

## EFFECTS OF COMPREHENSIVE REHABILITATION ON WEIGHT REDUCTION IN MYOCARDIAL INFARCTION PATIENTS

R.-L. Karvetti and L.-R. Knuts

*From the Rehabilitation Research Centre of the Social Insurance Institution, Turku, Finland*

**ABSTRACT.** The effect of a comprehensive rehabilitation programme, including diet therapy, was studied in overweight male myocardial infarction (MI) patients randomly assigned to a rehabilitation group ( $n=69$ ) and a control group ( $n=64$ ). The results show a mean weight decrease of 3.8 kg in the rehabilitation group and a mean weight increase of 1.1 kg in the control group ( $t=-5.78, p<0.001$ ). The proportion of patients reducing their weight more than 5 kg was 33% in the rehabilitation group and 5% in the control group ( $\chi^2=15.6, p<0.001$ ). Patient characteristics which significantly affected the weight change by univariate analysis were age, level of overweight, smoking habits, employment situation and social problems. Multivariate analyses yielded a two-variable model with moderate explanatory power in the rehabilitation group. The model includes the variables Body Mass Index and cessation of smoking before MI.

**Key words:** Myocardial infarction, diet therapy, weight loss, comprehensive rehabilitation

There are a number of studies of obesity and overweight in which the relationship between weight change and living habits has been investigated. It is well documented that physical activity promotes the weight reduction of overweight persons (6, 19), especially when combined with moderate dieting (4, 15). The cessation of smoking is usually associated with weight gain (9, 14, 17). The socioeconomic status seems to be one of the many possible factors influencing weight change (8, 18), and it is systematically related to the level of fatness (7).

In some psychological studies it has been reported that appetite and weight changes vary with the severity and recovery of depression, the phase of depression and the medicament in depression (20). There are depressive persons gaining weight or losing weight (21). Accompanying obesity and medical illness there are stresses which might become psychological impediments and thwart weight loss and its maintenance (23).

In this report it will be examined how com-

prehensive rehabilitation, including intensive diet therapy and physical exercise programmes, affected the weight reduction of overweight male myocardial infarction patients taking into consideration such factors as age, health status, changes in the life style and some social and psychological problems of the patients.

The study was carried out in the Rehabilitation Research Centre of the Social Insurance Institution in Finland in connection with a large rehabilitation research project in which the mortality, morbidity, vocational rehabilitation and nutrition of myocardial infarction patients were investigated (11-13). Part of the results are still unpublished and the follow-up investigations are continuing.

### MATERIAL AND METHODS

The group under study consisted of male myocardial infarction patients under 65 years of age who were treated and discharged from Turku University Hospital during the years 1973-75. The weighting, the dietary history interview, laboratory tests and the Beck Depression Inventory (2) were carried out in the hospital about 10 days after the infarction and repeated one year later. When leaving the hospital the patients were randomly assigned to a rehabilitation or a control group. The rehabilitation group participated in a comprehensive rehabilitation programme which lasted one year.

Only persons with overweight, determined by tables of ideal weight (10), were included in this report. The total number of patients included was 133 with 69 in the rehabilitation group and 64 in the control group. Patient characteristics are summarized in Table I.

During the first weeks of treatment the patients in the rehabilitation group were weighed once a week. Later the weighing was done at intervals of three months. In weight controls the patients were wearing their underwear and the weighing was done each time by the same dietitian. The scale was calibrated in regular intervals.

The food consumption of the patients was recorded 10 days after MI and one year after MI by using a modified method of Burke's dietary history interview (3). In the

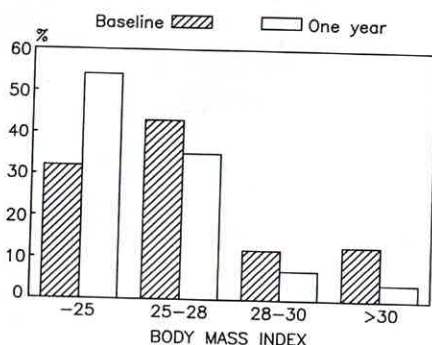


Fig. 1. Distribution of the BMI in the rehabilitation group.

