

# Predictors of Successful Smoking Cessation in Cardiac Rehabilitation Patients with a History of Acute Coronary Syndrome

## Predyktory skutecznego zaprzestania palenia wśród pacjentów rehabilitowanych kardiologicznie po przebyciu ostrego zespołu wieńcowego

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### SUMMARY

**Aim:** To establish socio-psychological and clinical smoking predictors cessation at the stage of health-resort rehabilitation in patients who have recently suffered an acute coronary event.

**Materials and Methods:** 68 patients aged 42–68 years (average age  $56.70 \pm 6.1$  years) who underwent a cardiorehabilitation program in the heart rehabilitation department of the health-resort complex „Morshinkurort” after a recent ACS (no more than 28 days ago) were examined. Depending on the smoking habit, all patients were divided into two groups. The first (I) group included smoking patients who gave up smoking in the course of CR ( $n=38$ , average age  $57.10 \pm 6.73$  years), the second (II) group included smokers who continued smoking during the health-resort stay treatment ( $n=30$ , average age  $56.58 \pm 5.74$  years). Predictors of smoking cessation were determined in patients of the studied groups using the method of binary logistic regression.

**Results:** In the course of the study, 5 independent predictors of quitting smoking were established, which turned out to be statistically significant – smoking index, anxiety level, body mass index, comorbidity and marital status. The chances of quitting smoking were 1.79 times greater (95% CI from 1.25 to 2.56) in patients with higher BMI and 3.23 times (95% CI from 0.57 to 18.40) in those who are in family status. High comorbidity, higher SI score, and higher anxiety levels were significantly associated with a reduced likelihood of quitting smoking.

**Conclusions:** Cardiac rehabilitation patients with high nicotine dependence, lower body weight, loneliness, significant anxiety symptoms, and multiple comorbidities are less likely to successfully quit smoking. Established independent predictors of smoking cessation must be used when choosing strategies for the treatment of tobacco addiction at the stage of CR. Screening and treatment for anxiety disorders should be included in smoking cessation programs to improve the SI effectiveness.

**Key words:** cardiorehabilitation program, health-resort, nicotine dependence, multiple comorbidities

**Słowa kluczowe:** program rehabilitacji kardiologicznej, sanatorium, uzależnienie od nikotyny, liczne choroby współistniejące

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### INTRODUCTION

Smoking remains one of the most aggressive risk factors for cardiovascular disease (CVD) [1-3], as smokers have been shown to have twice the risk of cardiovascular (CVD) mortality than non-smokers. Accordingly, quitting smoking in people even in the elderly is useful [4]. Data from a meta-analysis showed that the increased CV risk in patients who got rid of this habit decreased over time [4]. Another study found a directly proportional relationship between smoking and CVD: the more cigarettes smoked and the longer the

history of smoking, the higher the risk of myocardial infarction (MI) [5].

The authors of a meta-analysis of 12 cohort studies suggested that smoking cessation is closely related to a reduction in overall mortality [6]. It was found that in patients who did not give up smoking after an MI, mortality increased significantly and amounted to 20%. The scientific results of another retrospective American study Partners YOUNG-MI Registry [7] showed that smoking cessation in young patients (< 50 years old) who underwent MI was reliably

associated with a decrease in total mortality and mortality from CV diseases by approximately 70-80%. And this, in turn, confirms the critical importance of smoking cessation in young patients after MI. Another convincing result was obtained in a 15-year follow-up of patients who underwent coronary bypass surgery [8]. A study found that patients who smoked within 1 year after surgery had a risk of subsequent MI and reoperation more than twice as high as patients who quit smoking after surgery [8]. Patients who continued to smoke 5 years after surgery had an even higher risk of MI and reoperation compared with patients who quit smoking after surgery and patients who had never smoked. It was also found that the risk of MI was similar among non-smokers and those who managed to quit smoking after surgery [8]. In a meta-analysis of 20 studies, it was found that the effect of smoking cessation was prognostically more favorable than lowering cholesterol, in which the latter sometimes the greatest attention is focused [9].

Despite the fact that smoking necessity cessation in the process of cardiorehabilitation (CR) has been proven, little is known among the participants of CR about the factors associated with the patients' refusal to quit smoking. That is why researchers have begun to study predictors of smoking cessation in order to improve and increase the effectiveness of cardiorehabilitation programs. The results of many studies have established variables that influence the process of quitting smoking, namely: the degree of tobacco dependence (number of cigarettes smoked per day, smoking history), number of previous attempts to quit smoking, gender, age, marital status and level of depression. However, the obtained scientific results of such studies are contradictory and require additional study to accurately determine the factors that are associated with the successful cessation of smoking by smoking patients after an acute coronary event at the stage of active completion of CR programs.

### AIM

To establish socio-psychological and clinical predictors of smoking cessation at the stage of health-resort rehabilitation in patients who have recently suffered an acute coronary event.

