

Evaluation of Changes in The Hematological Parameters, Lipid Profile and Depressive Symptoms Before and After Smoking Cessation Treatment

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ABSTRACT

Introduction: Tobacco dependence is a cluster of behavioural, cognitive, and physiological phenomena. We aimed to investigate the changes in the hematological parameters, lipid profile and depressive symptoms before and after smoking cessation.

Methods: In this intervention study, 150 cases admitted to the clinic to quit smoking and stopped smoking for at least three months were investigated. All participants have received motivational interview and appropriate medical treatment (varenicline, bupropion, nicotine replacement therapy). We designed the study to evaluate the effects of cigarette smoking on some biochemical markers and depressive symptoms.

Results: Motivational interviews were conducted on all participants, and 68,7% (n = 103) were treated with varenicline, 19,3% (n=29) with bupropion and 12% (n=18) with nicotine replacement therapy (NRT). There was a statistically significant relationship between the treatment method and the smoking cessation duration (p=0.002). Cessation period was longer in the group using varenicline. After quitting smoking, the Beck Depression Scores (BDS) decreased significantly (p<0.001). In cases with smoking duration between 3-6 months, the levels of carbon monoxide (CO) (p<0.001), white blood count (WBC) (p<0.001), hematocrit (p=0.003), hemoglobin (Hb) (p=0.002) and mean corpuscular volume (MCV) (p<0.001) decreased significantly.

Conclusions: In our study, positive changes were observed in hematologic, biochemical parameters and depressive symptoms after quitting smoking. So, it is important that the society should be informed about the dangers of smoking. In particular, primary health care physicians should ask each patient whether they smoke or not, and encourage to quit smoking.

Key words: Smoking cessation, hematological parameters, lipid profile, depression.

INTRODUCTION

Smoking addiction is the most important cause of preventable mortality and morbidity that threatens human health seriously (1). Cigarette has pharmacological, mutagenic, toxic and inflammatory effects on the cells with nearly more than 4000 chemical and more than 60 carcinogenic substances. It significantly increases the incidence of many diseases due to long-term tobacco use, especially atherosclerosis, chronic obstructive pulmonary disease (COPD) and cardiovascular diseases (CVD) (1-5).

The World Health Organization (WHO) estimates that 20.2% of the world's population aged ≥15 years were current smokers in 2015. Despite a steady reduction in smoking globally, tobacco still kills over 7 million people each year. In Turkey, 27% of adults who are above 15 years of age were tobacco smokers (41.4% in males, 13.1% females) (1-3).

Nicotine metabolite cotinine and thiocyanate are the components which affect the endocrine system. Nicotine enhances

sympathetic system activation, plasma triglyceride (TG) and very low-density lipoprotein cholesterol (VLDL-c), and it lowers the level of high-density lipoprotein cholesterol (HDL-c) (3-6). Long-term cigarette smoking causes chronic endothelial damage, leads to coronary atherosclerosis and risks cardiovascular diseases by promoting smooth muscle proliferation in the circulatory system and increasing platelet adhesion. Carbon monoxide (CO) directly damages by reducing the oxygenation of the myocardium (5,6).

Smoking affects the hematopoietic system, increases leukocyte, eosinophil and platelet number in peripheral blood. The mean platelet volume (MPV>10 fL) causes intracoronary thrombus formation and acute coronary syndrome (7,8).

Depression is a disease with physical, emotional, behavioral and cognitive symptoms that we often encounter in primary care. In addition to the high incidence of depression in smokers, the

presence of depression also makes smoking cessation difficult (9,10). In our country, the Ministry of Health Tobacco Control Office has been distributing smoking cessation medications to smoking cessation clinics without money since 2011. Free drug distribution continues in 2018 as well. After the motivational interview, the doctors working at the smoking cessation clinic decide what medicine the patient must use.

This study is intended to investigate the changes in hemogram, lipid profile, CO level and depressive symptoms in those who were successful in the 3rd month before and after the treatment.

METHODS

Design and settings of the study

This study was planned as an intervention study and conducted between 05.01.2016 - 05.01.2017. Our study included 150 patients who applied to Family Medicine Polyclinic at Necmettin Erbakan University, Meram Medical Faculty for smoking cessation and who quit smoking for at least 3 months. This study was approved by the ethics committee of the Meram Medical Faculty (403/2016) and it was conducted according to the principles of the Declaration of Helsinki. Eligible patients were informed about the study before starting work, notified about the right to refuse to participate or to withdraw consent at any time, and then obtained the written informed consents.

