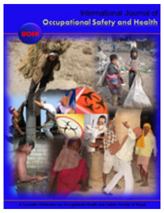


Available Online at http://nepjol.info/index.php/IJOSH

International Network for the Availability of Scientific Publications INASP

International Journal of Occupational Safety and Health, Vol 2. No 2 (2012) 27 - 33

**Original Article**

# Evaluation of Cardiopulmonary Stress of the China Clay Mine Workers

Amal Pari[1], Prakash C. Dhara[2]

[1]Department of Physiology, Suri Vidyasagar College, Birbhum-731101, West Bengal, India

[2]Department of Human Physiology with Community Health, Vidyasagar University, West Bengal

## Abstract:

Several risk factors are associated with cardiopulmonary stress of industrial workers. Most important factors are job strain, job demand, physical effort, work station environment etc. In India, study on occupational cardiopulmonary stress among china clay miners is scanty.

The present study was aimed to evaluate the cardiopulmonary stresses of the china clay mine workers.

The investigation was carried out on male workers from different china clay mines in the Birbhum district, West Bengal. The cardiovascular stress was evaluated by noting pulse rate of the subjects both during rest and during performance of different types of mine tasks. The cardiovascular stress index (CSI) was evaluated in different mine task. The work rest cycle of different china clay mine tasks was analyzed by video-photographic method. Different pulmonary function parameters, viz, FVC, FEV1, FER and PEF were measured by a digital spirometer to assess the severity of Chronic Obstructive Pulmonary Disease (COPD).

The results showed that the working pulse rate and CSI vary with different mine task. It was highest in subjects carrying china clay by head mode. The magnitude of CSI was found to vary with the change of work time and the rest time among the workers. Pulmonary function parameters of china clay mine workers were significantly lower ($P<0.01$) than other industrial workers. About 79% of total population was suffering from different grades of COPD. Among them, 12% were suffering from severe COPD and 60% from moderate COPD. The higher prevalence of COPD among china clay mine workers might be due to exposure of china clay dust in the work place.

It was concluded that the china clay mine workers were suffering from high degree of physiological stress while performing different mine tasks.

**Key Words:** Cardiovascular stress, COPD, China clay mine, Work rest cycle.

## Introduction

Historically, mining has been viewed as an inherently high-risk industry. Previous research findings as well as the changing demography in the mining industry have highlighted the need for a comprehensive study programme to be implemented in the mining industry. The issues of anthropometry, workstation design, functional work capacity, worker fatigue, shift cycles, chronic occupational and other diseases, and nutrition have emerged as some of the important factors affecting the health and safety of miners.

Literature survey revealed that there are several risk factors significantly associated with cardiovascular stress. The most important factors are job strain [1], job demand [2] and high physical effort [3]. Besides, it has also been reported that increases in the daily incidence of cardiovascular mortality and

Corresponding Author: Dr. Prakash C. Dhara

Email: prakshdhara@rediffmail.com

morbidity are associated with increase in daily levels of particulate matter in air [4] and work stress [5].

Epidemiological study carried out by several groups of investigators revealed that continuously exposed to dust, whatever it may be coal dust, wood dust, tea dust, agricultural dust, brick dust, [6-11] causes decline in lung function volumes [12,13], non-allergic obstructive respiratory tract diseases [14].

Kaolin is a natural component, popularly termed as china clay. Internationally it has been mined and traded, where India also produces large quantities of kaolin. In India, kaolin is found in different states like, West Bengal, Rajasthan, Kerala, Tamilnadu, Orissa etc. and in West Bengal, Birbhum, Bankura, and Purulia districts are the good reserve sources.

In India, study on occupational cardio-pulmonary stresses in miners are scanty. No studies have been found upon the workers of china clay mine. Very few studies are sporadic on coal miners [15-17] and other occupations [18].

In the present study, an attempt has been made to evaluate the cardiopulmonary stress of the china clay (Kaolin) mine workers.

## Methods

**Site and subject:** The study was carried out in different China Clay mines of Birbhum district in West Bengal state (India). All mines are manually operated open cast mine having depths of 90-100 feet. The study was conducted on only male workers (25-35yrs, selected at random). All of them volunteered for the study. The study was approved by the institutional human ethical committee.

**Task Performed:** The workers of the china clay mine have to perform four types of mine tasks, viz., soil cutting with crowbar, soil cutting with pickaxe, basket loading, lifting and carrying of loaded basket on head. Hence there are four types of workers group- a) crowbar operators, cutting china clay using crowbar, b) pickaxe operators, breaking large lump of china clay into medium size suitable for loading to basket c) spade operators, perform basket loading using spade and lifting, d) head carriers, carry loaded basket from loading point to disposal point.

