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Original Article

Does Cardiovascular Disease Risk Decrease after Smoking Cessation in Occupational Risk Groups?

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ABSTRACT

Objectives: Smoking cessation is very important for workers due to the possibility of exposure to additional environmental risks in the workplace environment. This study was performed to determine the changes in the Framingham Risk Score (FRS) and 10-year risk of cardiovascular disease (CVD) of employees before smoking cessation and after 6 months.

Materials and Methods: Five hundred and sixty-two employees who want to quit smoking were included in the study. In this prospective study, the baseline and 6-month FRS, and 10-year risk of CVD of workers were calculated. Furthermore, the Hospital Anxiety and Depression Scale was used for assessments of employees' anxiety and depression symptoms.

Results: After 6 months, 37% of the participants quit smoking. It was determined that 11.9% of employees have a high CVD risk and 10.6% moderate CVD risk. After 6 months, there was a statistically significant reduction in FRS who quit smoking ($P < 0.001$). In addition, within the 6 months after smoking cessation, 10-year coronary heart disease risk reduction was higher in quitters than those who cannot quit smoking (47.6% decrease in quitters and 14.9% in nonquitters, $P < 0.001$). Significant decreases in fasting blood glucose levels were determined after smoking cessation ($P = 0.003$).

Conclusions: The FRS and CVD risk of smoker employees were decreased 6 months after smoking cessation. In 6 months, CVD risk is reduced in almost half of those who quit smoking. Even in the short term, it is possible to reduce the CVD risk of a worker who quits smoking.

Key words: Cardiovascular disease, Framingham Risk Score, smoking, smoking cessation

INTRODUCTION

The tobacco epidemic is one of the biggest public health threats the world has ever faced, killing more than 8 million people a year around the world.[1] Smoking is also one of the major risk factors for cardiovascular diseases (CVD), which are the major cause of mortality and morbidity in developed countries.[1-4] It has been reported that CVD risks were elevated at almost all levels of the current smoking intensity. CVD risks are reduced by quitting smoking before the age of 45 years.[4] Over one-third of CVD deaths and one-quarter of acute coronary syndrome hospitalization in young people can be attributed to smoking.[1]

Furthermore, people who work in high-risk workplaces are at an increased risk of CVD.[5] More than 30% of coronary heart disease (CHD) deaths are caused by active smoking or secondhand smoke exposure.[6] Previous studies reported that smokers are 1.5–3 times more likely to develop CHD.[7] The lifetime risk for CVD varies depending on the status of the individual risk factor. Controlling risk factors such as smoking, and obesity is important in reducing mortality

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and morbidity.[8,9] Interventions for risk factors are critical in the primary prevention of CVD.[10] Individuals are monitored for cardiovascular risk to prevent CVD. For that purpose, numerous risk calculation techniques such as "FRS, SCORE, PROCAM, QRISK, and CUORE" are used.[9,11] The Framingham Risk Score (FRS) is commonly used to estimate a patient's 10-year risk of CHD. Adult Treatment Panel of the National Cholesterol Education Program III guidelines recommend Framingham Risk Scoring for the assessment of the absolute CHD risks.[11]

According to the WHO data, smoking is responsible for 10% of all CVDs.[10] In terms of CVD, smoking is a major risk factor that can be modified. The prevalence of smoking is higher among blue-collar workers than in the general population.[12-14] Blue-collar workers face many hazardous exposures on the job that can combine with smoking. The number of workers employed by the facilities established in the Denizli Organized Industrial Zone is approximately 24,000 people. Therefore, smoking cessation programs in blue-collar environments is essential.

Recent studies have shown that smoking cessation provides a 50% reduction in mortality and morbidity and a 65% reduction in the risk of a heart attack in patients with CVD.[7,15-17] Another study showed that smoking cessation before the age of 40 years decreases the risk of mortality associated with continuous smoking by around 90%.[5] Furthermore, it is essential to quit smoking, especially for employees, due to the likelihood of exposure to additional environmental risks in the workplace environment. There are limited studies examining the effects of smoking cessation in terms of CVD risk in workers.