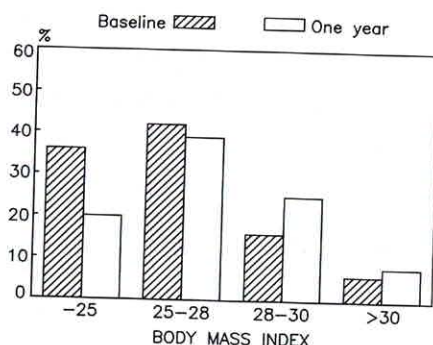


Fig. 2. Distribution of the BMI in the control group.

rehabilitation group the changes in the patients' diet were also followed during the intervention period by obtaining dietary recalls every three months.

The social problems assessed were those related to the family, the work and the economy of the patient (13).

The statistical data analysis was carried out using BMDP-programs (5). Statistical methods used were one-way analysis of variance and multiple linear regression.

#### The rehabilitation programme

The rehabilitation of the patients started in the Rehabilitation Research Centre about one month after MI. A team, including a physician, a dietitian, a physiotherapist, a psychologist, a social worker and a nurse received the patients and their wives on their arrival in the institution. The team members explained their part in the rehabilitation programme. This was how the patients were able to get acquainted with their total rehabilitation programme. This kind of meeting also created confidence between the patients and their instructors and motivated all involved to collaboration.

The subjects stayed two weeks in the Centre and later, because living in the same town, came to the treatments and classes, which took place several times a week. Later during the rehabilitation year the programme was reduced

step by step. The patients were all the time under the control of the same physician and the rehabilitation team discussed weekly its actions as well as the problems of the patients. This was how each unit was able to adapt their instructions to each patient individually.

The nutrition part of the rehabilitation programme included a six-week nutrition education programme, consisting of 6 nutrition classes in small groups and 3 individual counselings during the rehabilitation year. The nutrition education programme was directed towards correcting the faults in each patient's diet and motivating the patients to reduce their weight by using a low-calorie diet. Information was given on the diet of coronary patients, as well as on new food preparation, purchasing and eating behaviors.

The nutrition counseling was based on the generally accepted pattern of diet for myocardial infarction patients (1, 22): reducing food energy, fats, sugar, cholesterol and salt in the diet and increasing polyunsaturated fats, low fat foods and vegetables. A daily diet of 1200 kcal was introduced to all overweight patients. It consisted daily of whole grain cereals, potato, vegetables and fruits, the maximum of 500 g of low fat milk or milk products, 20-25 g of vegetable margarine or vegetable oil, 100-150 g of lean meat or fish and no more than 3 eggs per week. The daily meals and food-portion were demonstrated by using food models and natural foods, and the patients were instructed how to use food exchange lists in replacing the unfavourable food items with suitable portions of other foods. In

Table I. Baseline characteristics of the persons in the study

	Rehabilitation group (n=69) Mean $\pm$ SD	Control group (n=64) Mean $\pm$ SD
Age at onset of MI, years	53.5 $\pm$ 7.3	53.0 $\pm$ 6.8
Weight, kg	79.6 $\pm$ 10.4	79.6 $\pm$ 8.6
BMI <sup>a</sup>	26.4 $\pm$ 2.5	26.4 $\pm$ 2.4
Serum cholesterol, mmol/l	5.9 $\pm$ 1.1	5.9 $\pm$ 1.2
Serum triglycerides, mmol/l	1.7 $\pm$ 0.6	1.8 $\pm$ 0.6
Energy intake, kcal	3 357 $\pm$ 1 239	3 443 $\pm$ 1 165

<sup>a</sup> Body Mass Index: weight (kg)/(height (m))<sup>2</sup>.

Table II. Proportion of patients with a loss of weight of more than 3 kg or more than 5 kg in the rehabilitation and control groups

	Loss of weight	
	>3 kg (%)	>5 kg (%)
Rehabilitation group (n=69)	49	33
Control group (n=64)	13	5
	$\chi^2=19.1$ $p<0.001$	$\chi^2=15.6$ $p<0.001$



Table III. Mean weight change (kg) during one year after MI in relation to age, overweight, depression and social status

