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RELATIONSHIPS BETWEEN SMOKING CESSATION AND EXERCISE ADOPTION

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CE MÉMOIRE INTITULÉ:

RELATIONSHIPS BETWEEN SMOKING CESSATION AND EXERCISE ADOPTION

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RÉSUMÉ

Le tabagisme est une cause majeure, mais évitable, de décès. Par contre, l'activité physique aide les gens à vivre plus longtemps. De plus, l'exercice physique contribue à contrôler le poids, l'hypertention et le diabète, il modère les changements d'humeur, améliore les fonctions immunitaires, etc.

En ce mémoire, une méta-analyse a été utilisée pour évaluer un effet causal possible de l'exercice sur l'abandon du tabac. Les études ont utilisé l'exercice comme intervention. Le nombre de fumeurs au début et pendant le suivi à long terme (6 à 24 mois), parmi le groupe pratiquant des exercices physiques et le groupe témoin, ont été identifiés. Cinq essais randomisés ont été choisis pour cette méta-analyse. Dans trois d'entre eux, l'abandon du tabac a été le but principal de l'étude. L'exercice a été utilisé aussi pour prévenir la rechute pendant ou après un programme. Les études ont produit une cote de qualité modérée de 7 a 9 pour un total de 13 points. Le rapport de cotes typique des trois études qui avaient pour but principal l'abandon du tabac était de 2,35 (intervalle de confiance à 95% 0.75-7.31). Quand les deux autres études ont été ajoutées, it est tombé à 1.85 (I.C. a 95% 0.65-5.24). En conclusion, à cause du faible nombre d'études et de la petite taille de l'échantillon dans chaque étude, entre autres, l'effet de l'exercice sur l'abandon du tabac demeure incertain.

Les résultats de la méta-analyse n'ont pas donné une explication définitive de l'effet de l'activité physique sur l'abandon du tabac. De futures recherches, qualitatives et quantitatives, sur les comportements différents doivent etre conduites afin de mieux comprendre leur interaction en agissant sur les comportements liés a la santé.

SUMMARY

Cigarette smoking is a major preventable cause of death. To the contrary, exercise helps people to live longer. Also, exercise helps to facilitate regulation of body weight, control hypertension and glucose intolerance, moderate mood changes, improve immune function, etc.

In this thesis, a meta-analytic review was used to assess the possible causal effect of exercise on smoking cessation. Studies which employed an exercise program for an intervention group and reported the numbers of smokers of both exercise and control groups at baseline and at 6 to 24 months later were systematically reviewed. Five randomized trials were selected. In three of these, smoking cessation was the main outcome and exercise was employed for relapse prevention concurrently with or after a group smoking cessation program. The studies produced a moderate qualitative score of 7 to 9 out of a total score of 13 points. The typical odds ratio of the three studies which primarily aimed at smoking cessation was 2.35 (95% C.I. 0.75-7.31). When the other studies were added, it dropped to 1.85 (95% C.I. 0.65-5.24). In conclusion, due to the small number of studies and the small sample size for each study, the effect remained unclear.

The results of the meta-analysis did not give a definite explanation for the effect of exercise on smoking cessation. The future researches on the different behaviors, both qualitative and quantitative, must be conducted to understand the interaction of the health-related behaviors better.

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CHAPTER 1. INTRODUCTION

1. General introduction

Chronic diseases are the major causes of death and disability in industrialized countries. It is clear that health and social habits, or lifestyle, are intricately involved in multiple and interactive ways with the pathogenesis of the major chronic diseases. Lifestyles associated with major health problems include tobacco smoking, physical inactivity, ~~a~~ diet, obesity, inadequate sleep habits, etc. (Belloc 1971).

2. Review of the health-related behaviors: smoking and physical activity

This thesis focuses on two health-related behaviors, that is, smoking and physical activity. The reasons for selecting these two behaviors are that they are quite different or rather opposite behaviors each other; smoking is a negative behavior and physical activity is a positive one. The next two parts briefly review each behavior.

