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The carbon monoxide measurements' effect on smokers to give cessation decision in primary care

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ABSTRACT

The aim of this study was to investigate the levels of ExpCO and its effect on giving decision to stop smoking in primary care. The study was held in Tekkeköy Family Health Center. A total of 853 current smokers (391 in study group and 462 in control group) included into the study. Both group of smokers got first two steps of "5 A" method (Ask, Advice, Assist, Assess and Arrange) for smoking cessation however the ExpCO levels were measured only in the study group. CO levels in expiratory air were measured by the single breath method using a calibrated carbon monoxide monitor and the time of the last smoked cigarette (TLC) of the participants were examined. The mean ExpCO level was 16.9±7.7 ppm in study group. The mean Fagerstrom Nicotine Dependency Test (FNDT) score was 5.0±2.7 in both groups. The mean package/year value in the both participants were 16.0±14.8 (min=1, max=100) and the mean Fagerstrom Nicotine Dependence Test (FNDT) score was 5.0±2.7. The mean ExpCO level was 15.7±8.7 ppm in study group. A significant positive correlation was determined between FTND score and ExpCO. TLC values in males were significantly lower than females ($p<0.001$) in both groups. In a linear regression model it was seen that age, package/year value, FNTD scores and TLC are independent risk factors for elevation of ExpCO values. 23 (5%) smokers in the control group and 47 (12%) in the study group decided to quit smoking ($x^2=15.412$, $p<0.001$). This measurement might have an effect on motivating smokers to quit smoking.

1. Introduction

According to World Health Organization (WHO), smoking is the leading preventable cardiovascular risk factor for mortality (WHO, 2008). Huge efforts are spent to decrease the ratio of smokers in developed countries after its negative effect on human health is well understood. In the last two decade in spite of its established detrimental effects, widespread use of smoking is decreased at western countries. However today tobacco industry aims to increase the smoking rates in the developing countries which have limited resources for health care (Pineros et al., 2016). The most recent descriptive overview by WHO estimates that 29% of adults in Europe is smoking (Alwan, 2011).

Most of the case many primary care physicians prefer to use Fagerstrom Nicotine Dependence Test Scale (FNDT) in their daily practice in order to determine the dependency level of the smokers (Fagerstrom et al., 1996). This test is self-administered, and depends on smoker's subjective claims. In dealing with cessation therapies with smokers sometimes it is a necessity to determine objectively the level

of cigarette smoke that the smoker is exposed. This is true in cases in order to control the claims of the smoker or to identify other environmental risk factor cessation and relapse. It is well known than there are at least 3984 chemical substances can be identified in cigarette smoke which the most ones can be identified are nicotine, carbon monoxide (CO) and tar (Margolis et al., 2016). For objective screen in order to determine whether the individual is currently exposing to cigarette smoke (active or passive) several tests including detecting metabolites of nicotine (Cotinine) and tar in blood or urine and being used widely in practice. The disadvantages of these tests can be identified as they may be invasive, expensive, requiring special kits and time consuming. Because of this reasons evaluation of CO levels (ExpCO) in expiratory air is becoming very popular in smoking cessation clinics. Although CO exposure by occupational and environmental pollution the ExpCO levels may increase in normal individuals, this measurement reflects the exposure of cigarette smoke in term of smoking addiction and second hand exposure (Ripoll et al., 2012; Lindson-Hawley et al., 2016). The measurements one or two hours after a cigarette gives the best results with a high rate of reliability (Okutan, 2007). CO levels in expiratory air (ExpCO) is an effective and easy and actual indication of consumption and addiction (Middleton and Morice, 2000). Besides its reliability of reflecting the exposed amount of cigarette smoke there are several advantages of this method. First of all this technique is very cheap and simple to perform which requires little technical knowledge and skill. The other advantage of this method is results taken immediately (Middleton and Morice, 2000). Measuring ExpCO levels in primary care units may have other advantages. While using 5 A (Ask, Advise, Assist, Assess, Arrange) method for their smoker population primary care physicians use several feedback and motivation techniques on their patients (Quinn et al., 2009). These interventions are based on the hypothesis that one of the reasons why people continue smoking, in spite of knowing the harmful effects of tobacco, is that they underestimate the personal risk of becoming ill because of it. In this sense, the measurements in currents smokers interventions will offer motivational feedback to promote awareness of the risk (Weinberg et al., 1981). It has been suggested that some smokers who manage to quit smoking are more aware of the adverse effects of tobacco or to have had their health seriously compromised (Mclure, 2001). For this reason CO measurements may help primary care physicians to motivate their smoker patients with the damage of smoking to their health in the first hand.

