

Cost-Benefit Analysis of a Worksite Oral-Health Promotion Program^a

Toru ICHIHASHI^{1, 2*}, Takashi MUTO² and Koji SHIBUYA¹

¹The Lion Foundation for Dental Health, 3–7, Honjo 1-chome, Sumida-ku, Tokyo 130-8644, Japan

²Dokkyo Medical University School of Medicine, 880, Kita-kobayashi, Mibu, Tochigi 321-0293, Japan

Received July 3, 2006 and accepted November 2, 2006

Abstract: This study was conducted to examine whether oral-health promotion programs provided as an occupational health service for employees were cost-beneficial for employers. The subjects were composed of 357 male workers (20–59 yr of age) who participated in oral-health promotion programs conducted at their workplaces between 1992 and 1997. The design of this study was a quasi-experimental study design in which the three programs (light: 1 visit; medium: 2–4 visits; and heavy: 5–6 visits) were compared through cost-benefit analysis conducted from the viewpoint of the employers. The programs consisted of oral-health checkups by dentists and oral-health education, including that on the proper brushing method, by dental hygienists. The costs of the program included direct costs for the payment of oral-health-care staff and for teaching materials, and indirect costs for the time for employee participation in the program (20 min/employee per visit). The accumulated dental expenses for the seven years were used to calculate benefits, which were determined, based on the differences between 0 visits and each program. The benefit/cost ratios of the three programs were –2.45, 1.46, and 0.73, respectively. These results suggest that a worksite oral-health promotion program of medium frequency is cost-beneficial for employers.

Key words: Oral health, Worksite, Cost-benefit analysis, Effectiveness

Introduction

In Japan, national health expenditures have been increasing every year. In 2000 total amounts exceeded \$275.1 billion (30.4 trillion yen), representing 7.98% of national income¹. Dental expenditures stood at 8.42% \$23.5 billion (2.6 trillion yen) of these national health expenditures. Given this background, reducing medical expenses has become an urgent task for the Health, Labor and Welfare Ministry. In this context, a number of health campaigns, including “Healthy Japan 21” and “Promoting oral health via the 80/20 movement” have been carried out², reflecting a greater focus on healthy living and a shift from an emphasis on disease control toward preventive health care in Japan.

In the workplace, the Total Health Promotion Plan (THP),

which emphasizes the promotion of mental as well as physical health, was implemented to maintain and promote employee health³. Most people spend approximately 40 yr in the worksite, from youth to middle age. This period witnesses the frequent occurrence of periodontal disease and lifestyle-related diseases (i.e., diseases caused by unhealthy habits); thus, the worksite stands as a good target for health education efforts^{4–6}. Oral health activity is expected to reduce dental expenses, and these dental expenses represent approximately 20 percent of total medical expenses claimed within health insurance associations⁷. It is an important strategy for the health insurance association to encourage dental awareness among employees and to improve oral health habits in order to reduce dental expenses. From the employer’s point of view, an economic evaluation of the oral health promotion program will be helpful⁸. In this context, it is important to show the benefits of oral health management programs to employers. There are many reports about the effects of activities promoting

^aPresented at the 13th International Congress on Occupational Health Services, November 30 – December 3, 2005, Utsunomiya, Japan.

*To whom correspondence should be addressed.

oral health⁹⁻¹⁴), but there are few reports concerning the effect of such activities on oral healthcare costs^{15, 16}.

The purpose of this study is to examine whether oral-health promotion programs provided as an occupational health service for employees are cost-beneficial for employers.

Subjects and Methods

Subjects

The subjects were employees working in a household product company in Tokyo, Japan. There were about 800 employees; approximately 85% of them were male. All employees were insured through this company's health insurance society. An oral health promotion program was implemented at this workplace prior to this study. This program was carried out once a year, with employee participation on a voluntary basis. This study excluded female workers (approx. n = 120), retired persons (approx. n = 130) and those who were admitted to the hospital during the course of the study (n = 67), as well as those who spent more than \$4,006(500,000 yen) for medical treatment (n = 3) between 1992 and 1998. Female workers were excluded due to the small number. Persons who retired during the study period were also excluded, because of lack of complete data between 1992 and 1998.

The subjects were thus composed of 357 male workers (20–59 yr of age) who participated in oral-health promotion programs conducted at their workplaces between 1992 and 1997. The subjects were working as full-time employees from 1992 to 1998.

The subjects were divided into four groups, according to the extent of their participation in the dental health program between 1992 and 1998; participation 0 times (0 visits), once (light), from twice to 4 times (middle), 5 and 6 times (heavy) (Table 1). The company's Health and Safety Committee approved the program to be carried out, and informed consent was obtained from each subjects.

