Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

Annals of Biological Research, 2014, 5 (11):32-35
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Lung function parameters in spray painters in Calabar, Nigeria

Aribo, E. O. and Antai, A. B.

Department of Physiology, College of Medical Sciences , University of Calabar, Calabar – Nigeria

---

SUMMARY

In this study, the relationship between exposure to spray paints and respiratory end points (lung function indices) in spray painters compared with a control was studied. The study population consisted of 154 automobile spray painters aged between 21 – 54 years. Equivalent number of mean aged between 18 – 53 years was used as control. All subjects worked and lived in Calabar. Forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), forced expiratory volume in one second expressed as a percentage of forced vital capacity (FEV_1%) and peak expiratory flow rate (PEFR) were used as indices of pulmonary function. A vitalograph spirometer was used to measure FEV_1 and FVC while FEV_1% was computed. The peak expiratory flow rate (PEFR) was measured using a mini-Wright peak flow meter. A structured questionnaire was used to obtain biodata. Anthropometric parameters were not significantly different between control and test subjects. FVC was significantly lower in test than in control groups ($P<0.001$). FEV1 was significantly lower in the test when compared with that of control ($p<0.001$). In the same way, the PEFR of the test group was significantly lower compared with the control ($p<0.001$). The FEV_1% was not significantly different in the two groups. There was an inverse relationship between duration of exposure to spray painting and lung function parameters (FVC, $p<0.01$; FEV, $p<0.01$ and PEFR, $p<0.01$). In conclusion, we report that chronic exposure to spray painting impairs lung function which is worse with increasing duration of exposure.

Key words: Lung function, spray paints, spray painters

INTRODUCTION

Spray painting is the art of applying a liquid-coating substance such as paint or lacquers converted into aerosol or mist and directed unto a surface to produce an evenly distributed film of the required thickness and texture. The eventual spray is a mixture of substances which include solvents (styrene, isocyanates, xylene and alcohol) with inhibitors and pigments like acrylates and methylacrylates as well as additives like metals [1,2].

There has been an increasing activity in the spray painting industry in Nigeria mainly due to increased number of automobiles on our roads, and increased awareness of the usefulness of spray painting both to protect objects from rust and to make them more appealing. The boom in the industry encourages young men into the business especially those who are unable to go to school due to prevailing economic situation in the country and so have to undertake spray painting as a means of livelihood. Spray painting can be done via an airless spraying, compressed air spraying or by electrostatic spraying. Our subjects used the compressed air method.

These chemicals are known to have several effects on the human systems including the pulmonary system. Isocyanates or paint products remain the most common causes of occupational asthma or painter's lung worldwide [3,4,5] with a prevalence rate of about 10%, [6]. Paint is the greatest source and contributor of isocyanate exposure [7]. Xylene produces dose-related respiratory depression and respiratory tract irritation [8,9]. The acrylates and methylacrylates are associated with difficulty in breathing and irritation of throat, nose and lung passages [10].

Spray painting is a potentially hazardous occupation which is even made worse by the wide composition of the eventual spray. Risk of respiratory affectation is influenced by nature or composition of the paint (oil based > water based), duration of exposure, concentration of vapour, type of spray gun and nebulizer as well as the type of spraying booth [11]. A lower lung function indices among automotive spray painters has also been demonstrated [12]. Emphysema and reduction in lung function have also been linked with exposure to paints [13,7].

During the process of spray-painting the painter is exposed to all the chemicals which are atomized. Though components of the paint can be absorbed through other routes like skin and mucous membranes, inhalational route accounts for up to 63.6% of total absorption [14]. Typically, spraying is done in technically designed booths with the best been the downdraft design [15]. In Calabar, there are no technically designed spraying booths.

Despite the established adverse effects of spray painting on health, spray painters in Calabar metropolis do not use standard spraying booths; and anywhere can serve as spraying booths even garages. Protective wears like face masks are not often used and yet many of them have been in the profession for many years. This study therefore sought to establish the effect of spray paints on lung function under the conditions obtainable in workshops in Calabar, Nigeria.

MATERIALS AND METHODS

The study population consisted of 154 automobile spray painters (test group) aged between 21 – 54 years while the control group was made up of equivalent number of randomly selected male adult civil servants, students and business men aged between 18 – 53 years all of whom work and reside in Calabar. The mean age, height and weight of the control group were 32.95± 0.70; 1.69±0.01 and 70.09± 0.79 respectively. Consent was from each subject before being recruited into the study. Exclusion criteria were physical illness and exposure to pollutants at home or work place.

A self structured questionnaire was used to find out exposure to other pollutants, duration of exposure to spray painting, life style and obvious diseases. Weight was measured with Camry bathroom weighing scale and height with stadiometer. Lung function was determined in the standing position. FEV_1 and FVC were assessed with Vitalograph spirometer (Vitalograph Ltd, Buckingham, England) while the PEFR was determined using mini-Wright peak flow meter (AIRMED, Clement Clarke International Ltd., England). Standard procedures were used and necessary precautions taken during measurements of lung function and other data. Three different readings were taken for each subject and the best of the three used for the subject (Vaughan *et al.*, 1989). Prediction formulae were determined for the lung function parameters of control subjects, each formulae taking into account, the height, weight and age of the control subject.

