Original Article

Spirometry findings among drug users in the Indonesian National Narcotics and illicit drug Bureau Rehabilitation Center

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Abstract

Background: The increasing prevalence of drug user in Indonesia is affecting the health sectors. The lungs health were affected by the use of the illicit drug. However, lung function among drug users is still unclear. **Methods:** This descriptive-analytic study involves 144 drug users who met the inclusion criteria. Chest X-ray was performed to identify the subject with pulmonary tuberculosis to exclude from the study. Subjects were then undergone spirometry test and interviewed using questionnaires. **Results:** One hundred and forty-four subjects were included in this study. One hundred and twenty-one (84.03%) were male and 128 subjects showed normal lung function. Proportion of abnormal spirometry was 10.4% (n = 15). The restriction was found in ten subjects, and obstruction was found in four subjects. There was significant correlation between the ratio of forced expiratory volume in 1 s to forced vital capacity (FEV_1/FVC) and age (P = 0.000; r = −0.454, moderate correlation), time of using cannabis (P = 0.01; r = −0.345, weak correlation), time of using methamphetamine inhalation (P = 0.004; r = −0.25, weak correlation), duration of using heroin injection (P = 0.025; r = −0.337, weak correlation), time of using cigarette (P = 0.000; r = −0.365, weak correlation), and the amount of cigarette consumption/day (P = 0.04; r = −0.238, weak correlation). **Conclusion:** This study found that there was a weak correlation between declined FEV_1/FVC with a time of smoking, the amount of cigarette consume per day, time of cannabis inhalation, time of methamphetamine inhalation, and time of heroin injection.

Key words: Cannabis, drug abuse, heroin, lung function, methamphetamine

INTRODUCTION

Narcotics and other illicit drugs are still a major problem in Indonesia. The data from National Narcotics Control Bureau of Indonesia in 2004 showed the prevalence of drug abuse is 1.9% of the population.[1] Narcotics drug could depress ventilation through inhibition in the central respiratory system. The depression of respiratory system starts in 7 min after intravenous injection and resume to normal within 2–3 h.[2]

The use of cocaine inhalation significantly reduced lung diffusion capacity marked by decreased diffusing capacity of the lungs for carbon monoxide (DLCo).[3] This is related to the damage of lung structure and has been reported in noncardiogenic lung edema, diffuse alveolar hemorrhage,

Access this article online	
Quick Response Code:	Website: www.jnsbm.org
	DOI: 10.4103/0976-9668.198353

How to cite this article: Samoedro E, Yunus F, Antariksa B, Nurwidya F. Spirometry findings among drug users in the Indonesian National Narcotics and illicit drug Bureau Rehabilitation Center. J Nat Sc Biol Med 2017;8:69-74.

acute lung edema, interstitial pneumonia, and fibrosis. Cocaine inhalation could damage the alveolar capillary membrane.[4] The cocaine itself could cause the constriction of the pulmonary capillary system. Moreover, embolization of cocaine contaminants in the pulmonary capillary can cause decreased lung diffusion capacity.[3] Heroin could increase the histamine release and several cases of asthma attack developed from heroin inhalation.[5] A study from de los Bueis, *et al.* shows that the reduced lung diffusion capacity was more prevalent than obstruction.[6]

Drummond *et al.* revealed in their study that from 974 drug users, 15.5% had an airway obstruction and heroin drug consumption was one of the risk factors to develop chronic obstructive lung disease (COPD).[7] Damage in capillary-alveolar membrane could reduce DLCo. This damage was caused by contaminant particle and vasoconstriction from intravenous cocaine.[8] The assumption that cannabis and cigarette had a similar effect seems reasonable because of their similar psychoactive ingredients: tetrahydrocannabinol and nicotine. However, several studies reported that the effect of cannabis and cigarette was distinguishable.[9] Carbon monoxide and tar deposition were 4–5 times higher in cannabis smoker than cigarettes smoker.[10] The cannabis inhalation method was different from cigarette smoke and was considered as a factor that causes the damage of airway system among cannabis smoker.[11,12] The assumption that chronic cannabis smoker has the same effect with cigarette smoke was coming from a weak evidence. Since 1970, several studies were conducted to find the evidence of airway obstruction in cannabis smoker. Most of the study failed to establish a relationship between airway obstruction (represented by forced expiratory volume in 1 s [FEV_1]) and cannabis smoking. A systematic review performed by Albertson *et al.* in 2007 showed that the relationship between cannabis smoking and airway obstruction was unconvincing.[13]