2-1 Smoking

1) Smoking and health

Smoking is a major preventable cause of premature death. The more prominent problems associated with tobacco use and exposure are several types of cancer, cardiovascular disease, respiratory disease, and osteoporosis (U.S. Department of Health Education and Welfare 1979). It is estimated that during the 1990s tobacco will cause about 30% of all deaths of

persons 35-69 years of age in developed countries (Peto 1992).

In spite of the clear threat to their health, smokers rarely succeed in quitting. In Japan, the smoking rate is gradually decreasing to a little less than 60% in men, and it is increasing to 15% in women (Source: Japan Tobacco 1994). This trend in Japanese women seems to be due to the pressure of U.S. tobacco companies.

2) Interventions for smoking cessation

Various intervention schemes have been introduced to encourage smoking cessation such as simple provision of information and suggestions in smoking cessation classes, nicotine replacement, and community or national campaigns (Fisher 1993). Systematic reviews (Kotteke 1988, Viswesvaran 1992, Law 1995) have examined their effectiveness according to the nature of the interventions: 1) types of intervenor such as physician and non-physician, 2) types of subjects such as volunteers, pregnant women, and patients with cardiovascular diseases, and 3) types of intervention modality such as counseling, nicotine replacement therapy, and acupuncture.

Kottke et al. (1988) examined 108 intervention comparisons in 39 controlled trials by meta-analysis. They concluded that a team of physicians and nonphysicians using multiple intervention modalities to deliver individualized advice on multiple occasions would produce the best result. Using 633 studies and a sample size of 71,806, Viswesvaran and Schmidt (1992) concluded that the most successful methods are instructional and conditioning based methods. Law and Jin (1995) analyzed data from 188 randomized controlled trials. They reported that the effect of personal advice and encouragement to stop smoking given by physicians is modest after 1 year (2%), but it is cost-effective. Advice and

encouragement are particularly effective for smokers at special risk, such as pregnant women and patients with ischemic heart disease. Nicotine replacement therapy is effective in an estimated 13% of smokers who seek help in cessation.

However, these reviews did not cover interventions that aim at concurrent or subsequent cessation of smoking by modification of other behaviors.

2-2 Physical Activity

1) Physical activity and health

In 1989 Blair et al. showed that higher levels of physical fitness appear to delay all-cause mortality primarily due to lowered rates of cardiovascular disease and cancer. Besides, the relationship between changes in physical fitness and all-cause mortality has been investigated and men who improved adequate physical fitness were less likely to die from all causes and from cardiovascular disease during follow-up than persistently unfit men. Berlin et al. (1990) has conducted meta-analysis of physical activity in the prevention of coronary heart disease and reported that a summary relative risk of death from coronary heart disease of 1.9 (95% confidence interval 1.6-2.2) for sedentary compared with active occupations.

Exercise is known to improve other health-related factors as well (Pate 1995). Among these factors are blood lipid profile (Haskell 1986), resting blood pressure in borderline hypertensives (Duncan 1985, Hagberg 1989), glucose tolerance and insulin sensitivity (Kovisto 1986), bone density (Dalsky 1988), stress (Roth 1987), and immune function (Nehlsen-Cannarella 1991).

2) Exercise adherence

Determinants of exercise adherence have been studied by several researchers (Dishman 1985, King 1992, Oldridge 1983). In the U.S., black women, the less educated, overweight individuals, and the elderly are the most consistently reported inactive groups in terms of overall physical activity (King 1992). Dishman (1985) analyzed data of studies of exercise adoption in the dimensions of personal characteristics, environmental characteristics, and activity characteristics in both supervised exercise programs and spontaneous programs. As a whole, supervised programs reported a higher probability of exercise adoption. For example, personal characteristics such as past program participation, high risk for coronary heart disease, and self-motivation are major determinants for exercise adoption. In environmental characteristics, spouse support, perceived available time, access to facilities, and social reinforcement are the key factors for supervised programs, but family influences or peer influence seem to be sufficient for spontaneous adoption of exercise.

In psychological and behavioral research, the acquisition of exercise habits is a process of three stages (Knapp 1988): (a) the decision to start exercising, (b) the early stages of behavior change, and (c) maintenance of the new behavior. Strategies for facilitating a decision to exercise, drawn from health beliefs, self-regulatory, and decision-making models, are important for emphasizing potential reinforcement beyond preventive health benefits and enhancing self-efficacy. For habit acquisition stimulus control measures, reduction of punishing contingencies, and the provision of social, material, and other forms of reinforcement are recommended. Continuing exercise cues and reinforcement, avoidance of punishment, and

self-attribution of positive change are necessary for maintenance.

