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Predictors of Weight Reduction and Smoking Cessation in Overweight and Obese Patients with Acute Myocardial infarctions

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－Abstract－

Background : Little is known about predictors of lifestyle modification in overweight or obese patients with acute myocardial infarctions.

Methods : Between October 2005 and May 2007, 311 overweight or obese patients with an AMI visited Kyungpook National University Hospital. Among them, 216 patients (63±11 years old, 144 males) with ≥1 year of follow-up were included.

Results : Body weight of all patients showed a significant decrease and 20% showed a >3% weight reduction at 1 year of follow-up. Ninety-six (44%) patients were smoking at baseline, and 52% of them had quit by 1 year of follow-up. Only six smokers were successful with both a >3% weight reduction and smoking cessation. In multivariate analysis, age (OR 1.084, 95% CI 1.028-1.144, p=0.003) and smoking cessation (OR 0.167, 95% CI 0.048-0.575, p=0.005) were independent predictors of weight reduction. Abdominal circumference was a negative predictor of smoking cessation (OR 0.903, 95% CI 0.820-0.994, p=0.037).

Conclusions : Mean body weight of all patients showed a significant decrease at follow-up. Smoking cessation and age were independent predictors of weight reduction, and abdominal circumference was a negative predictor of smoking cessation.

Key Words : Myocardial infarction, Weight loss, Smoking cessation

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Introduction

Obesity and smoking have become a major threat in Korea. The prevalence of obesity in Korea is rapidly increasing in the general population.[1] Although the smoking rate is decreasing in the general Korean population, of those older than 20 years, and is currently 27%, which is high compared to developed Western countries.[2] Over the last few decades, numerous epidemiological and clinical studies indicate that obesity and smoking are associated with cardiovascular disease (CVD), but lifestyle modification can decrease the prevalence of CVD.[3-7]

Both smoking and obesity are risk factors in patients with acute myocardial infarctions (AMIs).[6,7] Smoking is harmful to patients with AMIs, and there is tremendous benefit of smoking cessation after an AMI on recurrent cardiovascular events.[8-10] Although there have been conflicting data regarding the relationship between obesity and CVD,11 recent data indicate that obesity is also an independent CVD risk factor, and that weight reduction in overweight and obese individuals has beneficial effects.[3,5,6,12] The current guidelines of the American College of Cardiology/American Heart Association recommend therapeutic lifestyle modifications including weight reduction and smoking cessation for all overweight or obese patients with AMIs.[13] However, few data are available regarding the patterns and predictors of weight reduction and smoking cessation despite the known benefits on the cardiovascular outcomes.[14] The purpose of this study was to investigate factors associated with successful weight reduction and smoking cessation in overweight or obese patients with AMIs.

Methods

Study subjects

A total of 613 patients with an AMI visited Kyungpook National University Hospital between October 2005 and May 2007. Among those patients, 216 obese or overweight patients were followed for ≥1 year after their AMI and were included in this study. One hundred-twelve (52%) patients were obese and 96 (44.4%) were smokers at baseline. All the subjects were given the recommendation to reduce their weight and quit smoking when they were discharged from the hospital after the AMI.

An AMI was defined as the rise and/or fall in the cardiac biomarkers with at least one value above the 99 percentile of the upper reference limit together with symptoms of ischemia, significant ECG changes indicative of ischemia, or both.15 The demographic and clinical data including the age, sex, height, weight, body mass index, smoking status, Killip class, left ventricular ejection fraction (LVEF), cardiac biomarkers, and CVD risk factors were obtained from the hospital

records. The study protocol was approved by the Institutional Ethics Committee of Kyungpook National University Hospital and informed consent was obtained for the use of personal information for the analysis.

