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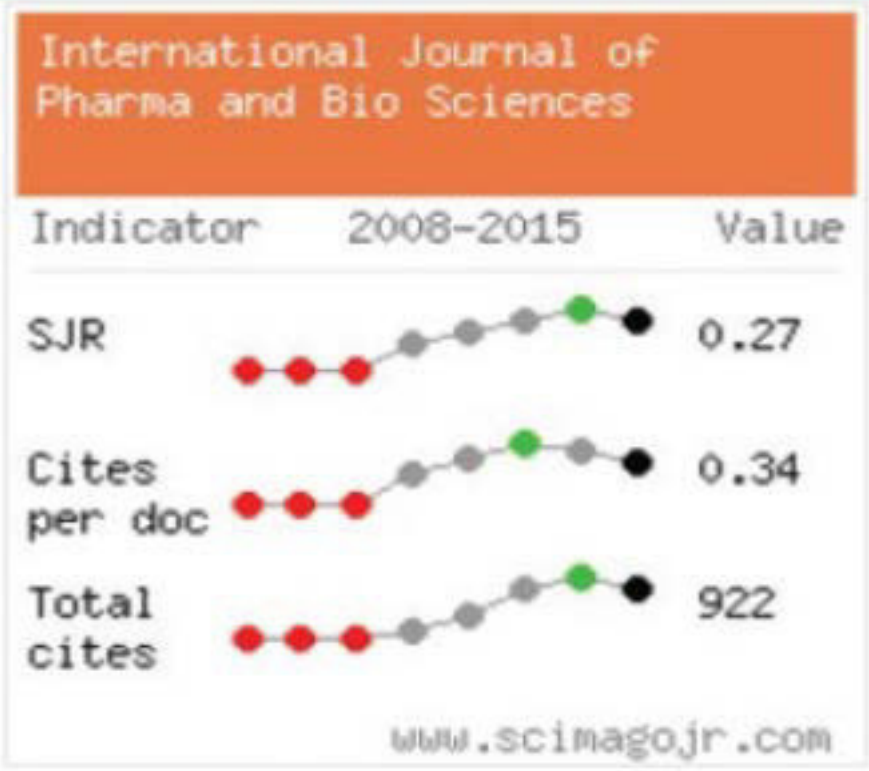

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A CROSS-SECTIONAL STUDY ON THE RESPIRATORY STATUS OF THE STEEL FOUNDRY WORKERS OF WEST BENGAL

SAMIR KUMAR PAINE §†, MOUMITA SETT*, NITIS CHANDRA SAHA†, SUBHASHIS SAHU*

**Ergonomics and Occupational Physiology Laboratory, Department of Physiology, University of Kalyani, Kalyani, Nadia, West Bengal.*
§Regional Labour Institute, Directorate General Factory Advice Service, Govt. of India, Lake Town, Kolkata-89, West Bengal
†Department of Chemistry, University of Kalyani, Kalyani, Nadia, West Bengal

ABSTRACT

Steel foundry workers are at risk in terms of respiratory disorders including asthma, Chronic Obstructive Pulmonary Disease (COPD) and even lung cancers. However, a cross-sectional study was done on 899 male foundry workers engaged in manufacturing different parts of locomotives in the district of Burdwan, West Bengal, India. There is dearth of data regarding the pulmonary status and the prevalence of respiratory disorders among these groups of workers in West Bengal.Physical parameters and spirometry were performed on these workers and they were classified as per smokers (Group I) and non smokers (Group II). Also status of the working environment was collected and produced by the certified agency of the authority (steel foundry factory) concerned. From the data analyses it was seen that both the group of workers were prone to suffer from respiratory problems with aggravating conditions of the group II workers, though the working time were 8 hours in both the groups. It was evident from the results obtained from Forced Vital capacity (FVC) (I-2.14±0.44, II-2.52±0.23; $p<0.0001$), Forced Expiratory Volume in 1^{st}sec (FEV_1)(I- 1.92±0.38, II- 2.32±0.17; $p<0.0001$) and FEV_1/FVC (I- 88.86±0.19, II- 88.94±4.27; NS). They may have the prevalence of occupational asthma or COPD; though the working environmental results produced by the factory authority were shown to be under permissible exposure limits. Other signs and symptoms include wheezing, coughing, shortness of breath etc. However, long-term follow-up study is needed along with clinical trials with bronchodilators. A new recommendation for the permissible exposure limits in this case must be set up. Additional reports of imaging will be an added value. The workers did not use any protective gears so must be encouraged to wear Personal Protective Devices (PPDs). All these lacunae will be hopefully filled up in the future studies.