3. Hypothesis of the study

As stated above, smoking and physical activity seem to be opposite behaviors. If the two behaviors are exclusive each other, smokers are expected to quit smoking ~~on~~ AFTER adopting exercise. Based on this idea, the thesis examined a possibility of utilizing an exercise program to cause smoking cessation. Meta-analysis was used to systematically review the results of controlled trials on this issue.

CHAPTER 2. A META-ANALYTIC REVIEW OF THE EFFECT OF EXERCISE ON SMOKING CESSATION

1. Abstract

Objective. To assess the effect of group exercise programs on smoking cessation.

Data Sources. A MEDLINE search, a manual review of journal articles, and a search of previous reviews were used.

Study Selection. Published studies which 1) employed an exercise program for an intervention group and, 2) reported numbers of smokers of both exercise and control groups at baseline and at 6 to 24 months later were selected.

Data Extraction. Five randomized trials were selected. In three of these, smoking cessation was the main outcome and exercise was employed for relapse prevention concurrently with or after a group smoking cessation program. The studies produced a moderate qualitative score of 7 to 9 out of a 13 total score of modified DerSimonian's quality checklist.

Data Synthesis. The summary odds ratio of the three studies which primarily aimed at smoking cessation was 2.35 (95% C.I. 0.75-7.31). When the two other studies were added, it dropped to 1.85 (95% C.I. 0.65-5.24).

Conclusions. Due to small number of studies and the small sample size for each study, the effect remains unclear. Further analysis, both qualitative and quantitative, is necessary to clarify these issues.

2. Background and objective of the study

Smoking is a major preventive cause of premature death. It is estimated that during the 1990s tobacco will cause about 30% of all deaths of persons 35-69 years of age in developed countries (Peto 1992). A variety of methods have been proposed on smoking cessation. Systematic reviews (Kotteke 1988, Viswesvaran 1992, Law 1995) have examined their effectiveness according to the nature of the intervention: 1) types of intervenor such as physician and non-physician, 2) types of subjects such as volunteers, pregnant women, and patients with cardiovascular diseases, and 3) types of intervention modality such as counseling, nicotine replacement therapy, and acupuncture. However, these reviews did not cover interventions that aim at concurrent or subsequent cessation of smoking by modification of other behaviors.

Smokers are less likely to engage in other health-related behaviors, compared with non-smokers (Emmons 1994). So sedentary smokers could be targeted by both exercise adoption and smoking cessation interventions. The relationship between smoking behavior and physical activity has been reviewed by Blair et al. (Blair 1985, Blair 1990). In contrast to the earlier report, the more recent review concluded that cross-sectional studies indicated that physical activity is inversely associated with smoking habits. As for the use of exercise as an intervention method for smoking cessation, they mentioned the need for further consideration with a larger sample and cited only one experimental study (Hill 1985).

This study reviewed intervention studies of the effectiveness of exercise on smoking cessation by means of a meta-analysis.

3. Methods

This meta-analysis was conducted with the following steps: literature search, study selection, qualitative meta-analysis, data extraction, and quantitative meta-analysis (Jenicek 1989). The author conducted all the steps by himself.

3.1 Literature search

Intervention studies published before April 1995 and dealing with exercise and reported changes in cigarette smoking habits were systematically reviewed.

MEDLINE and Dissertation Abstracts International were used for a computerized bibliographic search. In MEDLINE search, literature which contained at least one MeSH Subject Heading (Lowe 1994) in each of the three groups were retrieved (Appendix 1). All volumes of the following three journals were reviewed manually: American Journal of Preventive Medicine, Preventive Medicine, and Medicine and Science in Sports and Exercise (formerly Medicine and Science in Sports). References of review articles and retrieved articles were examined and researchers in the field were also contacted to make the search more complete.

