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Chasing the dragon, related to the impaired lung function among heroin users

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Abstract

Aim: To describe the pulmonary function and prevalence of dyspnoea among methadone patients and to study the relation with exposure to heroin by inhaling. *Study population:* A sample of 100 patients from methadone maintenance treatment (84% male, average age 42 years). *Measurements:* Questionnaires were used to measure life-time exposure to heroin, cocaine, cannabis, tobacco, and symptoms of dyspnoea. Spirometry was performed and residual difference of measured FEV_1 from the age, sex, height and ethnicity predicted value (ΔFEV_1) was used as a main outcome parameter. Findings: The median ΔFEV_1 was −0.26 l (inter quartile range −0.70; +0.12). Twenty per cent experienced dyspnoea while 'walking at a normal pace with someone of their own age'. History of cigarette smoking was reported by 98%; heroin smoking by 88%. Multiple linear regression analysis showed a statistically significant association between heroin-smoking and ΔFEV_1, logistic regression analysis showed an association between heroin-smoking and prevalence of dyspnoea. *Conclusions:* Chronic heroin smoking seems to be related to an impaired lung function and higher prevalence of dyspnoea. However, part of the observed lung function impairment will be caused by tobacco smoking. Further research is needed to quantify the effect of heroin smoking and disentangle the effect of smoking heroin and tobacco.

Keywords: Substance abuse; Heroin; Respiratory function; Spirometry

1. Introduction

'Chasing the dragon' implies that heroin is heated on foil and heroin vapour is inhaled through a straw. To enhance evaporation, a mixture of base-heroin and caffeine is generally used (Huizer, 1987). Since the start of the heroin epidemic in the early seventies in Amsterdam, chasing the dragon has become the dominant route of administration. Nowadays, 85% of the heroin users in Amsterdam smokes its heroin. Trends towards smoking heroin are observed in Spain, the UK and Ireland (Strang et al., 1997; Smyth et al., 2000).

Chasing the dragon is considered to be a safer mode of heroin use than injecting. Risks of fatal overdose, HIV, HBV and HCV infection are more prevalent among injectors. Chasing the dragon, however, is not without risks. Overdose mortality may occur (Darke and Ross, 2000) and in individual cases, lethal leucoencephalopathy has been reported (Wolters et al., 1982; Kriegstein et al., 2000).

It is known that heroin affects the pulmonary function. It affects the respiratory control centres which may lead to fatal pulmonary depression (White and Irvine 1999). Like other opiates, heroin is known to release histamine (Withington et al., 1993; Edston and van Hage-Hamsten, 1997) and case series of asthma triggered by inhalation of heroin have been reported (Cygan et al., 2000; Hughes and Calverley, 1988). Injecting heroin may cause septic emboli (originating from an

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infection at the injection site or tricuspid valve endocarditis) or foreign body emboli (originating from contaminants or fillers in the injectate). Furthermore, infectious diseases such as TB and pneumonia are more prevalent among heroin users, especially among HIV infected drug users (Lao, 1997; van Brussel et al., 1995). Lung-function studies among small samples of (ex) heroin injectors indicated a decrease of diffusing capacity rather than obstructive complications (Spiritus et al., 1973; Camargo and Colp, 1975). Lung function studies among samples of heroin inhalers are not known.

At the Amsterdam methadone treatment centres there is an increasing concern about the pulmonary function due to chronic use of heroin by chasing the dragon. However, little is known about the effect of heroin smoking on pulmonary function. The Amsterdam population of heroin users may provide valuable information about the chronic effects of smoking heroin on pulmonary function. The aim of this study is to describe the lung function and complaints of dyspnoea among heroin addicts treated with methadone and to study the relation with the exposure to heroin by chasing the dragon, controlling for other causes of lung function impairment.

2. Methods

2.1. Study population and data collection

The study was conducted at a methadone maintenance outpatient clinic of the municipal health service (MHS) of Amsterdam. Patients of this treatment centre are generally not able or willing to stop using illicit drugs. The major goal of methadone maintenance treatment is to reduce the harm that is caused by the use of these drugs.

Three times a year all patients of the methadone treatment are subjected to a periodical medical check up. For the purpose of this study the lung function of the patients was measured during this check up. The protocol was approved by the medical ethical committee of the MHS and the University of Amsterdam. A trained research assistant asked 123 patients to perform a spirometric test before filling out a questionnaire. This way the answers of the questions could not influence the technician when spirometry was conducted. Three patients refused to co-operate. Twenty patients appeared to be unable to conduct the spirometric test according to criteria of quality and reproducibility of the American Thoracic Society but did fill out the questionnaire. In this article we focus on the 100 patients who performed a valid spirometric test.