Weight and smoking status assessment

The weight and smoking status were assessed both at the time of the AMI and one year after the AMI. To assess any change in the weight and smoking status, the patients were asked to report their current weight and smoking status during a follow-up phone interview, one year after the AMI. Patients were assigned to one of two weight categories: overweight (BMI = 23~24.9 kg/m^2) or obese (BMI ≥25 kg/m^2), based on the World Health Organization criteria for Asian populations.[16]

Weight changes were defined as a percentage of change in weight: the weight at follow-up minus the weight at baseline divided by the weight at baseline. We defined a successful weight reduction as a greater than 3% decrease from the baseline weight. To classify the smoking status, a patient was defined as a "quitter" if he or she was smoking at the time of the AMI and then quit smoking for at least 3 months by the 1 year follow-up. The patients who smoked both at the time of the AMI and at 1 year of follow-up were classified as a "non-quitter", and those who were not smoking either at the time of their AMI or at 1 year of follow-up were considered nonsmokers.

Statistical analysis

The data are expressed as the mean ± SD or percentages. All comparisons of the baseline variables were assessed with the chi-square test for categorical variables and Student's t-test for continuous variables. The patients were categorized into two groups on the basis of the change in their weight or smoking status; patients with or without a weight reduction of >3%, or a quitter or non-quitter. A multivariate logistic-regression model was used to determine the independent predictors of a 1 year weight reduction of >3% or successful smoking cessation. For all analyses, a two-sided $p < 0.05$ was considered as statistically significant. The statistical analyses were performed using SPSS version 15.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

Results

Baseline characteristics

The mean age of the study population was 63 ± 11 (32~93) years (Table 1). At baseline, 112 (52%) patients were obese and 104 (48%) were overweight. Hypertension (48%) was the most common co-morbidity in those patients. One year after AMI, approximately 20% of the patients had a >3% weight reduction. Ninety-six (44%)

Table 1. Characteristics at baseline and 1 year of follow-up

Demographics	Total (n=216)
Baseline	
Age (year)	63.2±11.4
Male (n, %)	144 (66.7)
Height (cm)	163.4±9.1
Weight (kg)	68.8±9.7
Abdominal circumference (cm)	93.4±6.2
Hip circumference (cm)	97.1±5.6
Body mass index (kg/m^2)	25.7±2.1
Body mass index ≥25 (n, %)	112 (51.9)
Body mass index = 23-24.9 (n, %)	104 (48.1)
Medical history	
Current smoker (n, %)	96 (44.4)
Pack-years (mean)	32.9±19.8
Hypertension (n, %)	105 (48.6)
Diabetes mellitus (n, %)	63 (29.2)
Hyperlipidemia (n, %)	43 (20.0)
Family history of cerebrovascular disease (n, %)	25 (11.6)
Disease severity	
Killip class (%)	
Ⅰ	191 (88.4)
Ⅱ	7 (3.2)
Ⅲ-Ⅳ	18 (8.3)
LVEF (%)	54.1±8.9
STEMI (n, %)	93 (43.1)
CK-MB (ng/ml)	67.4±151.6
cTnI (ng/ml)	94.7±611.8
Medications at discharge	
Anti-platelet drugs (n, %)	214 (99.1)
Beta-blockers (n, %)	198 (91.7)
ACE inhibitors (n, %)	187 (86.6)
Diuretics (n, %)	49 (22.7)
Lipid-lowering drugs (n, %)	169 (78.2)
One year follow-up	
Weight (kg)	67.8±9.3
Body mass index (kg/m^2)	25.5±2.3
Body mass index ≥25 kg/m^2 (n, %)	106 (49)
Body mass index = 23-24.9 kg/m^2 (n, %)	100 (46)
Weight change (%)	-1.1±6.5
Quit smoking (n, %)	50 (52.1)

Values are mean ± SEM, LVEF: left ventricular ejection fraction, STEMI: ST-segment elevation myocardial infarction, CK-MB: creatine kinase-MB isoenzyme, cTnI: cardiac troponin I, ACE: angiotensin converting enzyme.