Data Collection

The sociodemographic features (such as age, gender, occupation, educational level, working status) of the participants and their characteristics related to smoking, existing complaints, diagnosed medical diseases were recorded in the first visit. Motivational interviews were conducted with all participants and Nicotine replacement therapy (NRT) was applied to 12% (n=18), varenicline was given to 68,7% (n=103) and bupropion was applied to 19,3% (n=29) of the participants. In all patients who applied to the polyclinic for smoking cessation, routine blood count, serum LDL-c, HDL-c, T. cholesterol, TG and uric acid levels were measured; and PA chest X-ray, CO level, Fagerström nicotine dependence score, depression status by "Beck Depression Inventory" and pulmonary function tests were evaluated. The same procedures were repeated in the 3rd month of quitting smoking. They were checked on cessation day, after 7 days, 15 days, 1 month, and 3 months at our smoking cessation clinic, and then followed up with phone calls by the researchers in the sixth month and the first year. Those who were under 18 years of age, those who were pregnant and with severe psychiatric illness were not included in our study.

Evaluation of dependence level

In the first application, Fagerström Test for Nicotine Dependence (FTND) was applied to the participants so as to determine dependence level. The test consisted of 6 questions and the dependence score of the participants was calculated according to the answers. Those with 0-2 points were evaluated as very slightly dependent, those with 3-4 points were slightly, those with 5 point were moderate, those with 6-7 points were severe and 8-10 points were very highly dependent (11).

Evaluation of Depression Symptoms

The Beck Depression Inventory (BDI), consisting of 21 items covering emotional, cognitive, behavioral, and physical indications, enables us to evaluate the depressive symptoms and cognitive status of individuals in a comprehensive manner. It was developed by Beck in 1961 and it is a self-assessment inventory. Each option has four questions and scored from 0 to 3. If the total score is 9 or less, it is evaluated as "no depression", if it is between 10-16, it is evaluated as "mild depression, if it is between 17-23, it is "moderate depression" and 24 and higher score is accepted as "severe depression". In the studies in which BDI was used, cut off point (cut off value) was generally taken as 17 points (12). We took cut off point as 17 in our study as well.

Measurement of Carbon Monoxide Level

CO measurements in the expiratory airflow were made with the PiCO Smokerlyzer Breath CO Monitor Bedfont Scientific device. PiCO Smokerlyzer device measures CO level in expiratory airflow between 0-100 ppm.

Statistical evaluation

For the statistical analysis, SPSS (Statistical Package for Social Sciences) for Windows 20.0 program was used and appropriate descriptive statistics were performed. The conformity analysis of the data for normal distribution was performed by Kolmogorov-Smirnov test. Chi-square test was used in the analysis of the categorical (qualitative) data. While comparing the values of the patients before and after smoking cessation, Paired-Samples T test was used for the data conforming to normal distribution; and Wilcoxon test was used for the data which did not conform to normal distribution. The statistically considered as significant at $p < 0.05$ level.

RESULTS

150 people were included in our study in total, consisting of 126 men (84.0%) and 24 women (16.0%). Mean age of the participants was 43.1 ± 13.9 years and 80.7% (n=121) of them were married, 40% (n=60) were primary school graduates, 28.7% (n=43) were high school graduates and 31.3% (n=47) were university graduates. In the first application, cigarette consumption rate was 29.7 ± 22.9 packet/year, CO value was 12.4 ± 5.8 ppm, the average of Fagerström Nicotine Dependency Test was 5.6 ± 2.3 and BDI average was 12.4 ± 6.7 (Table 1).