2.2. Measures

2.2.1. Outcome

Two measures of outcome were used in this study: reported complaints of dyspnoea based on the Modified Medical Research Council questionnaire (Thiadens et al., 1998) and the Forced Expiratory Volume in 1 s (FEV_1). Six hierarchical questions (shown at Table 1) considering shortness of breath were asked. Generally the two most severe categories of shortness of breath (while walking at their own pace and at rest) are considered as having dyspnoea. In order to prevent empty cells when conducting the logistic regression analysis, patients who answered ‘Yes’ to the question “are you suffering from shortness of breath when you walk at a normal pace with someone of your own age?” were considered to have complaints of dyspnoea too. The spirometer (Vitalograph 2170, Spirotrac IV) was used to measure the FEV_1. Only one spirometer was used and all measures were performed by one technician. The residual difference of the measured FEV_1 from the age, sex, height and ethnicity predicted value (ΔFEV_1) was used as main outcome parameter. Moreover, the percentage of the client’s predicted FEV_1 value was calculated (% FEV_1). Predicted values are based on the guidelines of the European Respiratory Society (Quanjer et al., 1993). A race-adjusted correction factor was applied to the data obtained in black participants by multiplying the predicted value of FEV_1 by a factor 0.9 as recommended by the American Medical Association (1990)

	Predicted values FEV_1
Males (Caucasian)	$FEV_{1,predicted} = 0.0430 \times$ length (cm) $- 0.029$age (years) $- 2.49$.
Females (Caucasian)	$FEV_{1,predicted} = 0.0395 \times$ length (cm) $- 0.025$age (years) $- 2.60$
Negroid	$FEV_{1,predicted} = FEV_{1,predicted\ (Caucasian)} \times 0.9$

2.2.2. Exposure

Heroin use by chasing the dragon is the exposure variable of interest in this study. The variable indicating the life time exposure to heroin by chasing the dragon was constructed by multiplying the frequency of heroin use (number of days during the last 30 days of heroin use) and the total numbers of years that heroin was used. This variable ranged from null (never chasing the dragon) to a maximum value of 900 (30 years and 30 days a month). As 12% had a zero exposure, an ordinal variable of eight groups of approximately equal size was constructed. The value 0.0 was directed to the lowest exposure group (equivalent to zero exposure); the value 1.0 to the highest exposure group (equivalent to a duration of exposure of more than 20 years and daily use).

Table 1
Definitions of different categories of dyspnoea and ΔFEV_1, $\%FEV_1$

Are the following remarks applicable to you? I suffer from shortness of breath when	N	Median ΔFEV_1 (l) (inter-quartile-range)	Median $\%FEV_1$ (inter-quartile-range)
Degree 0, 'No' to all following question	45	0.00 (−0.31; 0.58)	100 (93–113)
Degree 1, I am in a hurry on flat ground	15	−0.26 (−0.71; −0.03)	93 (78–99)
Degree 2, I climb stairs or walk up a small hill at a normal pace	18	−0.36 (−1.20; −0.07)	89 (68–98)
Degree 3, I walk at a normal pace with someone of my own age	**9**	**−1.02 (−0.51; −0.21)**	**85 (69–93)**
Degree 4, I walk at my own pace on flat ground	**6**	**−0.89 (−2.14; −0.45)**	**75 (36–89)**
Degree 5, I am at rest	**7**	**−0.75 (−1.24; −0.26)**	**76 (67–93)**
Total	100	−0.26 (−0.70; 0.12)	93 (78–104)

Bold, considered as complaints of dyspnoea in this study.

2.2.3. Confounders

The vast majority of patients uses other drugs than opiates that may have additional harmful effects. This may bias the observed relation between heroin and lung function. In this study exposure to heroin by smoking is the variable of interest and exposure to other drugs (smoking of cocaine, cannabis and cigarettes) are potential confounders. Similar to the exposure to heroin by chasing the dragon, the exposure to marihuana and cocaine by inhalation is constructed by multiplying the period of use (in years) with the frequency of use (last 30 days of use). Subsequently, based on the percentage of non-exposure (21% among base-cocaine and 29% among marihuana) ordinal variables of five and four groups of approximately equal size were constructed (highest category was equivalent to a duration of more than 12.4 and 13.0 years and daily use of cocaine or marijuana, respectively).