KEYWORDS: ***steel foundry, smokers, spirometry, asthma, COPD.***

SUBHASHIS SAHU*

***Ergonomics and Occupational Physiology Laboratory, Department of Physiology, University of Kalyani, Kalyani, Nadia, West Bengal.**

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INTRODUCTION

In Iron and Steel and other manufacturing industries, foundries and forges produce a lot of pollutants in the environment – both working and ambient environment. In these processes, metals are extracted and produced from ores by various metallurgical processes. Some fugitive gaseous and dust emissions may cause primary occupational health problems to the workers engaged in the foundries.[1] The risk of lung cancer among foundry workers is 1.5 to 2.5 times higher than the general population.[2] The high risk of lung cancer among foundry workers is an important health concern worldwide, and the International Agency for Research on Cancer (IARC) considers foundry work as a significant cause of exposure to lung carcinogens.[3] Several studies in various countries have also reported that foundry workers have an increased risk of non-Hodgkin's lymphoma as well as nasopharyngeal, gastrointestinal, prostate, and kidney cancers.[4-7] A few studies have also highlighted the risks of non-malignant diseases such as respiratory, autoimmune, and cardiovascular diseases[8] as well as fatal injuries among foundry workers.[9,10]In India, various studies were carried out on the health hazards of the foundry workers, though it is contradictory in nature but all studies conclude that the physiological changes in workers' health is due to pollution in metal casting industries. A study in Agra, shows that the haemoglobin concentration was found gradually decreasing with the increase in age.[11] A study in the iron and steel workers in Central India showed the prevalence of morbidities among the workers was 60% and the most common morbidity was musculoskeletal disorders. Other occupation-related morbidities were bronchial asthma, tuberculosis, chronic bronchitis, folliculitis, injuries, heat stress, and chronic conjunctivitis.[12] Moreover, studies on foundriesaround Kolkata-Howrah urban metropolitancomplex have reported to produce huge amount ofparticulates and gaseous matter in the atmosphere.[13] However, the results of these studies have been inconsistent and there is dearth of data regarding the pulmonary functions and the respiratory status of the steel foundry workers working in the state of West Bengal, India.

MATERIALS AND METHODS

Study area

The plant is situated in the district of Burdwan about 305 Km away from Kolkata, capital of West Bengal, a state in Eastern India. The foundry work is associated with the production of different parts of locomotives, the sole such foundry in the state, manufacturing locomotives.

Sample size

The whole work plan of the study was summarized to the authority (steel foundry factory) concerned as well as to the workers and written consent was taken from the workers. Ethical approval was obtained from the Departmental Research Committee, University of Kalyani. About 899 male workers working in different departments of the steel foundry volunteered for this particular study. They were divided on the basis of being smokers (N=55) or non-smokers (844). The non-smokers mostly were addicted to chewing of tobacco/ beetle leaf. No office staffs were included in this study so no reference values were obtained for the study.All the permanent workers working in the factory for minimum of eight years were included in the study and workers employed on contractual/temporary basis as well as female workers were excluded from the study. They cannot be divided as per theyear of exposure as most of them were not well literate and gave an incomplete idea about their working period in the concerned place.They were not even categorized as per their departments as the factory place has no perfect boundary wall for each departments but rather they all work under one shed.

Physical characteristics

The height and the weight of the subjects were measured by means of an anthropometric rod and a properly calibrated weighing machine respectively without foot wears. Heights were measured in centimetre (cm) whereas weights were measured in kilogram (kg)[14].From the anthropometric data the Body Mass Index (BMI)[15] and Body surface area (BSA)[16] were calculated.

