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ABSTRACT:
Smoking is a proven risk factor for a reduction in lung function. The amount of damage to the respiratory tract is associated with the amount of cigarettes a person takes and the duration of smoking. This prospective observational cross-sectional study assessed the lung function of students aged 19 to 25 years in higher learning institutions in the National Capital District, Papua New Guinea. Spirometry was used to assess the lung function of 77 students consisting of 34 (44.2%) males and 43 (55.8%) females that met the inclusion criteria. Among the 34 male students, 16 (47%) were smokers and 18 (53%) were non smokers; among the 43 female students 15 (35%) were smokers and 28 (65%) were non smokers. For the male students no statistically significant differences ($p<0.05$) were obtained in the FEV_1, FVC, PEF and FEV_1/FVC% values of the smokers compared to non smokers. There were no statistically significant differences ($p<0.05$) in the spirometry parameters for the female smokers compared to non smokers. The mean FEV_1, FVC and PEF values obtained for the male students were significantly higher ($p=0.001$) than the corresponding mean values for the female students. However, there was no statistically significant ($p<0.05$) difference between the mean FEV_1/FVC% for the male and female student smokers. The mean FEV_1, FVC and PEF values for the male non smokers were significantly higher ($p=0.001$) than the corresponding mean values for the female non smokers. There was, however, no statistically significant ($p<0.05$) difference between the mean FEV_1/FVC% of the male and female students that do not smoke.

Key words: Smoking, lung function, students.
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INTRODUCTION:

Smoking has been proven to be associated with lung cancer and chronic obstructive pulmonary disease (COPD) and thus has a detrimental effect on lung function [1-7]. Tobacco smoking was found to be associated with increased prevalence of respiratory symptoms and reduced lung function. Female smokers are reported to have a greatly reduced expiratory lung function compared to their male counterparts [2, 8].

Anderson [9] looked at lung function in an adult population in the highlands of PNG in 1979 and found that in the over 45 years age group, 20%

of men and 10% of women had an FEV_1/FVC less than 60% and that the most prominent inhaled pollutant was wood smoke from fires in the houses and not tobacco smoke [9].

Yanga and Datta [3] looked at the effects of chronic smoking and betel nut chewing on the respiratory and cardiovascular parameters in a Melanesian male population in Port Moresby. They reported that chronic smoking and betel nut chewing were harmful to respiratory function, but smoking cigarettes and chewing betel nut for more than two years and less than five years did not show any changes in cardiovascular function [3].

The major aim of this study was to assess the pulmonary function of male and female students in institutions of higher learning. The major objective was to compare the pulmonary functions of smokers to non-smokers among the students.

SUBJECTS AND METHODS:

This study was a prospective observational cross-sectional study done between April and June 2013 in the National Capital District (NCD) of Papua New Guinea. Students were tested from three institutions of higher learning. The institutions were the Taurama and Waigani campuses of the University of Papua New Guinea (UPNG), the Port Moresby Business College (PBC) and the Don Bosco Technological Institute (DBTI) [10]. The sample size calculated used a design effect of one, a relative precision of 10%, and a confidence level of 95%. A sample size of 150 was considered appropriate for this study. Students noted their demographic data and other information in a self-designed pre-tested questionnaire. A student with history of any respiratory or cardiac illness was excluded from this study.

The weight and height of each student was measured and the body mass index (BMI) was further calculated using the weight and height.

Pulmonary function tests were then carried out on each student using a computerised spirometer, SpiroUSB model run with spida5 software. Calibration and testing was done using the American Thoracic Society (ATS) guidelines and criteria. Pulmonary function parameters tested were: FEV_1, Forced Vital Capacity (FVC), FEV_1/FVC, Peak Expiratory Flow (PEF) and Forced Expiratory Flow 25% and 75% (FEF_{25-75}).

Analysis of the data was done using Microsoft XP Excel Data Package and the Statistical Package for Social Sciences (SPSS) version 20. The Shapiro-Wilks test was used to assess normality of data. P-value of <0.05 is considered significant.

The Ethics and Research Grant Committee of the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea gave ethical clearance for this study to be carried

out. All the institutional heads also consented for the tests to be carried out in their institutions. [10]

RESULTS:

One hundred and sixteen (116) randomly selected students out of the 156 who volunteered, were asked to complete a questionnaire before performing the spirometry. Of these 116 students, 39 (33.6%) were excluded during the analysis of the questionnaire and spirometry results as they did not fulfil the inclusion criteria. Norrie has already shown the reasons for exclusion. [10]

77 students, 34(44.2%) males and 43(55.8%) females were finally accepted for analysis. Mean age for the female students was 22 ± 1.6 years (Mean ± SD) and for the male students was 22 ± 1.5 years.