Oral health promotion program in the workplace

The program consisted of oral-health checkups by dentists (approx. 3 min) and oral health instruction (approx. 7 min), in addition to calculus scaling at the anterior mandibular teeth (approx. 10 min) by dental hygienists. Oral health instruction included instructions on teeth care, including brushing, flossing, and inter-dental brushing. Apart from the calculus scaling of the anterior mandibular teeth, employees were encouraged to have this process performed at outside dental clinics. The program took about twenty

minutes per person.

Dental expenses

The treatment costs were the general practitioner's fee for dental treatment. The Japanese government determined the dental treatment fee, so there was no variance in this fee among individual dentists. The dental expenses were not information based on the memories of the employees. Dental treatment fees were claimed from the health insurance society by general practitioners on a monthly basis, so the health insurance societies had in their files the data of the actual dental expenses. Nevertheless, private patients were excluded from this study because it was difficult to investigate dental expenses without referring to health insurance payments.

Cost-Benefit analysis

A cost-benefit analysis¹⁷ was carried out to evaluate the program from the viewpoint of the employers. Costs and benefits were calculated over seven year period (between 1992 and 1998).

Cost estimation: The costs of the program were estimated in terms of direct and indirect costs. Direct costs included payment of oral-health-care staff and the cost of teaching materials, while indirect costs included the time required for employee participation in the program calculated based on mean personnel expenses within the company in 1992. Program cost for each group was calculated based on overall program cost.

Benefit: The accumulated dental expenses for the seven years (from 1992 to 1998) were used to calculate benefits, which were determined based on the differences between those that did not participate (0 visits) and the groups that did. The health insurance department of the company handled this data, approving its use in analysis insofar as subject anonymity was maintained.

These dental expenses and program costs were calculated using a 3% discount rate from 1993 to 1998. The exchange rate used was 1 U.S. dollar=124.80 Yen (Annual average exchange rate for 1992).

Results

Direct costs for the payment of oral-health-care staff and for teaching materials were \$25.76 per person in 1992. Indirect costs relating to the period of employee participation in the program (20 min) were \$6.61/employee per visit, based on mean personnel expenses within the company in 1992.

Table 1. Number of subjects and mean age in 1992

	Participation in the oral health promotion programs				(Mean ± S.E.)
	0 visits (0 visits/7 yr)	Light (1 visit/7 yr)	Medium (2–4 visits/7 yr)	Heavy (5–6 visits/7 yr)	
Number of subjects	35	103	160	59	
Age	40.3 ± 1.4	39.9 ± 0.8	39.6 ± 0.7	41.2 ± 1.1	N.S.

ANOVA

The costs of the program, including both direct and indirect costs, were thus \$32.37/person per visit in 1992. The groups studied were compared in terms of program cost, dental expenses, and benefits. Significant differences were not found in the initial dental expenses, number of dental visits, and dental expenses per visit (Table 2).

Table 3 shows the results of the cost-benefit analysis of the oral-health-promotion program. While significant differences were not found in the number of dental visits, the medium (17.2) and heavy (18.1) groups were lower than 0 visits (23.2) and light (22.7) groups.

Dental expenses (accumulated dental expenses per person from 1992 to 1998) were \$645.82 (0 visits), \$719.84 (light), \$522.14 (medium) and \$528.65 (heavy). Dental expenses in the medium and heavy groups were lower than those of the 0-visit group. Benefits of the three programs were \$-74.02 (light), \$123.68 (medium), and \$117.17 (heavy). Benefits in the medium and heavy groups were higher than in the light group. The benefit-cost ratios of the three programs were -2.45 (light), 1.46 (medium), and 0.73 (heavy). The medium group was thus the only group to show a ratio greater than one.

Discussion

This study clarified that the tendencies of dental expenses relation to the intensity of oral health promotion programs. Dental expenses in the medium (\$522.14) and heavy (\$528.65) groups were reduced relative to the 0-visit group (\$645.82) and to the light (\$719.84) group. These results suggested that the oral health promotion program contributed to a decline in dental expenses.

This study has several strengths. First, the insurance status was the same for all subjects. In Japan, universal coverage under a public medical care insurance system was achieved in 1961. In this insurance system, people receiving medical treatment only have to pay part of the medical expenses. In the case of employees themselves, they are required to pay

10% of the medical expenses. All employees were insured through this company's health insurance society, and the subjects in this study were all working as full-time employees from 1992 to 1998. Second, dental expenses were equal to the actual amount of money spent on dental treatment because they were calculated based on the dental expenses claimed from the health insurance society.

However, this study also has several limitations. First, the contents of dental treatments, which were obtained from the health insurance society, were not precisely detailed in this study (i.e. diagnosis, oral condition, prevention and dental treatments). Therefore, it was difficult to show clearly which dental services affected dental expenses. Second, it must be assumed that participants consisted of employees who were interested in oral health, since participation was voluntary. Therefore, interpretation of these results must be treated carefully to avoid over generalization. Third, private patients were removed from this study.