Working Environment

Working environment was measured by a static low volume sampler by the monitoring unit of the factory during the study period in 2013-14 and the data were collected from them and analysed.

Lung Function Tests

After a detailed explanation of the lung function test including the measuring procedure, a minimum of three lung function measurements were recorded.[17]Spirometric studies were conducted according to the recommendations of the American Thoracic Society (ATS)/ European Respiratory Society (ERS) Task Force on lung function testing[18]and compared to the reference formulas of the European Community for Coal and Steel (ECCS).[19] Following the manufacturer's guidelines, the systems were flow-volume-calibrated daily. After three satisfying recordings of static lung volumes, minimal three forced flow volume manoeuvres were performed, starting from residual volume (RV) with a deep and forced inspiration, followed by a forced and maximal expiration. Only those measurements were accepted where the expiratory time (T_E) exceeded four seconds, the variation of end-expiratory flow was below 25 mL/s and no cough disturbed the expiratory phase. All measured lung volumes obtained were expressed in terms of body temperature pressure saturated with water vapour (BTPS).[20]The respiratory data were collected by competent personnel of the health care unit. The workers were evaluated in terms of respiratory diseases according to consensus reports of Global Initiative for Chronic obstructive Lung Disease (GOLD) for Chronic Obstructive Pulmonary Disease (COPD).[21]

DATA ANALYSIS

Descriptive analysis of data was expressed as mean ± standard deviation (SD), range and percentage, and a P-value of <0.05 was used as the level of statistical significance. Between-group comparisons of parametric variables were made by a Student's t–test. Linear

regression analysis was performed for various lung function parameters.[22]

RESULTS

The steel foundry authority handed over the results of the status of the working environment and they identified and monitored only suspended particulate matter (SPM), Respiratory Particulate matter (RSPM), SO_2, NO_2, CO and CO_2 continuously exposed for 8 hours/ day. The range of SPM, RSPM, SO_2, NO_2, CO and CO_2 are 1.52-1.7 mg/m^3, 0.76-0.85 mg/m^3, 0.038-0.043 mg/m^3, 3.3-4.3 ppm, 357-429 ppm. The demographic features of the workers showed that Group I and Group II workers were of the same age groups (45.71±0.27 years and 47.53±0.37 years respectively), BMI (24.08±3.27 kg/m^2 and 24.61±3.42 kg/m^2 respectively) and BSA (1.83±0.4 m^2 and 1.821±0.1m^2 respectively) in average. Most of the workers were in the age range of 45-55 years. The respiratory parameters of the two groups of workers are tabulated in Table 1 and 2 respectively. From both the tables 1 and 2, it is clear that there is a significant difference between the two groups of workers due to the fact that the group I foundry workers have the combined effect of being exposed to the foundry smoke and noxious particles as well as their addiction to smoking. The smokers smoke generally during their tiffin/ lunch hours and not during their work. The non-smokers thus are seldom exposed to their smoke. From the figure 1 it is clear that the condition of the lungs of the Group I foundry workers is more severe than that of the group II workers. The reason is that apart from being exposed to the fumes and other noxious particles in the factory the group I workers are also smokers. Only severe air-flow obstruction is seen in group II workers. The GOLD classification of COPD among the foundry workers reveal that about 82 % non-smokers (those that were suffering from mild, moderate and severe air obstruction in all) have the prevalence of suffering from mild type of COPD (Type I) whereas the prevalence of Type II, III and IV COPD is more in the case of Group I foundry workers.