Exposure to tobacco was calculated by multiplying duration and frequency of use (mean daily number of cigarettes during the last 30 days) and expressed in pack-years. One pack-year is the equivalent to the exposure of one packet of cigarettes a day during 1 year. Tobacco exposure is expressed as a continuous variable in which one increment equals 10 pack-years of exposure. Among unexposed subjects the average ΔFEV_1 is expected to be null in all age categories. However, among heroin addicts, tobacco smoking is common and the average ΔFEV_1 is expected to show higher negative values with increasing age. In the analysis, age is a continuous variable in which the age of 20 is set to zero and one increment equals 10 years age difference.

In addition to exposure variables, other variables are related to the exposure to heroin by inhaling and/or the pulmonary function. The variables that were evaluated are 'body-mass index (BMI: weight (kg)/length $(m)^2$) lower than 18', 'a lifetime history of tuberculosis (TB) or pneumonia treated with antibiotics during the last 2 years' and 'reported symptoms of bronchial allergenic or non-specific hyperresponsiveness'. These variables could be confounders but also intermediate steps between exposure and disease or even symptoms of pulmonary impairment. Only in the first case statistical adjustment would be necessary. Therefore, two analyses were conducted, one with additional adjustment for BMI, TB/pneumonia and bronchial hyperresponsiveness and one without this adjustment (Rothman and Greenland, 1998).

2.2.4. Analyses

Multiple linear regression was applied to describe the relation between the exposure to heroin by smoking and ΔFEV_1, logistic regression was applied to describe the relation between the exposure to heroin by smoking and the occurrence of dyspnoea. The results of the linear regression and logistic regression analysis are presented in three steps. The first model shows univariate relations of exposure to smoking of heroin, cocaine, cannabis and cigarettes. Controlled for each other's influence these relations are presented again in the second model. In the third model additional variables were added: BMI < 18, complaints of bronchial hypersensitivity, history of TB (life-time) or pneumonia (2 years). Moreover, crude data are presented in scatter plots showing the ΔFEV_1 and prevalence of dyspnoea in each exposure category.

Next to the FEV_1 the Forced Vital Capacity (FVC): the total volume that can be expired after maximum inhalation) is measured. The FVC was 7.10 (standard deviation, S.D. 0.98) and the FVC% predicted was 100% (S.D. 15.9). The mean FEV_1/FVC ratio was 0.73 (S.D. 12.6). The maximum value of the FEV_1/FVC ratio was 0.93; indicating that the decreased FEV_1 was not the consequence of a decreased FVC.

3. Results

3.1. Description of the study population

Hundred patients successfully completed the questionnaire and spirometry. Their average age was 42.4 years (S.D. 6.7). The youngest was 22, the oldest 57-years-old. The majority was male (84%) and white (77%).

3.2. Exposure

All patients reported that they had used heroin, 88% used heroin by chasing the dragon. Moreover, 79% reported they ever inhaled cocaine and 71% had a history of smoking cannabis. During the last 30 days, 52 patients inhaled heroin, 49 cannabis and 49 cocaine. Less than half (41) had ever injected their drugs. Only 13 out of 100 patients had recently injected heroin, 11 of them both heroin and cocaine.

All patients but two had ever smoked cigarettes. Only one of the 'ever' smokers did not smoke during the month preceding the interview. Among cigarette smokers, the median age of starting cigarette use was 15 years. The average period of cigarette use was 26 years.

3.3. Complaints of dyspnoea and ΔFEV_1

The outcome variables (complaints of dyspnoea, ΔFEV_1 and $\%FEV_1$) are shown in Table 1. Forty-five patients reported no complaints of dyspnoea. Twenty-two patients reported dyspnoea of the third degree or higher. The ΔFEV_1 ranged from −3.0 until +1.1 l. The average value was −0.32 (S.D. 7.7) and the median value was −0.26 l (inter quartile range (IQR) −0.70; + 0.12). The $\%FEV_1$ ranged from 19 until 129 with an average value of 91 (S.D. 20.1) and a median of 93 (IQR: 78–104). Table 1 shows a decreasing ΔFEV_1 and $\%FEV_1$ with increasing degree of dyspnoea. Normal ΔFEV_1 and $\%FEV_1$ values are observed among those without any complaints of dyspnoea. Spirometric results among methadone patients with dyspnoea to the third degree and higher (mean ΔFEV_1, −0.89 l; $\%FEV_1$, 74%) are lower than among patients with none or minor complaints (mean ΔFEV_1, −0.16 l; $\%FEV_1$, 96%; both t-tests $P < 0.001$).

