into two categories; (i) high-absenteeism category (2 or more days absent in the previous 12 months) or (ii) low-absenteeism category (0-1 days absent in the previous 12 months).

Employees completed a health risk appraisal (HRA) which generated data on 10 health risk areas (alcohol use, back care, driving, eating, exercise and activity, mental health, self-care, smoking, stress and weight). For each area, individuals were classified as either high risk or low risk depending on their responses. In addition, an overall risk stratification was performed based upon total numbers of health risk factors: low health risk (0-3 risks) or high health risk (4 or more risks).

Higher absenteeism was related to high-risk status in eight out of the 10 health risk areas examined (high-risk status for alcohol consumption and self care were not statistically associated with higher absenteeism). The health risks with the greatest impact upon absenteeism were: (i) mental health (high-risk status confers a 47% greater chance of having high absence compared with low-risk status), (ii) poor back care (40% greater chance), (iii) stress (24% greater chance) and (iv) overweight (23% greater chance).

Individuals with four or more health risk factors were nearly twice as likely to be in the high-absenteeism group than those with three or fewer factors.

Notes



Ricci JA, Chee E.

Lost productive time associated with excess weight in the U.S. workforce.

J Occup Environ Med 2005; vol 47; pages 1227-1234.

The aim of this study was to examine health-related lost productive time (LPT) in overweight and obese workers.

LPT was measured by the sum of both self-reported absent time for health-related reasons per week (absenteeism) and self-reported health-related productivity time lost at work per week (productivity).

Data was extracted from a national telephone survey of U.S. workers carried out between September 2002 and May 2003. The study population consisted of 6,894 employed adults aged between 18 and 65 years.

Based on their body mass index (BMI), respondents were categorised as follows:

- (i) Underweight (BMI <18.5 kg/m²),
- (ii) Normal weight (BMI = 18.5-24.9 kg/m²),
- (iii) Overweight (BMI = 25.0-29.9 kg/m²),
- (iv) Obese (BMI ≥30.0 kg/m²).

Of the respondents, 2,868 (42%) were of normal weight, 2,490 (36%) were overweight and 1,536 (22%) were obese.

Analysis of the data indicated significant differences between obese workers, normal-weight and overweight workers with regards to self-reported health-related LPT. Obese workers reported higher rates of LPT than overweight and normal-weight workers and had reduced performance while at work.

BMI status	Health-related LPT	Average LPT (hours per week)
Normal weight	36.4%	4.2
Overweight	34.7%	4.2
Obese	42.3%	4.8

The study also demonstrated that the estimated excess annual cost (absenteeism plus presenteeism) of health-related LPT attributable to obesity for U.S. employers was \$11.70 billion per year. Absenteeism comprised only 33% (\$3.86) of the total cost of obesity related LPT.

Notes



The impact of health risks on absence from work and productivity

Musich S, Napier D, Edington DW.

The association of health risks with workers' compensation costs.

J Occup Environ Med 2001: vol 43; pages 534-541.

An estimated \$42.4 billion was paid out in workers' compensation costs in 1999 in the U.S. The average cost of claims was \$10,488 per injured worker. This study investigated the association between employee health risks and workers' compensation costs and whether the associations are similar to those established for medical care costs.

The four-year study, carried out between 1996 and 1999, used health risk appraisal (HRA) data and compensation cost data for 943 long-term employees of the Xerox Corporation. From the HRA, individuals were categorised into low, medium and high health risk groups according to the number of separate health risk factors they had (low risk, 0-2 health risk factors; medium risk, 3-4 health risk factors; high risk, 5 or more health risk factors).

Compensation costs increased with increasing health risk status from an average of \$2,178 per person in the low-risk group to \$15,162 per person in the high-risk group.

High compensation costs were related to individual health risks, especially modifiable risks such as smoking, poor physical health, physical inactivity and life dissatisfaction.

Notes



The impact of health risks on absence from work and productivity

Wright DW, Beard MJ, Edington DW.

Association of health risks with the cost of time away from work.

J Occup Environ Med 2002: vol 44; pages 1126-1134.

The purpose of this study was to assess the full costs associated with absenteeism and to investigate the impact different health risk factors have upon it.

A total of 6,220 hourly workers at Steelcase Inc. (U.S.) participated in a three-year study from 1998 to 2000. Time away from work (TAW) costs were calculated on an annual basis, as the sum of workers' compensation costs (including medical costs, wage compensation costs and fees), absenteeism costs (hourly costs) and short-term disability benefits (which start after four consecutive days of absence).

Employees took at least one health risk appraisal (HRA) during the study period. The HRA measured 15 health-related factors and classified individuals into three health risk categories; low risk (0-2 risk factors), medium risk (3-4 risk factors) and high risk (5 or more risk factors).

Over the three years, 4,090 employees had TAW costs totalling \$14,333,786; comprising \$6,489,613 in compensation costs (45.3%), \$4,566,725 (31.8%) in absence costs and \$3,277,448 (22.9%) in short-term disability costs.

Research revealed 81% of high-risk employees had a TAW occurrence during the three-year period compared with 73.8% and 61% of medium and low-risk employees, respectively.

Mean annual TAW costs increased with increasing risk status; low risk = \$1,243, medium risk = \$1,224 and high risk = \$1,764. Each of the health risk factors were associated with higher mean annual costs.

HRA participants had 3.8 fewer hours of absence per year and lower TAW costs (\$173 less) compared with non-participants.

Notes



The impact of health risks on absence from work and productivity

Burton WN, Conti DJ, Chen CY, Schultz AB, Edington DW.

The impact of allergies and allergy treatment on worker productivity.

J Occup Environ Med 2001: vol 43; pages 64-71.

The aim of this study was to investigate the impact of suffering from an allergic disorder on productivity over a six-month period in 1998.

In total, 634 telephone customer service representatives of Bank One (U.S.) took part in the study. In total, 327 reported allergy symptoms (hayfever, rhinitis, nasal allergy or asthma), of which, 71 used no medication. The study took place during a six-month period that incorporated the ragweed pollen season.

An objective computerised measurement system based on call handling numbers and duration was used to assess productivity.

A significant negative correlation was observed between pollen levels and productivity for workers with allergies. Compared with workers without allergies, employees with allergies who reported using no medication showed a 10% decrease in productivity during the pollen season. The calculated cost to the company of this deficit was \$52 per week per affected employee.

It was concluded that investing in non-sedating antihistamines for these employees would increase productivity, producing a return on investment of \$2 for every \$1 spent.

Notes



The impact of health risks on absence from work and productivity

Doi Y, Minowa M, Tango T.

Impact and correlates of poor sleep quality in Japanese white-collar employees.

Sleep 2003: vol 26; pages 467-471.

The aim of this study was to (i) estimate the prevalence of sleep-related issues within a working population and (ii) examine the impact of poor sleep upon workplace absence.

A total of 4,868 employees of a telecommunications company in Tokyo completed the Pittsburgh Sleep Quality Index to assess the prevalence of significant sleep dysfunction.

Sleep issues were reported by 45% of the respondents. Those with poor sleep were 89% more likely to take sick leave and 135% more likely to have difficulties performing their jobs than those without sleep problems. The most strongly associated factors underlying poor sleep quality were perceived stress and low job satisfaction.

Notes



Jacobson BH, Aldana SG.

Relationship between frequency of aerobic activity and illness-related absenteeism in a large employee sample.

J Occup Environ Med 2001: vol 43; pages 1019-1025.

The aim of this study was to investigate the relationship between habitual physical activity levels and all-cause sickness absence.

In total, 79,070 workers in the U.S. completed a health and lifestyle questionnaire that included questions on type and frequency of physical activity. A period of aerobic exercise was defined as any type of continuous activity that increased heart rate, made the individual breathe more heavily than normal and was continuous for at least 20 minutes.