### MATERIALS AND METHODS

68 patients aged 42-68 years (average age  $56.70 \pm 6.1$  years) who underwent a cardiorehabilitation program in the rehabilitation department after heart diseases of the „Morshinkurort” health-resort complex after a recent heart attack (no more than 28 days ago) were examined. Depending on the smoking habit, all patients were divided into two groups. The first (I) group included smoking patients who gave up smoking during the CR process ( $n=38$ , average age  $57.10 \pm 6.73$  years), the second (II) group – smokers who continued to smoke during the health-resort treatment ( $n=30$ , average age  $56.58 \pm 5.74$  years). The measures of the rehabilitation program were carried out according to the recommendations of the ESC working group on cardiorehabilitation and physical training [10]. The CR program included dosed therapeutic

walking, therapeutic gymnastics (ThG), laser therapy for the cubital vein, and optimal medical therapy (OMT). In order to quit smoking, all smoking patients were given individual counseling using the “5As” strategy, unmotivated smokers - the “5R” strategy in accordance with Order 746 dated 09/26/2012 “On the approval of Methodological recommendations for medical workers of health care institutions on providing medical and preventive care for persons who want to get rid of tobacco addiction” [11,12]. The length of stay of all cardiac rehabilitation patients in the rehabilitation department was 24 days.

All CR participants were interviewed using the Fagerstman test to assess the degree of nicotine addiction. The smoking index (SI) was calculated according to the formula:  $(SI) = Ch * C / 20$ , where Ch is the number of cigarettes smoked (per day), C is the smoking experience (years). All patients were also subjected to anthropometric measurements of body weight (m) using medical scales and height (h) to calculate BMI according to the formula:  $BMI = m/h^2$ , where m is body weight (kg), h is height (m). The level of depression and anxiety was assessed using the HADS scale (The Hospital Anxiety and Depression Scale) [13]. All rehabilitation patients underwent biochemical blood analysis, echocardiography and physical stress tests at the start of the cardiorehabilitation process.

We also used the primary data of rehabilitation patients to conduct the study: age, sex, presence of concomitant diseases, cardiovascular risk and marital status. In the course of the study, all of the above indicators were used to synthesize a mathematical model for predicting the outcome of smoking cessation in patients with ACS using the binary logistic regression method. The conducted analysis made it possible to establish the factors affecting the outcome of smoking cessation and to calculate the probability of this event depending on the values of independent predictors.

### RESULTS

During our calculations of binary logistic regression using the Wald exclusion method, 5 key parameters were determined that were statistically significant in terms of the influence on the process of smoking cessation in rehabilitation patients. The coefficients of the selected binary logistic regression model are presented in the Table 1.

The logistic regression model we created was statistically significant ( $G = 54.036$  at  $p(\chi^2) < 0.00000$ ) and the obtained Hosmer-Lemeshov (HL) value, which was 9.264 at a significance level of  $p > 0.05$  ( $p = 0.320$ ), indicated about the high consistency of our model. In the logistic model we created, the influence of indicators (SI, HADS-T, BMI, marital status and the presence of concomitant diseases) on smoking cessation was 58.79% (Table 2).

The effectiveness of the created model was confirmed with the help of our ROC-analysis by constructing a curve. The calculated area under the ROC curve (AUC) was 0.7877 [0.67-0.90] at  $p=0.0001$ , which corresponds to the “good” quality of the created model according to the expert AUC scale. The effectiveness of the model is represented by high threshold indicators of sensitivity (84.21%) and

**Table 1.** Coefficients of the binary logistic regression model calculated to predict the outcome of patients' smoking cessation

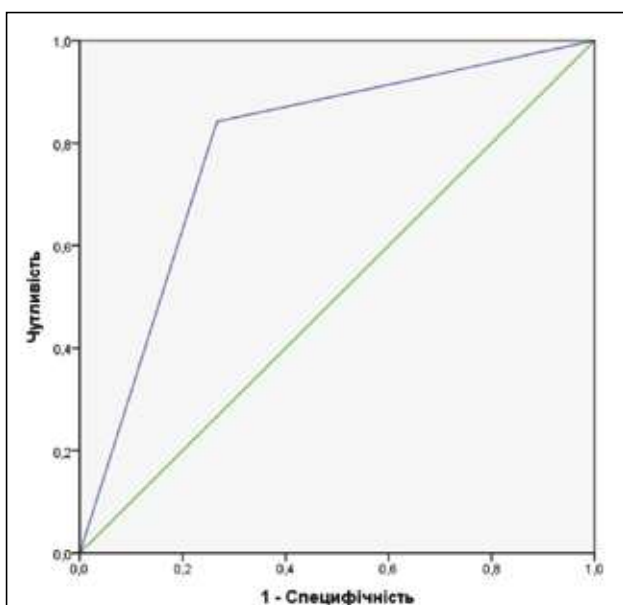
Indicators	Conventional designations	b -coefficients	Standard error	Wald Criterion	r	Odds	95% confidence interval	
							Lower	Upper
IR	X1	-0,1005	0,04	5,92	0,015	0,90	0,83	0,98
HADS-T	X2	-0,2298	0,16	2,18	0,023	0,79	0,59	1,08
BMI	X3	0,5830	0,18	10,27	0,001	1,79	1,25	2,56
Concomitant diseases	X4	-0,5139	0,92	0,31	0,042	0,60	0,10	3,66
Marital status (married)	X5	1,1713	0,89	1,74	0,046	3,23	0,57	18,40
Constant	K	-10,0809	4,76	4,48	0,034	0,00		