3.2 Study Selection

Studies were selected according to the following criteria: a) subjects had not suffered from chronic diseases like cardiovascular diseases, b) exercise was provided in a group program, and c) numbers of smokers of both exercise and control groups were reported at baseline and at 6 to 24 months later. Studies were excluded when they met any of the following exclusion

criteria: absence of control group, no original data, or duplication of another published report.

3.3 Analysis of Quality

The quality of each study was assessed with a set of 13 criteria (Table 1) based on those established by DerSimonian et al. (1982). To reduce bias in assessment, information on the authors and their institutions, the journal, and the funding sources was deleted, while the methods and the results sections were assessed separately.

3.4 Data Extraction

Data were abstracted in the same way as quality assessment: 1) information on the authors and their institutions, the journal, and the funding sources was deleted, and 2) the methods and the results sections were assessed separately.

3.5 Quantitative Meta-Analysis

The DerSimonian-Laird random-effects method (DerSimonian 1986) was employed to estimate a summary odds ratio after confirming the homogeneity of each odds ratio. If any one of the four cell frequencies was equal to zero, 0.5 was added to each cell (Fleiss 1981). Statistical analysis was done by MetaAnalyst (Lau 1995).

4. Results

4.1 Literature search and study selection

A total of 356 articles were found through MEDLINE search. Most of the articles were rejected because they were not experimental studies; in fact, only two articles met our criteria (Hill 1985, McMurdo 1992). One dissertation was found in Dissertation Abstracts Ondisc, but it was the same report as the full article that had been found by MEDLINE (Hill 1985). Three other articles (Wood 1983, Marcus 1991, Marcus 1995) were found through examination of references of retrieved articles or contact with researchers. The article by Marcus et al. (1991) was in a form of brief reports and no abstract was included in the MEDLINE database, so it could not be found by MEDLINE search for lack of keyword like randomized controlled trials. The second study by Marcus et al. (1995) was originally mentioned in the conference proceedings (Ref. 143 of Marcus et al. 1994; Marcus BH, Albrecht AE, Niaura RS, et al. Physical exercise improves maintenance of smoking cessation in women. National Heart, Lung, and Blood Institute Conference on Women, Behavior and Cardiovascular Disease. Bethesda, MD, 1991). By writing to the author, the published article (1995) of the same results was obtained. The article by Wood et al. (1983), in which smoking cessation was not the main outcome, was found through the examination of references.

4.2 Qualitative Meta-Analysis

The number of studies which met individual criteria on our checklist is shown in TABLE 1. All studies were randomized trials, but methods of randomization were reported only in two studies (McMurdo 1992, Wood 1983).

As for the item "power (determination of sample size)", only one study (McMurdo 1992) reported that they calculated a sample size beforehand. Even though the sample size was calculated for some other variables such as flexibility or leg strength other than a number of smokers, one point was given to the study because its main outcome was not the smoking cessation.

Exercise intervention was defined in all studies, but smoking cessation was verified biochemically only in two studies (Marcus 1991, Marcus 1995).

The quality scores of the studies were in a narrow range of 7 to 9 points with a mean of 8.0. Thus, no study was excluded from further analysis and no stratification was performed on the basis of quality score.

4.3 Descriptive review of the studies

TABLE 2 summarizes the characteristics of the five studies. Briefly, three studies (Hill 1985, Marcus 1991, Marcus 1995) made smoking cessation their main outcome. These studies were similar in that smoking cessation programs were provided for all subjects, while exercise programs were implemented only for those in an exercise group. Only male subjects were recruited for one study (Wood 1983) and only female subjects for two studies (Marcus 1991, Marcus 1995). The study by McMurdo and Burnett (1992) focused on elderly participants and provided a health education program only to the control group.

Characteristics of each study is introduced below.

1) Hill (1985)

Thirty-six volunteers who wished to quit smoking were randomly assigned to one of two groups which differed only in the level of physical activity. Quit rates were relatively high compared with the other studies; 7 out of 18 in the exercise group and 5 out of 18 in the control group quitted smoking at 5

weeks and 6 months later.

2) Marcus et al. (1991)

Twenty female healthy smokers were randomly assigned to either an eight-session smoking cessation program alone or to smoking cessation with 15 weeks of physical exercise using cycle ergometer. Smoking cessation was verified biochemically in this study. Odds ratio of the study was 6.18 with wide 95% C.I. (0.26-146.78).