Although there are many advantages in smoking cessation there are limited data about the effects of ExpoCO measurements in primary care in our country. In our study we aimed to investigate the mean values of ExpCO and its relation between several factors just like the time of the last cigarette (TLC) and the addiction levels of the smoking (FNDT) in participants. The other aim of our study is to investigate the effect of the ExpCO measurements on giving cessation decision on the smokers in primary care.

2. Matherial and method

2.1. Study design

This is a randomized controlled study. The study is held at the Tekkeköy Family Health Center between 1st August to 1 September 2015. Before the study the researcher (HP) at Tekkeköy Family Health Center was trained about the principles and skills of using an ExpCO device in a two hours clinical skills workshop. After his training he practiced the device with performing it to at least ten test subjects in supervision of their instructor (BMY). The smokers who had applied to Tekkeköy in the study period were included into the study. A total of 853 participants included into the study. After their informant constant were taken the smokers were divided into two groups with a basic random pattern (First smoker to the study group, second to the control etc.) as the smokers who get just 5 "A" approach (control group) while the other group get 5 "A" approach after measuring their ExpCO measurements are performed. The researcher gave advice the participants in the both groups to stop smoking. He also gave information about Smoking Cessation Clinic of Ondokuz Mayis University Department of Family Practice and referred the affirmative smokers. Overall there was 391 participants in the study group and 462 in control group. The volunteered smoker participants who were over 18 years, had been smoking until a year, with no condition/disease effecting his/her cognitive abilities (depression, stroke etc.), patients without lung diseases (Tuberculosis, Chronic Obstructive Lung Disease etc) were included into the study. The individuals who may be exposed to CO with occupational risk (Welders etc) were also omitted from the study (A total of 25 individuals). FNDT was applied to determine dependence level of the smokers with face-to-face interviews to all of the participants. CO levels in expiratory air were measured by the single breath method using a calibrated carbon monoxide monitor (PICO+ Smokerlyzer, Bedfont Scientific Ltd. UK). The subjects were instructed to take a deep breath, hold their breath, and exhale fully into the mouthpiece of the detector. The time of the last smoked cigarette (TLC) of the participants were examined in the study group.

2.2. Statistical analyses

The acquired data were examined and evaluated using SPSS 16.0 statistics program. Characteristics of the study group were presented with definitive type of analyses (number, percentage, average and

standard deviation). Data were evaluated using mutual independent group comparisons Mann-Whitney-U groups test and Pearson chi-square and Kruskall Wallis test analysis methods. The quantitative variables were presented as mean ± standard deviation (SD), and the categorical variables with figures and percentages (%). The chi-square test and multivariable logistic regression analysis were used in the assessment of data. The Odds Ratios (OR) from the regression analysis were presented with 95% confidence intervals (CI). A p value of $p<0.05$ was considered to be significant.

3. Results

The sociodemographic and smoking features of the both groups are presented at Table 1. The A total of 462 people participated in the control group and 391 in the study group. Mean age of the participants in both groups were 36.2±12.9 year, with age range of 17 to 82 years old. There was no difference between the mean of age between both genders (Men: 33.12±14.1, women=32.88±11.7) (t=0.189, p=0.850) in the study group. The mean package/year value in the both participants were 16.0±14.8 (min=1, max=100). There was a statistically significant difference between package/year values of in different genders (Men=17.56±17.1, women=14.57±14.7) (t=2.563, p=0.011) in the study group. The mean FTND score was 5.0±2.7 in all of the participants. There was no difference between the mean FTND scores between different genders (t=1.116, p=0.265) in study group. There was a correlation between the FNDT scores and package/ year values (r=0.398, p<0.001) in both groups.