3.4. FEV_1 and the use of drugs

Fig. 1 shows the relation of exposure to smoking heroin, cocaine or cannabis and ΔFEV_1. ΔFEV_1 values vary widely among the high heroin exposure and low cocaine exposure categories. Two subjects with symptoms of dyspnoea and FEV_1 values that are more than 2.5 l lower than expected, show extreme exposure values. They are included in the zero exposure group of cocaine and cannabis, and in the higher exposure groups of heroin.

Table 2 shows the results of the multivariate regression analysis. In Table 2A univariate relations are shown. Age was significantly related to a decreased ΔFEV_1. The relation with age and ΔFEV_1 can be considered as the effect of the increasing (life-time) exposure to the various drugs. Differences in exposure to cigarette smoking did not show a significant relationship with the ΔFEV_1. The degree of heroin exposure by

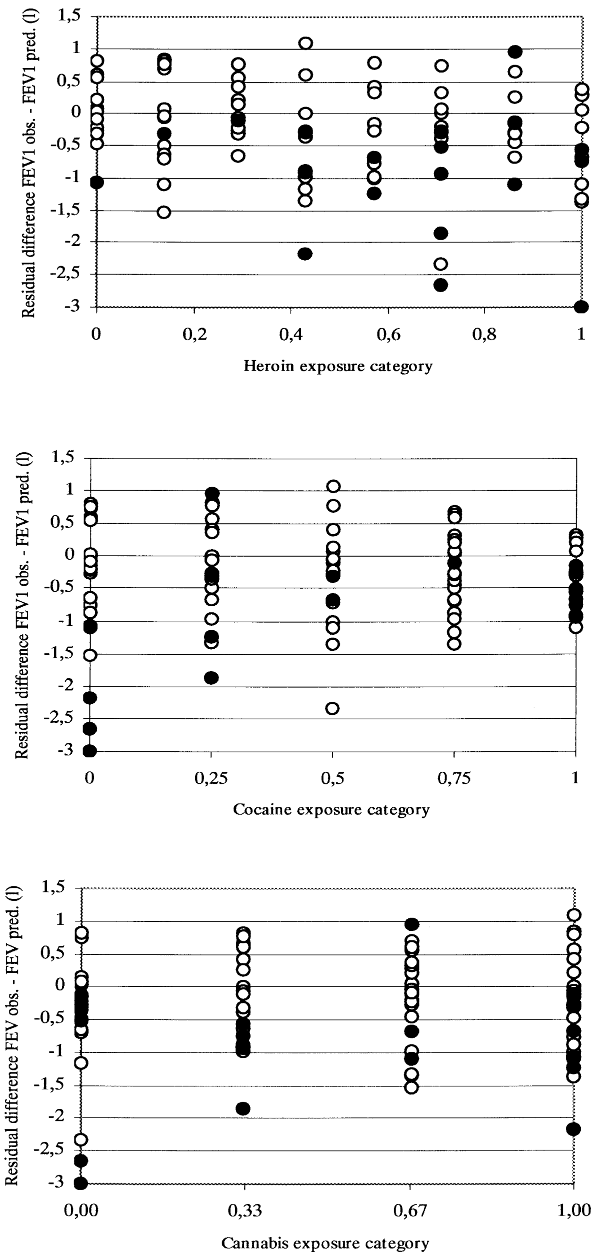

Fig. 1. Ordinal exposure to heroin (inhaling), cocaine (inhaling) and cannabis in relation to the ΔFEV_1 and dyspnoea. Black: dyspnoea in this study.

smoking was significantly related to a decreasing ΔFEV_1. The highest exposure category showed a ΔFEV_1 value 0.57 l lower than the none-exposure category. We did not observe any significant relation between exposure to cannabis or cocaine and ΔFEV_1.