**Table 2.** Characteristics of the binary logistic regression model

-2 Log Plausibility (G)	$\chi^2$	p	R2 Nigelkerka
54,036	39,288	0,00000	0,5879

**Table 3.** ROC analysis results

Area under the curve	Standard. error	p	95% CI	
			Lower limit	Upper limit
0,7877	0,06	0,0001	0,67	0,90

**Figure 1.** ROC-curve of diagnostic testing of the quality of the binary logistic model smoking cessation in patients undergoing ACS (specificity)

specificity (73.33%), which confirms its significant practical diagnostic value for use by health care institutions (Table 3, Figure 1).

Thus, in the course of our analysis, it was established that only five studied indicators, namely, the level of nicotine dependence (NI), the level of anxiety according to the HADS

scale, BMI, the presence of concomitant diseases and family status, are independent predictors of quitting smoking.

In particular, the chances of quitting smoking were 1.79 times greater (95% CI from 1.25 to 2.56) in patients with higher BMI and 3.23 times (95% CI from 0.57 to 18.40) – in patients who are in family status. High comorbidity, a higher IS score, and a higher level of anxiety were significantly associated with a reduced likelihood of quitting smoking.

## DISCUSSION

Our analysis revealed that rehabilitation patients with a high level of nicotine dependence, severe anxiety disorders, low BMI, multiple comorbidities, and the absence of a partner had a low probability of effective smoking cessation during the CR program. Compared with smokers who continued to smoke, patients who successfully quit smoking were less anxious, had lower nicotine dependence, fewer comorbidities, higher body weight, and more frequent marital status.

Our results are consistent with a number of other studies [14-17]. In particular, at the study of Ahmad Salmanet. al [14] also found that patients without a partner, with lower body weight, with major depressive disorders and with high comorbidity were less likely to quit smoking. However, the authors of this study also found that the younger the age of the patients and the lower the cardiovascular risk, the more likely rehabilitation patients will get rid of the bad habit. In our study, there was no significant difference in age and cardiovascular risk among the CR participants. Similar results were obtained in the study of E. Vangeliet. al [18], where age was not significantly associated with smoking cessation attempts. Marital status was

also identified as an important predictor of smoking cessation in another retrospective study [19]. The authors of the analysis observed that smokers, whose partners objected to smoking, gave up the bad habit more often.

We also did not observe statistically significant differences in the gender of rehabilitation patients. The obtained results were consistent with the conclusions of other studies, in which also no probable gender difference was found in smoking patients of the studied groups [20, 21]. On the other hand, some studies report that male gender is a strong independent predictor of smoking cessation [22], while in the study of T. Chandola et al. identified female gender as an important predictor of smoking cessation [19]. Such conflicting conclusions indicate the need for a series of more thorough statistical analyzes to identify factors of successful smoking cessation in participants of cardiorehabilitation programs. The quality of our study consisted in the use of an observational approach using a large set of primary data of rehabilitation patients to create a statistically significant logistic regression model.

Thus, the predictors of smoking cessation obtained by us are very important characteristics that must be taken into account when counseling smoking patients at the stage of the cardiorehabilitation process. This, in turn, can help in the correct choice and rapid application of more intensive treatment strategies for smoking cessation by angry smokers already at the start of health-resort treatment. Moreover, cardiac rehabilitation programs should prioritize rehabilitation patients without partners, with high nicotine dependence, severe anxiety disorders, and multiple comorbidities to maximize the SI use of health care resources.

## CONCLUSIONS

Cardiac rehabilitation patients with high nicotine dependence, lower body weight, loneliness, significant anxiety symptoms, and multiple comorbidities are less likely to successfully quit smoking. Established independent predictors of smoking cessation must be used when choosing strategies for the treatment of tobacco addiction at the stage of CR. Screening and treatment for anxiety disorders should be included in smoking cessation programs to increase the SI effectiveness.

*Our scientific-research work was carried out on the basis of rehabilitation department after cardiac diseases at "Morshynkurort" health-resort complex under supervision of scientific department at Danylo Halytsky Lviv National Medical University.*

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**Conflict of interest:**

The Authors declare no conflict of interest

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