Out of the 34 male students, 16(47%) were smokers and 18(53%) were non smokers.

Table 1 shows the descriptive statistics of the pulmonary function indices for the male students who smoke and those who do not smoke. There were no statistically significant differences ($p<0.05$) in the spirometry parameters for the male smokers compared to the non-smokers. The results indicate that smoking does not significantly affect the FEV_1, FVC, PEF and FEV_1/FVC% values for male students in the 19 to 25 years age group. Out of the 43 female students, 15(35%) were smokers and 28(65%) were non smokers.

Table 1: Descriptive statistics of the Pulmonary Function Indices for male smokers and non smokers

Parameters	**FEV_1 (Litres)**		**FVC (Litres)**		**PEF (Litres/min)**		**FEV_1/FVC (%)**	
	Smokers	**Non smokers**	**Smokers**	**Non smokers**	**Smokers**	**Non smokers**	**Smokers**	**Non smokers**
Mean	3.71	3.69	4.18	4.17	613.8	578.6	89.2	88.6
SD	0.44	0.43	0.59	0.51	90.3	107.2	3.6	4.7
Range	2.87-4.51	2.96-4.39	3.23-5.52	3.29-5.12	461.0-785.0	415.0-767.0	82.0-96.0	79.0-95.0
95% CI	3.48-3.95	3.48-3.90	3.86-4.49	3.92-4.43	565.6-661.9	525.3-631.9	87.3-91.1	86.3-91.0

95% CI: 95% Confidence Interval; IQR: Interquartile Range

Table 2: Descriptive statistics of the Pulmonary Function Indices for female smokers and non smokers

Parameters	FEV_1 (Litres)		FVC (Litres)		PEF (Litres/min)		FEV_1/FVC (%)	
	Smokers	**Non smokers**	**Smokers**	**Non smokers**	**Smokers**	**Non smokers**	**Smokers**	**Non smokers**
Mean	2.92	2.91	3.32	3.21	464.5	448.1	88.8	90.8
SD	0.44	0.36	0.67	0.44	73.0	72.3	5.0	4.2
Range	2.43-3.79	2.35-3.61	2.64-4.81	2.56-4.1	359.0-602.0	326.0-655.0	75.0-95.0	83.0-99.0
95% CI	2.68-3.16	2.77-3.05	2.95-3.69	3.04-3.38	424.1-504.9	420.0-476.1	86.0-91.6	89.1-92.4

Table 3: Duration of smoking habit among the male and female smokers

Duration of smoking	Male Students (n =16)	Female students (n = 15)
Less than 6 months	4 (25%)	2 (13%)
1-2 years	5 (31%)	3 (20%)
3-6 years	4 (25%)	9 (60%)
>6 years	3 (19%)	1 (7%)

Table 4: Frequency of smoking by the male and female smokers

Frequency	Male students (n=16)	Female students (n = 15)
Everyday	11 (69%)	8 (53%)
Every other day	2 (13%)	2 (13%)
Once/week	2 (13%)	2 (13%)
Once/month	0	2 (13%)
Once or twice/year	1 (6%)	1 (7%)

Table 5: Amount of cigarettes smoked per day by the male and female smokers

Amount smoked /day	Males students (n=16)	Female students (n=15)
1-2	10 (63%)	7 (47%)
3-6	5 (31%)	7 (47%)
>6	1 (6%)	1 (6%)

Table 2 shows the descriptive statistics for FEV_1, FVC, PEF and FEV_1/FVC% for female smokers and non smokers. There were no statistically significant differences ($p<0.05$) in the spirometry parameters for the female smokers compared to non smokers. The results indicate that smoking does not significantly affect the FEV_1, FVC, PEF and FEV_1/FVC% values for female students in the 19 to 25 years age group.

The data obtained for the male and female smokers, were analysed based on the duration of their smoking habit, their frequency of smoking and the amount of cigarette smoked per day. The results obtained are presented in tables 3, 4 and 5.

The result shows (Table 3) that 56% of the male students compared to 33% of the female students have been smoking for two years or less. More than half of the female smokers have been smoking for 3 to 6 years compared to 25% of the male smokers.

Among the male student smokers 69% have been smoking every day since they started compared to 53% among the female student smokers (Table 4).

Most of the male smokers (63%) have been smoking 1 to 2 cigarettes per day, compared to 47% of the female smokers (Table 5).

Weak non significant linear correlation was obtained between the duration of smoking and FEV_1 (rho = 0.053, p = 0.786) and also FVC (rho = 0.032, p = 0.856). A weak inverse non significant correlation (rho = -0.066, p = 0.712) between duration of smoking and FEV_1/FVC was also obtained.