Table 1
Respiratory parameters of the workers

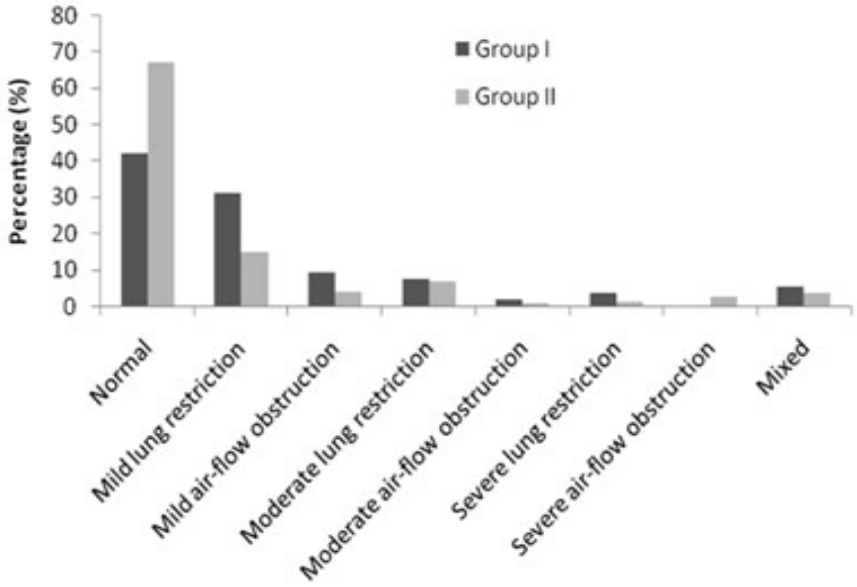
Parameters		Group I (N=55)	Group II (N=844)	Significance
FVC (l)	A	2.14±0.44	2.52±0.23	S (p<0.0001)
	%P	85.91±9.96	96.33±10.84	
FEV_1 (l)	A	1.92±0.38	2.32±0.17	S (p<0.0001)
	%P	93.09±58.05	97.56±4.65	
FEV_3 (l)	A	2.14±0.44	2.40±0.15	S (p<0.0001)
	%P	88.47±10.27	99.46±10.93	
PEFR (l/s)	A	4.57±1.6	5.24±1.42	S (p=0.0008)
	%P	67.05±21.88	76.99±24.03	
$FEF_{25\%-75\%}$ (l/s)	A	2.44±0.01	3.86±0.78	S (p<0.0001)
	%P	83.58±0.29	99.0±3.54	
$FEF_{25\%}$ (l/s)	A	3.98±0.09	5.10±1.52	S (p<0.0001)
	%P	63.4±1.84	74.5±23.69	
$FEF_{50\%}$ (l/s)	A	2.71±0.002	3.32±0.21	S (p<0.0001)
	%P	62.24±0.17	84.32±15.08	
$FEF_{0.2-1.2}$ (l/s)	A	3.17±0.67	4.08±0.86	S (p<0.0001)
	%P	62.25±11.84	80.29±17.88	
FEV_1/FVC	A	88.86±0.19	88.94±4.27	NS
	%P	101.12±8.05	108.41±3.17	
FEV_3/FVC	A%	99.81±0.13	99.82±0.13	NS
MVV (l/min)	A	50.92±19.15	64.69±8.69	S (p<0.0001)
	%P	50.64±17.22	63.08±7.01	

Values: mean±SD; A- Actual; %P- Percent predicted; FVC= Forced Vital Capacity, FEV1 & FEV3= Forced Expiratory Volume in 1 and 3 seconds, PEFR=Peak Expiratory Flow Rate, FEF=Forced Expiratory Flow at various intervals, MVV=Maximum Voluntary Ventilation.

Table 2
Other respiratory parameters of the workers

Parameters	Group I (N=55)	Group II (N=844)	Significance
SVC (l)	2.58±0.02	2.66±0.32	NS
ERV (l)	0.95±0.63	1.19±0.67	S (p=0.01)
IRV (l)	0.69±0.001	0.71±0.37	NS
IC (l)	1.69±0.007	2.66±0.49	S (p<0.0001)
FIVC (l)	2.04±0.26	2.46±0.69	S (p<0.0001)
Mvt (l)	1.77±0.59	1.96±1.03	NS
Vt (l)	1.0±0.001	1.46±0.21	S (p<0.0001)
PIFR (l/s)	3.02±1.03	3.28±1.24	NS
Vt/Ti	1.06±0.003	1.25±0.37	S (p=0.0002)
Ti/Ttot	0.4±0.001	0.65±0.13	S (p<0.0001)

Values: mean±SD; SVC= Slow Vital capacity, ERV= Expiratory Reserve Volume, IRV= Inspiratory Reserve Volume , IC= Inspiratory Capacity , FIVC= Forced Inspiratory Vital Capacity , Mvt= MVV maneuver tidal volume, Vt= Tidal Volume, PIFR= Peak Inspiratory Flow Rate, Vt/Ti= Mean Inspiratory Flow, Ti/Ttot= Inspiratory time by total cycle of duration.



