

Comparison of Frequency of Undiagnosed Chronic Obstructive Pulmonary Disease in Current or Former Tobacco Smokers Having Ischaemic Heart Disease

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ABSTRACT

Background and Objectives. This study compares the frequency of undiagnosed chronic obstructive pulmonary disease (COPD) in tobacco smokers suffering from ischaemic heart disease (IHD) and analyses the association of COPD severity with status, type and duration of smoking.

Methods. An analytical cross-sectional study conducted in current and former cigarette, *hookah* and combined cigarette and *hookah* smokers with IHD to detect previously undiagnosed COPD through spirometry.

Results. Among 124 males with IHD, majority [74 (59.7%)] were former smokers and were in the age ranged between 42 to 78 years. All had dyspnoea up to grade 4 and 64 (51.6%) also reported chronic cough and sputum production. According to type of smoking, 64 (51.6%) smoked cigarettes, 30 (24.2%) smoked *hookah* and 30 (24.2%) smoked both *hookah* and cigarettes. Forty-seven (37.9%) were found to have COPD, 24 (37.5%) among cigarette smokers, 12 (40%) among *hookah* smokers, while 11 (36.7%) were from cigarette and *hookah* smokers. Duration of smoking, its type and magnitude had no association with severity of COPD.

Conclusions. The frequency of undiagnosed COPD is high in smokers with IHD. *Hookah* and combined *hookah* and cigarette smokers are almost as susceptible to develop COPD as are cigarette smokers.

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Key words: Cigarette smoking, Chronic obstructive pulmonary disease, Hookah smoking, Ischaemic heart disease, Spirometry.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) and ischaemic heart disease (IHD)/coronary artery disease (CAD) may co-exist as they share tobacco abuse as a common risk factor.¹ COPD is the fourth leading cause of death in the world and further increases in its prevalence and mortality can be predicted in the coming decades.^{2,3} The absolute risk of developing COPD among continuous smokers is at least 25%, which is larger than was previously estimated.⁴ COPD prevalence in adult population is variable among different countries and depends upon study methods, ranging from 4% to more than 20%.⁵ It has been suggested that the risk for cardiovascular disease (CVD) is further increased in those smokers who have developed COPD, and that COPD might be an independent risk factor for CVD^{6,7}. It has been estimated that, for every 10% decrease in forced expiratory volume in one second (FEV₁), cardiovascular mortality increases by 28% and non-

fatal coronary events by almost 20%.⁶

In a recent study⁸ addressing the prevalence, severity and treatment of COPD in patients with CVD, the prevalence of airflow limitation due to undiagnosed COPD was found to be high, particularly in those with CAD managed in the hospital and was largely underdiagnosed, and therefore, under-treated. The exact prevalence of COPD in Pakistan is unknown. However, it is suggested that the risk of undetected airflow obstruction in smokers is associated with increasing age and the number of pack years of smoking.⁹

Hookah/shisha smoking which is more fashionable in the Middle-East is a re-emerging global tobacco epidemic devoid of side stream smoke.^{10,11} There are differences in tobacco processing, burning rate and temperature, and the use of additives for burning tobacco.¹² Reports by the World Health Organization (WHO) and the American Cancer Society have shown that, in a one-hour *hookah* session, users consume about 100 to 200 times the smoke and about

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70 times the nicotine as they do from one cigarette.^{13,14}

Spirometry is recommended in suspected patients as it remains the gold standard for diagnosing COPD and monitoring its progression.³ Diagnosis and management of underlying airway obstruction in patients with cardiovascular disease will also improve symptoms and carries the potential to reduce morbidity and mortality.^{6,15}

Data addressing undiagnosed COPD in patients with IHD is sparse and *to the best of our knowledge*, none of the studies have included *hookah* smokers. The objectives of the present study were to investigate the overall frequency of undiagnosed COPD in current or former tobacco smokers, compare the frequency of COPD in cigarette, *hookah* and combined cigarette and *hookah* smokers, and to evaluate the association of COPD severity with type and duration of tobacco smoking. We hypothesised a high frequency of undiagnosed (thus, untreated) COPD in smokers/ex-smokers with IHD and further that its frequency may be different in cigarette and *hookah* smokers.

MATERIAL AND METHODS

Study Patients

It was an analytical cross-sectional study carried out between July 2010 and January 2011. The study was approved by Doctoral Programme Committee, Shaikh Zayed Hospital, Lahore, Pakistan and included available consecutive 124 adult males above 40 years of age with stable IHD and a history of current or former cigarette, *hookah* or combined cigarette and *hookah* smoking, attending the cardiology out-patient department/ as well as those admitted in the hospital. The estimated sample size yielded a power of 80%. Our exclusion criteria were a previous diagnosis of airway obstruction, frail patients unable to perform the spirometric maneuvers, unstable angina or overt heart failure, severe systemic illnesses including advanced renal failure, chronic liver disease with ascites, or altered sensorium due to neurological disease and those with pre-existing chronic pulmonary diseases, such as tuberculosis, asthma, bronchiectasis, fibrosis, chest deformities or pleural effusion (conditions that could interact/alter spirometry results).