There are limited data about the relationship between lung function and history of using amphetamine. Several cases reported panlobular emphysema in methamphetamine injection drug user.[14] Methamphetamine injection was related to pulmonary hypertension which caused by contaminant embolization of pulmonary vascular bed and can form foreign body granuloma.[15] Animal testing showed inhalation methamphetamine increased airway resistance accompanied with reducing serotonin.[16] Children lived near the area of producing methamphetamine showed transient asthma symptoms.[14]

METHODS

This is a cross-sectional study conducted in rehabilitation center of the Narcotics and Illicit Drug User at the National Narcotics Bureau in Lido Sukabumi, Indonesia, from November to December 2012. All recipient were interviewed using questionnaires and performed a spirometry test using SPIROBANK II MIR and compared the data using pneumonia project data as a reference. We recruited 144 rehabilitation patients in a rehab center. Inclusion criteria were a history of using illicit drug or narcotics before entering a rehab center. Exclusion criteria were a patient whose pulmonary X-ray results showed tuberculosis. Unless stated otherwise, numerical data were presented as the mean ± standard deviation and the median (range from minimal to maximal).

RESULTS

Four recipients were excluded because the X-ray showed suspected tuberculosis. Most of the patient were male 121 (84.3%) and the occupation most of them were unemployed (47.2%). Education level was senior high school 65.3%, and master-degree were 1.4%.

Most of the recipient used multiple illicit drugs. There were four patients that used cannabis smoking and two patients used oral methamphetamine. The mean age of the recipient was 28.19 (±6.02) years, and the mean of body mass index was 23.07 (±4.05) kg/m^2. The mean height of the recipient was 167.4 (±5.91) cm.

Smoking status

Most of the recipients were cigarette smoker, and only two recipients were not an active smoker. The median duration of smoking habit was 12 (±5.33) years. The median number of cigarette consume per day was 6 (±5.33) cigarettes.

Cannabis status

Recipient used cannabis smoking were 86 (59.7%). The median duration of cannabis smoking was 10 (±5.01) years and median number of cannabis consumed per day was 3 (±1.85) cannabis.

Methamphetamine user status

Recipient used methamphetamine inhalation were 128 (88.9%) persons. Median duration consuming cannabis were 6 years, ranging from 1 year to 18 years.

Injected heroin status

Recipients used heroin injection were 44 persons (30.6%). The median duration was 14.5 (±5.5) years, ranging from 1 year to 22 years. Median heroin used per day was 0.5 (±0.27) g.

Cocaine inhaled status

Most of the recipients did not use cocaine inhalation, however, there were only three recipients (2.1%) used cocaine inhalation. The duration of using cocaine was 9 (±7) years and cocaine inhalation consumed per day was 0.8 (±0.28) g.

Oral methamphetamine

A recipient using methamphetamine oral were 49 persons (34%). The median duration of consuming methamphetamine oral was 7 (±4.34) years, ranging from 1 year to 17 years. Median dose per day of consumption was 2 (±1.36) tablets per day, ranging from 1 tablet to 8 tablets per day.

Last illicit drug used

Most of the recipients (102 persons, 70.8%) used methamphetamine inhalation as the last illicit drug used before rehabilitation.

HIV and another disease status

There were 89 (61.8%) recipients who did not aware of their HIV status, 17 recipients (11.8%) were HIV positive and 38 recipients were HIV negative. Five recipients were asthmatic, and four of them had a childhood history of asthma, while one recipient has no history of asthma during childhood.