N.B.: The Y-axis represents the different types of lung obstructions as analyzed from the spirometry data.

Figure 1
Lung status of the workers.

DISCUSSION

The steel foundry industry has always remained in the limelight due to poor occupational environment imposed on its workers. Though the reports of the working environment of this steel foundry show that the levels of SPM, RSPM, CO_2, SO_2, NO_2 and CO are all under the Permissible Exposure Limits (PEL) as per the West Bengal Factories Rules 1958, Rule 13 (B).[23]Thus these contaminants may not be responsible for the prevalence of respiratory abnormalities found among those workers. Respiratory abnormalities such as asthma and pneumoconiosis were reported among iron and steel workers by Johnson *et al.*[24] The BMI and the BSA of the workers showed that they do not suffer from any malnutrition/ under nutritionl.[15] In Latin America, the prevalence of COPD increased steeply with age with the highest prevalence among those over age 60 as their exposure increased simultaneously.[25]Spirometry measurements are evaluated by comparison with reference values based on age, height, sex and race.[26] However, there are no data to indicate that screening spirometry is effective in directing management decisions or in improving COPD outcomes in patients who are identified before the development of significant symptoms.[27]But spirometry is required to make the diagnosis in further clinical context.[28]A systemic review and meta-analysis studies carried out in 28 countries between 1990 and 2004.[29]Van Pelt and co-workers, studying FEV_1 in a cross-sectional and longitudinal study in young adults[30] found a plateau phase or a period of continued of lung growth when data were correlated to age. There is consent that FEV_1 in smokers declines earlier in smoking young adults, compared to non smoking controls[30,31]In the relevant age range of 18 to about 33 years, longitudinal studies have shown either an ongoing lung growth or a decline in lung function parameters has already started.[32] The overlap of asthma and COPD is known as asthma COPD Overlap syndrome (ACOS). Global Initiative for Asthma (GINA) and GOLD thus provides an approach to distinguishing between asthma, COPD and ACOS. Asthma may be a risk factor for the development of COPD, although the evidence is not conclusive. Adults with asthma were found to have a twelve-fold higher risk of acquiring COPD over time than those without asthma, after adjusting from smoking.[33] Again in a longitudinal study, self-reported asthma was associated with excess loss of FEV_1 in the general population.[34] Here in this study bronchodilators has not been used, so it cannot be specifically confirmed and concluded that the workers are suffering from either asthma or COPD as from the results seen in table 2 and 3. However, it can be said that the foundry workers in West Bengal may have a prevalence of occupational asthma. A previous study reports that there was an outbreak of occupational asthma in a foundry in 2001, probably due to phenol formaldehyde. The workers had been exposed for a maximum of 35 to a minimum of 9 years before their symptoms appeared, suggesting a long latency period.[35]Another study showed the prevalence of occupational asthma to be more frequent among the subjects who worked in the production department (n: 48, 16.78%) than the other persons who worked in the nonproduction department (n: 3, 4.91%) by chi-square test ($P<0.001$).[21] Considering the increasing age and height of the population and the changes in working conditions, a comprehensive multi-centre study on lung function of Caucasians should be initiated by the international respiratory societies[34] specifically a database must be created for different race and population groups, even in West Bengal, India.

CONCLUSION

In the present study it was observed that there may be an increase in the risk of COPD among the steel foundry workers in West Bengal, which is enhanced by the addiction of smoking. However, long-term follow-up study is needed and a new recommendation for the permissible exposure limits must also be set up for these groups of workers. More clinical trials with

bronchodialators and with individual clinical history or family history of the subjects concerned must be taken into consideration. Apart from these chronic cough, sputum production and dyspnoea progressing with exercise must be taken into account. Additional reports of imaging will be an added value. All these lacunae will be hopefully filled up in the future studies. However, cessation of smoking and evaluation of the foundry workers against their exposure levels at intervals would be of much help to them for further assessment and treatment.