Table 2B shows the results after controlling for age and influence of multiple drug use. Although exposure to base-cocaine is positively correlated with exposure to heroine by chasing the dragon (r^2, 0.4; $P < 0.001$), associations between cocaine, heroin and ΔFEV_1 appear to be stronger after adjustment. The FEV_1 values showed a decrease with increasing heroin inhaling

Table 2
Linear regression analysis: exposure vs. ΔFEV_1

	Beta	95% CI	*P*-value
A, Univariate relation with ΔFEV_1 (l)			
Age[a]	−0.17	(−0.42; 0.07)	0.16
Cigarettes[a]	−0.05	(−0.15; 0.05)	0.33
Cannabis[b]	0.11	(−0.29; 0.51)	0.58
Cocaine (smoking)[b]	0.15	(−0.28; 0.58)	0.49
Heroine (smoking)[b]	−0.57	(−1.03; −0.11)	0.02
B, Multivariate regression analyses (adjustment for exposure effects)			
Age[a]	−0.15	(−0.40; 0.10)	0.23
Cigarettes[a]	−0.05	(−0.15; 0.05)	0.35
Cannabis[b]	0.06	(−0.32; 0.44)	0.75
Cocaine (smoking)[b]	0.52	(0.05; 0.97)	0.03
Heroine (smoking)[b]	−0.78	(−1.28; −0.28)	0.003
C, Additional adjustment for, BMI < 18, history of TBC or pneumonia, complaints of bronchial hyper-responsiveness			
BMI < 18[c]	−0.33	(−0.64; 0.02)	0.03
History TB/pneumonia[c]	−0.25	(−0.61; 0.11)	0.17
Bronchial hyper-responsiveness[c]	−0.49	(−0.76; −0.21)	0.001
Age[a]	−0.13	(−0.36; 0.11)	0.09
Cigarettes[a]	−0.05	(−0.14; 0.04)	0.49
Cannabis[b]	0.05	(−0.30; 0.40)	0.88
Cocaine (smoking)[b]	0.48	(0.06; 0.90)	0.03
Heroine (smoking)[b]	−0.61	(−1.08; −0.15)	0.01

Estimated ΔFEV_1 among none exposure group (constant); 2B, 0.32 (95% CI −0.34; 0.98); 2C, 0.57 (95% CI −0.09; 1.23).
[a] Continuous variable, age 0 = 20 years, increment, 10 years; pack-years increment, 10 years.
[b] Ordinal variables lowest through highest category ranging 0 through 1.
[c] Dichotomous variable; 'no'/'yes' values '0'/'1'.

exposure and an increase with increasing exposure to cocaine by inhaling. This effect is probably caused by patients with an extremely low ΔFEV_1 who belonged to the higher heroin inhaling exposure categories but never inhaled cocaine (Fig. 1).

If the two most extreme values are omitted from the analysis, the ΔFEV_1 still shows a significant decrease with increasing exposure to heroin inhalation ($P = 0.05$). The significant association with cocaine, however, disappears ($P = 0.32$). Similarly, if the square $\%FEV_1$ is used to limit the influence of the lower values, the multivariate analysis still shows a significant association ($P = 0.03$) with heroin exposure and increase of ΔFEV_1 with increasing cocaine inhalation disappears ($P = 0.33$).

A BMI lower than 18 was observed in 26% of the patients, whereas 49% reported complaints of bronchial hyper-responsiveness and 21% a history of TB (seven patients lifetime) or Pneumonia (17 patients during past 2 years). Table 2C shows the influence of these potential confounders on the relation between heroin and FEV_1. In the univariate analysis the variables 'history of TB or pneumonia' and 'complaints of bronchial hyper-responsiveness' are significantly related to heroin exposure (χ^2 linear by linear association $P < 0.05$, $P < 0.01$)). The variable 'BMI < 18' did not show a significant relation with the level of heroin exposure. In the univariate analysis all three variables showed a significant associated with ΔFEV_1 (data not shown). In the multivariate analysis only the variables 'complaints of bronchial hyper-responsiveness' and 'BMI < 18' were significantly related to the ΔFEV_1. The higher prevalence of methadone patients with symptoms of bronchial hyper-responsiveness and exposure to heroin by inhaling partly explains the relation between heroin and ΔFEV_1.