Data Collection

After explaining the nature of the study and obtaining informed consent, age, weight and height, and contact details were recorded. History of tobacco use including smoking type (cigarette/*hookah*/combined), smoking status (current/former), and pack years was taken. The criteria used to quantify *hookah* smoking pack years included; heavy smokers (spending up to six hours per day in 3 to 8 smoking sessions using a tobacco weight equivalent to about 60 cigarettes; one year smoking being equivalent to three pack years of cigarette

smoking); medium smokers (up to 2 hours per day in 1 to 3 sessions, one year smoking being equivalent to one pack year of cigarette smoking); and light smokers (up to 20 minutes per day in one session, one year smoking being equivalent to 0.33 pack years of cigarette smoking.¹⁶ Symptoms recorded included cough and sputum production for at least three months for two consecutive years and dyspnoea assessment was done according to the Medical Research Council (MRC) dyspnoea grades. Acceptable co-morbid conditions (other than those in exclusion criteria) were also recorded. Patients were considered to have IHD if they had suffered from myocardial infarction (confirmed by electrocardiographic changes in the presence of positive tests of raised cardiac enzymes and/or compatible echocardiographic findings) and were on medical treatment or had angiographically proven CAD and were either on medical treatment or had undergone angioplasty, or stenting or had undergone coronary artery bypass surgery.

After explaining the procedure, spirometry was performed on a Spirolab II spirometer. Best of three attempts were recorded according to the recommended criteria of American Thoracic Society/European Respiratory Society. The diagnosis of COPD was established, and the severity of the disease was classified according to post bronchodilator values as per the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria 2007 (updated 2010). Patients undergoing spirometry were diagnosed to have COPD if their post bronchodilator FEV₁/ forced vital capacity (FVC) was less than 70%. The severity of COPD was classified as follows: mild COPD: FEV₁ ≥80% predicted, moderate COPD: 50% to 80% predicted, severe COPD: 30% to 50% predicted, very severe COPD: FEV₁ ≤30% predicted or FEV₁ ≤50% predicted plus chronic respiratory failure. Those found to have COPD were advised to seek medical advice.

Statistical Analysis

The analysis of the data was performed using Statistical Package for the Social Sciences (version-15). Dyspnoea, cough and sputum were expressed as frequencies and percentages, and spirometry variables and tobacco smoking pack years were reported as mean±SD. Prediction of COPD on the basis of age, smoking type, status and pack years was done by using binary logistic regression. The regression analysis was applied in five steps with backward Wald method. Nagelkerke R square of 0.005 at step 1 to 0.000 at step 5 gives the prediction power of five models. Relationship of severity of COPD with smoking type, status and pack years was done by using multinomial logistic regression. Comparison of all quantitative lung function variables was performed by using analysis of variance (ANOVA) and Tukey B and Bonferroni post-hoc tests were used for pair-wise comparisons if results were found significant on ANOVA.

RESULTS

There were 87 indoor and 37 out-door participants. Majority of the patients were below 60 years of age. Forty-seven (37.9%) were in the age group up to 50 years, while 48 (38.7%) were in the age group, 51-60

years. There were only 5 (4%) patients with age above 71 years. Majority of the patients were former smokers 74 (59.7%). According to the types of tobacco smoking, 64 (51.6%) were exclusively cigarette smokers, 30 (24.2%) were exclusive *hookah* smokers and 30 (24.2%) smoked both *hookah* and cigarettes (Table 1).