In the light group, the benefit-cost ratio was -2.45, and the difference between costs and benefits (benefit-cost) was \$-104.18. This showed that participating in the program only once in 6 yr did not decrease dental expenses. This is because an employee's initial introduction to an oral health promotion program in the worksite leads to increased dental treatment and dental expense in the second year, as risk detection leads to an increase in the use of dental care services¹⁶. However, modified health behavior and increased awareness cannot be ensured through a single visit in 6 yr. Among the 0-visit group, on the other hand, no initial dental health instruction or oral health advice is offered; as a result, dental expenses were higher in the light group than in the 0-visit group, due to increased use of dental care services after the initial (and sole) dental health examination.

In the middle group, the benefit-cost ratio stood at 1.46, and the difference between cost and benefit (benefit-cost) was \$38.75. Through continuous participation in the program, most participants may have changed their oral health behavior^{10, 12} and maintained their oral health status^{9, 12, 13}.

Table 2. Dental expenses, dental visits and dental expenses per visit in 1992

(Mean ± S.E.)

	Participation in the oral health promotion programs				
	(0 visits/7 yr)	Light (1 visit/7 yr)	Medium (2–4 visits/7 yr)	Heavy (5–6 visits/7 yr)	
Dental expenses (\$/person)	65.41 ± 22.79	90.35 ± 21.72	98.24 ± 15.60	84.86 ± 53.13	N.S.
Dental visits (visits/person)	2.5 ± 0.9	2.7 ± 0.7	2.9 ± 0.4	2.5 ± 0.7	N.S.
Dental expenses (\$/visit/person)	29.67 ± 5.10	35.90 ± 4.24	32.96 ± 3.09	29.21 ± 2.60	N.S.

ANOVA

Table 3. Cost-Benefit analysis of worksite oral health promotion programs for 7 yr

(Mean ± S.E.)

	Dental expenses (\$/person/7yr) 1992–1998 (mean ± S.E.)	Benefit* (\$/person/7 yr)	Cost (\$/person/7 yr)	Benefit/Cost ratio	Benefit–Cost (\$/person/7 yr)
0 visits	645.82 ± 121.75	–	0	–	–
Light	719.84 ± 91.55	–74.02	30.16	–2.45	–104.18
Medium	522.14 ± 47.69	123.68	84.93	1.46	38.75
Heavy	528.65 ± 94.56	117.17	159.78	0.73	–42.61

*Benefit = (Dental expenses in the Light, Medium or Heavy group, respectively)–(Dental expenses in the 0-visit group)

These improvements may have reduced the risk of oral disease and complaints about oral health problems. Furthermore, dental visits resulting from recommendation for dental treatment led most patients to receive further individual oral-health-care instruction, involving factors such improvement of oral health care, better oral health habits, and greater awareness of preventing caries and periodontal disease. These factors may also be said to have had the effect of reducing oral-related anxiety, the necessity of severe treatments, and frequent treatment visits.

In the heavy group, the benefit-cost ratio is 0.73, with the difference between cost and benefit (benefit–cost) was \$–42.61. These results indicated that the program was inefficient for the heavy group. However, dental expenses among the heavy group (\$528.65) were similar to those in the middle group (\$522.14). Thus it appears that the factor leading to inefficiency lies in the number of visits to the program (heavy: 5.31 visits, middle: 2.84 visits). In other words, frequent visits to the program increased costs in the heavy group. The oral health promotion program carried out in this study remained constant for 6 yr. Such a program might prove excessive for the heavy group. These factors might be able to combine to hold down the benefit-cost ratio. These results indicated that lower-cost or costless programs should be carried out for heavy users. Consequently, it might be efficient to apply a screening system or oral health

guidance from a dental hygienist, without the need for a dentist to conduct a checkup, and/or for not all of the contents of this program to be necessarily carried out; abbreviated procedures are simpler and can be completed over a shorter period of time.

Meanwhile, overall results showed that the benefit–cost ratio varied among three groups. Therefore, from the viewpoint of benefits and costs, it is more efficient to employ a program tailored to each group. In particular, this method will prove effective in differentiating high-risk groups from low-risk groups through oral health screening, and will also help in determining appropriate frequencies of the program. One of the advantageous features of this study is to clarify how the intervals to the program can be managed most efficiently and which dental services affected dental expenses the most.

In order to implement and manage an oral health promotion program in the worksite, it is necessary to evaluate the oral health status of all employees, through cooperation with corporate health-care personnel.