The mean ExpCO level was 16.9±7.7 ppm in study group. The mean ExpCO values were significantly higher in men (18.07±8.2) compared with women (13.9±8.9) (t=3.785, p<0.001). A significant positive correlation was determined between FTND score and ExpCO (Men equals to r=0.402, p<0.001; women equals to r=0.484, p<0.001). TLC values in men were significantly lower than women (t=3.428, p<0.001). A mid-level negative correlation was detected between ExpCO and TLC for both sexes man (r=-0.507, p<0.001); Female (r=-0.612, p<0.001). In a linear regression model the factors which might have effect on ExpCO value is investigated. This model has a value of 0.315 value of 0.315 and Durbin Watson value as 1.630. It was seen that age, package/year value, FNTD scores and TLC are independent risk factors for elevation of ExpCO values. The model is shown at Table 2.

23 (5%) smokers in the control group (12 women 50%) and 47 (12%) in the study group (15 women 31.9%) decided to quit smoking (x^2=15.412, p<0.001) and applied to Ondokuz Mayis University Family Medicine Smoking Cessation Clinic.

4. Discussion

Our study is designed as a pilot study and investigated the mean ExpCO levels in smokers and the factors effecting its measurements. Our measurements revealed that the mean ExpCO level is s 15.7±8.7 ppm among in our participants. In some international studies it is documented that the mean of ExpCO levels in smokers varies between 9.5-21.6 ppm (Zayasu et al., 1997; Low et al., 2004; Chatkin et al., 2007) and 1.3-4.3 ppm in nonsmokers. Some researchers suggested the cutoff ExpCO levels as 6 ppm and 6.5 ppm in smokers and non-smokers respectively (Middleton and Morice, 2000; Doruk et al., 2012). However there are some

Table 1. Comparison of sociodemographic and smoking features of all the smokers in both groups

Variables	Control (n=462)	Study (n=391)	p
Gender	Women 159, 37.8% Men 303, 62.2%	149, 35.7% 242, 64.3%	x^2=1.005 P=0.451
Age (mean)	35.50±13.66	36.22±11.6	t=0.54 p=0.562
Mean time spent in education (years)	14.40±1.17	14.78±3.3	
Occupation Housewife Student Farmer Manual laborer White collar (teacher etc.) Private (small trader etc.)	 110, 23, 8% 28, 6% 112, 24.2% 124, 26.8% 41, 8.8% 35, 7.5%	 108, 27.6% 41, 10.4% 97, 24.8% 96, 24.8% 29, 7.4% 20, 5.1%	 x^2=0.265 p=0.658
Age of starting to smoke	18.00±3.6	18.70±9.7	t=0.058 p=0.275
Package/year (mean)	16.8±1.2	17.1±2.2	t=6.897 p=0.107
The mean score of FNDT*	4.9±1.7	5.5±0.8	t=0.154 p=0.241
Number of quit attempts (mean)	2.1±1.4	1.8±1.8	t=0.874 p=0.987
Total number of quit attempts so far*	137	71	x^2=1.215 P=0.007

Table 2. The independent factors for affecting ExpCo measurements

Mode 1		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. error	Beta	t	Sig.	Lower bound	Upper bound
1	(Constant)	17.753	1.508		11.771	0.000	14.788	20.718
	Package/year	0.073	0.032	0.137	2.259	0.024	0.010	0.137
	Age	-0.193	0.037	-0.289	-5.195	0.000	-0.266	-0.120
	FNDT	1.107	0.151	0.340	7.334	0.000	0.810	1.404
	TLC	-0.007	0.001	-0.293	-7.082	0.000	-0.008	-0.005

ExpCO: The carbon monoxide in Expiratory; **FNTD:** Fagerstrom Nicotine Dependence Test; **TLC:** The Last Cigarette Time

studies pointing out lower cutoff values as 5 ppm (Low et at., 2004).