REFERENCES

1. Shrivastava AK. Health hazards of foundries and forges. Inthe 57th Indian Foundry Congress at Science, Kolkata 13th–15th February 2009.
2. Sherson D, Svane O, Lynge E. Cancer incidence among foundry workers in Denmark**.** Arch Environ Health. 1991 Apr 1;46(2):75-81.
3. Field RW, Withers BL. Occupational and environmental causes of lung cancer. Clin Chest Med. 2012 Dec 31;33(4):681-703.
4. Xu Z, Brown LM, Pan GW, Liu TF, Gao GS, Stone BJ, Cao RM, Guan DX, Sheng JH, Yan ZS, Dosemeci M. Cancer risks among iron and steel workers in Anshan, China, Part II: Case-control studies of lung and stomach cancer. Am J Ind Med. 1996 Jul 1;30(1):7-15.
5. Porru S, Placidi D, Carta A, Gelatti U, Ribero ML, Tagger A, Boffetta P, Donato F. Primary liver cancer and occupation in men: A case-control study in a high-incidence area in northern Italy. Int J Cancer. 2001 Dec 15;94(6):878-83.
6. Gaertner RR, Theriault GP. Risk of bladder cancer in foundry workers: a meta-analysis. J Occup Environ Med.. 2002 Oct 1;59(10):655-63.
7. Krstev S, Dosemeci M, Lissowska J, Chow WH, Zatonski W, Ward MH. Occupation and risk of stomach cancer in Poland. J Occup Environ Med.2005 May 1;62(5):318-24.
8. Koskela RS, Mutanen P, Sorsa JA, Klockars M. Factors predictive of ischemic heart disease mortality in foundry workers exposed to carbon monoxide. Am J Epidemiol.2000 Oct 1;152(7):628-32.
9. Park RM, Ahn YS, Stayner LT, Kang SK, Jang JK. Mortality of iron and steel workers in Korea. Am J IndMed.2005 Sep 1;48(3):194-204.
10. Barreto SM, Swerdlow AJ, Smith PG, Higgins CD, Andrade A. Mortality from injuries and other causes in a cohort of 21,800 Brazilian steel workers. J Occup Environ Med. 1996 May 1;53(5):343-50.
11. Parveen S, Rawat RS. Assessment of occupational hazard in iron foundry workers at Nunihai industrial estate, Agra. Asian J ExpBiol Sci. 2010;1(1):197-200.
12. Biswas MJ, Koparkar AR, Joshi MP, Hajare ST, Kasturwar NB. A study of morbidity pattern among iron and steel workers from an industry in central India. Indian J Occup Environ Med. 2014 Sep;18(3):122.
13. Dutta S, Datta PK, Ghosal S, Ghosh A, Sanyal SK. Low Cost Pollution Control Devices for Continuous Cupolas. 0 Indian Foundry J. 2004 May;50(5):29-33.
14. Saha A, Sahu S, Paul G. Evaluation of cardiovascular risk factor in police officers. **Int J Pharma Bio Sci.**. 2010;1(4):263-71.
15. Sahu S, Maity SG, Moitra S, Sett M, Haldar P. Cardiovascular Load During Summer Work of Two Age Groups of Van-Rickshaw Pullers in West Bengal, India. Int J OccupSafErgon. 2013 Jan 1;19(4):657-65.
16. Banerjee S, Sen R. Determination of the surface area of the body of Indians. J Appl Physiol. 1955;7:585-8.
17. Marek W, Marek E, Mückenhoff K, Smith HJ, Kotschy-Lang N, Kohlhäufl M. Lungenfunktionim Alter: BrauchenwirneueReferenzwerte?. Pneumologie. 2009 Apr;63(04):235-43.
18. Wanger J, Clausen JL, Coates A, Pedersen OF, Brusasco V, Burgos F, Casaburi R, Crapo R, Enright P, Van Der Grinten CP, Gustafsson P. Standardisation of the measurement of lung volumes. EurRespir J. 2005 Sep 1;26(3):511.
19. Quanjer PH, Tammeling GJ, Cotes JE, Pedersen OF, Peslin R, Yernault JC. Lung volumes and forced ventilatory flows. EurRespir J. 1993 Mar6; Suppl 16: 5-40.
20. Chattopadhyay BP, Alam J. Spirometric function of ventilatory function of non-smokers and different graded of smokers of Calcutta. Indian J Environ Protec. 1996;14:274-9.
21. Kayhan S, Tutar U, Cinarka H, Gumus A, Koksal N. Prevalence of occupational asthma and respiratory symptoms in foundry workers. Pulm Med. 2013 Sep 22;2013.
22. Sachs L, Hedderich J. AngewandteStatistik: Methodensammlungmit R. Springer-Verlag; 2006 Oct 14.
23. http://www.wbfactoryonline.in/pdf/faqs_about_factory_license_registration.pdf (accessed May 12, 2015).
24. Johnson A, Moira CY, MacLean L, Atkins E, Dybuncio A, Cheng F, Enarson D. Respiratory abnormalities among workers in an iron and steel foundry. Br J Ind Med. 1985 Feb 1;42(2):94-100.
25. Menezes AM, Hallal PC, Perez-Padilla R, Jardim JR, Muino A, Lopez MV, Valdivia G, de Oca MM, Talamo C, Pertuze J, Victora CG. Tuberculosis and airflow obstruction: evidence from the PLATINO study in Latin America. EurRespir J. 2007 Dec 1;30(6):1180-5.
26. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi RE, Coates A, Van Der Grinten CP, Gustafsson P, Hankinson J, Jensen