Statistical analysis

Results were presented as mean ± SEM. Unpaired student t-test was used for comparison between means. Excel was used to produce the charts and scattered plots. A p-value of less than 0.05 ($p<0.05$) was considered statistically significant.

RESULTS

Comparison of the ventilatory function indices between predicted and observed values did not show any significant difference, Table 1.

A comparison of the anthropometric parameters of the two groups did not reveal any significant difference between the groups, Table 2.

The mean FVC of the test group was significantly lower, 2.72±0.07 when compared with that of the control, 4.43±0.07 ($p<0.001$). A comparison of the mean FEV_1 showed it was significantly lower in the test, 2.71±0.06, than in the control, 3.35±0.68 ($p<0.001$). A significant reduction in the mean PEFR was also observed in the test group, 522.60±4.87 compared with control, 582.60±5.98 ($p<0.001$). The mean FEV_1% was not significantly different in the two groups. All these are shown in table 2.

There was no significant difference in lung function parameters between spray painters who smoke and those that did not, Table 3.

The mean PEFR was significant and inversely proportional to the duration of exposure ($r = -0.353$, $p<0.01$). There was also a significantly inverse relationship between mean FEV_1 and duration of exposure ($r – 0.296$, $P<0.01$).

Mean FVC also decreased significantly with increasing duration of exposure (r = -0.310, P<0.01). There was no significant correlation between mean FEV_1% and duration of exposure (Table 4).

TABLE 1: Comparison of ventilatory function indices (FVC, FEV_1, FEV_1% and PEFR) between predicted and observed controls

Parameters	Observed (N=154)	Predicted (N = 154)	P-values
FVC (L)	4.43±0.07	4.45±0.04	NS
FEV_1	3.35±0.68	3.39±0.02	NS
FEV_1%	75.27±0.76	75.27±0.18	NS
PEFR (L/min)	582.60±4.87	582.63±2.02	NS

Key: NS = Not significant

TABLE 2: Comparison of mean values of anthropometric parameters (age, height and weight) and ventilatory function indices (FVC, FEV_1, FEV_1% and PEFR) of control with those of test subjects.

Parameters	Control (N=154)	Test (N = 154)	P-values
Age (yrs)	32.95±0.70	33.42±0.2	NS
Height (m)	1.69±0.01	1.67±0.01	NS
Weight (kg)	70.19±0.78	70.09±0.79	NS
FVC (L)	4.43±0.07	2.72±0.07	***
FEV_1	3.35±0.68	2.71±0.06	***
FEV_1%	75.27±0.76	73.23±0.98	NS
PEFR (L/min)	582.60±4.87	522.60±5.98	***

*NS=Not significant; ***=P<0.001*

TABLE 3: Comparison of mean values of ventilatory function indices (FVC, FEV_1, FEV_1% and PEFR) of smokers and non-smokers in control group.

Parameters	Smokers (N=27)	Non-smokers (N = 127)	P-values
FVC (L)	4.31±0.15	4.45±0.08	NS
FEV_1	3.28±0.11	3.37±0.06	NS
FEV_1%	76.11±1.81	75.09±0.84	NS
PEFR (L/min)	580.00±10.72	583.14±5.47	NS

Key: NS = Not significant

TABLE 4: Correlation coefficient (r) between duration of exposure and lung function parameters in test subjects

Parameters	Duration of service (yrs)	
	Correlation coefficient (r)	Significant level (p)
FVC	-0.310	**
FEV_1	-0.296	**
FEV_1%	-0.106	NS
PEFR	-0.353	**

*p=p-value; NS=Not significant ; **=p<0.01*

DISCUSSION

In this work, the lung function indices, FVC, FEV_1, PEFR and FEV_1% were assessed among spray painters in Calabar and compared with a similar number of control subjects. The relationship between duration of exposure to sprays painting and respiratory impairment was also determined.

Due to the relationship between anthropometric indices, age, height and weight, and lung function parameters FVC, FEV_1, FEV_1% and PEFR [16], the reliability of the equations was tested by comparing observed or measured values of lung function with values obtained by calculation using the formula for each of the two groups (test and control). Results from this study demonstrated no significant difference between the observed and the predicted lung function values for age, weight and height and thus proving the reliability of the test, [17]. This invariably means that normal healthy adults were used for the control.

Lung function parameters correlated positively with anthropometric parameters, this is in line with previous studies [16,18]. However, there was no observed significant difference between the mean anthropometric values of both the control and the test group when they were compared. Since both groups had similar anthropometric indices, social factors or place of residence, any difference in lung function indices between the two groups can only be attributed to spray paint which the test group was exposed to [3,7].