Table 1. Mean values of some characteristics of the participants before treatment

Parameters	Mean \pm SD	Median	Min-Max
Age (year)	43.1 ± 13.9	43	18-78
BMI (kg/m ²)	26.8 ± 4.7	26.4	17.4-44.4
*FNND score	5.6 ± 2.3	6	1-10
Cigarette (packet/year)	29.7 ± 22.9	24	2-30
CO Level (ppm)	12.4 ± 5.8	12	1-28
Beck depression score	12.4 ± 6.7	12	0-30

*FNND: Fagerström Nicotin Dependence Test

Table 2. The laboratory test findings before and after 3 months of smoking cessation

Parameters	Before Cessation Median (Min-Max)	After Cessation Median (Min-Max)	Z / t	p*
WBC(mm ³)	8.600 (5.000-8.800)	7.800 (4.400-11.100)	-3.134*	0.002
Hb(g/dL)	15.7 (7.8-19)	15.0 (12.5-18.3)	-2.858*	0.004
HCT(%)	44.9 (22.7-54.5)	43.7 (37.1-52.8)	-4.046*	<0.001
MCV(fL)	84.2 (77.6-95.2)	83.0 (77.0-89.2)	-7.175*	<0.001
MPV(fL)	10.0 (8.7-13.3)	10.1 (8.3-12.6)	-0.977*	0.329
T.Cholesterol(mg/dL)	191.5 (100.0-278.0)	189.0 (120.0-334.0)	-0.583*	0.560
Triglyceride (mg/dL)	140.0 (63.0-531.0)	139.0 (74.0-714.0)	-1.795*	0.073
HDL-c (mg/dL)	42.6 (25.0-87.6)	43.1 (29.2-64.7)	-1.571*	0.116
Uric acid (mg/dL)	5.7±1.02	6.1±1.1	-4.532**	<0.001
BDI***Score	12.0 (0-30)	6.6 (0-25)	-8.420*	<0.001
CO (ppm)	12.7±5.7	1.5±0.5	17.450**	<0.001
Platelet (mm ³)	256.050±59.412	250.700±51.662	1.256**	0.453
LDL-c (mg/dL)	120.0±30.2	124.8±47.3	-1.074**	0.055

*Wilcoxon test, **Paired-samples t test, ***BDI: Beck Depression Inventory

Table 3. The comparison of the laboratory test findings before and after smoking cessation in terms of genders

Parameters		FEMALES (n=24)		MALES (n=126)	
		Median (min-max)	p*	Median (min-max)	p*
WBC(mm ³)	BC	7.200 (4.300-13.900)	0.149	8.100 (4.200-8.800)	0.007
	AC	7.450 (4400-12200)		7.700 (4.600-11.100)	
Hb(g/dL)	BC	13.7 (8.7-15.8)	0.428	15.7 (7.8-19.0)	0.007
	AC	13.7 (9.1-16.5)		15.4 (12.3-18.3)	
HCT(%)	BC	41.1 (31.9-47.9)	0.011	45.3 (22.7-54.5)	<0.001
	AC	40.3 (29.9-45.5)		44.2 (37.1-52.8)	
MCV(fL)	BC	84.2 (61.0-98.0)	0.019	84.7 (66.8-96.7)	<0.001
	AC	82.5 (61.4-92.8)		82.7 (65.5-97.0)	
MPV(fL)	BC	10.0 (6.5-12.9)	0.764	10.1 (7.4-13.3)	0.201
	AC	10.1 (9-12.5)		10.1 (8.0-12.6)	
T.Cholesterol(mg/dL)	BC	195.5 (98.0-326.0)	0.932	191.0 (107.0-326.0)	0.553
	AC	194.5 (110.0-321.0)		186.5 (118.0-334.0)	
Triglyceride (mg/dL)	BC	111.5 (66.0-214.0)	0.502	147.0 (45.0-497.0)	0.087
	AC	102.0 (58.0-205.0)		139.0 (51.0-714.0)	
HDL (mg/dL)	BC	46.1 (33.0-100.0)	0.764	42.0 (25.0-87.6)	0.063
	AC	48.9 (38.0-87.6)		42.0 (29.2-63.1)	
BDI Score	BC	15.5 (0-30)	<0.000	11.0 (0-28)	<0.001
	AC	10.0 (0-22)		5.0 (0-25)	
CO (ppm)**	BC	9.5±4.7	<0.000	13.0±5.8	<0.001
	AC	1.7± 0.5		1.5±0.5	
Platelet (mm ³)**	BC	282.580±59.241	0.434	250.410±54.177	0.654
	AC	275.920±62.553		249.130±48.966	
LDL (mg/dL)**	BC	125.0±36.6	0.384	116.5±29.9	0.088
	AC	131.5±3.5		122.5±4.3	
Uric acid (mg/dL)**	BC	4.7±1.0	0.188	5.7±1.0	<0.001
	AC	5.0±1.2		6.1±1.1	