Lung functions test

Most of the recipients (129 recipients, 89.6%) showed normal spirometry result, whereas 15 recipients (10.4%) showed abnormal spirometry result. The median of FEV1/forced vital capacity (FVC) ratio was 86.6 (±6.5), ranging from 48.8 to 99.1.

The median %FVC in normal spirometry was 101.80 (±11.1), ranging from 80.30 to 136.6 and the median FEV1/FCV was 86.7 (±4.88), ranging from 75.5 to 98.4 [Table 1].

Correlation between spirometry results and illicit drug

Median %FVC of cannabis smoke 86.9 (range: 66.2–99.1), and there was no correlation between median %FVC and cannabis smoking ($P = 0.179$). Median FEV_1/FVC among cannabis users was 98.6 (range: 62.3–136.5), and there was no correlation between FEV_1/FVC and cannabis smoking ($P = 0.516$).

There was no correlation between duration of cannabis smoking and %FVC ($P = 0.602$). However, there was a weak correlation between duration of cannabis smoking and decline in FEV_1/FVC ($P = 0.001$; $r = -0.345$) as described in Figure 1.

Median %FVC among methamphetamine inhalation users was 99.55 (range: 62.3–138.5), while among nonusers, the median %FVC was 100.6 (79.0–138.5) and there was no correlation between median %FVC in methamphetamine inhalation user and nonuser ($P = 0.972$). The median FEV_1/FVC among methamphetamine user was 86.9 (range: 48.8–99.1), and among nonuser was 85.5 (range: 66.2–98.1). We found no correlation between FEV_1/FVC in methamphetamine inhalation user and nonuser ($P = 0.243$).

No correlation between %FVC and duration of using methamphetamine inhalation ($P = 0.372$). We found a weak correlation between duration of using methamphetamine inhalation and a decline in FEV_1/FVC ($P = 0.004$; $r = -0.250$) as described in Figure 2. There was no correlation between %FVC and FEV_1/FVC amount of methamphetamine used $P = 0.061$ dan $P = 0.81$.

The median % FVC in the heroin intravenous injection group was 100.65 (range: 62.3–136.5), while in nonheroin

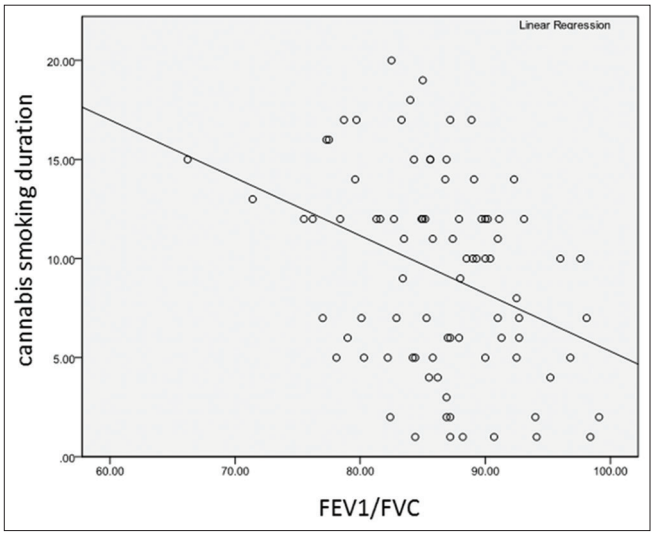

Figure 1: Scatterplot that describes the correlation between cannabis smoking duration and decline of forced expiratory volume in 1 s to forced vital capacity, Spearman's $r = -0.345$; $P = 0.01$

Table 1: % forced vital capacity and forced expiratory volume in 1 s/forced vital capacity

Spirometry results	%FVC			FEV_1/FVC		
	Median (±SD)	Minimal	Maximal	Median (±SD)	Minimal	Maximal
Normal	101.80 (±11.10)	80.30	136.50	86.70 (±4.88)	75.50	98.40
Restriction	76.95 (±5.87)	62.30	79.00	90.95 (±8.00)	75.50	99.10
Obstruction	97.85 (±11.40)	88.90	110.50	71.90 (±3.40)	66.20	74.10
Mix	67.60 (±-)	67.60	67.60	48.80 (±-)	48.80	48.80