Annual sickness absence was lower for those with higher levels of physical activity. The most marked difference was observed between those who did no activity and those who did one day of activity per week. Non-exercisers had 46% greater absence rates than those that exercised once per week. Further but smaller reductions were seen as weekly exercise levels increased. In addition, non-exercisers were 51% more likely to be absent for seven days a year or more than those reporting two days of exercise per week and 30% more likely than those reporting doing activity on one day per week.

Notes



Boles M, Pelletier B, Lynch W.

The relationship between health risks and work productivity.

J Occup Environ Med 2004: vol 46(7); pages 737-745.

This study investigated the relationship between employee health risks and both on-the-job productivity and absence from work.

A total of 2,264 employees from a U.S. employer were recruited to the study (approximately 45% of the eligible population). All participants completed a health risk assessment and the Work Productivity and Activity Questionnaire, a commonly used and validated work productivity measure.

A clear relationship was observed between total number of health risk factors and presenteeism and absence from work. As the total number of health risk factors increased, the average percentage time lost through both absence and presenteeism also increased. Individuals with no health risk factors reported 1.3% and 0% lost time due to presenteeism and absence, respectively. These figures rose to 25.9% and 6.3% lost time for those with eight health risk factors.

The individual health risk factors most strongly associated with absent days from work were: physical inactivity, high levels of stress and diabetes. For productivity, poor diet, body mass index outside the normal range, physical inactivity, high levels of stress and lack of emotional fulfillment were most strongly associated.

This study adds to the evidence base supporting the direct association between employee health risk status and work performance. The observation that there is a large difference in productivity between the most and least healthy employees strengthens the argument for corporate health promotion programmes.

Notes



The impact of health risks on absence from work and productivity

Burton WN, Pransky G, Conti DJ, Chen CY, Edington DW.

The association of medical conditions and presenteeism.

J Occup Environ Med 2004: vol 46(Suppl 6); pages S38-S45.

The aim of this study was to investigate the relative contribution of different medical conditions on presenteeism.

A total of 16,651 employees of Bank One in the U.S. completed a health risk appraisal (HRA) and the Work Limitations Questionnaire (a measure of work impairment) in July 2002. In all, 47% of respondents reported the presence of at least one medical condition, with 22.5% reporting two or more conditions. Each additional medical condition was associated with a 4-5% increase in work impairment in the areas of (i) time management, (ii) physical work activities, (iii) mental/interpersonal activities, and (iv) overall work output.

The condition observed to have the greatest impact upon all of these areas was depression. Employees reporting depression were more than twice as likely to report limitations in work output because of their condition. Other conditions found to have a positive association with work limitations were (i) arthritis, (ii) back pain, (iii) diabetes, (iv) heart disease, (v) heartburn, (vi) high blood pressure, (vii) irritable bowel syndrome, and (viii) the menopause.

This study illustrates the extent of the impact of medical conditions on the working population. Not only do individuals incur greater health care costs, they are also much more likely to have impairments in work performance. This suggests that the integration of disease management and lifestyle management programmes in the workplace could yield benefits to both employee and employer.

Notes



The impact of health risks on absence from work and productivity

Burton WN, Chen CY, Conti DJ, Schultz AB, Pransky G, Edington DW.

The association of health risks with on-the-job productivity.

J Occup Environ Med 2005; vol 47(8); pages 769-777.

The aim of this study was to investigate the impact of different health risk factors upon productivity while at work (presenteeism).

A total of 28,375 employees of Bank One in the U.S. completed a health risk appraisal (HRA) and a brief version of the Work Limitations Questionnaire between 2002 and 2004. The average age of participants was 38.8 years and 73.1% were female.

The most common health risk factors observed in this population were (i) stress (35%), (ii) low levels of physical activity (30%), (iii) life dissatisfaction (29%), and (iv) obesity (28%). A direct relationship was observed between the number of health risk factors an individual reported and their overall work limitation. Individuals reported greater overall work limitation when classified as high risk for (i) smoking, (ii) physical activity, (iii) seat belt usage, (iv) use of medication for relaxation, (v) poor life satisfaction, (vi) poor physical health, (vii) poor job satisfaction, (viii) obesity, (ix) high blood pressure, and (x) high stress.

The estimated impact of these risk factors upon work productivity ranged from a 1.3% productivity loss for high blood pressure to 8.4% for the use of medication for relaxation. When cumulative risk factors were analysed, each additional risk factor was associated with a productivity loss of 2.4% compared with individuals with no risk factors. On average, individuals categorised as medium risk (3-4 health risk factors) had an excess productivity loss of 6.2% compared with those at low risk (0-2 health risk factors). High-risk individuals (5 or more health risk factors) had an excess productivity loss of 12.2% compared with low-risk individuals.

Individuals classified as medium or high risk were estimated to be costing the organisation between \$1,392 and \$2,592 in lost productive time per year.

This study confirms the intrinsic link between health status and work productivity, and gives an idea of the scale of financial loss attributable to health risk factors.

Notes



The impact of health risks on absence from work and productivity

Collins JJ, Baase CM, Sharda CE, Ozminkowski RJ, Nicholson S, Billotti GM, *et al.*

The assessment of chronic health conditions on work performance, absence, and total economic impact for employers.

J Occup Environ Med 2005: vol 47(6); pages 547-557.

The aim of this study was to estimate the costs associated with absenteeism and lost productive time at work (presenteeism) attributable to health risks for employees of the Dow Chemical Company in the U.S.

A population of 7,797 employees participated in an online health survey between July and September 2002. Participants completed the Stanford Presenteeism Scale and the SF-36 health-related quality of life questionnaire. Data was collected on medical and pharmaceutical claims costs, smoking status, the presence of chronic health conditions and various biometric factors.

A total of 65% of participants had at least one chronic medical condition, the most common being (i) allergies (37.1%), (ii) arthritis (21.8%), and (iii) back/neck disorders (16.3%).

For those with a chronic condition, average absenteeism during a four-week period varied from 0.9 to 5.9 hours depending upon the condition (breathing disorders 5.9 hours, depression/anxiety 3.7 hours, migraine headaches 2.4 hours, diabetes 1.3 hours, stomach/bowel disorders 1.9 hours, and allergies 0.9 hours).

Reported presenteeism varied from a 17.8% to a 36.4% decrement in ability to function, again dependent upon the condition (depression 36.4%, breathing disorders 23.8%, back/neck disorder 21.7%, and allergies 18.2%).

Across the whole study population, the average cost per employee was \$2,278 for medical care, \$661 for absenteeism and \$6,721 for presenteeism. Extrapolating this to the whole of the Dow workforce shows the total cost to be 10.1% of payroll costs.

This study provides further evidence for the huge impact health risks have upon total business costs. It also confirms that costs associated with presenteeism are far in excess of direct medical care costs.

Notes



Mills PR.

The development of a new corporate-specific health risk measurement instrument, and its use in investigating the relationship between health and well-being and employee productivity.

Environ Health 2005: vol 4(1); pages 1-9.

The aim of this study was to develop and validate a health risk appraisal (HRA) and to assess the impact of employee health risk status upon work productivity.

A total of 2,224 employees of three UK-based organisations completed the new HRA, the SF-36 health-related quality of life questionnaire and the World Health Organisation Health & Work Productivity Questionnaire.

The 20-question HRA was found to have excellent validity, both on internal measures and in comparison with other measures, such as the SF-36. A 23.5% difference in productivity was observed between individuals in the lower quartile of health compared with those in the upper quartile. Individuals with low and medium health risk status were found to be almost four times as likely to meet productivity standards than those with high-risk status.

This study is one of the few to critically validate an HRA and ensure that data that is generated is accurate and meaningful. In addition, the findings of higher productivity in employees with better health status adds to the body of evidence supporting health management as an important business issue.

Notes



Arena VC, Padiyar KR, Burton WN, Schwerha JJ.

The impact of body mass index on short-term disability in the workplace.