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CONFLICT OF INTEREST

Conflict of interest declared none.

R. Interpretative strategies for lung function tests. EurRespir J. 2005 Nov 1;26(5):948-68.
27. Schirnhofer L, Lamprecht B, Firlei N, Kaiser B, Buist AS, Halbert RJ, Allison MJ, Studnicka M. Using targeted spirometry to reduce non-diagnosed chronic obstructive pulmonary disease. Respiration. 2011;81(6):476-82.
28. Zwar NA, Marks GB, Hermiz O, Middleton S, Comino EJ, Hasan I, Vagholkar S, Wilson SF. Predictors of accuracy of diagnosis of chronic obstructive pulmonary disease in general practice. Med J Aust. 2011 Aug 15;195(4):168-71.
29. Halbert RJ, Natoli JL, Gano A, Badamgarav E, Buist AS, Mannino DM. Global burden of COPD: systematic review and meta-analysis. EurRespir J. 2006 Sep 1;28(3):523-32.
30. Van Pelt W, Borsboom GJ, Rijcken B, Schouten JP, Van Zomeren BC, Quanjer PH. Discrepancies between longitudinal and cross-sectional change in ventilatory function in 12 years of follow-up. Am J RespirCrit Care Med. 1994 May;149(5):1218-26.
31. Robbins DR, Enright PL, Sherrill DL. Lung function development in young adults: is there a plateau phase?.EurRespir J. 1995 May 1;8(5):768-72.
32. Marek W, Marek EM, Mückenhoff K, Smith HJ, Degens P, Kalhoff H, Kotschy-Lang N, Kohlhäufl M. Lung function in young adults-which references should be taken. Al Ameen J Med Sci. 2010;3(4):272-83.
33. Silva GE, Sherrill DL, Guerra S, Barbee RA. Asthma as a risk factor for COPD in a longitudinal study.Chest. 2004 Jul 1;126(1):59-65.
34. Lange P, Parner J, Vestbo J, Schnohr P, Jensen G. A 15-year follow-up study of ventilatory function in adults with asthma.N Engl J Med. 1998 Oct 22;339(17):1194-200.
35. Hannu T, Piipari R, Tuppurainen M, Nordman H, Tuomi T. Occupational asthma caused by stainless steel welding fumes: a clinical study. EurRespir J. 2007 Jan 1;29(1):85-90.

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