FVC: Forced vital capacity, FEV: Forced expiratory volume, FEV_1: Forced expiratory volume in 1 s, SD: Standard deviation

intravenous user, the median %FVC was 98.5 (range: 67.6–129.6). There was no correlation between median %FVC in heroin intravenous user group and the nonuser group ($P = 0.209$). Moreover, the median FEV_1/FVC in heroin intravenous user group was 84.9 (range: 66.2–92.7), and in nonheroin intravenous user, the median FEV_1/FVC was 87.2 (range: 48.8–99.1). We found no correlation between the FEV_1/FVC heroin the median FEV_1/FVC user group and in the nonuser group ($P = 0.243$).

There was no correlation between %FVC and duration of using heroin intravenous ($P = 0.562$). However, we found a weak correlation between duration of using heroin and FEV_1/FVC ($P = 0.025$; $r = -0.337$) as described in Figure 3. No correlation between %FVC and FEV_1/FVC with the amount of heroin used ($P = 0.197$; $r = 0.974$).

The median %FVC among cocaine inhalation group was 105.6 (range: 102.1–116.3) and in noncocaine inhalation, group was 99.4 (range: 62.3–136.5). There was no correlation between median %FVC in cocaine inhalation user group and the nonuser group ($P = 0.221$). The median volume ekspirasi paksa satu detik in 1 s/kapasitas vital paksa among cocaine inhalation user group was 90 (range: 84.0–90.2) and in nonuser was 86.6 (range: 48.8–99.1). There was no correlation between the FEV_1/FVC in cocaine inhalation user group and nonuser group ($P = 0.497$). We also found no correlation between the %FVC and FEV_1/FVC with the duration of cocaine inhalation used ($P = 0.667$ and $P = 0.667$, respectively). There was no correlation between the amount of cocaine used with the %FVC and FEV_1/FVC ($P = 0.33$ and $P = 0.33$, respectively).

The median %FVC in methamphetamine oral group was 101.8 (range: 67.0–129.6), and in the nonmethamphetamine oral group was 98.6 (range: 62.3–136.5). There was no correlation between the median %FVC in methamphetamine oral user group and the nonuser group ($P = 0.765$). The median FEV_1/FVC in methamphetamine oral user group was 86.7 (range: 48.8–99.1) and in nonmethamphetamine oral user group was 86.6 (range: 71.4–98.1). There was no correlation between the FEV_1/FVC in methamphetamine oral user group and the nonuser group ($P = 0.966$). There was also no correlation between %FVC and FEV_1/FVC with the duration of oral methamphetamine used ($P = 0.192$ and $P = 0.066$, respectively). There was no correlation between the amount of methamphetamine used with %FVC and FEV_1/FVC ($P = 0.566$ and $P = 0.780$, respectively).

Correlation between % forced vital capacity and forced expiratory volume in 1 s to forced vital capacity with cigarette smoking

The median %FVC among smoker was 99.85 (range: 62.3–136.5) and in nonactive smoker was 86.1 (range: 67.6–104.7). There was no correlation between median %FVC in the smoker and the nonactive smoker ($P = 0.402$). The median FEV_1/FVC among smoker was 99.8 (range: 66.2–99.1) and in nonactive smoker was 70.95 (range: 40.0–99.1). There was no correlation between FEV_1/FVC in the smoker and the nonactive smoker ($P = 0.833$).

Correlation between % forced vital capacity and forced expiratory volume in 1 s to forced vital capacity with the last used illicit drug

There were correlations between the last used illicit drug cannabis inhalation and methamphetamine inhalation, and between intravenous heroin and oral methamphetamine.