This study was conducted in Pamukkale University Hospital Smoking Cessation Polyclinic which is located in Denizli Organized Industrial Zone to determine the change in FRS and 10-year CVD risk among workers who quit smoking and those who could not quit smoking.

MATERIALS AND METHODS

Sample size and study design

In this prospective study, the sample size was calculated using G*Power 3.1.9.7. Considering a power level of 0.80, a two-tailed alpha level of 0.05, and to detect of a 10% difference between smokers and quitters (Cohen's d effect size: 0.2), the required minimum sample size was estimated to be 398 (199 per group). This longitudinal study was conducted on 562 employees who applied to the Smoking Cessation Policlinic in the Industrial Zone in Denizli, Turkey in March–December 2015. The procedures were explained to all patients and written informed consent was obtained from participants. The study was approved by the Ethics Committee of Pamukkale University (ref: 02.09.2013/31488).

Measures

Data were collected through face-to-face interviews. The questionnaire including age, gender, marital status, and educational level was administered to all participants. Nicotine dependence was measured using the Turkish version of the Fagerström Test for Nicotine Dependence (FTND). FTND comprises six questions. Its sum reflects the severity of physical nicotine dependence. Participants whose Fagerström scores were 0–2 points were classified as very low dependent, 3–4 points were classified as low dependent, participants with a total score of 5 were classified as medium dependent, 6–7 were classified as high dependent, and those who scored 8–10 points were very highly dependent.[18,19] In addition, the Turkish version of the Hospital Anxiety and Depression Scale (HADS) was used for assessments of anxiety and depression symptoms which was originally developed by Zigmond and Snaith.[20,21] The scale consists of 14 items measuring depression (7 items) and anxiety (7 items) factors. HADS is a 4-point Likert-type scale with a maximum of 21 points for each factor.[20,21]

Age, sex, smoking status, systolic-diastolic blood pressures, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglyceride levels were used for the calculation of CVD risk.[22] Total cholesterol levels ≥5.2 mmol/dl (>200 mg/dL), LDL cholesterol >3.3 mmol/dl (>130 mg/dL), triglyceride higher than 1.7 mmol/dl (≥150 mg/dL), and HDL cholesterol <1.03 mmol/dl (<40 mg/dL) were considered as risk for Framingham risk calculation.[22] Absolute CVD risk percentage over 10 years was classified as low risk (<10%), intermediate risk (10%–20%), and high risk (>20%).[11,22,23]

In addition to pharmacotherapy (varenicline or bupropion), all participants were provided with behavioral smoking cessation counseling (up to 15 min) based on the 5 As (ask–advise–assess–assist–arrange). Clinical practice guideline, motivation, recognizing smoking triggers, coping strategies, weight control, and medication use were among the issues discussed in counseling.

Follow-up

All participants who were included smoking cessation program were invited to the polyclinic for control 6 months later. At 6-month follow-up, participants were asked whether they smoke cigarettes. Participants were defined as "continuing smokers" if he/she could not quit smoking and is still smoking. Quitters were defined as those who had not smoked for at least 6 months. Furthermore, the measurements described earlier (systolic and diastolic blood pressures, total

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cholesterol, HDL cholesterol LDL cholesterol, and triglyceride) were repeated at 6-month follow-up visits. CVD risks of quitters and continuing smokers were calculated again.

Statistical analysis

All analyses were performed using R software version 4.0.4 (R Foundation for Statistical Computing, Vienna, Austria). The descriptive characteristics of the participants were first calculated as frequencies and percentages for the categorical variables. The continuous variables were expressed as mean and standard deviations. Kolmogorov–Smirnov test and graphical methods (histograms, boxplots, and Quantile-Quantile plots) were used to check the normality of continuous variables. None of the major outcomes followed a normal distribution. Mann–Whitney *U* test was used to compare continuous variables between continuing smokers and quitters. Wilcoxon signed-rank test was used to compare continuous variables between baseline and follow-up data. The Chi-square test was used to compare differences in the proportions of qualitative variables. A two-sided $P < 0.05$ was considered statistically significant.