*Wilcoxon test, **BDI**: Beck Depression Inventory, **BC**: Before Cessation, **AC**: After Cessation

**Paired-samples t test

Table 4. The comparison of the laboratory test findings before and after smoking cessation in terms of age groups

Parameters		Age of patient (<43) (n=74)		Age of patient(≥43) (n=76)	
		Median (min-max)	p*	Median (min-max)	p*
WBC(mm ³)	BC	7.200(4.200-12.600)	0.222	8.400 (4.300-8.800)	0.003
	AC	7.406 (4.600-12.200)		8.000 (4.400-11.100)	
Hb(g/dL)	BC	15.9 (9.1-19.0)	0.113	15.3 (7.8-18.6)	0.015
	AC	15.6 (8.7-18.3)		15.0 (12.3-17.8)	
HCT(%)	BC	45.4 (31.9-51.2)	0.026	44.5 (22.7-54.5)	0.002
	AC	44.2 (29.9-52.8)		43.0 (37.5-50.9)	
MCV(fL)	BC	83.8 (61.0-90.7)	<0.001	85.7 (75-98.0)	<0.001
	AC	82.5 (61.4-89.0)		83.7 (73.0-97.0)	
MPV(fL)	BC	10.0 (6.5-13.0)	0.378	10.2 (8.7-13.3)	0.572
	AC	10.1 (8.0-12.5)		10.1 (8.3-12.6)	
T.Cholesterol (mg/dL)	BC	183.0 (98.0-147.0)	0.590	203.0 (107.0-326.0)	0.156
	AC	182.5 (110.0-291.0)		195.0 (120.0-334.0)	
Triglyceride (mg/dL)	BC	121.0 (45.0-287.0)	0.603	160.0 (66.0-531.0)	0.079
	AC	117.0 (170.0-397.0)		155.0 (58.0-714.0)	
HDL (mg/dL)	BC	41.8 (26.0-87.6)	0.056	43.1 (25.0-100.0)	0.708
	AC	42.3 (29.2-63.1)		43.3 (32.6-87.6)	
BDI Score	BC	11 (0-30)	<0.001	14 (0-28)	<0.001
	AC	4 (0-24)		6 (0-25)	
CO (ppm)	BC	12.9±5.7	<0.001**	11.8±5.8	<0.001
	AC	1.5±0.5		1.5±0.5	
Platelet (mm ³)	BC	252.000±51.709	0.765**	258.210±55.490	0.253
	AC	253.650±52.000		252.370±51.900	
LDL (mg/dL)	BC	110.2±26.3	0.052**	125.0±33.5	0.339
	AC	110.0±2.8		129.5±5.1	
Uric acid (mg/dL)	BC	5.5±1.0	0.003**	5.6±1.1	<0.001
	AC	5.8±1.2		6.0±1.1	

*Wilcoxon test, **Paired-samples t test, BC: Before Cessation, AC: After Cessation

Table 5. The comparisons of smoking cessation period and quitting methods

Quitting method	SMOKING CESSATION PERIOD								χ ²	p
	3-5 months (n=82)		6-8 months (n=68)		9-11 months (n=107)		≥12 months			
	n	%	n	%	n	%	n	%		
Varenicline	46	69.7	26	70.3	18	72.0	13	59.0	28.445	<0.001
Bupropion	16	24.3	8	21.6	4	16.0	1	4.6		
NRT	3	4.5	0	0	3	12.0	1	4.6		
Without treatment	1	1.5	3	8.1	0	0.0	7	31.8		
Total	66	100.0	37	100.0	25	100.0	22	100.0		

BDI score applied to the participants in the first application was below 17 in 80.7% (n=121) of the patients and above 17 in 19.3%. BDI score of the patients who stopped smoking at least for 3 months was below 17 in 95.3%; 17 and over in 4.7% of the participants. Accordingly, BDI score decreased significantly after quitting smoking (p <0.001).