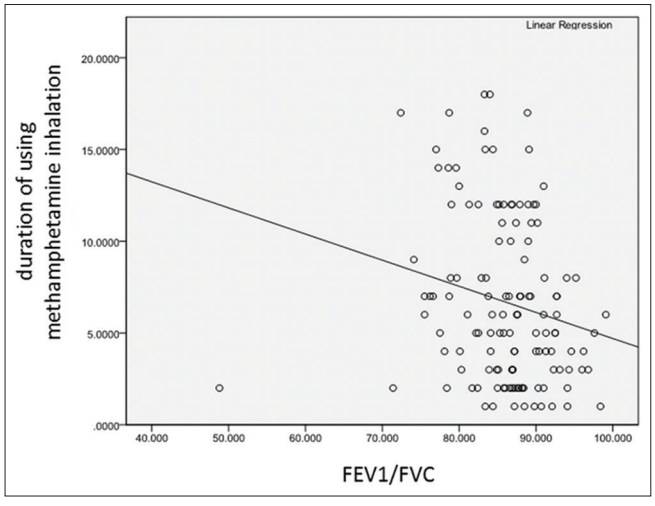

Figure 2: Scatter plot correlation between methamphetamine inhalation user and decline of forced expiratory volume in 1 s to forced vital capacity Spearman correlation test $r = -0.25$; $P = 0.004$

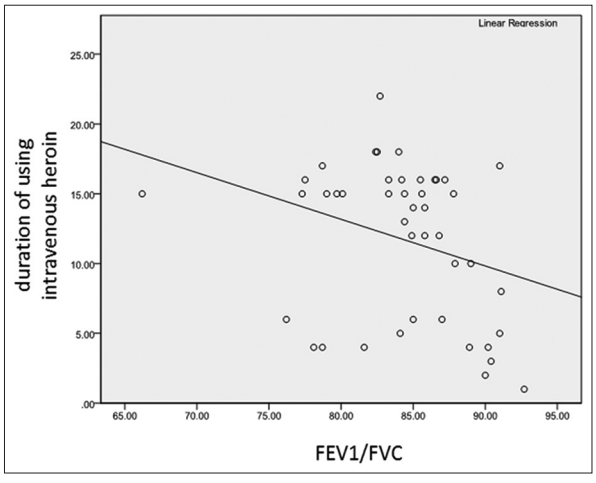

Figure 3: Scatter plot correlation between duration of using intravenous heroin and decline of forced expiratory volume in 1 s to forced vital capacity (Spearman test $r = -0.337$; $P = 0.025$)

In the *post hoc* analysis, there was a correlation between median %FVC in the last used illicit drug cannabis and intravenous heroin ($P = 0.01$), cannabis and oral methamphetamine ($P = 0.013$), methamphetamine inhalation and heroin intravenous ($P = 0.034$), and finally, methamphetamine inhalation and oral methamphetamine ($P = 0.032$).

There was no correlation between the median FEV_1/FVC and the last illicit drug used ($P = 0.278$) as described in Table 2. There was a correlation between the median %FVC illicit drug used and the route (inhalation, injection, and oral). The *post hoc* analysis showed a significant correlation between %FVC inhalation and injection route ($P = 0.006$), inhalation and oral ($P = 0.025$). There was no correlation between the injection and the oral route ($P = 0.407$). There was also no correlation between the median FEV_1/FVC and the last illicit drug used ($P = 0.478$).

DISCUSSION

Correlation between % forced vital capacity and forced expiratory volume in 1 s to forced vital capacity with cannabis, methamphetamine inhalation, intravenous heroin, cocaine inhalation, and oral methamphetamine

This study found no correlation between the %FVC and cannabis used, duration and amount of cannabis used. There was a correlation between FEV_1/FVC and duration of cannabis used, ($P = 0.01$; $r = -0.345$). This result was different with the study from Tashkin, *et al.* which showed that there was no correlation between the decline of FEV_1 and cannabis use.[17] However, a study from Aldington, *et al.* showed that there was a correlation between cannabis smoking and obstruction of the air flow, hyperinflation, and bronchial damage.[18]