The demonstration of a significant reduction in the lung function indices FVC, FEV_1 and PEFR in spray painters compared to the controls agreed with other studies [7,13] on lung function of workers exposed to spray paints. However, there was no significant difference in FEV_1% between the two groups. There is paucity of information on the mechanism by which spray paints cause damage to the respiratory system but it could be explained by the hypersensitization of the airway following exposure to components of spray paint [19] which causes bronchial hyper-responsiveness involving T-lymphocytes [7]. The hyper-responsiveness of the conducting systems in the lung results in bronchospasm and narrowing of these air passages. It is not impossible for there to be parenchymal changes as well. The finding of a significantly low FVC, FEV1 and PEFR suggestive of an obstructive pattern [16] and a non-significant change in or a normal FEV1%as seen in restrictive pattern of pulmonary disorders strongly indicate that the nature of pulmonary damage is a mixed pattern. [20,21]. Though smoking is known to be a significant prior determinant of the risk of hypersensitization [22], there was no significant difference in lung function among painters who smoke and others that did not. This could be due to an overwhelming effect of spray paints which greatly over- shadowed the possible contribution of smoking in the observed deterioration in lung function of spray painters. Poor attitude to safety measures like use of standard spraying booths might have contributed to the reduction in lung function parameters.

This study also demonstrated an inverse relationship between duration of exposure of painters to paint and lung function indices (FVC, FEV and PEFR). This observation is in consonant with the views of other scientist [3,23] and demonstrated the change in pulmonary physiology with increasing exposure.

In conclusion, this study has shown that chronic exposure to spray paints impairs lung function with the pattern of impairment being predominantly of the mixed type and which was not attenuated by smoking. It is also concluded that lung function impairment becomes worse with increasing duration of exposure to spray paints. Also, safety attitude of workers in the industry was very poor and might have contributed to the decline in lung function.

REFERENCES

[1] Wikipedia (**2011**) http/en/Wikipedia.org/wiki/paint.
[2] Tornling G, Alexanderson R, Plato N. *Am J Indust Med*, **1990**, 17, 299-310.
[3] Meredith SK McDonald JC. *Occup Med*, **1994**, 44, 183-189.
[4] Bascon R. Isocyanates asthma. *The proceedings of the Am Thorac Soc*, **2008**, 5, 751-754.
[5] Bernstein IL, Chan-Yeung M, Malo JI, Bernstein DI. Asthma in the work place. *Marcel Dekker*, New York, **1993**, 1-4.
[6] Park HS, Nahm DS. *Clin Exp Allergy*, **1997**, 27, 1145-1150
[7] Pronk A, Preller I, Raulf-Heimsoth M, Jonkers ICI, Lammers J, Wouters IM, Dockers G, Wisnerwski AV, Heederik D. *J Resp Crit Care Med*, **2007**, 175,1090-1097.
[8] Carpenter CP, Kinkead ER, Geary JD, Sullivan LJ, King LM. *Toxicol Appl Pharmacol*, **1975**, 33, 543-548.
[9] Kandyala E, Raghavendra SP, Rajasekharan ST. *J Oral Maxillofacial Pathol*, **2010**, 14(1), 1-5.
[10] Fediukovich LV, Kotiovski LU, Sviderskaia LN, Borisor Lu M. *Genetica*, **1988**, 24(5), 1132-1134.
[11] Heitbrink, WA, Verb RH, Fiscthbach TJ, Wallance, ME. *Indust Hygiene Assoc J*, **1996**, 57(3), 304-310.
[12] Randolph BW, Lalloo UG, Gouw E, Colvin MS. *South Afri Med J*, **1997**, 87(3), 318-323.
[13] Reyes S, Rocha de la, Brown MA, Fortenberry JD. *CHEST*, **1987**, 92(1), 100-104.
[14] Glindmeryer HW, Lefante JJ, Lefante G, Rando RJ, Freyder, L, Hnizdo E, Jones R. (**2004**). *Am J Indust Med*, **2004**, 6(2), 104-111.
[15] Heitbrink WA, Verb RH, Fiscthbach TJ, Wallance ME. *Indust Hygiene Assoc J*, **1996**, 57(3), 304-310.
[16] Cotes EJ. Lung Function. Blackwell Scientific Publications. Oxford, **1993**, 445-513.
[17] Ley B, Harold RC, King T. *Am J Resp Crit Care Med*, **2011**, 183(4), 431 – 440.
[18] Peters EJ, Esin RA, Immananangha KK, Sisiya S, Osim EE. *Central Afri J Med*, **1999**, 45(5), 119-124.
[19] Osim EE, Esin RA. *Central Africa Journal of Medicine*. **1996**, 42(2), 43-46.
[20] Bascom R. Isocyanates asthma: The proceedings of the *Am Thoracic Soc*, **2008**, 5, 751-754.
[21] Jonson B, Bitzen U. Clinical utility of lung mechanics measurements. *J Organ Dysfunction*, **2008**, 41, 38-42.
[22] Venables K, Dally M, Nunn A, Stephens R, Rarrer R, Hunter J, Stewart M, Hudges E, Taylor A.N. *Bri Med J*, **1989**, 99(7), 939-942.
[23] Yuki MK, Yasumari M, Yoshio O, Shiyi M, Yasuyuki Y. *Respiration*, **2003**, 70(3), 284-291.