According to the duration of the smoking cessation, the patients we included in our study were separated by two groups of 3-6 months and over 6 months. In individuals whose smoking cessation period was between 3-6 months; when CO level and

BDI scores measured in the first application were compared to the results of measurements after stopping smoking, both parameters were found to be significantly lower (p<0.001). In individuals whose smoking cessation period was between 3-6 months; when the levels of WBC (p=0.001), HCT (p=0.003), Hb (p=0.002), MCV (p<0.001) in the first application were compared to the levels after quitting smoking, a statistically significant decrease was found in all values. In individuals whose smoking cessation period was between 3-6 months; when MPV (p=0.090), platelet number (p=0.213), T. Cholesterol (p=0.917), HDL-c (p=0.324), TG (p=0.668) and LDL-c level (p=0.286) measured in the first application were

compared to the values after cessation, no significant relation was detected between these values ($p > 0.05$). In individuals whose smoking cessation period was between 3-6 months; when the level of uric acid measured at the first visit was compared with the level after cessation, the uric acid level was found to be statistically higher after smoking cessation ($p < 0.001$) (Table 2).

The comparison of the tests before and after smoking cessation in terms of genders is seen in Table 3. In males, WBC ($p = 0.007$), Hb ($p = 0.007$), HCT ($p < 0.001$), MCV ($p < 0.001$) levels, CO values ($p < 0.001$) and BDI scores ($p < 0.001$) after stopping smoking were statistically lower than the values in the first application. MPV, total cholesterol, TG, HDL-c, platelet and LDL-c levels did not change in both genders and age groups taking into account the first application and cessation after 3 months ($p > 0.05$). The comparison of the tests before and after smoking cessation in terms of age groups is seen in Table 4. There was a statistically significant relationship between the treatment method applied in the first visit and the smoking cessation times ($\chi^2 = 25.958$, $p = 0.002$). Cessation period was longer in the group using varenicline (Table 5). Varenicline seems to be more effective than the other drugs in the cessation treatment.

DISCUSSION

The primary care physicians should ask each patient whether they smoke or not. They should help them to quit smoking and engage in motivational interviews. Approved pharmacological treatments for quitting smoking are highly effective with motivational interviews. A variety of treatment methods are applied to patients who apply to our polyclinic to quit smoking by applying behavioral change therapy. A total of 150 people, including 126 men and 24 women, who applied for smoking cessation and who quit smoking were included in our study. There was no significant relationship between smoking cessation duration and gender, age, educational level, marital status, working status and presence of an existing disease. In our study, while the level of CO was 12.4 ± 5.8 ppm in the first application, it was 1.5 ± 0.49 ppm after 3-month cessation and this fall was significant. In a study conducted by Komiyama et al., in a total of 50 patients (31 male, 19 female) with a mean age of 61 ± 13 years who quit smoking for 1 year, they examined the effects of smoking cessation on plasma proteins, BMI and CO. CO levels in smokers significantly reduced stopping leaving cigarette smoking (from 16.2 ppm to 1.4 ppm) (13).

Platelet activation is a major factor in the pathogenesis of cardiovascular diseases in smokers. MPV is a risk factor defined in the formation of atherothrombosis as a marker of platelet function. In a study conducted by Vizioli et al. the number of platelets was reported to be lower in regular smokers than in the control group who never smoke. They showed that there was an inverse relationship between MPV and platelet number (14). In a study by FitzGerald et al., it was stated that chronic smoking increased platelet activation and platelet function improved after smoking cessation (15). In our study, there was no significant relationship between MPV and platelet values checked at least 3

months before and after smoking cessation. Kario et al. indicated in their study that MPV value was highest in elderly smokers with atherosclerotic risk factors and there was also significant increase in the smoker group without atherosclerotic risk factors. In 8 smokers with atherosclerotic risk, they found a significant decrease in MPV after 1-3 months of smoking cessation (16). Takajo et al. found out that platelet aggregation decreased in chronic smokers compared to the non-smokers. They also stated that platelet function reduced in those who quit smoking even for two weeks, and platelet aggregation reduced in long-term (17). This change is attributed to the reduction of redox imbalance and oxidative stress after stopping cigarette. As can be seen, the effects of the cigarette on MPV and platelet number varies. This suggests that the factors apart from smoking such as chronic diseases and age affect MPV and platelet number. In our study, when we compared the WBC, Hb, HCT, MCV parameters of smokers after smoking cessation, it was seen that these values showed a significant decrease after cessation but a significant increase in uric acid value. Similarly, in a study conducted by Lowe et al., MCV and WBC values in smokers were found to be statistically higher than in those who quit smoking (18). In a study by Kawada, it was stated that there was a significant increase in hemoglobin levels of smokers compared to the non-smokers. In the same study, the patients who quit smoking were followed up for 2 years and 5 years, and it was shown that Hb and WBC values in those who quit smoking reached normal range 2 years later but they reached the levels of those who never smoked 5 years later (19).