The current study also confirmed that there is no correlation between %FVC and cannabis inhalation, duration and amount per day of using cannabis inhalation. There was a significant correlation between FEV_1/FVC with the duration of cannabis inhalation ($P = 0.004$; $r = -0.25$). This result showed there was a weak correlation between declined FEV_1/FVC and the duration of using cannabis inhalation. There was no correlation between FVC with the duration and amount of using injected heroin. There was a significant correlation between median FEV_1/FVC in a subject using injected heroin (84.95) and in noninjected heroin (87.2). This result showed that median FEV_1/FVC of injected heroin user was lower than the noninjected heroin group. There was a significant correlation between the FEV_1/FVC and the duration of using injected heroin ($P = 0.025$; $r = -0.337$), which suggests a weak correlation between FEV_1/FVC and duration of using injected heroin. A study from Overland, *et al.* showed that the prevalence of COPD among injected drug user was 6%.[19] Injected drug users was one of the risk factors for COPD.[7]

We also revealed that there is no correlation between the %FVC and FEV_1/FVC with the used of cocaine inhalation and the amount of cocaine consumed per day. This result might cause by the small number of the respondent ($n = 3$). There was no correlation between the %FVC and FEV_1/FVC with the used of oral methamphetamine and amount of methamphetamine consumed per day. This result might suggest that the oral route had less effect to the lung.

Correlation between the % forced vital capacity and forced expiratory volume in 1 s to forced vital capacity with the last illicit drug used

There was significant correlation %FVC from the last illicit drug used between the cannabis inhalation and injected heroin ($P = 0.01$), and between that cannabis inhalation and oral methamphetamine ($P = 0.013$). This result showed that there was a significant difference between inhaled cannabis with injected heroin and oral methamphetamine. There was no correlation between the injected heroin and the oral methamphetamine. There was a significant correlation in terms of route of the illicit drug between inhalation route and injected route ($P = 0.006$) and between inhalation and oral ($P = 0.025$). There was no correlation between injection route and oral route ($P = 0.407$).

Study limitations

The proportion of alteration of spirometry test results in the drug users were only 10.4%, and there is a need for a bigger sample to obtain a better analysis. The data were not normally distributed, so we unable to perform multivariate analysis. A bigger sample would be helpful to achieve normal distribution. There were no baseline drug user data to compare; therefore, we used prediction

Table 2: Correlation between % forced vital capacity and forced expiratory volume in 1 s/forced vital capacity last illicit drug used

Variable	Cannabis	Methamph inhalation	Heroin injection	Oral methamphp	*P*
% FVC	89.55 (78.9–109.8)	98.6 (62.3–125.3)	105.8 (67–136.5)	108.8 (104.4–129.6)	0.005*
FEV_1/FVC	87.2 (83.5–99.1)	86.7 (48.8–98.4)	85.5 (66.2–92.7)	88.2 (78.4–92.6)	0.278*

*Kruskal–Wallis, *Post hoc* Mann–Whitney with alpha correction=0.0167, Cannabis–methamphetamine inhalation *P*=0.052, Cannabis–intravenous heroin *P*=0.010, Cannabis–oral methamphetamine *P*=0.013, Methamphetamine inhalation–intravenous heroin *P*=0.034, Methamphetamine inhalation – oral methamphetamine *P*=0.032, Intravenous heroin–oral methamphetamine *P*=0.356. FVC: Forced vital capacity, FEV: Forced expiratory volume, FEV_1: Forced expiratory volume in 1 s

from Indonesian Pneumomobile project. We are unable to determine the most influencing variable because we did not perform multivariate analysis. Drug users were not using only one kind of illicit drug, and that could become a confounder. In this study, we are also unable to exclude the potential confounder. Further cohort or case–control study is needed to confirm our findings in the current study.

CONCLUSION

The proportion of spirometry alteration results among drug users were 10.4%, and there was no significant difference from the general population. There was a correlation between declined FEV_1/FVC with the duration of cannabis inhalation, methamphetamine inhalation, injected heroin, age, period of smoking, and amount cigarette consumed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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