One of the important factor that effects the measurement of ExpCO in smokers is found as age in our study. As age is mostly correlated with calculating the package/year values it is not surprising that it is a depended factor for levels of ExpCO. As the time of the smokers using cigarette increases the negative effects of cigarette smoke increases the damage in lungs. The package/year is reflecting the amount of the total cigarette smoke that have been exposed it is not surprising to see that it is an independent risk factor for ExpCO. However it is surprising to see that this relation is not very strong (OR=0.073, 95% CI; 0.01-0.137, p=0.024). This result may be explained that the ExpCO measurement is more related with actual smoke exposure rather than past. This concept is more interesting as the package/year and FNDT values have a correlation in our study FNDT seems to be more important (OR= 1.107, 95% CI; 0.8-1.4. p<0.001) than package/year values. Our results were confirmed with the results of (Low et at., 2004). In their study Low et al. found the mean ExpCO level is 11.6 ppm and it has a positive correlation between FNDT scores. Similar with our study two studies held in Turkey by Deveci et al. (2004) and Temel et al. (2009) found positive correlation ExpCO levels with FNDT scores (Doruk et al., 2012). To analyze objectively the results of the FNDT it is imperative to remember that the two questions is most important ones. First one is about the time of the first cigarette (3 points) and the other the amount of the cigarettes taken in a day (3 points). Especially the time intervals between cigarettes decreases with the number of cigarettes smoked in a day. In order to support this concept Hung et al. (2006) found the mean exhaled CO level of those consuming 1-10 cigarettes a day was significantly lower than the mean exhaled CO level of those consuming >10 cigarettes a day in their study.

The smoker's individual smoking conditions are assessed by ExpCO levels and the time period the last cigarette smoked is the important determinant of ExpCO levels. Because of the half-life of CO being 5 to 6 hours, the last cigarette smoked is affected the ExpCO levels significantly (Peterson and Steward et al., 1970; Crowley et al., 1989). The amount of CO in the expiratory air starts to decline after 3 hours from smoking, measures at that moment naturally come out as low and may not give an exact result In our study it is seen that TLC values in men participants were significantly lower than women participants (p<0.001). A mid-level negative correlation was detected between ExpCO and TLC for both sexes: man (r=-0.434, p<0.001); women (r=-0.535, p<0.001). Parallel to our results, Low et al. (2004) found a significant negative correlation between the time of the last cigarette smoked and levels of ExpCO in their study. They revealed a cigarette which is smoked 5 hours ago might indicate a high level of ExpCO. Terao et al. (1998) showed that the time elapsed since last smoke had effects on the expired air carbon monoxide level. Our study revealed that TLC is an independent factor for ExpCO measurements.

One of the most important finding in our study is the positive effect of performing ExpCO measure on the cessation decision in study population. In the literature the success of different interventions for smoking often measured with cessation rate. In recent approach it has been recommended to the primary care physicians to accept smoking as a chronic disease which requires a life long struggle (Rao and Pilot, 2014). "5 A" method is born from that need. One of the most important factor that this method work is depends on the relationship between smoker and physician. When the physician motivates, encourages, supports and offers unlimited help to their patients it has the best possibility to work. It is known that the just using the first two steps of the "5 A" method app. 5% of the smokers quit smoking (Dorothy et al., 2008). Our study revealed measuring ExpCO in study doubled the cessation decision compared with control group compared with our control group. It can be argued that giving decision doesn't mean cessation of smoking. However it is an important to thing to get the attraction of the smokers tip the balance of their decision in favor of cessation.

This pilot study has limitations. First of all it was conducted in a single Family Health Center which may affect the features of our study universe. The individuals who were enlisted to this center may not represent to other parts of our country. The population of this area is mostly workers and farmers. Although

the decision of smokers about quit smoking is decided upon their approval to our clinic, it no way to investigate the real effect of measuring ExpCO levels in smokers. To stop smoking is complex decision for smokers. As the smoking might be considered as a chronic disease the effect of this measurement might not be isolated. However our study gave us important clues about ExpCO measurements and factors which might have effect on it. Our linear regression model had a R2 value of 0.315 which means that 31% differences in the ExpCO measurements can be explained by this model. As a easy, cheap and effective method increase in ExpCO measurements may have positive effects for smoking cessation activities and follow-up. More information is needed in this topic.

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