	Rehabilitation group			Control group		
	Mean $\pm$ SD	n	p	Mean $\pm$ SD	n	p
Age (years)						
Under 50	-1.6 $\pm$ 5.1	17	NS <sup>a</sup>	2.5 $\pm$ 3.8	23	0.04
50-64	-4.5 $\pm$ 5.8	52		0.3 $\pm$ 3.9	41	
Overweight <sup>b</sup>						
Slight (BMI $\leq$ 28)	-2.6 $\pm$ 4.5	52	0.02	1.6 $\pm$ 4.2	50	0.01
Moderate (BMI>28)	-7.4 $\pm$ 7.5	17		-0.8 $\pm$ 2.2	14	
Depression <sup>c</sup>						
No (0-13 points)	-4.2 $\pm$ 6.0	52	NS	0.9 $\pm$ 4.0	46	NS
Yes (>13 points)	-2.0 $\pm$ 4.5	15		1.6 $\pm$ 4.1	17	
Social status						
Administrative and clerical employees	-5.4 $\pm$ 6.0	27	NS	0.8 $\pm$ 4.3	21	NS
Skilled and unskilled workers	-2.8 $\pm$ 5.4	42		1.3 $\pm$ 3.9	43	

<sup>a</sup> NS = not significant.<sup>b</sup> Body Mass Index.<sup>c</sup> Beck Depression Inventory.

food preparation classes model meals were prepared and eaten by the subjects. The motivation for nutrition education was very good. About 90% of the patients in the treatment group attended every nutrition class.

The physical exercise programme was based on the results of an ergometric test for each patient. The intensity of the exercises was adapted to each patient's heart rate level, which was followed during the supervised training. During the first two weeks the training was rather light and consisted of relaxation and warming-up exercises every day for 15-20 min. This was followed by 40 min of gymnastic exercises three times per week. The training was based on conventional exercise programmes for myocardial infarction patients and lasted up to 3 months after MI. After the intensive training period the conducted programme was reduced to one time per week for the remaining 9 months of the rehabilitation year, and the patients were motivated to take daily light exercise and walks in the fresh air by themselves.

Antismoking advice from the physician and antismoking films were used to motivate the patients to give up smoking. In the beginning of the rehabilitation period all the patients had a consultation with the social worker and the psychologist. More than half of the patients also had later discussions with them during the rehabilitation period.

## RESULTS

The year after infarction resulted in a mean weight change in the rehabilitation group of -3.8 kg with a range from -23.6 to +9.5 kg. The mean weight change in the control group was +1.1 kg ranging from -8.3 to +10.1 kg. The distribution of the Body

Mass Index before and after infarction is presented in Fig. 1 and 2. Comparison of this group difference yields a statistically highly significant result ( $t = -5.78$ ,  $p < 0.001$ ). The proportion of patients with a weight loss of more than 3 kg or more than 5 kg was also significantly higher in the rehabilitation group (Table II).

From Table III it is seen that only overweight and age were significantly related to the weight change. Among the variables in Table IV smoking habits, employment and social problems are related to the weight change in the rehabilitation group. It is interesting to note that the highest mean weight reduction was achieved by persons who already before their myocardial infarction had stopped smoking. It is also noted that those who had retired before MI and those who had no or slight social problems had the highest mean weight loss.

After studying the pairwise association between weight change and the variables in Tables III and IV it was decided to use multivariate techniques to study the association between weight change and the whole set of variables. The data for the two groups were analysed separately. All combinations of explanatory variables were screened by the all subsets multiple linear regression technique, which lead to the following simple regression models for the weight change. In the rehabilitation group the weight changes are well described by a pair of

Table IV. Mean weight change (kg) during one year after MI in relation to smoking habits, employment situation, level of physical exercise, health status and social problems after MI

	Rehabilitation group			Control group		
	Mean $\pm$ SD	n	p	Mean $\pm$ SD	n	p
Smoking habits						
Stopped before MI	-6.1 $\pm$ 4.7	31	0.01 <sup>a</sup>	0.3 $\pm$ 3.3	24	0.05 <sup>a</sup>
Stopped after MI	-2.3 $\pm$ 7.1	21		3.1 $\pm$ 4.9	17	
Continuing	-1.6 $\pm$ 4.3	17		0.5 $\pm$ 3.6	23	
Employment						
Retired before MI	-6.0 $\pm$ 7.6	17	0.03 <sup>a</sup>	1.8 $\pm$ 4.1	15	NS <sup>a,b</sup>
Retired after MI	-1.4 $\pm$ 4.8	23		0.8 $\pm$ 4.5	22	
Returned to work	-4.5 $\pm$ 4.5	29		0.9 $\pm$ 3.6	27	
Level of physical exercise						
Low	-2.9 $\pm$ 5.3	39	NS	1.2 $\pm$ 4.4	40	NS
Medium or high	-5.0 $\pm$ 6.1	30		1.0 $\pm$ 3.4	24	
Health status <sup>c</sup>						
NYHA class 1	-5.0 $\pm$ 6.1	22	NS	1.6 $\pm$ 3.3	19	NS
NYHA classes 2-4	-3.3 $\pm$ 5.5	47		0.9 $\pm$ 4.3	45	
Social problems						
None or slight	-5.2 $\pm$ 5.9	43	0.01	1.1 $\pm$ 4.2	42	NS
Moderate or severe	-1.6 $\pm$ 4.7	26		1.0 $\pm$ 3.7	21	