Table 2. Characteristics at baseline and their distribution by the change in the weight and smoking status at 1 year follow-up

Demographics	Weight change (n=216)			Smoking status (n=96)		
	Reduced (n=44)	Not reduced (n=172)	*p* value	Quitter (n=50)	Non-quitter (n=46)	*p* value
Baseline						
Age (year)	64.4±11.6	62.9±11.3	0.425	61.0±11.3	57.8±11.7	0.179
Male (n, %)	28 (63.6)	116 (67.4)	0.633	43 (86.0)	43 (93.5)	0.231
Height (cm)	165.3±9.4	163.0±9.0	0.125	167.1±8.8	167.4±6.7	0.827
Weight (kg)	72.6±13.2	67.8±8.3	0.025	70.3±9.7	72.7±10.9	0.254
Abdominal circumference (cm)	94.9±6.8	93.0±6.1	0.103	91.7±5.3	94.3±5.8	0.042
Hip circumference (cm)	98.5±5.6	96.8±5.5	0.101	95.6±5.2	97.6±5.5	0.103
BMI (kg/m^2)	26.4±2.5	25.5±2.0	0.013	25.1±1.8	25.8±2.2	0.079
BMI ≥25 kg/m^2 (n, %)	29 (65.9)	83 (48.3)	0.037	21 (42.0)	24 (52.2)	0.318
Medical history						
Current smoker (n, %)	22 (50.0)	74 (43.0)	0.343	NA	NA	NA
Pack-years (mean)	31.2±13.9	33.3±21.2	0.667	34.0±22.6	31.7±16.5	0.582
Hypertension (n, %)	27 (61.4)	78 (45.3)	0.058	24 (48.0)	19 (41.3)	0.510
Diabetes mellitus (n, %)	16 (36.4)	47 (27.3)	0.055	10 (20.4)	12 (26.1)	0.512
Hyperlipidemia (n, %)	7 (16.3)	36 (20.9)	0.712	5 (13.5)	10 (24.4)	0.224
Family history of CVD n, (%)	4 (9.1)	21 (12.3)	0.171	4 (8.2)	10 (23.3)	0.078
Disease severity						
Killip class (%)						
I	37 (84.1)	154 (89.5)	0.311	45 (90.0)	45 (97.8)	0.205
II	3 (6.8)	4 (2.3)		3 (6.0)	0 (0.0)	
III-IV	4 (9.1)	14 (8.1)		2 (4.0)	1 (2.2)	
LVEF (%)	53.9±9.1	54.1±8.9	0.874	53.8±8.4	54.7±10.3	0.663
STEMI (n, %)	17 (38.6)	76 (44.2)	0.507	29 (58.0)	20 (43.5)	0.155
CK-MB (ng/ml)	53.9±101.2	70.9±162.1	0.508	57.4±104.5	89.0±239.6	0.399
cTnI (ng/ml)	44.4±90.9	107.7±684.3	0.542	66.5±81.9	249.9±1,325.8	0.331
Medications at discharge						
Anti-platelet drugs (n, %)	44 (100.0)	170 (98.9)	0.472	50 (100.0)	46 (100.0)	NA
Beta-blockers (n, %)	39 (88.6)	159 (92.4)	0.415	46 (92.0)	43 (93.5)	0.781
ACE inhibitors (n, %)	39 (88.6)	148 (86.0)	0.653	46 (92.0)	42 (91.3)	0.902
Diuretics (n, %)	10 (22.7)	39 (22.7)	0.994	8 (16.0)	8 (17.4)	0.855
Lipid-lowering drugs (n, %)	30 (68.2)	139 (80.8)	0.070	38 (76.0)	33 (71.7)	0.635
One year follow-up						
BMI (kg/m^2)	24.7±2.8	25.6±2.1	0.019	25.0±2.0	25.5±2.3	0.301
BMI ≥25 kg/m^2 (n, %)	17 (39.5)	89 (53.6)	0.10	22 (44.9)	24 (54.5)	0.353
Weight change (%)	-9.0±9.4	1.0±3.3	<0.001	0.2±6.7	-2.8±7.2	0.034
Quit smoking (n,%)	6 (27.3)	44 (59.5)	0.008	NA	NA	NA

Values are mean ± SEM, BMI: body mass index, CVD: cardiovascular disease, LVEF: left ventricular ejection fraction, STEMI: ST-segment elevation myocardial infarction, CK-MB: creatine kinase-MB isoenzyme, cTnI: cardiac troponin I, ACE: angiotensin converting enzyme.

patients were smoking at baseline, and 50 (52%) of smokers had quit for more than 3 months one year after AMI. None of nonsmokers at the time of their AMI smoked one year after AMI.