RESULTS

A total of 562 workers enrolled in our smoking cessation program. The mean age of the participants was 37.2 ± 9.9 years and 84.9% of them were male. The mean age of smoking initiation among participants was 17.0 ± 3.9 years. 23.5% of workers were very highly nicotine dependent according to the FTND. When participants were evaluated in terms of the 10-year CVD risk level, it was found that 11.9% of them have high risk, 10.6% has moderate risk and 77.5% have low risk, as shown in Table 1.

Anxiety and depression scores were found as 7.9 ± 4.2 and 6.6 ± 3.7, respectively, according to "The Hospital Anxiety and Depression Scale." The participant's gender, marital status, educational status, mean age at the start of smoking, smoking duration and smoking package/year, anxiety, depression scores, and cardiovascular biomarkers (systolic-diastolic blood pressures, total cholesterol, HDL, LDL, triglyceride, and fasting blood glucose levels) are shown in Tables 1 and 2.

Assessments of smoking status were conducted at a 6-month follow-up, and it was found that 37% of the participants (n = 208) quit smoking and 63% of them (n = 354) were unsuccessful in quitting for 6 months. Six-month outcomes were compared between successful quitters and relapsers.

It was found that the characteristics of quitters (except for the level of nicotine dependency and anxiety score) were similar to participants who cannot quit smoking ($P > 0.05$).

Table 1: Some sociodemographic characteristics of all participants

	n (%)
Gender	
Female	85 (15.1)
Male	477 (84.9)
Marital status	
Not-married	78 (13.8)
Married	460 (81.9)
Divorced	24 (4.3)
Educational status	
Primary school	184 (32.8)
Secondary school	91 (16.1)
High school	188 (33.5)
College	99 (17.6)
Fagerstrom score	
Very low	89 (15.9)
Low	117 (20.9)
Medium	56 (10.0)
High	168 (29.8)
Very high	132 (23.5)
CVD risk	
<10% (low risk)	436 (77.5)
10%-20% (intermediate risk)	59 (10.6)
>20% (high risk)	67 (11.9)

CVD: Cardiovascular disease

Table 2: Baseline characteristics of all participants

	Mean±SD
Age (years)	37.2±9.9
Age at start of smoking (years)	17.0±3.9
Smoking duration (years)	19.3±10.5
Smoking package/year	21.6±14.7
Anxiety score	7.94±4.24
Depression score	6.55±3.68
SBP (mmHg)	122.64±13.71
DBP (mmHg)	73.66±10.34
Total cholesterol (mg/dl)	189.6±43.6
LDL (mg/dl)	118.2±47.1
HDL (mg/dl)	41.5±10.0
Triglyceride (mg/dl)	180.7±113.0
Glucose (mg/dl)	106.4±37.4

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, LDL: Low density lipoprotein, HDL: High density lipoprotein, SD: Standard deviation

There was no significant difference between the mean age of smoking initiation, smoking duration, systolic and diastolic blood pressures…etc., between quitters and could not quit smoking. Nicotine dependence was significantly higher in workers who cannot quit smoking. 76.5% of very highly nicotine-dependent participants were continuing smokers while 23.5% of them were quitters ($P < 0.001$). Furthermore, the anxiety scores of continuing smokers were higher than quitters ($P < 0.001$). The baseline characteristics of continuing smokers and quitters are shown in Table 3.

Baseline and 6-month follow-up, CVD risk factors were compared between quitters and continuing

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Table 3: Baseline characteristics of continuing smokers and quitters

	Quitters, *n* (%)		Continuing smokers, *n* (%)		*P*
Total	208	37.0	354	63.0	-
Gender					
Female	25	29.4	60	70.6	0.115
Male	183	38.4	294	61.6	
Marital status					
Not-married	32	41.0	46	59.0	0.363
Married	170	37.0	290	67.0	
Divorced	6	25.0	18	75.0	
Educational status					
Primary school	64	36.4	117	63.6	0.394
Secondary school	32	35.2	59	64.8	
High school	65	34.6	123	65.4	
College	44	44.4	55	55.6	
Fagerstrom score					
Very low	36	40.4	53	59.6	<0.001
Low	60	51.3	57	48.7	
Medium	18	32.1	38	67.9	
High	63	37.5	105	62.5	
Very high*	31	23.5	101	76.5	
	Mean±SD				*P*
	Quitters		Continuing smokers		
Age (years)	38.0±10.9		37.1±9.1		0.699
Age at start of smoking (years)	17.4±4.3		16.8±3.7		0.108
Smoking duration (years)	20.2±11.1		19.1±9.85		0.777
Smoking package/year	21.0±16.1		22.5±13.9		0.278
SBP (mmHg)	121.8±12.0		121.3±13.0		0.528
DBP (mmHg)	74.3±9.6		73.8±10.2		0.570
Anxiety score	7.6±3.9		8.9±4.1		<0.001
Depression score	6.9±3.6		7.0±3.5		0.799