Smoking affects the lipid profile negatively. Apart from common atheroprotective effect, HDL-c has anti-inflammatory, antioxidant, antithrombotic and fibrinolytic activities. HDL-c improves endothelial function by activating NO synthase (20). In our study, there was no significant difference in the number of platelets, MPV, T. cholesterol, TG, LDL-c, and HDL-c levels after participants quit the cigarette. In the study of Kutlu et al, the MPV levels of smokers were significantly higher than those of non-smokers, but there was no difference in platelet number (21).

After smoking cessation, there was a significant increase in uric acid level compared to the levels before cessation. In some studies in the literature review, the uric acid levels of smokers and non-smokers were examined and no significant relationship was found between the groups (20,22). In a study by Zabłocka-Słowińska et. al, uric acid level was found to be lower in smokers than in non-smokers (23). Further research is needed in primary care to determine if there is a clinically useful role of serum uric acid levels in risk stratification.

In our study, BDI score was 17 and more in 19.3% of the participants in the first application, but it was 17 and more in 4.7% of them after smoking cessation. BDI score reduced significantly after quitting smoking. In a similar study by Brown et al., the severity of depressive symptoms differed in terms of smoking status. Nicotine dependence symptoms and CES-D (Center for Epidemiologic Studies Depression Scale) depression scores were significantly higher in smokers than in non-smokers, than in those who previously quit smoking and were not nicotine-dependent (24).

The incidence of depression in smokers is higher than in non-smokers (24,25). Also, in a study conducted by Unsal et al., it was found that there was a positive relationship between depression and nicotine addiction level and packet/year (26). Balfour et. al also suggested that quitting smoking promoted depressive symptoms or accelerated the occurrence of depressive symptoms in those with a predisposition (10). An important concern shared by many clinicians is that quitting smoking will exacerbate the symptoms of depression. We think that implementing tobacco control programs in a more effective manner will overcome this concern. Even if you quit smoking for a short time, it is reported that it corrects blood parameters as it is in our study (27). In our study, smoking cessation period was longer in the group using varenicline. Similarly, it is stated in the study by Marakoğlu et. al that smoking cessation period in the group using varenicline was longer than bupropion and NRT (28).

After quitting the cigarette, the patients should be followed up for a longer period so that the hematological and biochemical parameters can be fully evaluated. The fact that patients can not be followed up for a long time is a limitation of our work.

CONCLUSION

In our study, positive changes were found in hematologic, biochemical parameters and depression symptoms after smoking cessation. There was no significant difference between individuals whose smoking cessation periods were 3-6 months and 6 months. However, before and after smoking cessation, we found a decrease in CO, Hb, MCV, HTC values and BDI score; we found an increase

in uric acid value. It is important to raise public awareness on the acute and chronic harms of smoking. Approved pharmacological treatments, phone calls, motivational interviews and clinical follow-up for quitting smoking would increase the success rate. Encouraging those who want to quit smoking would be effective in preventing many diseases.

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The limitations of the study

Although the subject of our study was very broad and important, we had to keep our working group small because of the economic factors. The fact that this study was not planned in larger groups as a multi-center study shows our limitation.

Ethics Committee Approval: Necmettin Erbakan University Meram Medical Faculty Ethics Committee 2016/403

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - FD, RK; Design - FD, RK; Supervision - FD, RK; Fundings - FD, RK; Materials - FD, RK; Data Collection and/or Processing - FD, RK; Analysis and/or Interpretation - FD, RK; Literature Search - FD, RK; Writing Manuscript - FD, RK x; Critical Review - FD, RK

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