Weight change and smoking cessation at 1 year after the myocardial infarction

After 1 year, 45.1% of the subjects lost weight, 31.6% of the subjects had no weight change, and 23.3% of the subjects gained weight. The mean body weight and BMI changed from 68.8 ± 9.7 kg to 67.8 ± 9.3 kg (p=0.014) and 25.7 ± 2.1 kg/m^2 to 25.5 ± 2.3 kg/m^2 (p=0.02) at baseline and 1 year after AMI, respectively. One year after AMI, 106 (49%) patients were obese, 100 (46%) were overweight, and another 10 (5%) were normal weight (Table 2). The weight change varied by the severity of the baseline obesity and smoking status one year after AMI. Overweight quitters showed a 1.8% weight gain, overweight non-quitters showed a 1.8% weight reduction, the obese quitters showed a 2.0% weight reduction, and obese non-quitters showed a 3.8% weight reduction (p=0.029) (Fig. 1). The weight, BMI, obesity, and smoking cessation one year after AMI were significantly associated with a weight reduction of >3%. The weight changes between diuretic-user and non-user were not significantly different. There were no significant differences in age, sex, BMI, baseline obesity, medical history of CVD risk factors, Killip class, LVEF, serum levels of the cardiac biomarkers, or discharge medications between the quitters and non-quitters. However, the quitters had a significantly lower abdominal circumference than the non-quitters at baseline (91.7 ± 5.3 cm vs. 94.3 ± 5.8 cm; p=0.042). The pack/years of smoking at baseline had no significant

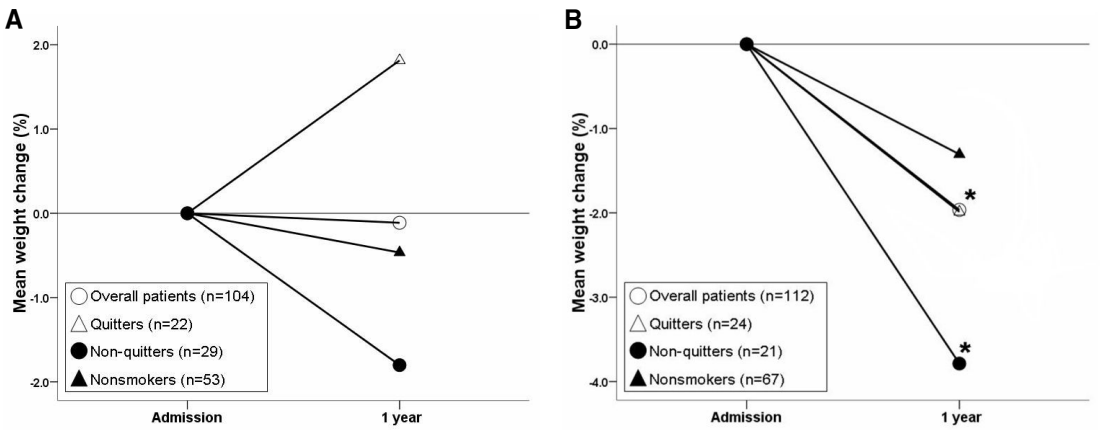

Fig. 1. An unadjusted weight change according to the severity of the baseline obesity and smoking status at 1 year after an acute myocardial infarction in overweight patients (A) and obese patients (B).
* p<0.05 compared with baseline weight.