Table 1. Descriptive measures of cases among three groups of smokers

	Type of Tobacco Smoking					
	Cigarette		Hookah		Combined	
	Mean±SD	n (%)	Mean±SD	n (%)	Mean±SD	n (%)
Age (in years)	56.5±9.8		56.9±7.8		55.0±7.6	
Smoking status						
Current		23 (35.9)		10 (33.3)		17 (56.7)
Former		41 (64.1)		20 (66.7)		13 (43.3)
Ischaemic heart disease						
History of myocardial infarction (on medical treatment)		14 (21.9)		2 (6.7)		6 (20.0)
Diagnostic coronary angiography		15 (23.4)		12 (40.0)		12 (40.0)
Therapeutic coronary angiography		12 (18.8)		6 (20.0)		6 (20.0)
Coronary artery bypass grafting		23 (35.9)		10 (33.3)		6 (20.0)
Cough and sputum						
Present		31 (48.4)		18 (60.0)		15 (50.0)
Absent		33 (51.6)		12 (40.0)		15 (50.0)
Dyspnoea						
Grade 1		14 (21.9)		2 (6.7)		7 (23.3)
Grade 2		24 (37.5)		14 (46.7)		15 (50.0)
Grade 3		24 (37.5)		14 (46.7)		8 (26.7)
Grade 4		2 (3.1)		0 (0.0)		0 (0.0)
Grade 5		0 (0.0)		0 (0.0)		0 (0.0)
COPD diagnosis						
Present		24 (37.5)		12 (40.0)		11 (36.7)
Absent		40 (62.5)		18 (60.0)		19 (63.3)
COPD severity						
Mild		5 (20.8)		0 (0.0)		0 (0.0)
Moderate		7 (29.2)		3 (25.0)		6 (54.5)
Severe		8 (33.3)		6 (50.0)		3 (27.3)
Very severe		4 (16.7)		3 (25.0)		2 (18.2)
Pack years						
Up to 30		41 (64.1)		8 (26.7)		14 (46.7)
31 - 50		9 (14.1)		12 (40.0)		7 (23.3)
51 - 70		13 (20.3)		4 (13.3)		3 (10.0)
71 - 90		1 (1.6)		5 (16.7)		5 (16.7)
91 & above		0 (0.0)		1 (3.3)		1 (3.3)
FEV₁/FVC^{ns}	78.3±14.8		74.6±12.7		73.3±11.4	
FEV₁ (Litres)^{ns}	2.1±0.7		2.4±0.9		2.2±0.8	
FEV₁% predicted^{ns}	73.9±22.7		77.6±27.5		73.3±24.0	
FVC (Litres)*	3.0±0.8		3.4±0.8		2.9±0.7	
FVC% predicted^{ns}	83.9±16.8		90.7±12.1		85.8±10.9	
PEF (Litre/sec)^{ns}	5.1±2.4		5.4±2.3		4.5±1.7	
PEF% predicted^{ns}	64.4±23.6		66.0±23.4		60.1±20.3	
FEF₂₅₋₇₅ (Litre/sec)^{ns}	2.4±1.1		2.0±0.9		2.2±1.0	
FEF% predicted^{ns}	59.8±25.8		60.5±26.5		56.9±25.8	

*=p<0.05; ns=p>0.05; n=Number of patients; SD=Standard deviation; COPD=Chronic obstructive pulmonary disease

Among combined smokers, majority (56.7%) were current smokers. The distribution of current and ex-smokers in other groups was similar.

The distribution of grades of dyspnoea among three groups of patients is shown in table 1. Among these patients, dyspnoea of grade 1 was least prevalent among *hookah* smokers 6.7%, grade 2 was most prevalent in combined smokers (50.0%) and grade 3 in cigarette smokers (46.7%). There was no significant association of dyspnoea with type of smoking (p=0.17).

Various co-morbid conditions that were observed among the three groups of smokers were diabetes mellitus, hypertension or both of these. Thirty-three (26.6%) patients had these co-morbid states.

Overall, 47 (37.9%) patients had COPD out of which 19 (40.4%) were current smokers while remaining 28 (59.6%) were ex-smokers. The frequency of COPD was similar in the three types of smokers (Table 1). There were 20.6% mild cases of COPD among cigarette smokers but none among *hookah* and combined smokers. In the *hookah* smokers, majority (50.0%) had severe COPD, and in combined smokers, majority (54.5%) had moderate COPD.

The situation of pack years distribution for COPD positive and negative cases was not different than that in types of smoking. Among patients with less than 30 pack years of smoking, 26 (41.3%) had COPD. Similarly there were 9 (32.1%), 5 (25.0%) and 7 (63.6%) COPD cases among patients with pack-year groups of 31-50, 51-70 and 71-90, respectively. There were only two cases with more than 90 pack years of smoking and both did not have COPD (Table 1).

On logistic regression analysis, to study the association of age, pack years, smoking types and status with presence/absence of COPD, it was observed that in all the five models, absence of COPD was predicted with 100% accuracy while presence of the disease was not detectable showing that none of the variables among age, pack years, smoking type and status had any association with COPD (Table 2).

Spirometric variables (mean±SD) for FEV₁, FVC, FEV₁/FVC, peak expiratory flow (PEF) and FEF 25%-75% among the three groups of patients is shown in table 1.

On ANOVA, only FVC differed significantly with a p-value of 0.048. On pair-wise comparison for FVC using Tukey B post-hoc test, it was observed that *hookah* smokers had significantly higher values than combined smokers. The FVC of cigarette smokers was not significantly different from the other two groups.

Comparison of spirometric variables between current and ex-smokers did not show significant differences. Comparison of spirometric variables across patients grouped by pack years of smoking showed that FEV₁ was significantly different (p=0.005) along with FVC (p=0.043). Other parameters were not significantly different (p>0.05).