*Significance within group. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation

smokers [Table 4]. There were no significant differences in baseline cardiovascular biomarkers between quitters and continuing smokers ($P > 0.05$). Of those who quit smoking, at the end of the 6 months, HDL cholesterol levels increased; total cholesterol and triglyceride levels decreased, but these differences were not statistically significant ($P > 0.05$). Similarly, the changes in biomarkers of those who could not quit smoking were not statistically significant ($P > 0.05$). While fasting blood glucose tended to decrease in quitters (108–98.7, $P = 0.003$), there was no statistically significant difference with those who continued to smoke, as shown in Table 4.

There was no difference between the baseline mean FRS of continuing smokers and quitters (6.4 and 7.0 respectively and $P = 0.427$). Six months of successful smoking cessation decreased Framingham scores. While the mean FRS of the quitters was found 7.0 ± 7.3 at baseline, it decreased to 3.9 ± 3.7 at the 6-month follow-up visit ($P < 0.001$). At the end of 6 months, it was seen that the FRS was much lower in those who quit smoking compared to those who could not quit smoking (3.9 and 7.2 respectively and $P = 0.022$), as shown in Table 5.

The baseline 10-year CVD risk level was found similar among quitters and continuing smokers ($P = 0.464$). However, after 6 months, it was found that 1.4% of quitters had a high risk of CVD, but this rate was 21.3% in those who could not quit smoking ($P < 0.001$) [Table 5]. When the changes in CVD risk levels were evaluated, it was seen that compared to continuing smokers, quitters tended to have a reduced risk of CVD (47.6% decrease in quitters and 14.9% decrease in continuing smokers) ($P < 0.001$) [Table 5].

DISCUSSION

Blue-collar workers have been identified as a high-risk group for smoking. Previous studies have shown that smoking causes a seven-fold increase in peripheral arterial disease and a two-fold increase in coronary artery disease.[24,25] Significant reductions in coronary artery disease and stroke rates have been recorded in developed countries thanks to interventions directed at interchangeable risk factors.[25]

Smoking is a major modifiable risk factor for CVD, and stopping smoking as early as possible is important,

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but also it has been shown that quitting smoking at any age reduces mortality.[25] It is stated that smoking cessation is more effective than any pharmaceutical treatment in reducing CVD risk.[26] In the current study, we examined whether quitting smoking for 6 months decreases CVD risk in workers.

One out of every 5 participants in our study had a moderate or high CVD risk. A study showed that people usually quit smoking after they have had a CVD.[7] Cohort studies have demonstrated improvements in mortality associated with smoking cessation.[27,28] For that reason, these people must quit smoking before they have a CVD.

In this study, among quitters, a significant reduction in the mean Framingham risk was demonstrated at 6 months concerning baseline. Furthermore, the CVD risks of these participants decreased by 47.6%. At the end of 6 months, the percentage of participants at high risk of CVD who quit smoking decreased from 6.3% to 1.4%, while it increased from 4.0% to 21.2% for those who could not quit smoking.

Cardiovascular benefits of smoking cessation were observed in other studies.[7,26-29] It is well documented that smoking cessation reduces the risk of morbidity and mortality of CVD.[30] In a 12-year cohort study, it was shown that the risk of CHD is 4.2 times higher in smokers than in nonsmokers.[31] Within 2 years of quitting, one-third of the elevated risk of CHD was eliminated. Then, over the 10–14-year period after quitting smoking, the extra risk reverted to that of individuals who had never smoked.[31]

In terms of prevention or treatment of CVD, it is very important to provide scientific evidence that shows which intervention is more effective so that health policymakers can decide where to allocate resources regarding disease control and health expenditures.