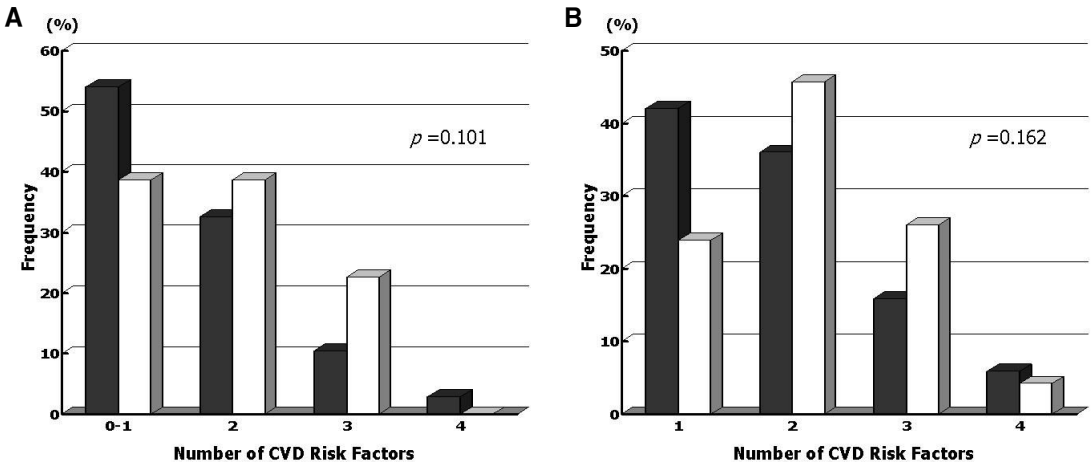

Fig. 2. Percentage of the weight reduction and smoking cessation according to the number of cardiovascular risk factors. (A) Weight reduction. Closed bar: a weight reduction of >3%, open bar: a weight change of ≤ 3% or weight gain of >3%. (B) Smoking cessation. Closed bar: quitter, open bar: non-quitter, CVD: cardiovascular disease.

association with the weight change or smoking status one year after AMI (Table 2). The number of major CVD risk factors including a history of hypertension, diabetes mellitus, hyperlipidemia, current smoking, and family history of CVD was not associated with a weight reduction and/or smoking cessation (Fig. 2). Although it was not statistically significant, the patients who had a higher number of CVD risk factors were less likely to lose weight and quit smoking.

Multivariate analysis predicting a weight reduction and smoking cessation

In the multivariate analysis, the age (odds ratio [OR] 1.067, 95% confidence interval [CI] 1.017 to 1.121, p=0.009) was an independent

Table 3. Multivariate logistic regression analysis for predicting the weight reduction and smoking cessation at 1 year after an acute myocardial infarction

	OR	95% CI	p value
Weight reduction			
Age	1.067	1.017-1.121	0.009
Male	1.624	0.260-10.146	0.604
BMI	1.206	0.946-1.537	0.131
Smoking cessation	0.216	0.068-0.688	0.009
Smoking cessation			
Age	0.418	0.068-2.562	0.346
Male	1.026	0.980-1.075	1.026
Abdominal circumference	0.903	0.820-0.994	0.037

OR: odds ratio, CI: confidence interval, BMI: body mass index.

predictor of a weight reduction one year after AMI (Table 3). Smoking cessation (OR 0.216 95% CI 0.068 to 0.688, p=0.005) was a negative predictor of a weight reduction after an adjustment for confounding variables. Although the BMI was significantly associated with a weight reduction of >3% one year after AMI in the univariate analysis, it (OR 0.805, 95% CI 0.494 to 1.312, p=0.384) was not an independent predictor of a weight reduction one year after AMI when adjusting for the confounding variables. The abdominal circumference (OR 0.903, 95% CI 0.820 to 0.994, p=0.037) was a negative predictor of smoking cessation one year after AMI, after adjusting for age and sex (Table 3). Only six (27.3%) smokers achieved both a >3% weight reduction and smoking cessation. Conversely, 16% of the quitters had a weight gain >3%.