3.5. Dyspnoea and exposure to drugs

Table 3 presents the results of the logistic regression analysis of the relation between dyspnoea and the exposure to drugs. These results show large similarities with those of the linear regression analyses described above. Among the methadone patients, heroin exposure was associated with an increased prevalence of dyspnoea. Reported differences of exposure to cocaine, cannabis or cigarettes were not statistically significant related to the prevalence of dyspnoea. Dyspnoea was reported more frequently among patients with complaints of bronchial hyper-sensitivity. In contrast to results of the linear regression analysis, no significant

Table 3
Logistic regression analysis: exposure vs. dyspnoea

	Odds ratio	95% CI	*P*-value
A, Univariate relation with dyspnoea			
Age[a]	1.5	(0.7; 3.2)	0.33
Cigarettes[a]	1.3	(1.0; 1.7)	0.07
Cannabis[b]	0.9	(0.3; 3.0)	0.81
Cocaine (smoking)[b]	1.5	(0.4; 5.5)	0.59
Heroine (smoking)[b]	5.2	(1.1; 26.7)	0.03
B, Multivariate logistic regression analyses (adjustment for other exposure effects)			
Age[a]	1.2	(0.5; 2.9)	0.67
Cigarettes[a]	1.3	(0.9; 1.8)	0.11
Cannabis[b]	0.9	(0.2; 3.2)	0.84
Cocaine (smoking)[b]	0.6	(0.1; 2.6)	0.46
Heroine (smoking)[b]	7.6	(1.3; 45.4)	0.03
C, Additional adjustment for BMI < 18/history of TBC or pneumonia/complaints of bronchial hyper-responsiveness			
BMI < 18[c]	0.9	(0.3; 3.3)	0.88
History of TB/pneumonia[c]	3.8	(1.1; 12.8)	0.03
Bronchial hyper-responsiveness[c]	3.3	(1.0; 10.3)	0.04
Age[a]	1.0	(0.4; 2.6)	0.93
Cigarettes[a]	1.3	(0.9; 1.9)	0.10
Cannabis[b]	0.8	(0.2; 3.5)	0.82
Cocaine (smoking)[b]	0.5	(0.1; 2.6)	0.43
Heroine (smoking)[b]	5.6	(0.8; 40.9)	0.09

[a] Continuous variable, age 0 = 20 years; increment, 10 years; cigarettes increment 10 pack years.
[b] Ordinal variable; lowest through highest category ranging 0 through 1.
[c] Dichotomous variable; no/yes; 0/1.

association between dyspnoea and BMI is observed. The association between ‘history of TB and/or pneumonia’ and heroin exposure by chasing the dragon partly explains the relation between heroin and prevalence of dyspnoea (data not shown). After additional adjustment the odds ratio of heroin exposure and dyspnoea is not significantly higher than one.

Analysis performed with a more narrow definition of dyspnoea (13% that reported to experience a short of breath while walking at their own pace or in rest) showed similar results. However, due to the low number of values per cell odds ratios and confidence intervals are inflated (data not shown).

4. Discussion

This study demonstrates that methadone patients show an impaired lung function both if we consider complaints of dyspnoea and ΔFEV_1 and $\%FEV_1$ In a sample of the general population with a comparable age and gender distribution only 1% with serious complaints of dyspnoea (when walking at his own pace or at rest) would have been expected (Rijcken et al., 1996). In this study 13% of the patients reported such complaints of dyspnoea. The median $\%FEV_1$ was 93 (S.D. = 20). The average $\%FEV_1$ observed at a population survey conducted within various regions of the Netherlands (N = 2589) was 108 (S.D. = 17) (Quanjer et al., 1993).

Furthermore, data suggest a relation between heroin use by chasing the dragon and an impaired lung function. We were able to construct subgroups reflecting differences in life-time exposure to heroin by chasing the dragon by taking into account differences in routes of administration (injecting versus chasing the dragon), differences in duration of inhaling heroin and frequency of inhaling heroin during the last month of use. ΔFEV_1 values decreased and prevalence of dyspnoea increased with increasing heroin exposure. Bias towards zero is possible if heroin inhalers lowered their consumption due to an impaired lung function. Due to limitations of a transversal study and limited accuracy of life-time exposure to heroin quantification of the effect is not possible. The effect of patients who failed spirometric test is expected to be limited. They were older (average 49 years) but exposure to heroin or cigarettes nor the severity of the reported symptoms of dyspnoea significantly differed from the others.

An impaired pulmonary function was not shown among all subjects of the highest category of exposure to heroin by inhaling. So probably, if inhaling of heroin is causally related to an impaired lung function, not all heroin users are equally vulnerable. In this respect a similarity with cigarette smokers may arise. Non-specific airway responsiveness is considered to predispose some cigarette smokers to develop Chronic Obstructive Pulmonary Disease (COPD). Only 15% of the cigarette smokers will eventually develop COPD (Tashkin et al., 1996). Among heroin inhalers there may be a susceptible subpopulation too. For example, it could be hypothesised that those who inhale heroin and also show a histamine release after exposure to opiates are specially vulnerable.