J Occup Environ Med 2006: vol 48; pages 1118-1124.

The aim of this study was to evaluate the impact of body mass index (BMI) on workplace productivity, as measured by the frequency and duration of short-term disability (STD) events in a working population.

Analysis was conducted on a total of 17,622 employees from a large financial services corporation in the U.S., who completed a health risk appraisal (HRA) between January 2000 and July 2002. Of whom, 1,690 (9.6%) had at least one STD event during the study period.

The duration and number of STD events was examined by BMI classification:

- (i) Underweight (BMI <18.5 kg/m²),
- (ii) Normal weight (BMI = 18.5-24.9 kg/m²),
- (iii) Overweight (BMI = 25-29.9 kg/m²),
- (iv) Obese (BMI ≥30 kg/m²).

Comparative analysis was done on two participant groups: (i) workers with an STD event and (ii) workers with no STD event.

Overweight or obese individuals were more likely to have an STD than normal or underweight individuals. The average BMI for employees with an STD event was 29.1 kg/m² and 26.6 kg/m² for employees without an STD event.

When the results for duration of STD were examined, underweight workers had the longest average STD duration (51.8 workdays over the study period) followed by obese individuals (48.8 workdays).

The study found that workers who were overweight or obese experienced a greater number of STD events and a greater number of workdays lost as a result, than those of normal weight.

Notes



Stewart WF, Ricci JA, Chee E, Morganstein D, Lipton R.

Lost productive time and cost due to common pain conditions in the U.S. workforce.

JAMA 2003: vol 290(18); pages 2443-2454.

The aim of this study was to estimate the amount of productive time lost due to common painful conditions and to estimate the economic costs associated with this.

Between 2001 and 2002, a representative sample of the U.S. workforce (28,902 people) completed the American Productivity Audit (a telephone survey). The respondents were asked to report time absent from work, reduced performance at work due to overall pain and due to specific painful conditions (including headache, back pain, arthritis and other musculoskeletal pain).

Of the respondents, 53% reported having at least one specific painful condition over the two weeks preceding the survey. Lost productive time was attributed to headaches by 5.4%, backpain by 3.2%, arthritis by 2.0% and musculoskeletal pain by 2.0%. Overall pain was reported as the cause of lost productive time by 13% of the respondents. The majority of lost productive time (77%) was explained by reduced performance at work rather than absence days.

It was estimated that workers with a painful condition lost 4.6 hours per week of productive time on average. Those with headaches lost 3.5 hours per week, those with arthritis or back pain lost 5.2 hours per week, and those with musculoskeletal pain lost 5.5 hours per week.

This loss in productive time was estimated to cost U.S. employers \$61.2 billion per year.

This study highlights the significant impact the presence of pain can have on productivity. This would suggest that strategies to reduce and manage pain in employees may have a positive effect on employee productivity and business performance.

Notes



The impact of health risks on absence from work and productivity

Tsai SP, Wendt JK, Ahmed FS, Donnelly RP, Strawmyer TR.

Illness absence patterns among employees in a petrochemical facility: impact of selected health risk factors.

J Occup Environ Med 2005: vol 47; pages 838-846.

The objective of the study was to quantify the impact of health risk factors on absenteeism.

A total of 2,550 employees from Shell U.S. who completed the Shell Health Surveillance System (HSS) questionnaire between January 1994 and December 2004 were included in the study.

The analysis looked at six selected health risk factors: (i) smoking, (ii) overweight and obesity, (iii) elevated cholesterol, (iv) elevated triglycerides, (v) hypertension, and (vi) elevated blood glucose. The analysis only included absences that lasted six days or more.

Absence duration was significantly associated with health risks; employees reporting one or more health risk factors had longer absence durations than those without risk factors. Current smokers had nearly twice as many work days lost compared with their non-smoker counterparts.

Similarly, obese employees had significantly higher rates of workdays lost than those of normal weight. Male employees with obesity lost 10.5 workdays compared with 6.8 days for normal-weight employees. Female employees with obesity lost 21.8 workdays compared with 7.7 days for normal-weight employees.

The frequency of absent days was strongly correlated with the number of health risk factors present. Absence rates were lower for employees with no risk factors than those with four or more risk factors. The number of workdays lost was also correlated with the number of risk factors present. Employees with no risk factors reported the least amount of workdays lost.

This study demonstrated that the presence of greater numbers of health risk factors results in a higher rate and longer duration of absence.

Number of risk factors	Frequency of absences (episodes per 100 employees)	Workdays lost per employee per year
0	11.8	4.1
1	16.3	6.4
2	23.0	8.8
3	27.4	9.3
4 or more	32.3	12.6

Notes



The impact of health risks on absence from work and productivity

Musich S, Hook D, Baaner S, Edington DW.

The association of two productivity measures with health risks and medical conditions in an Australian employee population.

Am J Health Promot 2006: vol 20; pages 353-363.

The aim of this study was to explore the impact of health status on job performance, as measured by self-reported presenteeism and absenteeism (due to illness), in an insurance company.

In total, 224 employees completed a health risk appraisal (HRA) in 2004. Twelve health risk factors known to impact future costs were used for the analysis. Health risks status was determined by counting the number of individual health risks for each participant:

- (i) Low risk: 0-2 health risks,
- (ii) Medium risk: 3-4 health risks,
- (iii) High risk: 5 or more health risks.

The presence of eight chronic medical conditions were also recorded (heart problems, diabetes, cancer, bronchitis/emphysema, asthma, arthritis, allergies and back pain).

High-risk health status was associated with higher rates of presenteeism and absenteeism.

Individuals classified as high risk for stress and life dissatisfaction reported significantly higher presenteeism rates than low-risk individuals.

Significantly higher rates of presenteeism were also observed for those who used drugs/medication for relaxation, had poor perception of health and physical inactivity. For absenteeism, poor perception of health and being overweight were associated with significantly higher illness-related absence hours per month.

The rate of presenteeism and hours of absenteeism per individual per month were significantly higher for those with one or more medical conditions than those with none.

This study confirmed the relationship between the health status of employees and day-to-day job performance and time away from work.

Status	Presenteeism rate	Absenteeism (hrs per month)
Low risk	14.5%	2.4
Medium risk	23.7%	3.1
High risk	32.7%	5.1

Notes



The impact of health risks on absence from work and productivity

Musich S, Hook D, Baaner S, Spooner M, Edington DW.

The association of corporate work environment factors, health risks, and medical conditions with presenteeism among Australian employees.

Am J Health Promot 2006: vol 21; pages 127-136.

The aim of this study was to investigate the impact of work environment factors, health risks, and medical conditions on job performance, based on self-reported measures of presenteeism.

A total of 1,523 Australian employees across various industries completed a health risk appraisal (HRA) between October 2004 and November 2005. The HRA was divided into three parts:

- (i) Work factors (i.e. working conditions, management/leadership and work/life balance).
- (ii) Health risks (i.e. alcohol use, blood pressure, body weight, cholesterol, drug/medication use for relaxation, job satisfaction, life satisfaction, perception of health, physical activity, safety belt use, smoking, and stress).
- (iii) Medical conditions (i.e. allergies, arthritis, asthma, back pain, bronchitis/emphysema, cancer, diabetes, and heart problems).

Presenteeism was measured by the amount of time an employee's ability to perform tasks at work was decreased due to health problems.

On average, significantly higher rates of presenteeism were observed for employees reporting adverse workplace conditions, management/leadership and work/life balance, compared with those who responded positively with regard to these factors.

Work factors

	Average percentage presenteeism
Positive working conditions	14.3%
Adverse working conditions	22.7%
Positive management/leadership	14.8%
Adverse management/leadership	21.7%
Positive work/life balance	14.2%
Adverse work/life balance	24.2%

Analysis of health risks indicated that life dissatisfaction, job dissatisfaction, stress, use of drugs/medication for relaxation and poor perception of health were all significant predictors of presenteeism.