Discussion

We demonstrate that smoking cessation and age are independent predictors of a weight decrease in overweight or obese patients one year after AMI. Although randomized controlled trials are not available on the predictors of weight changes in patients with AMIs, a multicenter observational study suggests that depression, lack of health insurance, smoking cessation, morbid obesity, and increased age are significantly associated with a weight change.[14] The observation that obese patients are more likely to lose weight than overweight patients may not be solely due to higher resting metabolic rates among heavier patients, but also may reflect greater social pressure to lose weight.[14,17] Although a greater weight reduction was observed in the obese patients but not the overweight patients in the univariate analysis, the baseline BMI was not an independent predictor of a weight reduction. Interestingly, although there was an effect of age on weight reduction, it might be due to age-related loss of muscle mass.

In this study, 52% of the smokers at baseline had quit smoking one year after AMI. Similar findings were observed in other studies demonstrating that the rate of smoking cessation was 42~71% within 6 months after an AMI.[10,18,19] Although 70% of the smoking patients with an AMI stopped smoking 3 months after the AMI, one-third had resumed smoking after 4 years.[19] These findings suggest that an intervention that may induce a brief smoking cessation may not be effective for long-term smoking cessation. Therefore, it may be important to identify the demographic, psychosocial, and clinical factors that are predictors of the long-term smoking cessation in those patients. We found that patients with a relatively high abdominal circumference were more likely to continue smoking, even though they were already overweight or obese.

Although obesity is strongly associated with the risk of acute coronary events regardless of the smoking status, obese nonsmokers have a lower risk of acute coronary events than obese smokers.[3] Smoking patients with obesity and an AMI may have the worst prognosis for major adverse cardiac events including recurrent MI, revascularization, and death. A reliable and effective intervention for smoking cessation is required for these patients.

Despite the substantial benefits of smoking cessation, the process of achieving that goal is not simple. Successful smoking cessation may be associated with a significant weight gain.[20] Weight gain after smoking cessation needs attention, as it might attenuate some of the beneficial effects of the smoking cessation. Obese nonsmokers have a higher risk of acute coronary events than do healthy normal weight or overweight smokers.[3] Recent studies reported that smokers who quit within one month after an AMI had a mean of a 2.7% weight gain as compared to those who continued to smoke, and 28.2% of the quitters had a weight gain over 5%.[14,21] Similarly, we report that only a few of the smoking patients achieved both a weight reduction and smoking cessation in this study.

In the present study, there were no significant differences in the weight change and smoking cessation according to the number of CVD risk factors. One potential explanation of this finding is the poor knowledge of one's own risk factors in the post-MI patients. Over 80% of the patients are unable to state any of their own modifiable risk factors.[22] Full knowledge of the risk factors correlates with a greater adherence to lifestyle changes.[23] Although cardiac education programs appear to increase the knowledge in patients with an AMI, whether or not this knowledge actually influences a change in their behavior is unknown. A substantial gap may exist between 'knowing' and 'doing' according to the demographic and socioeconomic background of the patients. Structured, systematic, and individualized cardiac teaching programs to elicit behavioral changes are urgently needed.

Our study had some limitations that should be considered. First, the retrospective nature of this analysis and the small sample size are major limitations of this study. Second, only patients who survived at least 1 year were included. Patients who died before the 1 year follow-up might have been the best candidates for lifestyle modification. Third, body weight was measured objectively by the physicians at baseline, but was measured subjectively via self report by the patient during the follow-up phone discussion. The use of patient-reported weight data is likely to yield an underestimation of their actual weight. Fourth, the roles of the behavioral and socioeconomic factors known to influence a weight change and smoking

cessation such as the physical activity, dietary habit, health insurance, education status, and occupation were not investigated. Fifth, we defined a weight change of >3% as a significant weight change because we had less obese patients than previous studies which defined a weight reduction of >5% as significant.[21]

Summary

Smoking cessation and higher age were independent predictors of a weight change, and the abdominal circumference was a negative predictor of smoking cessation in overweight and obese patients with an AMI, one year after the incident. Only a few smokers were successful in both achieving a weight reduction and smoking cessation. New interventions to support a weight reduction and smoking cessation in those patients are urgently needed.

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