3) Marcus et al. (1995)

In the previous study by Marcus et al. there was the problem that subjects in the exercise group had increased contact with staff via their 15 weeks of thrice weekly exercise sessions. Then this study used contact control to whom health education was given with the same frequency as the exercise program. Smoking cessation was verified biochemically in this study, too. The odds ratio was lower than that of the previous study, but still high as 3.86 (95% C.I. 0.33-45.57).

4) Wood et al. (1983)

Eighty-one sedentary but healthy men aged 30-55 including 14 smokers participated in a one year randomized study of the effects of exercise on plasma lipoprotein concentrations. Running program was given to exercise program with 3 to 5 times a week for one year, and no program was given to control group. None of the smokers quit smoking in either exercise group or control group.

5) McMurdo and Burnett (1992)

Eighty-seven healthy volunteers aged 60-81 including 11 smokers were randomly allocated to either an aerobic exercise class or a health education group. If the study employed health education whose main topic was smoking cessation only in the control group, it should have been excluded from this meta-analysis. But since the program covered several topics, such as the ageing process, the benefits of exercise, the importance of diet, osteoporosis, and stress management as well as the dangers of smoking tobacco and how to stop, this study was included in the meta-analysis. Health education might have been effective on the smoking cessation, and the odds ratio was 0.33.

4.4 Quantitative meta-analysis

The odds ratio for each trial and summary odds ratios are shown in TABLE 3. The summary odds ratio of the three studies which primarily aimed at smoking cessation was 2.35 with a wide confidence interval (95% C.I. 0.75-7.31). When the two other studies were added, summary odds ratio dropped to 1.85 (95% C.I. 0.65-5.24).

5. Discussion

Only five studies were left in our review. In three of them smoking cessation was the main outcome, and a program for that aim was provided for both exercise and control groups. They showed relatively high odds ratios for exercise group. This means that exercise can be more effective when combined with a smoking cessation program. The three studies, however, might be highly selected studies with a positive results for exercise intervention.

5.1 Studies excluded from the analysis

Four studies excluded for not meeting criteria such as subjects' health status (Wilhelmson 1975, Taylor CB 1988) or follow-up duration (Bonnano 1974, Ilmarinen 1977) showed no difference in quit rate between exercise and control groups after intervention, either. Two other studies were excluded because the exact number of smokers was not indicated (Taylor HL 1973, Russell 1988). One of these studies (Russell 1988) presented no statistically significant odds ratio and led to the conclusion that there was no difference in cessation results between exercise and control groups. Here, some bias is suspected in that exact data were given only for studies in which the results favored the exercise group.

The study by Heirich et al. (1993), in which an individual counselling on exercise was provided instead of a group aerobics program, was also excluded. The program was reported to be successful in getting smokers to quit cigarette smoking. The effectiveness of an individual exercise program should be systematically evaluated in the future.

5.2 Qualitative review of the studies

For the qualitative review, the modified DerSimonian's checklist (DerSimonian 1982) was used instead of the quality rating system by Chalmers (Chalmers 1981). The reason was that the Chalmers' system, which was originally prepared for the clinical trials, have so many items that it was not adaptable to the exercise intervention trials with rather small sample size. The DerSimonian's checklist was adapted by excluding the item of blinding.

Each item was given one point (Carrier 1992) and the sample studies scored 7 to 9 out of a 13 total points in the checklist. Although the studies were all randomized trials, statistical methods such as randomization or analyses were not reported. The small number of subjects in these studies might have made statistical methods unnecessary.

Smoking cessation were biochemically confirmed only in two studies (Marcus 1991, Marcus 1995), in which higher odds ratios were obtained than the other studies. So it is unlikely that the studies without biochemical verification have reported biased results.

5.3 Exercise intervention

Intervention exercise programs employed in the studies differed in several characteristics such as type, intensity, frequency, and duration. Changes in physical fitness level from baseline to follow-up were reported in four studies (McMurdo 1992, Marcus 1995), one study a significant difference between changes in the exercise and control groups (Wood 1983), and one study both a significant difference and significant change (McMurdo 1992). Variables reported also differed from study to study: resting heart rate, estimated maximal oxygen consumption, maximum exertion level, and so

on. Most of the studies seem to have been successful in increasing the physical fitness level of the exercise group.