Among medical conditions, heart problems, allergies, back pain and asthma were associated with increased chance of reporting presenteeism.

This study demonstrated that the organisational aspect of work life, including working conditions, management effectiveness, and the work/life balance, coupled with health risks and medical conditions are important factors in day-to-day job performance.

Notes



The impact of health risks on absence from work and productivity

Kleinman NL, Brook RA, Rajagopalan K, Gardner HH, Brizee TJ, Smeeding JE.

Lost time, absence costs, and reduced productivity output for employees with bipolar disorder.

J Occup Environ Med 2005; vol 47; pages 1117-1124.

The aim of this study was to analyse the impact of bipolar disorder (BPD, often referred to as manic depression) on lost work time (absenteeism) and at-work productivity.

Data for the study was collected between January 2001 and December 2002 from a large insurance claims database of more than 230,000 employees across the U.S. Diagnosis and treatment data together with absenteeism records and day-to-day personal-level work output was used for the analysis.

The total population was divided into four groups:

- (i) Employees with a BPD diagnosis in 2001 (group 1).
- (ii) Employees without a BPD diagnosis in 2001 or 2002 (group 2).
- (iii) Employees with mental health diagnoses other than BPD in 2001 (group 3).
- (iv) Employees who did not have BPD or another mental health diagnosis in 2001 or 2002 (group 4).

Analysis showed that employees with BPD (group 1) had greater absenteeism than the other groups. As a consequence, employees with BPD incurred 2.3 times greater absence-related costs than employees without BPD.

In addition, compared with employees with a mental health diagnosis other than BPD, individuals with BPD incurred 1.5 greater costs due to absenteeism.

Group	Absenteeism days per employee per year	Total absence-related costs
1	18.9	\$1,995
2	7.4	\$885
3	12.2	\$1,318
4	6.1	\$776

Over the period of a year employees with BPD had significantly lower work productivity compared with the other four groups. On average, individuals with BPD showed a 20-22% productivity decrement.

This study demonstrated that having a diagnosis of BPD is strongly associated with higher costs for both lost work time and at-work productivity loss.

Notes



Ricci JA, Chee E, Lorandeau AL, Berger J.

Fatigue in the U.S. workforce: Prevalence and implications for lost productive work time.

J Occup Environ Med 2007: vol 49; pages 1-10.

The objective of this study was to estimate the prevalence of fatigue and its impact on health-related lost productive time (LPT) for U.S. workers. The sample population consisted of 28,902 employed individuals from 49 states across the U.S. Individuals participated in a telephone interview between August 2001 and May 2003. Affirmative responses to the following questions were used to define the presence of fatigue: in the two weeks prior to the telephone interview did you have (i) low levels of energy, (ii) poor sleep, or (iii) a feeling of fatigue. Applying this definition, 11,719 participants (41%) screened positive for fatigue.

LPT was measured as the sum of self-reported hours per week absent from work because of health-related reasons (absenteeism) and health-related reduced performance while at work (presenteeism). Participants were divided into two groups: (i) workers with fatigue and (ii) workers without fatigue. The study further examined a subset of workers with fatigue who reported:

- 1) Fatigue as their only health condition.
- 2) Fatigue with co-occurring health conditions.

The analysis looked at nine co-occurring health conditions and symptoms (pain, digestive problems, feeling sad/blue, cold/flu, allergies, asthma/chronic breathing problems, cancer, heart disease and diabetes).

Workers with fatigue were significantly more likely to report at least one of the nine co-occurring health conditions than those without (94.0% versus 59.9%, respectively).

The prevalence of fatigue differed by health characteristics. The frequency of fatigue was significantly higher for workers with one or more of the nine co-occurring conditions than for those who reported fatigue as their only health condition. The prevalence was highest in those feeling sad or blue (68.3%).

In total, 9.2% of the study population reported losing productive time specifically due to fatigue. Workers under 40 years of age were more likely than older workers to lose productive time from fatigue. Those who reported LPT due to fatigue lost an average of 4.1 hours of productive work per week. Most productive time (85.4%) was lost as reduced performance while at work (presenteeism), rather than as work absence.

On average, workers with fatigue who had additional health conditions lost 5.6 hours per week compared with 3.3 hours reported by their non-fatigued counterparts. Overall, workers with fatigue cost U.S. employers an estimated \$136.4 billion per year in health-related LPT, an excess of \$101.0 billion per year compared with workers without fatigue.

The study found a clear association between fatigue and LPT. In addition, fatigue, when co-existing with other conditions, is associated with greater LPT.

Notes



The impact of health risks on absence from work and productivity

Bunn WB, Stave GM, Downs KE, Alvir JM, Dirani R.

Effect of smoking status on productivity loss.

J Occup Environ Med 2006; vol 48; pages 1099-1108.

The aim of this study was to determine health-related productivity losses due to smoking in various U.S. organisations.

The study utilised data from 34,934 employees from 147 companies who participated in a Wellness Inventory (WI) between 2002 and 2005. These companies represented a variety of organisational types from across the U.S.

The WI captured days lost from work (absenteeism) and unproductive time at work due to health conditions (presenteeism). Eleven common health conditions were included in this analysis:

- i. allergic rhinitis/hayfever,
- ii. anxiety disorder,
- iii. arthritis/rheumatism,
- iv. asthma,
- v. coronary heart disease,
- vi. depression,
- vii. diabetes,
- viii. high stress,
- ix. hypertension,
- x. migraine,
- xi. respiratory illness.

Respondents were classified as: non-smokers, current smokers, or former smokers.

Non-smokers were almost twice as likely to report better health status than smokers. Former smokers were more likely to report a better health profile than current smokers.

Total days lost due to health conditions were significantly higher for current smokers than for non-smokers and former smokers.

Current smokers missed more days due to health conditions than former and non-smokers. Analysis of medical conditions revealed that allergic rhinitis/hayfever was the most commonly experienced condition (59.5% of females and 56.0% of males). Non-smokers and former smokers reported significantly fewer days of work missed for allergic rhinitis/hayfever than current smokers.

Analysis on smoking costs revealed that, employees who smoke cost \$4,430 in lost productivity time compared with \$2,623 for non-smokers and \$3,246 for former smokers.

The study found that current smokers incurred the highest productivity losses due to health-related absenteeism. Consequently, these losses translated into higher costs to employers for current smokers.

Productivity results	Non-smokers (n = 21,877)	Former smokers (n = 8,452)	Current smokers (n = 4,605)
Average days missed due to health conditions per employee per year	4.4	4.9	6.7
Average hours lost per year due to absenteeism	35.2	39.2	53.6
Average hours lost per year due to presenteeism	42.8	56.0	76.5
Medical conditions	Non-smokers (n = 21,877)	Former smokers (n = 8,452)	Current smokers (n = 4,605)
Average days missed due to allergic rhinitis/hayfever (per year)	Females: 1.95 Males: 1.88	Females: 1.81 Males: 2.59	Females: 2.52 Males: 2.82

Notes



The business benefits of health promotion programmes

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The business benefits of health promotion programmes

Golaszewski T, Snow D, Lynch W, Yen L, Solomita D.

A benefit-to-cost analysis of a worksite health promotion program.

J Occup Med 1992: vol 34; 1164-1172.

In 1986, the Travelers Insurance Company in the U.S. introduced a comprehensive health promotion programme to its 36,000 employees and retirees nationwide. This study assessed the benefit-to-cost ratio of the programme.

The health promotion programme consisted of multiple health communications (newsletters, brochures, videos, and a medical self-care book) along with social activities (such as health fairs and contests). A variety of health and lifestyle management courses were provided including smoking cessation, weight control and stress management. For some employees, a fitness facility was introduced.