Bronchial hyper-responsiveness and history of TB/pneumonia seem to be partly responsible for the association between heroin and ΔFEV_1 and dyspnoea, respectively. It is not exactly clear whether these variables should be considered as confounders, intermediate factors, or symptoms of pulmonary impairment. If we consider these variables as intermediate factors or symptoms additional adjustment would be incorrect. The variables could also be confounders. A history of TB and pneumonia for example, could be indicative for poor living conditions and, therefore, be more prevalent among those with the highest exposure to heroin administered by inhaling. If this is the case, adjustment is justified. However, those who are not exposed to heroin by chasing the dragon, injected their heroin and their living conditions are not expected to be better.

Considering a causal mechanism it may be important to realise that the purity of heroin that is inhaled in Amsterdam is approximately 30%. Caffeine is the main adulterant (Forensic Laboratory of Amsterdam, 2000, personal communication). However, caffeine, administered orally, is a bronchodilator and appears to improve lung function in people with asthma (Bara et al., 2000).

All but two study participants smoked tobacco, the average exposure of cigarettes among the total group is estimated to be 20.2 pack-years. Although the validity of a retrospectively calculated exposure variable is limited (Bernaards et al. 2001), we may assume that part (possibly most) of the pulmonary impairment in this population can be attributed to the smoking of cigarettes. Moderate to heavy cigarette smoking men have, on average, a 15 ml/year larger decline of FEV_1 than non-smokers (Kerstjens et al., 1997). Unfortunately, we cannot transpose these findings to this transversal study because people with a low $\%FEV_1$ are at higher risk for mortality (Knuiman et al., 1999). No (statistical significant) relation between exposure to tobacco and ΔFEV_1 or dyspnoea was determined. This should be interpreted as the result of a lack of contrast among the methadone clients (almost everybody continuously smoked cigarettes) rather than a lack of effect. Moreover, if heavy cigarette smokers lowered their consumption due to an impaired lung function, the reported contrast of tobacco exposure is likely to be lower than the real contrast (again, bias towards zero). This could decrease the capability of the ‘cigarette exposure’ variable to control for potential confounding. In this study, the relation between heroin smoking and ΔFEV_1 or dyspnoea did not decrease after adding the number of pack-years to the analyses. Moreover, the number of pack-years of tobacco exposure as reported was not significantly related to the level of heroin exposure ($r^2 = 0.03$; $P = 0.76$). This suggests that the real confounding bias will be limited.

Nevertheless, in order to improve the lung function, limitation of the exposure to cigarettes calls for special attention (Richter et al., 2001; Richter and Ahluwalia, 2000). Cannabis exposure was not significantly related to a decreased ΔFEV_1 or increased prevalence of dyspnoea. Other studies concerning the effect of cannabis on pulmonary function offer conflicting results. Tashkin concluded that the FEV_1 did not decline due to cannabis smoking (Tashkin et al., 1997) but Taylor observed altered spirometric results (FEV_1/FVC) among (non-tobacco smoking) cannabis dependent individuals at age 21 years (Taylor et al., 2000). Moreover, it is suggested that airway inflammations are more prevalent among combined marijuana and tobacco smokers (Roth et al., 1998). The apparently positive effect of cocaine on ΔFEV_1 is considered to be an artefact and caused by the effect of a few subjects with a severely impaired lung function who never smoked base-cocaine. Possibly they did not start using base-cocaine because of their impaired lung function. In Amsterdam, cocaine smoking started during the 1980s, and, increased during the 1990s. Although a negative effect of base cocaine on FEV_1 has not been observed, other physical problems may hinder oxygen uptake. Inhaling base-cocaine is associated with pulmonary inflammation and infiltration on X-ray (Kon et al., 1996) and may cause a decreased diffusion of oxygen from the lungs to the blood (Tashkin et al., 1992; Tashkin, 2001).

5. Conclusion

The results of this transversal study suggests that chronic heroin use by chasing the dragon is related to an impaired lung function and higher prevalence of dyspnoea. More research is needed to quantify the possible effect, to disentangle the effect of smoking heroin and tobacco and to identify whether and what kind of particularly vulnerable subpopulations exists.

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