**Evaluation of Cardiovascular Stress:** Cardiovascular stress of the china clay mine workers was evaluated by determining Cardiovascular Stress Index (CSI) using the following formula [19].

$$\text{CSI} = \frac{100\ (\text{Heart rate during work} - \text{Heart rate during rest})}{\text{Heart rate maximum} - \text{Heart rate at rest}}$$

Where, Heart rate maximum = 220 – Age (years)

The resting pulse rate (PR) was measured by 30 beats time recording method before joining the work and working PR was measured by 10 beats time recording method using an electronic stopwatch. The working pulse rate was measured in different hours of the work shift. From the measured working PR, work pulse were determined.

**Evaluation of Pulmonary Stress:** Lung function test of the china clay mine workers was performed by a digital spirometer (Micro Medical Ltd., England) which measures 4 parameters on single application. The parameters are Forced Vital Capacity (FVC), Forced Expired Volume-1st (FEV1), Forced Expiratory Ratio (FER) and Peak Expiratory Flow (PEF). Before measurement, the subjects were properly instructed and run through a rehearsal for better effort. Three trials for each subject were given and the highest value was recorded.

To assess the severity of COPD, lung function test value was predicted from the standard prediction equation of normal male subjects [20]. The following equation was used for predicting FEV1.

Predicted FEV1= -0.028xA+0.047xH-3.737, A-Age in years, H-Height in Centimeters.

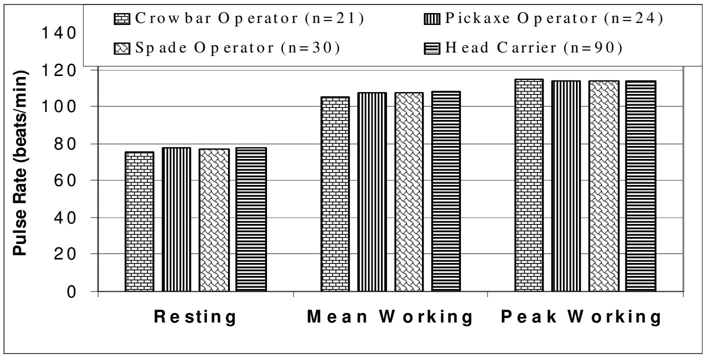
The criteria followed for categorization of the severity of COPD were based upon the GOLD spirometric criteria for COPD severity [21].

**Work rest Cycle:** The total duration of work was divided into work period and rest period. Each of the china clay mine tasks was recorded by video photography and it was transferred to the computer by means of suitable software. The tasks were studied on the computer screen and time for work and rest periods was taken by the clock of the computer. The percentage of work period and rest periods was computed with respect to the total duration of work shift.

## Results

Study of pulse rate renders best way to evaluate the cardiovascular stress of the workers. In the present study pulse rates (PR) of the mine workers engaged in different mine tasks have been presented in fig 1. The result showed that the PR was increased with the onset of work in different mine tasks. The result also revealed that there was no significant difference in working pulse rate among different groups of mine workers. Thus it indicated that physiological stresses in different mine tasks was not different. However, the working pulse rate was found to increase significantly ($P<0.001$) from that of resting condition. So, the physiological stress was raised with the onset and progress of work of the china clay mine workers.

**Figure 1. Pulse Rate (Resting and Working) of different China clay mine task groups. (P<0.001, t-test performed in mean working and peak working wrt resting)**



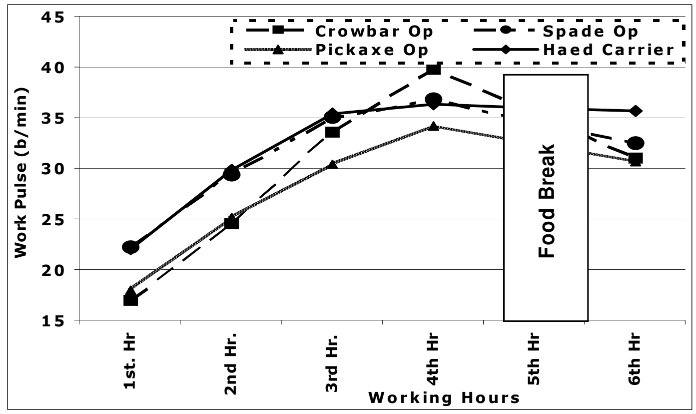

Results of work pulse of the workers engaged in four different mine tasks are presented in table 1 and revealed that it was little lower in crowbar operators and pickaxe operators than that in head carriers and spade operators. The work pulse of different groups of mine workers showed gradual increase of work pulse with the advancement of working hours (figure 2) and continued up to the end of 4th working hour. At 6th hour of work, after a food break of 1 hour, it was decreased.