Broadly speaking, there are many benefits to an oral health promotion program that cannot easily be evaluated in terms of money¹⁸⁾. Further, these benefits are easy to overlook due to the difficulties of quantifying them in economic terms. In particular, it is unclear how these benefits may offset lost worker productivity^{19–24)}. If it were possible to calculate all

such factors as benefits, the benefit-cost ratio would be larger than indicated in this paper. Thus, the benefits in this study must be viewed as a minimum monetary estimation.

It can be concluded that the study has demonstrated that a worksite oral-health promotion program of medium frequency is cost-beneficial for employers. The relevant cost-benefit analysis, which takes into consideration employee participation in the oral health program, illustrates the importance of on-site oral-health promotion programs.

Acknowledgement

The authors express their thanks to Dr. Masaki Koshimizu and Mr. Satoshi Koga. They helped to complete the research and provided very helpful and relevant information.

References

- 1) Health and Welfare Statistics Association (2002) Journal of health and welfare statistics 2000, 224–9, Kosei-Do, Tokyo (in Japanese).
- 2) Shinsho F (2001) New strategy for better geriatric oral health in Japan: 80/20 movement and Healthy Japan 21. *Int Dent J* **51**, 200–6.
- 3) Japan Industrial Safety and Health Association (1990) Total health promotion plan: start health promotion for mind and body, JISHA, Tokyo.
- 4) Fishwick MR, Ashley FP, Wilson RF (1998) Can a workplace preventive programme affect periodontal health? *Br Dent J* **184**, 290–3.
- 5) Schou L (1989) Oral health promotion at worksites. *Int Dent J* **39**, 122–8.
- 6) Kawamura M, Iwamoto Y (1999) Present state of dental health knowledge, attitudes/ behavior and perceived oral health of Japanese employees. *Int Dent J* **49**, 173–81.
- 7) National Federation of Health Insurance Societies (2002) Annual Report 2000, 20–4, National Federation of Health Insurance Societies, Tokyo (in Japanese).
- 8) Cunningham SJ (2000) Economic evaluation of health care— is it important to us? *Br Dent J* **188**, 250–4.
- 9) Westerman B (1993) Appropriate dental care for employees at the workplace. *Aust Dent J* **38**, 471–5.
- 10) Peterson PE (1989) Evaluation of a dental preventive program for Danish chocolate workers. *Community Dent Oral Epidemiol* **17**, 53–9.
- 11) Ahlberg J, Tuominen R, Murtomaa H (1996) Dental knowledge, attitudes towards oral health care and utilization of dental services among male industrial workers with or without an employer-provided dental benefit scheme. *Community Dent Oral Epidemiol* **24**, 380–4.
- 12) Lim LP, Davies WIR (1996) Comparison of various modalities of “simple” periodontal therapy on oral cleanliness and bleeding. *J Clin Periodontol* **23**, 595–600.
- 13) Lie T, Due N-A, Abrahamsen B, Boe OE (1988) Periodontal health in a group of industrial employees. *Community Dent Oral Epidemiol* **16**, 42–6.
- 14) Ahlberg J, Tuominen R, Murtomaa H (1997) A 5-year retrospective analysis of employer-provided dental care for Finnish male industrial workers. *Community Dent Oral Epidemiol* **25**, 419–22.
- 15) Ichihashi T, Muto T (2001) Effectiveness of worksite dental health promotion activity in terms of dental and medical expenses and number of visits for treatment. *J Dent Hlth* **51**, 168–75 (in Japanese).
- 16) Ide R, Mizoue Y, Tsukiyama Y, Ikeda M, Yoshimura T (2001) Evaluation of oral health promotion in the workplace: the effects on dental care costs and frequency of dental visits. *Community Dent Oral Epidemiol* **29**, 213–9.
- 17) Warner KE, Luce BR (1982) Cost-benefit and cost-effectiveness analysis in health care, Health Administration Press, Chicago.
- 18) Richard AW, Thomas B, Noreen C, Gary C (2001) Evaluation of health promotion and education programs, 129, Mayfield Publishing Company, California.
- 19) Horowitz HS, Heifetz SB (1979) Methods for assessing the cost-effectiveness of caries preventive agents and procedures. *Int Dent J* **29**, 106–17.
- 20) Lowell WG, James KS Jr (1973) Job status and expectations of exemptions from work due to illness. *J Occup Med* **15**, 633–4.
- 21) Meadow D, Rosenthal M (1983) A corporation-based computerized preventive dentistry program. *J Am Dent Assoc* **16**, 467–70.
- 22) Reisine ST (1984) Dental disease and work loss. *J Dent Res* **63**, 1158–61.
- 23) Hollister MC, Weintraub JA (1993) The association of oral status with systemic health, quality of life, and economic productivity. *J Dent Educ* **57**, 901–2.
- 24) Ichihashi T, Muto T, Shibuya K (2002) Influence of dental disease on workers in terms of hours lost from work or daily life activities. *J Dent Hlth* **52**, 141–9. (in Japanese).