A total cost-to-benefit analysis was completed from 1986 to 1990. Costs included facility rent, personnel, materials, capital expenses, and pension liability. Benefits included savings from reduced health care costs, improved health status (defined through calculation of 'health age'), reduced absenteeism, lower life insurance payouts and increases in productivity.

The programme reached a positive benefit-to-cost ratio of over \$300,000 in the first year, with this figure increasing substantially in the second year to \$4.9 million (primarily because of increased productivity and decreased absenteeism) and increased steadily through to 1990. Utilising predictions of benefit-to-cost through to the year 2000, the net cumulative benefit was estimated to be over \$146 million on an investment of \$60 million over a 15-year period. This gives a return on investment of \$3.4 for every \$1 invested in the health promotion programme.

Notes



The business benefits of health promotion programmes

Edington DW, Yen LT, Witting P.

The financial impact of changes in personal health practices.

J Occup Environ Med 1997: vol 39; pages 1037-1046.

This study assessed the financial impact of changes in employee health risk status on medical claim costs in a large U.S. manufacturing company (Steelcase).

A group of 796 employees who had complete medical claims records from 1985 to 1990 and had completed health risk appraisals (HRAs) before and after that period were included. Based on their HRA, employees were classified as either low health risk (2 or fewer risk factors) or high health risk (3 or more risk factors) based on 10 variables (smoking, physical activity, medication use, excess absence, alcohol, seatbelt use, systolic and diastolic blood pressure, cholesterol and body weight).

Medical claims were examined for two time periods: 1985 to 1987 (time 1) and 1988 to 1990 (time 2), with employees classified as either high cost or low cost for each time period (expressed in 1996 U.S. dollars). At time 1 and time 2, being at high risk for any one of the health risk measures was related to higher medical claim costs.

Individuals who changed risk status between the two time periods also changed costs. Those who transitioned from high-risk to low-risk status had a decrease in medical care costs of \$129 per year on average. Those who transitioned from low-risk to high-risk status had increased medical care costs of \$734 per year on average. Employees who remained low risk had increased medical costs of \$69 and those who remained high risk had increased costs of \$287.

During the study period, the percentage of employees with high-risk status decreased from 31.8% in 1985 to 25.3% in 1990. This study demonstrates that a change in personal health status is associated with significant and meaningful changes in health care costs.

Notes



The business benefits of health promotion programmes

Goetzel RZ, Jacobson BH, Aldana SG, Vardell K, Yee L.

Health care costs of worksite health promotion participants and non-participants.

J Occup Environ Med 1998; vols 40; pages 341-346.

The aim of this study was to compare both the total and lifestyle-attributable medical care costs for employees of a major corporation (Proctor & Gamble) participating in a worksite health promotion programme.

In all, 3,993 employees participated in the programme over a three-year period and their data was compared with 4,341 non-participants. A health risk appraisal (HRA) assessed tobacco use, nutrition, exercise, safety, self care, dental health, preventive medical care, medical history, alcohol use, stress, weight, blood pressure, body mass index and cholesterol levels. After completion of the HRA, participants received reports, counselling and behaviour change support as well as quarterly follow-ups and health improvement plans designed for fitness, weight management and smoking cessation.

Medical claims were followed and compared between health programme participants and non-participants for a three-year period. Claims were broken down into whether they could be attributable to lifestyle-related factors (such as smoking, overweight and alcohol consumption) or not.

By the third year of the worksite health promotion programme, participants had 29% lower total medical costs compared with non-participants (\$1,339 versus \$1,731, respectively) and 36% lower annual lifestyle-related medical costs (\$445 versus \$604, respectively). These cost savings were not evident for the first two years.

Non-participants experienced 25% more lifestyle-related hospital admissions per 1,000 employees compared with participants, and 28% more lifestyle-related hospital days per 1,000 employees in the third year of the health intervention programme.

The total lifestyle-related medical costs were 34.8% (\$2.3 million), 33.8% (\$2.5 million) and 37.7% (\$3 million) of total annual medical costs for the entire group for the first, second, and third study years, respectively. On average, potential lifestyle-related medical costs accounted for about 35% of total medical costs over the three years.

This study highlights the financial benefits of a medium-term commitment to a worksite health promotion programme by way of lower total and lifestyle-related health care costs.

Notes



The business benefits of health promotion programmes

Fries JF, Bloch DA, Harrington H, Richardson N, Beck R.

Two-year results of a randomized controlled trial of a health promotion program in a retiree population: the Bank of America Study.

Am J Med 1993: vol 94; pages 455-462.

The aim of this study was to evaluate the effectiveness of a health promotion programme in reducing health risks and medical claims costs for a population of 4,712 Bank of America retirees.

Subjects were randomised into three groups and followed for 24 months:

Group 1: the intervention group, received an individualised health promotion programme including a health risk appraisal (HRA), with feedback and targeted health information.

Group 2: received an HRA, without feedback, for the first 12 months and then the full intervention for the second 12 months.

Group 3: acted as a control group and received no health promotion services.

A health risk score was derived from the HRA. Medical claims data was analysed for all three groups.

Overall health risk scores for the health intervention groups improved by 12% at 12 months and by 23% (from baseline) at 24 months.

For the first 12 months, intervention Group 1 averaged a \$60 reduction in medical claims per person compared with an average increase of \$15 for Groups 2 and 3 combined. At 24 months, the intervention groups had 10% lower medical claims costs than the control group.

Notes



The business benefits of health promotion programmes

Ozminkowski RJ, Dunn RL, Goetzel RZ, Cantor RI, Murnane J, Harrison M.

A return on investment evaluation of the Citibank, N.A., health management program.

Am J Health Promot 1999: vol 14; pages 31-43.

In 1994, Citibank introduced a comprehensive health and disease management programme to its employees. The aim of this study was to evaluate the impact of this intervention on medical claims costs and to calculate a return on investment (ROI) for the programme.

Between 1994 and 1997, 11,194 employees participated in the health promotion programme; 11,644 non-participating employees were monitored as a control group.

Participants completed a health risk appraisal (HRA) that assessed: (i) smoking, (ii) alcohol, (iii) vitality, (iv) body weight, (v) exercise, (vi) nutrition, (vii) stress, (viii) medication usage, (ix) seat belt usage, (x) chronic health problems, and (xi) overall health perception. Based on HRA data, employees found to have multiple risk factors and employees with specific health conditions or risk factors (i.e. asthma, arthritis, diabetes, back pain, high blood pressure, lung disease, heart disease, tobacco use and high body weight) were invited to participate in an intervention programme. The programme included telephone counselling, educational materials, and further HRAs with follow-up reports. All employees who completed an HRA (including those at low risk) received a confidential letter, report, health education materials and details of a free telephone health line.

Medical costs for programme participants increased by 25% from the pre-HRA to the post-HRA period (from \$170 to \$212 per person per month). However, costs for non-participants increased by 43% (from \$180 to \$257 per person per month). The increase in medical expenditures over time was \$34.03 lower per person per month for health programme participants compared with non-participants.

An ROI analysis calculated programme costs at \$1,850,893, benefits at \$8,439,372 and resultant savings of \$6,588,479. This generated a ROI for the programme of \$4.56 for every \$1 spent.

Notes



The business benefits of health promotion programmes

Bly JL, Jones RC, Richardson JE.

Impact of worksite health promotion on health care costs and utilization. Evaluation of Johnson & Johnson's Live for Life program.

JAMA 1986; vol 256; pages 3235-3240.

The aim of this study was to examine the effect of Johnson & Johnson's 'Live for Life' health promotion programme on health care utilisation and costs by employees of the Johnson & Johnson Corporation.

In all, 8,451 employees received the 'Live for Life' programme; a comprehensive worksite health promotion programme consisting of health screens, lifestyle improvement programmes (including smoking cessation and stress management) and work environment changes (such as healthy cafeteria foods and exercise facilities). A control group of 2,955 employees who did not receive the programme was included for comparison.