<sup>a</sup> Significance level for testing the hypothesis of all means equal.<sup>b</sup> NS = not significant.<sup>c</sup> New York Heart Association (16) functional classification: 1 = no functional limitation, 2-4 = slight to severe limitations.

explanatory variables, Body Mass Index and cessation of smoking before MI (Table V). This model accounts for 25% of the total variation of weight change.

The sign of the coefficients show that slight overweights are generally associated with small weight reductions. Cessation of smoking before MI is often observed together with high loss of weight. The regression coefficient of each variable in the model is highly significant.

The regression model for weight change in the control group consists of only one explanatory var-

iable, cessation of smoking after MI. The sign of the regression coefficient indicates that the cessation is often associated with a weight gain. The low significance level for the model implies that the weight changes in the control group are not very closely associated with the variables in Tables III and IV.

## DISCUSSION

The figures of Table II show that the weight changes were quite different in the groups under study. Because of the random assignment of pa-

Table V. Regression models for the weight change in the rehabilitation and control groups

Variable	Regression coefficient	Standard error	t	p	
<i>Rehabilitation group (n=69)</i>					
Body Mass Index	-0.81	0.25	-3.26	0.002	$R^2=0.25$
Stopped smoking before MI	-3.55	1.23	-2.88	0.005	$F(2, 66)=10.8$
Intercept	19.07				$p=0.0001$
<i>Control group (n=64)</i>					
Stopped smoking after MI	2.73	1.09	2.51	0.015	$R^2=0.09$
Intercept	0.38				$F(1, 62)=6.29$
					$p=0.015$



tients to the groups there were no noticeable differences between the groups at baseline. Thus it was concluded that the participation in the rehabilitation programme had a very significant influence on the weight reduction.

The results in Table III suggest that moderate overweight may have motivated patients to a more definite weight reduction than slight weight problems. The subgroup of controls with moderate overweight is the only observed subgroup of controls with a mean loss of weight. The mean weight change in the two age groups differ significantly among the controls. The corresponding difference in the rehabilitation group is quite large, although not statistically significant ( $p=0.07$ ). The general pattern was that the older patients reduced their weight more than the younger, although it is often assumed that young patients are most willing to accept new life styles.

The findings of relations between smoking habits and weight reduction in the rehabilitation group are probably related to a general positive attitude towards changing habits related to health.

Changes in eating habits, assessed by dietary interviews, were not included in the analysis of association with weight changes because the interview results are not methodologically sufficient measures of changes on the individual level. The energy content of the patients' diet before infarction was rather high (Table I). As reported elsewhere, the changes on the group level were rather favorable for the rehabilitation group. The mean intakes of energy, fats, sucrose and cholesterol decreased and the P/S ratio and the mean intake of vitamin C increased considerably more in the rehabilitation than in the control group, which also changed its food habits (12).

The data in Tables II-IV show that weight reduction in the rehabilitation group was rather successful. This was not the case in the control group. The number of patients reducing their weight substantially was very low and it is not possible to draw definite conclusions about the association between the weight changes and the patient characteristics.

## CONCLUSIONS

The results of this study point out clearly the favorable effect of the comprehensive rehabilitation programme on the weight reduction of the patients. The results also show that many impediments in the

life style of the individual patients made it difficult to reach the goals of rehabilitation on the individual level. It would be desirable therefore, when planning and carrying out the rehabilitation programmes, to take into consideration the individual diversities of patients, because these factors might significantly confound the achievement of the objectives of rehabilitation and the profitability of the programmes.

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*Address for offprints:*

Ritva-Liisa Karvetti  
 Rehabilitation Research Centre of the Social  
 Insurance Institution  
 Peltolantie 3  
 20720 Turku 72  
 Finland