Exercise adherence may be more important than physiological change in causing smoking behavior change. In our sample studies, exercise adherence was observed by the distance which participants had completed in a week in one study (Wood 1983), and attendance at the exercise sessions in three studies (McMurdo 1992, Marcus 1991, Marcus 1995). These latter three studies reported attendance rates of 80% or higher. Koplan et al. reported that in a cohort of road race runners giving up smoking was significantly more frequent for current runners than for retired runners after a one year follow-up (1982). Wilhelmsen et al. found that one year after acute myocardial infarction, patients in the experimental group who were undergoing training showed a higher quitting rate than those who were not (1975).

5.4 Mechanisms of the effect of the intervention

The mechanism of the intervention could be understood well by the way how smokers change their behaviors. The stages of change (Prochaska 1983, DiClemente 1991) in the case of smoking, physical activity, and dietary fat intake and the relationship among these factors were studied in a sample of 1,559 manufacturing workers (Emmons 1994). Smokers were found to be in earlier stages of readiness for physical activity and dietary fat intake than non- or ex-smokers. In addition, stages of readiness regarding smoking were related to physical activity; individuals in the later stages in preparation for smoking cessation reported spending more time doing physical activity, than did smokers in earlier stages.

Self-efficacy is an essential perception in accomplishing behavioral

change, and past mastery experiences serve to amplify future efficacy cognitions (Bandura 1977, Bandura 1986). Exercise have been shown to increase self-efficacy (McAuley 1991). Therefore, once sedentary persons adopt exercise, that self-efficacy can help them quit smoking. Furthermore, exercise is shown to improve the ability to cope with psychosocial stresses and to manage irritations (Taylor CB 1985, Crews 1987). Psychosocial stresses after the attempts of quitting can be reduced by exercise.

Epidemiological studies have revealed that smokers weigh less than nonsmokers and gain weight when they stop smoking (Kato 1989, Klesges 1989). Women are more likely than men to endorse smoking as an active weight loss strategy (Klesges 1988). However, in the study (Marcus 1995) where only female subjects were recruited, the exercise group was significantly heavier than the control group at the baseline. These women in the exercise group probably had more incentive to reduce weight than those in the control group. As a result of their exercise, not only were they able to lose weight, but they were more likely to quit smoking.

5.5 Conclusion

Although the results of this meta-analysis seems to demonstrate a positive effect of exercise on smoking cessation, due to the small number of studies and the small sample size for each study, much of its effect is inconclusive. Methods of intervention like those offered by the three studies with higher odds ratios might be effective. The large controlled trial, now undertaken by Dr. Marcus and her colleagues (Marcus 1997), and other trials are necessary to clarify these issues.

TABLE 1 Qualitative assessment of the studies on the effect of exercise on smoking cessation

	Number of studies TOTAL = 5
DerSimonian's checklist	
Eligibility criteria defined	4
Admission before allocation	5
Random allocation	5
Method of randomization reported	2
Treatment complications reported	0
Loss to follow-up reported	5
Statistical analyses performed	2
Statistical methods described	2
Power (determination of sample size)	1
Other Criteria	
Baseline characteristics reported	3
Definition of exercise	5
Biochemical verification of abstinence	2
Compliance with exercise program reported	4

TABLE 2 Descriptive review of the studies on the effect of exercise on smoking cessation

First author (year)	Characteristics of participants	Age range	Exercise Group: Type	Exercise Group: Frequency, duration
1) Studies with smoking cessation as the main outcome				
Hill (1985)	Smokers interested in quitting	25-50	Group counseling and aerobic exercise	2/wk, 5 wks
Marcus (1991)	Female healthy smokers	20-50	Smoking cessation program, use of cycle ergometer	2/wk, 4 wks 3/wk, 15 wks
Marcus (1995)	Female healthy smokers	22-56	Smoking cessation program, use of cycle ergometer	1/wk, 12 wks 3/wk, 15 wks
2) Studies in which smoking cessation was not the main outcome				
Wood (1983)	Male employees	(30-55)	Running	3-5/wk, 12 months
McMurdo (1992)	Elderly healthy volunteers	(60-81)	Exercise classes for the elderly	3/wk, 8 months

Notes: wk, week.