Medical care costs and medical utilisation data were compared between the two groups over a five-year period from 1979 to 1983.

Over the study period the intervention group had a lower number of hospital admissions and hospital visits and showed lower rates of increase in medical claims compared with the control group. The average annual per capita increase in costs were \$18 and \$46 for participants and controls, respectively (1979 U.S. dollars).

Of note, savings between the two groups only emerged after three years of the health promotion programme, with the costs for the two groups being similar from 1979 to 1981.

Notes



Melhorn JM, Wilkinson L, Riggs JD.

Management of musculoskeletal pain in the workplace.

J Occup Environ Med 2001: vol 43; pages 83-93.

The aim of this study was to investigate the impact of a musculoskeletal pain prevention programme targeted at new employees of a large U.S. aircraft manufacturer.

An initial musculoskeletal health risk appraisal was followed by a tailored intervention programme designed to increase awareness and understanding of musculoskeletal problems and encourage behaviours to prevent its occurrence. A total of 199 new employees took part in the programme between 1998 and 1999. An age, gender and job-matched group who did not receive the programme were used as a control group.

Employees who took part in the programme had lower injury rates, less severe injuries, lower workers' compensation costs and better productivity than the control group.

Musculoskeletal problems that did develop in the intervention group cost less to treat than in the control group (\$2,468 versus \$3,800, respectively). Taking into account the cost of the intervention, the net direct cost saving per case of musculoskeletal pain was \$1,332, providing a benefit to cost ratio of over 34 to 1.

Notes



The business benefits of health promotion programmes

Bertera RL.

The effects of workplace health promotion on absenteeism and employment costs in a large industrial population.

Am J Public Health 1990: vol 80; pages 1101-1105.

Between 1983 and 1984 the Du Pont Company investigated the impact of their comprehensive worksite health promotion programme upon absence days and the associated wage costs within a 'blue collar' employee population.

The health promotion programme included a health risk appraisal with follow-up consultation, self-directed and group health education opportunities (e.g. fitness, weight control and stress management), a bi-monthly newsletter, cafeteria/vending machine modifications, and various contests and events.

The study population consisted of 29,315 employees who received the programme and 14,573 employees who did not and acted as a control group.

Data on absence days and associated wage costs were collected for one year prior to implementation of the programme and during the study.

Employees who received the health promotion programme had a significant decrease in disability days compared with 'non-intervention' employees (average decrease of 14% versus 5.8%, respectively).

Savings due to lower absence costs at health promotion intervention sites offset the programme costs in the first year, and provided a return of \$2.05 for every \$1 invested in the programme by the end of the second year (1985 U.S. dollars).

Notes



The business benefits of health promotion programmes

Knight KK, Goetzel RZ, Fielding JE, Eisen M, Jackson GW, Kahr TY, *et al.*

An evaluation of Duke University's Live For Life health promotion program on changes in worker absenteeism.

J Occup Med 1994: vol 36; pages 533-536.

Between 1989 and 1991, 4,972 Duke University hourly employees (service workers and technicians) took part in this study that aimed to compare absence from work between employees who participated in the 'Live for Life' health promotion programme (provided by Johnson & Johnson) and those who did not.

In 1988, absenteeism hours for the two groups were nearly identical (mean annual absence: 72.4 hours in the intervention group and 72.5 hours in the control group). In the third year of the programme (1991), although absenteeism rose in both groups, programme participants experienced an average of 4.4 fewer absence hours a year compared with non-participants (81.6 versus 86.0 hours, respectively).

Notes



The business benefits of health promotion programmes

Holzbach RL, Piserchia PV, McFadden DW, Hartwell TD, Herrmann A, Fielding JE.

Effect of a comprehensive health promotion program on employee attitudes.

J Occup Med 1990: vol 32; pages 973-978.

The aim of this study was to evaluate the impact of Johnson & Johnson's 'Live for Life' health promotion programme on work-related attitudes and engagement of employees.

In all, 2,040 individuals from four companies offering the Live for Life programme were compared with 1,201 individuals from three companies that were only offered annual health screening over a two-year period. A 20-item 'attitude' questionnaire was administered to all participants at baseline, and again at year one and year two. The questionnaire included specific questions on organisational commitment, job involvement, growth opportunities and working conditions.

Intervention group employees showed consistent improvements in all measures of attitude, which were significantly greater than for non-participants. In particular, a 6.7% improvement in organisational commitment was observed.

Notes



The business benefits of health promotion programmes

Schultz AB, Lu C, Barnett TE, Yen LT, McDonald T, Hirschland D, *et al.*

Influence of participation in a worksite health promotion program on disability days.

J Occup Environ Med 2002: vol 44; pages 776-780.

The purpose of this study was to assess the impact of participation in a worksite health promotion programme on sickness absence days.

A total of 4,189 male employees of General Motors Corporation (U.S.) were invited to participate in a comprehensive workplace health promotion programme between 1995 and 2000. In all, 2,596 individuals (62%) participated and 1,593 (38%) did not.

A health risk appraisal was available to all employees, the results of which were used to direct appropriate health status interventions.

The number of sickness absence days (both long and short term) was compared between programme participants and non-participants, a year before the baseline assessment and for five years afterwards.

During the study period, the percentage of employees absent due to illness or disability increased by 160% for the participant group and by 252% for the non-participant group. Similarly, an increase in the average number of annual sickness absence days per person was also observed for both groups, but again non-participants had a greater absence rate than participants (23.2 versus 17.2 days, respectively) at the end of the study.

Calculation of the cost to benefit ratio showed a return of \$2.3 for every \$1 spent on the programme due to lower absence rates.

Notes



The business benefits of health promotion programmes

Harvey MR, Whitmer RW, Hilyer JC, Brown KC.

The impact of a comprehensive medical benefit cost management program for the city of Birmingham: results at five years.

Am J Health Promot 1993: vol 7; pages 296-303.

Between 1985 and 1990, a comprehensive health costs management effort was initiated for employees of the city of Birmingham (AL, U.S.), as a direct response to a 295% increase in medical benefits costs that had occurred between 1975 and 1985 (average increase from \$692 to \$2,047 per person per year). The programme had the main objective of lowering medical care costs below the state average by 1990.

A major part of the cost management focus was a multicomponent health promotion programme that included: (i) a mandatory health risk appraisal, (ii) voluntary personal health consultations, (iii) health education programmes in areas such as stress management, weight management and smoking cessation, (iv) installation of a brand new comprehensive fitness centre, and (v) incentives to participate.

During the intervention period the average annual costs per employee were virtually unchanged (\$2,047 in 1985 and \$2,075 in 1990). However, employees saw an 82% increase in health care costs during the same time period. In 1985, the mean city cost per employee was \$397 above the state average. In 1987, average costs for city employees fell to \$54 below the state average. And by 1990, the city of Birmingham employee average was \$922 below the state average.

The cost of delivering the programme was approximately \$2 million (\$400,000 annually) over the five-year period, yielding a benefit-to-cost ratio of \$3.6 for every \$1 spent. In addition, both the number of hospital admissions and number of days spent in hospital decreased by 55% and 38% respectively, during the study period.

Notes



The business benefits of health promotion programmes

Shephard RJ.

Long term impact of a fitness programme – the Canada Life Study.

Ann Acad Med Singapore 1992: vol 21; pages 63-68.

The aim of this study was to assess the impact of the Canada Life Assurance fitness programme after 12 years of operation. Employees of another insurance company based on the same street as Canada Life were used as a control population for comparative purposes.

Although general health & well-being was promoted as part of the programme, the main focus was on physical activity and use of the staff gymnasium. At initial opening, approximately 50% of employees became members of the fitness facility; however, after 12 years this dropped to approximately 13%.

Voluntary staff turnover was significantly lower in frequent participants of the fitness programme as compared with non-participants and controls (9.9% versus 18%, respectively).