In post-hoc analysis by Bonferroni test, FEV₁ was significantly different by 0.061L between up to 30 pack years and 51-70 pack years group (p=0.02). Other paired comparisons were not significantly different (p>0.05). For FVC, paired comparisons did not reveal significant differences, probably because the precision in margin of error was lost on multiple comparisons.

The association of COPD severity with type of smoking and pack years is show in tables 3 and 4. Multinomial logistic regression was applied that revealed no significant associations of type of smoking and pack years with severity of COPD.

Table 3. Percent distribution of cases by severity of COPD across groups by pack years of smoking

Pack Years of Smoking	COPD Severity			
	Mild	Moderate	Severe	Very Severe
Upto 30	19.2	26.9	30.8	23.1
31-50	0.0	33.3	55.6	11.1
51-70	0.0	40.0	40.0	20.0
71-90	0.0	57.1	28.6	14.3

Table 4. Percent distribution of cases by severity of COPD among types of smokers

Type of Smoking	COPD Severity			
	Mild	Moderate	Severe	Very Severe
Cigarette	20.8	29.2	33.3	16.7
<i>Hookah</i>	0.0	25.0	50.0	25.0
Combined	0.0	54.5	27.0	18.2

Table 2. Results of binary logistic regression for presence/absence of COPD

	B	S.E.	Wald	df	p-value	Exp(B)	95% CI for Exp(B)	
Age	-0.014	0.022	0.410	1	0.522	0.986	0.944	1.030
Pack years	0.002	0.009	0.039	1	0.844	1.002	0.984	1.020
Smoking type	-0.018	0.239	0.006	1	0.940	0.982	0.614	1.570
Smoking status	-0.002	0.384	0.000	1	0.995	0.998	0.471	2.116
Constant	1.261	1.496	0.711	1	0.399	3.529		

DISCUSSION

Chronic obstructive pulmonary disease is now considered a novel cardiovascular risk factor as the burden of CVD is higher in smokers who have developed COPD as compared to patients those without COPD.^{6,17} Yet the prevalence, level of diagnosis, and adequacy of treatment of COPD among patients with IHD has not been investigated extensively. The overall frequency of undiagnosed COPD in our study population suffering from IHD was 37.9% that is substantial and relevant as COPD is now considered to be a preventable and treatable disease.³ A similar study of patients with COPD found that 50% also had CAD, hypertension, or heart failure.¹⁸ According to the Spanish study by Soriano *et al*,⁸ there was underdiagnosis of airflow limitations ranging from 60% in population participants with CVD up to 87.2% in hospital patients with CAD. Compared to that study, the overall frequency of undiagnosed COPD was almost 6% higher in our population and none were getting proper respiratory treatment.

In our study, the frequency of undiagnosed COPD in *hookah* smokers was almost similar to that in cigarette smokers that was against our working hypothesis. Although other studies¹⁹ have not directly compared *hookah* with cigarette smoking in the causation of COPD, it is apparent from our study that *hookah* use is as injurious to health as cigarette smoking. This is contrary to the common myth in the society about the safety of *hookah* smoke due to filtration of chemicals after it passes through water.

It was also shown in the present study that there was no association of severity of COPD with the type and duration of tobacco smoking. In a prospective study of smokers to determine the absolute risk of developing COPD, it was observed that the 25-year incidence of moderate and severe COPD was 20.7% and 3.6%, respectively.⁴ Similar to the present study, this study,⁴ also supports that all the new smokers do not develop COPD. The genetic influences appear important as illustrated by Fletcher and Peto, who specifically used the term 'non-susceptible smokers', that these and non-smokers had a similar gradual decline in FEV₁ compared to the accelerated decline in smokers.^{20,21}

The present study has also shown that more than one in three patients with IHD had concomitant COPD that is slightly more as compared to other studies.⁸ It is emphasised that the present study was conducted in a developing country, where the causative factors of IHD and COPD are likely to be different as compared to those in the developed world. The COPD co-morbidity in IHD patients shown in this study suggests an enormous burden in terms of

disability, mortality and health expenditure in developing countries.²²

The limitations of this study are the small numbers of exclusive *hookah* and combined *hookah* and cigarette smokers as these were difficult to find and enroll in urban areas and that the reduction in lung function may have been caused in part by other diseases such as heart failure or use of beta blockers or aspirin in those with airways hyper-responsiveness.

CONCLUSIONS

It is concluded that there is a high frequency of undetected, and therefore, untreated COPD in tobacco smokers with IHD; and that *hookah* and combined *hookah* and cigarette smokers are almost as prone to develop COPD as cigarette smokers. Further, likelihood of development of COPD on the basis of status, type and duration of smoking is debatable. As untreated COPD with IHD carries high morbidity and mortality, we recommend the use of spirometry which is an easy, cheap tool and a gold standard for COPD diagnosis, as a screening test in all the smokers with IHD.

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