Age range in parenthesis is that of all participants in the study.

TABLE 2 (continued)

Control Group		
Type	Frequency, duration	Total duration
Group counseling	2/wk, 5 wks	5 wks +6 months
Smoking cessation program	2/wk, 4 wks	7 wks +12 months
Smoking cessation program, health education	1/wk, 12 wks 3/wk, 15 wks	15 wks +12 months
No program		12 months
Health education	6/8 months	8 months

TABLE 3 Meta-analysis of the studies on the effect of exercise on smoking cessation

First author (year)	Quality score	Exercise No.	Exercise Quit	Control No.	Control Quit	Odds Ratio (95% C.I.)
1) Studies with smoking cessation as the main outcome						
Hill (1985)	7	18	7	18	5	1.65 (0.41-6.71)
Marcus (1991)	8	10	2	10	0	6.18 (0.26-146.78)
Marcus (1995)	8	10	3	10	1	3.86 (0.33-45.57)
Summary odds ratio for these 3 studies						2.35 (0.75-7.31)
Test for heterogeneity			p = 0.69			
2) Studies in which smoking cessation was not the main outcome						
Wood (1983)	9	7	0	7	0	1.00 (0.02-57.31)
McMurdo (1992)	8	5	0	6	1	0.33 (0.01-10.11)
Summary odds ratio for all 5 studies						1.85 (0.65-5.24)
Test for heterogeneity			p = 0.84			

Notes: C.I., confidence interval

Appendix 1 Keywords for MEDLINE Search

Literature which contained at least one MeSH Subject Heading in each group were retrieved.

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1. Group 1

   exercise

   exercise therapy

   exertion

   physical fitness

2. Group 2

   clinical trials

   intervention studies

   evaluation studies

   program evaluation

   random allocation

   randomized controlled trials

   research design

   follow-up studies

   comparative study

3. Group 3

   smoking

   smoking cessation

   tobacco use disorder

CHAPTER 3. Conclusion

This thesis studied the relationship between smoking cessation and exercise adoption. Although the meta-analysis provided only a preliminary summary of the effect of exercise on smoking cessation, it indicates that an exercise program combined with a smoking cessation program or with one-to-one counseling might be effective. The study could not clearly show the possible gender contrast of the effect of exercise on smoking cessation. Further studies with larger samples need to be conducted and data must be analyzed by sex for more comprehensive results.

Although this meta-analysis dealt with randomized controlled trials in which interventions were provided in a group exercise programs, most people were found to prefer physical activity on their own, outside a formal group structure (King 1990). On the other hand, the study by Heirich et al. (1993) showed better exercise adoption rates for one-to-one counseling than for only offering physical fitness facilities. The key to the success was believed to lie in the fact that participants were contacted directly and regularly by health professionals. This study was also successful in getting smokers to quit cigarette smoking.

Contrary to the individual approach, Hillsdon et al. (1995) has recently reviewed randomized controlled trials of physical activity promotion in free living populations. Five features commonly seen in studies with high levels of participation were 1) home based programs, 2) unsupervised, informal exercise, 3) frequent professional contact, 4) walking as the promoted exercise, 5) moderate intensity exercise.

In a systematic review of randomized controlled trials of multiple risk

factor interventions for preventing heart disease (Ebrahim 1997), they concluded that such interventions implemented through standard health education methods have limited use in the general population. Instead, they recommend health protection through fiscal and legislative measures. King (1994) also suggested that in addition to individual-level, face-to-face approaches of physical activity promotion , supplementation and expansion are important at the environmental, organizational, institutional, and societal/legislative levels.

Physical inactivity and smoking are the major concerns for health promotion. People with less healthy behaviors would not change their habits until the social norms change. Population strategies together with high-risk strategies (Rose 1992) must be effectively implemented to combat these unhealthy behaviors. When those strategies are implemented in the evidence-based public health (Jenicek 1998), the possible effect of the exercise on smoking cessation could serve as the evidence.

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