Absenteeism for programme participants was observed to be 1.3 days per year less than controls and non-participants. Taking into account the proportion of the company who participated, this was estimated to be equivalent to 0.13% of total payroll costs. Additionally, a 2.7% improvement in productivity was observed early on in the history of the programme compared with controls.

Cost-benefit analysis for the long-term impact of the programme for the business showed a return of \$4.8 for every \$1 invested.

Notes



The business benefits of health promotion programmes

Serxner S, Gold D, Anderson D, Williams D.

The impact of a worksite health promotion program on short-term disability usage.

J Occup Environ Med 2001: vol 43; pages 25-29.

The purpose of this study was to examine the impact of a worksite health promotion programme on short-term disability (STD) days.

In total, 1,628 employees from a large U.S. telecommunications company who had at least one STD episode between 1996 and 1998 were included in the study.

In total, 450 employees who participated in a comprehensive health promotion programme between 1997 and 1998 were compared with 1,178 non-participants in terms of net work days lost at three assessment points; the year prior to the launch of the health promotion programme, and each of the two years post launch. A key feature of the programme was reimbursement for employees participating in community based wellness initiatives and incentives for completing a health risk appraisal.

Overall, non-participants had an increase of 14.8% in STD days (from 33.2 days per year to 38.1), whereas health programme participants had a decrease in STD days of 3.6% (from 29.2 to 27.8 days). After adjusting for baseline differences, there was an average six days per year difference between the two groups at the end of the study.

Notes



The business benefits of health promotion programmes

Ozminkowski RJ, Goetzel RZ, Santoro J, Saenz BJ, Eley C, Gorsky B.

Estimating risk reduction required to break even in a health promotion program.

Am J Health Promot 2004; vol 18(4); pages 316-325.

This study estimated the reduction in health risks that would be needed to break even financially on a health promotion programme.

A 10-year financial impact model was developed for a population of 52,124 employees of Motorola. The model used data collected in 2001 to predict the demographic make-up of the company for the next 10 years.

The health risk profile of the company was estimated from the results of a health risk appraisal. The risk factors considered were: (i) poor exercise habits, (ii) poor eating habits, (iii) high body weight, (iv) currently smoke cigarettes, (v) high total cholesterol, (vi) high blood glucose, (vii) high blood pressure, (viii) high stress, (ix) being depressed, and (x) heavy alcohol use.

The medical care costs were then forecast based on the demographic make-up of the company and the health risk status of the employees.

Knowing that the health promotion programme at Motorola cost \$282 per employee per year, it was then possible to calculate the amount of risk reduction required to break even financially – so that the amount invested in the programme exactly matched the amount saved in health care costs as a result of those efforts.

It was found that in order to break even on the health promotion programme, the health risks of the employees at Motorola would need to be reduced by 1.15% per year.

This research calculated the amount of change in health risks that is needed to justify investment in health promotion programmes and showed that only small shifts in risk status can easily cover the costs associated with implementing the programmes.

Notes



The business benefits of health promotion programmes

Pelletier B, Boles M, Lynch W.

Change in health risks and work productivity over time.

J Occup Environ Med 2004: vol 46(7); pages 746-754.

The aim of this study was to assess the effect of a workplace wellness programme on the health risk status and work productivity or employees.

A total of 500 employees from a large company in the northeast of the U.S. were surveyed before and after they participated in a wellness programme. In both 2001 and 2002, employees completed two questionnaires: a health risk appraisal and the Work Productivity and Activity Impairment Questionnaire - General Health.

At baseline, the number and type of health risk factors were significantly associated with absenteeism (percentage of time missed from work due to health problems) and presenteeism (percentage of time impaired while on the job).

A significant reduction in the percentage of people with poor diet, high cholesterol, overdue preventative visits and high stress was seen for programme participants.

	Before	After
Poor diet	80%	73%
High cholesterol	50%	18%
Overdue preventative visits	32%	20%
High stress	31%	27%

It was also observed that 49% of the study group reduced their number of health risk factors, with 19% reducing two or more and 30% reducing one.

As the participants reduced their health risks, presenteeism and absenteeism decreased. A reduction of one health risk factor resulted in a 9% improvement in presenteeism and a 2% reduction in absenteeism, when baseline demographic characteristics were taken into account.

This study shows that reductions in health risks (through the use of workplace wellness programmes) are associated with positive changes in work productivity and supports the investment in such programmes.

Notes



The business benefits of health promotion programmes

Burton WN, McCalister KT, Chen CY, Edington DW.

The association of health status, worksite fitness center participation, and two measures of productivity.

J Occup Environ Med 2005: vol 47(4); pages 343-351.

This study examined the effect of participation in a worksite fitness centre on productivity and absenteeism.

In 2002, 999 employees of Bank One in the U.S. completed a health risk appraisal (HRA) as well as the Work Limitations Questionnaire (WLQ). The WLQ is a validated work performance instrument with questions designed to evaluate the percentage of work time lost due to emotional or physical problems. Four work areas are assessed: (i) time management, (ii) physical work activities, (iii) mental/interpersonal activities and (iv) overall output. Absence records were also examined as an additional measure of productivity.

Participants in the company's worksite fitness centre (200 individuals) were compared with 799 non-participants.

When baseline demographic differences were controlled for, strong associations were found between participation in the worksite fitness centre and higher productivity, as well as reduced work absence. Fewer fitness centre participants reported work impairment than non-participants. Non-participants were nearly twice as likely as participants to report health-related work limitations in the areas of time management and physical work, and 1.5 times as likely to report limitations in overall output.

When their absence records were compared, non-participants had significantly more days absent than participants (3.15 versus 1.86 days, respectively). It was calculated that non-participants cost \$258 more in lost work time per employee than participants.

This research highlights the valuable contribution of a worksite fitness centre in increasing productivity and decreasing absence.

Notes



The business benefits of health promotion programmes

Goetzel RZ, Ozminkowski RJ, Baase CM, Billotti GM.

Estimating the return-on-investment from changes in employee health risks on the Dow Chemical Company's health care costs.

J Occup Environ Med 2005; vol 47(8); pages 759-768.

The aim of this study was to estimate whether health risk reduction programmes are worthwhile investments for companies.

A 10-year financial impact model was developed by the Health and Human Performance Services Department of the Dow Chemical Company. The model projected future health care costs for Dow employees based on different health risk reduction scenarios (from no intervention to major intervention).

The model was developed using demographic data collected on Dow's employees in 2001. This data was used to predict the demographic make-up of the company for the next 10 years. In addition, the health risk profile of the company for the next 10 years was estimated from the results of Dow's Health Questionnaire and bio-metric data collected at a health screening.

The model was used to predict Dow's health care expenditures for the next 10 years. Different scenarios were simulated: (i) no intervention, (ii) major intervention, (iii) modest intervention, and (iv) a 'break even' scenario, where each health risk was reduced enough so that the amount invested in a health promotion programme exactly matched the amount saved in health care costs as a result of those efforts.

The results of the model suggested that small reductions in health risks could lead to large savings for the company. For the company to 'break even', only a 0.17% point reduction in each health risk would be needed.

The model predicted that, with no intervention, Dow's health care expenditures would be expected to increase by 3.1% per year. For the major intervention scenario, where each health risk would be reduced by 1% per year, Dow's health care expenditures would be expected to increase by 1.3% per year – a large reduction. If the benefits under this scenario are compared with the cost of the health promotion programme, \$3.21 would be saved for every dollar spent. For the modest intervention scenario, where each health risk would be reduced by only 0.1% per year, health care expenditures would be expected to increase by 2.6% per year. This represented a slight negative return on the investment in health promotion programmes, with only \$0.76 return for every dollar invested.

This model showed that in large corporate populations, small changes in health risk status can yield highly beneficial financial returns. This model did not include the indirect costs associated with ill-health, such as lost productivity and absenteeism. If these were included, the potential savings could be even greater.