There was a weak linear non-statistically significant relationship between frequency of smoking and FEV_1 (rho = 0.036, p = 0.081) and FEV_1/FVC (rho = 0.061, p = 0.732). However, an inverse non-statistically significant relationship (rho = -0.036, p = 0.839) was obtained between frequency of smoking and FVC.

Weak linear non-statistically significant correlations were also obtained when the amount of cigarettes smoked per day were compared with FEV_1 (rho = 0.078, p = 0.662), FVC (rho = 0.022, p = 0.90) and FEV_1/FVC (rho = 0.013, p = 0.941).

Inverse non-statistically significant relationships were obtained between the duration of smoking and FEV_1 (rho = -0.041, p = 0.796), FVC (rho = -0.007, p = 0.964) and FEV_1/FVC (rho = -0.134, p = 0.392) for the female smokers.

For the female smokers correlation coefficients showed linear non-significant relationship between the amount of cigarettes smoked per day and the FEV_1 (rho = -0.086, p = 0.584), FVC (rho = -0.056, p = 0.724) and FEV_1/FVC (rho = -0.108, p = 0.489).

Weak linear non-significant relationship was obtained between amount of cigarette smoked per day and FEV_1 (rho = 0.020, p = 0.901) and also FVC (rho = 0.056, p = 0.721). The relationship between amount of cigarette

smoked per day and FEV_1/FVC was weak inverse and non-statistically significant (rho = -0.180, p = 0.249) for the female smokers.

When the male smokers were compared to the female smokers, FEV_1, FVC and PEF for the male students were significantly higher (p=0.001) than the corresponding mean values for the female students. There was no statistically significant (p<0.05) difference between the mean FEV_1/FVC% for the male and female student smokers.

The mean FEV_1, FVC and PEF values for the male non smokers were significantly higher (p=0.001) than the corresponding mean values for the female non smokers. There was, however, no statistically significant (p<0.05) difference between the mean FEV_1/FVC% for the male and female students that do not smoke.

DISCUSSION:

According to Celli [11] FEV_1 in non smokers with no respiratory illness will start to decline by 25 to 30 mls per year starting at ages 25 to 30 years. People who smoke have a steeper decline than non smokers and heavy smokers have steeper decline compared to light smokers. The number cigarette smoked and the frequency of smoking is both important factors [11].

Thus age is correlated with the number of cigarettes smoked as well as number of cigarettes smoked per day [11]. In our study, it was shown that the FEV_1, FVC and PEF in male smokers were significantly greater than that of the female smokers (p=0.001). A study of young people in NCD in 1997 revealed that 90% of males and 63% of females smoked [12]. According to the WHO profile in 2014, Papua New Guinea has a current tobacco smoking prevalence of 41%, with more adult male smokers (55%) compared to adult females (27%) [13]. However, there is still no known operational policy, strategy or action plan to reduce the burden of tobacco use in the country.

In our study, comparison of smokers and non-smokers revealed no statistically significant differences in spirometry data for both male and female students. The age range in our study was narrower and younger than that of Cheng (25-55years), Yanga (18-40 years), Zhong (40 years and older), Zielinski (39 years and older) and Kim (18 years and older) [5,3,1,14,2]. According to Celli [11], the FEV_1 starts to decline at ages 25 to 30 years which is much older than our study population. This may be the explanation for the non-significant changes observed in our present study.

Gold et al found that adolescents (10-18years) who smoked developed mild airway obstruction and slowed growth of lung function and girls were more vulnerable than boys with regards to the effects of smoking on lung function growth [15]. Apostol et al [16] stated that starting to smoke at a very early age is associated with a

faster decrease in FEV_1. In our study most of the students started smoking between 1 to 6 years prior to the study which is still at a much later age than 10 – 18 years. Datta and Yanga noted that smoking for more than two years but less than five years did not show any changes in lung function [3]. Zhong et al did spirometry tests on selected urban and rural populations in China and reported a prevalence of COPD of 8.2% [1]. Smoking was a risk factor in two-thirds of those patients with COPD and the risk for COPD increased with the number of cigarettes smoked [1]. Kim et al did a nationwide spirometry study on selected population in Korea [2]. They found that 7.8% of adults over 18 years had lowered lung function indices suggesting airflow obstruction. However, after age 45 years, airflow obstruction prevalence increased with increasing age and was higher in men than women. They also found that airflow obstruction was higher in smokers compared to non smokers in subjects who were 45 years or older [2].

This suggests that the effects of smoking on lung function in our present study population may become more pronounced with time. A follow up study of these students in later years may identify changes in their lung function as a result of smoking.

CONCLUSION:

The results from this study showed no current statistically significant effects of smoking on the lung function of students aged 19 to 25 years in Port Moresby.

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