Table 4: Comparison of baseline and 6-months follow-up cardiovascular disease risk factors between continuing smokers and quitters

	Mean±SD		P^a
	Quitters	Continuing smokers	
Total cholesterol (mg/dl)			
Baseline	190.6±42.2	180.6±40.0	0.356
6-months follow-up	177.9±46.1	181.6±48.4	0.364
P^b	0.183	0.725	
LDL cholesterol (mg/dl)			
Baseline	112.7±35.5	109.2±44.1	0.931
6-months follow-up	113.1±43.5	111.7±32.7	0.649
P^b	0.750	0.386	
HDL cholesterol (mg/dl)			
Baseline	40.7±11.0	41.5±10.2	0.156
6-months follow-up	43.7±11.3	40.5±10.7	0.067
P^b	0.068	0.102	
Triglyceride (mg/dl)			
Baseline	189.7±107.7	165.8±100.5	0.059
6-months follow-up	155.9±90.1	178.8±150.9	0.604
P^b	0.192	0.751	
Glucose (mg/dl)			
Baseline	108.0±39.0	96.5±36.2	0.242
6-months follow-up	98.7±36.1	98.1±41.7	0.165
P^b	0.003	0.563	

[a]*P* value: Mann-Whitney *U*-test (between groups) (comparison of continuing smokers and quitters), [b]*P* value: Wilcoxin test (within group) (comparison of baseline and 6 months follow-up). LDL: Low density lipoprotein, HDL: High density lipoprotein, SD: Standard deviation

Table 5: Changes in Framingham risk score and cardiovascular disease risk among continuing smokers and quitters

	Mean±SD		P^a
	Quitters	Continuing smokers	
Framingham risk score			
Baseline	7.0±7.3	6.4±6.7	0.427
6-months follow-up	3.9±3.7	7.2±7.6	0.022
P^b	<0.001	0.867	
Baseline CVD risk level, *n* (%)			
<10% (low risk)	141 (67.8)	248 (70.1)	
10%-20% (intermediate risk)	54 (26.0)	92 (26.0)	
>20% (high risk)	13 (6.3)	14 (4.0)	
P^a	0.464		
6-months follow-up CVD risk level, *n* (%)			
<10% (low risk)	189 (90.9)	249 (70.3)	
10%-20% (intermediate risk)	16 (7.7)	30 (8.5)	
>20% (high risk)*	3 (1.4)	75 (21.2)	
P^a	<0.001		
The change of CVD risk, *n* (%)			
Decreased*	99 (47.6)	53 (14.9)	
Increased	10 (4.8)	23 (6.5)	
No change	99 (47.6)	279 (78.6)	
P^a	<0.001		

*Significance within group, [a]*P*: Comparison of continuing smokers and quitters (between groups), [b]*P*: Comparison of baseline and 6 months follow-up (within group). CVD: Cardiovascular disease, SD: Standard deviation

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It has been shown that receipt of smoking cessation advice by health-care professionals increases the rate of quitting.[32] For this reason, within the perspective of preventing CVD, it is important for each doctor to question the smoking status of the patients and to encourage smokers to quit smoking or refer them to smoking cessation polyclinics.

Smoking cessation can help to reduce the severity of smoking-related diseases. It is important to highlight that the CVD risk started to decline after smoking cessation in a short time frame of 6 months, which would be encouraging to those who are trying to quit smoking or are thinking about quitting.

Study limitations

There are some limitations associated with this study, such as short-term follow-up and generalizability of the results to other industries and work settings. Due to the young study sample, mortality and morbidity rates could not be evaluated. Nevertheless, to the best of our knowledge, our research is one of the few studies evaluating the effect of short-term smoking cessation on the change in cardiovascular risk among blue-collar workers.

CONCLUSIONS

About 37% of participants quit smoking. In 6 months, CVD risk is reduced in almost half of those who quit smoking. According to our results, we can conclude that even in the short term it is possible to reduce the CVD risk of a worker who quits smoking. Smoking cessation is important for reducing the 10-year CVD risk of employees who have additional exposures, such as workplace exposure.

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Conflicts of interest

There are no conflicts of interest.

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