Notes



The business benefits of health promotion programmes

Burton WN, Chen CY, Conti DJ, Schultz AB, Edington DW.

The association between health risk change and presenteeism change.

J Occup Environ Med 2006: vol 48; pages 252-263.

The purpose of this study was to identify whether changes in health risks are associated with changes in presenteeism (on-the-job productivity loss) in a large U.S. financial services company.

The study involved 7,026 employees who completed two health risk appraisals (HRAs) between 2002 and 2004. The two HRAs were defined as: (i) time 1 (first HRA), and (ii) time 2 (second HRA).

HRA participants were classified into three overall health risk categories: (i) low risk (0-2 risk factors), (ii) medium risk (3-4 risk factors), and (iii) high risk (5 or more risk factors).

Results of the first HRA revealed that 66.7% of participants were low risk, 23.0% were medium risk, and 10.3% were high risk. These percentages shifted in the second HRA to 64.6%, 24.4%, and 11.0%, respectively.

Analysis showed that employees who increased their risk status, or stayed high risk, had greater productivity losses than those who remained low risk or reduced a health risk category. A total of 55% of those who were low risk at time 1 remained low risk at time 2, with their productivity loss decreasing by 1.1% during this time. However, 1.5% of those who were low risk at time 1 were high risk at time 2, and their excess productivity loss increased by 8.1%.

This study demonstrated that changes in self-reported health risks (positive or negative) are strongly associated with changes in self-reported productivity.

Notes



The business benefits of health promotion programmes

Ozminkowski RJ, Goetzel RZ, Wang F, Gibso TB, Shechter D, Musich S, et al.

The savings gained from participation in health promotion programs for Medicare beneficiaries.

J Occup Environ Med 2006; vol 48; pages 1125-1132.

The aim of the study was to estimate the savings in medical costs incurred by Medicare beneficiaries who participated in a retiree health promotion programme.

The study involved a total of 59,324 retired employees (and their dependents) of a large U.S. company, who participated in one or more health promotion programmes between 1996 and 2002.

Health promotion programmes offered to individuals included:

- i. Health risk appraisal (HRA).
- ii. On-site biometric screenings.
- iii. Telephone-based lifestyle management consulting.
- iv. Self-care advice by nurse telephone-line support service.
- v. Educational classes offered at the worksite.

Compared with individuals who did not participate in any health promotion programme, medical costs from year to year were significantly lower for employees who completed an HRA.

Average annual savings in medical costs for those using only the HRA were approximately \$408. Using the HRA plus one other programme increased savings to \$442. The HRA plus two programmes increased savings further to \$569.

Programmes that were not guided by HRA completion usually did not reduce costs. Participating in a programme independently, without taking an HRA, led to a cost increase of \$215.

This study demonstrated that engaging in an HRA-directed health promotion programme results in a significant positive impact on the financial savings in medical costs for employers.

Notes



The business benefits of health promotion programmes

Halpern MT, Dirani R, Schmier JK.

Impacts of a smoking cessation benefit among employed populations.

J Occup Environ Med 2007: vol 49; pages 11-21.

The purpose of this study was to project the health and economic benefits of providing a workplace smoking cessation programme.

A 20-year impact model, developed from a previous study, projected the costs and savings of a workplace smoking cessation benefit for employers.

The model was developed using demographic data on a cohort of 10,000 workers from across the U.S.

For the analysis, the model presented four combined industries and geographical regions:

- i. Business and professional services in the Northeast.
- ii. Education and health services in the West.
- iii. Manufacturing in the Midwest.
- iv. Wholesale and retail trades in the South.

The model identified three smoking-related health conditions: coronary heart disease (CHD), chronic obstructive pulmonary disease (COPD), and lung cancer. In addition, analysis was done on absenteeism and productivity losses due to smoking.

Over the 20-year period, the numbers of CHD, COPD and lung cancer cases prevented with a workplace smoking cessation benefit were substantial for all groups. Similarly, the model predicted that coverage of workplace smoking cessation benefits resulted in significantly increased numbers of employees giving up smoking, medical care costs savings and workplace costs savings.

The model showed that investing in a smoking cessation benefit for employees who smoke can yield a substantial return on investment at 20 years of almost 5.1.

Group	Prevented CHD cases	Prevented COPD cases	Prevented lung cancer cases	Medical care costs savings at 20 years (millions)	Workplace costs savings at 20 years (millions)	Combined total savings (millions)
Education and health services in the West	27	23	2	\$1.1	\$1.6	\$2.7
Business and professional services in the Northeast	78	52	6	\$2.7	\$4.7	\$7.4
Manufacturing in Midwest	84	51	7	\$2.7	\$3.5	\$6.2
Wholesale and retail trades in the South	94	61	7	\$2.9	\$4.1	\$7.0

Notes



The business benefits of health promotion programmes

Aldana SG, Merrill RM, Price K, Hardy A, Hager R.

Financial impact of a comprehensive multisite workplace health promotion program.

Prev Med 2005: vol 40; pages 131-137.

The aim of this study was to determine the impact of wellness programmes (WPs) on employee health care costs and absence rates.

The participants were 6,246 School District employees in Nevada, U.S., across 90 schools within the district, who participated in a WP between 2001 and 2002.

Eleven different WPs designed to encourage employees to engage in healthy lifestyles were offered including physical activity, nutrition and relaxation programmes.

Health care costs were based on employee claims data and absenteeism was defined as paid work time missed due to illness.

Individuals were categorised into three groups:

- (i) Those who participated in none of the programmes over the two years.
- (ii) Those who participated in programmes in only one year.
- (iii) Those who participated in programmes for two years.

Of the population, 1,407 (22.5%) participated in WPs for one year, and 1,264 (20.2%) participated in WPs both years.

Analysis showed a significant difference in absenteeism rates among those who participated in a WP as opposed to those who did not participate. Non-participants had higher rates of illness-related absenteeism compared with participants.

Wellness participation	Average days missed per participant a year
None	15.4
1 year	15.1
2 years	14.3

The study found no short-term differences in health care costs between those who participated in voluntary WPs and those who did not.

It was estimated that programme participation was associated with \$3,041,290 higher absenteeism costs during 2001 and 2002 compared with non-participants. These savings translated into savings of \$15.6 for every dollar spent on the programmes.

This study supports the theory that improvement of health risks through worksite health promotion programmes can yield beneficial returns for employers.

Notes



The business benefits of health promotion programmes

Mills PR, Tomkins SC, Schlangen LJM.

The effect of high correlated colour temperature office lighting on employee wellbeing and work performance.

J Circad Rhythms 2007: 5; 2.

The aim of this study was to quantify the impact of new broad spectrum fluorescent lighting on employee health and performance at work.

The study involved 69 call center employees from Standard Life Healthcare in Stockport, UK, between February and May 2005. Study participants came from two floors of the same office block with one floor acting as the intervention group and one as the control group: (i) Floor A (*intervention group* - new broad spectrum lighting system implemented on the floor) and (ii) Floor B (*control group* - lighting unchanged). Of the employees, 23 were in the control group and 46 were in the intervention group.

Data was collected on alertness, work performance, concentration and health-related quality of life, using the SF-36 questionnaire, constructs from the WHO-HPQ questionnaire and call-handling data over the three-month period of the study.

The intervention group showed a significant improvement in their ability to concentrate over the study period compared with the control group, who only showed a borderline improvement in these areas. The mean individual score improved by 36.8% in the intervention group, compared with only 1.7% in the control group.

Further improvements were observed in the intervention group in areas of fatigue (26.9%), alertness (28.2%), daytime sleepiness (31%) and work performance (19.4%).

The proportion of incoming calls answered from week nine until the end of the study in the intervention group improved by 0.53%, with no change observed in the control group.

This study found a clear relationship between the new broad spectrum lighting and improvements in employee well-being and work performance.

Notes







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