**Table I Comparison of Work pulse (b/min) and percentage of work time between different groups of worker in China clay mine**

| Workers Group | Work Pulse (Mean± SD) (b/min) | Percentage of work time (%) in a work shift |
|---|---|---|
| Crowbar Operator (N=21) | 29.11 ±8.59 | 71.31 ± 1.89 |
| Pickaxe Operator (N=24) | 27.68 ±9.66 | 71.29 ± 2.77 |
| Spade Operator (N=30) | 31.13 ±10.40 | 79.72 ± 2.95 |
| Head Carrier (N=91) | 31.86 ±8.21 | 77.96 ± 0.86 |

The cardiovascular stress index (CSI) of the workers for different mine tasks has been shown in table 2. It was noted that the china clay mine workers were suffering from cardiovascular stress with respect to other industrial workers (table 3). However, there was no significant difference of CSI among different categories of workers. The duration of activity might be related to the cardiovascular stress [22]. The work rest cycle of different categories of china clay mine workers have been analyzed and compared to the CSI (table 2). It was observed that greater the work period, greater was the value of CSI. For example, the highest percentage of work period was noted in case of head carrying and the greatest value of CSI was also noted in the same group of workers. However, in case of pickaxe operation, both the values of work time (% of total work shift time) and CSI were the lowest. On the other hand, the rest period was inversely related to the CSI (table 2). The lowest rest period was observed in case of head carrying where the CSI was the highest.

**Figure 2. Work pulse of China clay mine workers in different working hours.**




Data of lung function test (LFT) from the workers in an industry may be helpful to provide essential guidelines for following up the health status of worker, particularly who are exposed to dust at work place. The lung function parameters of china clay mine workers were studied and the results have been presented in table 4. The results showed that the average FVC was 2.25 ± 0.44 liters which was lower than the Indian normal value (3.5 to 4.5 liters) [23]. About 75% of air is expelled in 1st sec of measurement of VC, termed as FEV1. Accordingly the normal value of FEV1 would be 2.25 – 2.60 liters. The present study showed that FEV1 in china clay mine workers was 2.00 ± 0.40 liters, which was found to be lower than normal value. FER is the FEV1 percentage of FVC. As both FVC and FEV1 were low, accordingly FER was also low. Thus the present study indicated that the china clay mine workers had low FVC, FEV1 and FER values.

**Table II Mean + SD of CSI and percentages of work and rest periods of total work shift in different china clay mine tasks.**

| Job Category | CSI | Actual Work Period (%) | Rest Period (%) |
|---|---|---|---|
| Spade operation N=24 | 26.31 ±.43 | 79.72 ± 2.95 | 20.28 ± 2.95 |
| Pickaxe operation N=20 | 24.21 ± 8.90 | 71.29 ± 2.77 | 28.71 ± 2.77 |
| Head Carry N=26 | 26.73 ± 7.78 | 77.96 ± 0.86 | 22.04 ± 2.17 |

PEF is the best single measure for the assessment of pulmonary health status of the human subject. The results of PEF of the china clay mine workers have been presented in table 4.

The lung function parameters of the china clay mine workers were compared with the workers engaged in other industrial as well as non-industrial job (table 5 and 6). Milanowski et al [24] studied lung function parameters among woodworkers engaged in sawmill and furniture factory at Lublin, Poland and they observed that the values of FVC, FEV1 and FER were significantly lower than that of office workers, who were taken as control with no exposure of dust. When those lung function parameters were compared with the present study it was noted that the china clay mine workers had significantly lower values than that of woodworkers as well as office workers (P<0.01 or higher). Statistical analysis showed that PEF value of mine workers were significantly lower (P<0.001) than that of stone grinder and jute mill worker (table 6).

**Table III Comparison of CSI (Mean ± SD) between present work and other works**

| China Clay mine workers (Present study) | Steel Workers [33] | Car assembly workers [32] |
|---|---|---|
| 26.20 ± 8.35 | 25.0 ± 14.0 | 20.0 ± 7.0 |

**Table IV Mean, SD and Range of Lung Function Parameters of China clay mine workers (n=185).**

| Parameters | Mean ± SD | Range |
|---|---|---|
| FVC (lit) | 2.58 ±0.44 | 1.4 – 3.76 |
| $FEV_1$ (lit) | 2.00 ±0.40 | 1.37 – 3.22 |
| FER | 77.59 ±7.89 | 66 – 100 |
| PEF (lit/min) | 302.09 ±9.28 | 280 – 328 |

The severity of COPD of the male china clay mine workers was assessed and the results have been presented in Fig 3. Results showed that about 79% of total populations were suffering from different grades of severity of COPD. Among them, 12% were suffering from severe COPD and 60% from moderate COPD.

**Table V Comparison of Lung Function parameters (Mean ± SD) of China clay mine workers with other workers**

| Parameters | China clay mine workers (n=185) | Wood workers [24] (n=17) | Office workers [24] (n=41) |
|---|---|---|---|
| FVC (lit) | 2.58 ± 0.44 | 3.89 ± 0.64* | 4.99 ± 0.57* |
| $FEV_1$ (lit) | 2.00 ± 0.40 | 3.45 ± 0.54* | 4.07 ± 0.51* |
| FER | 77.59 ± 7.89 | 87.5 ± 9.50* | 81.6 ± 10.4** |

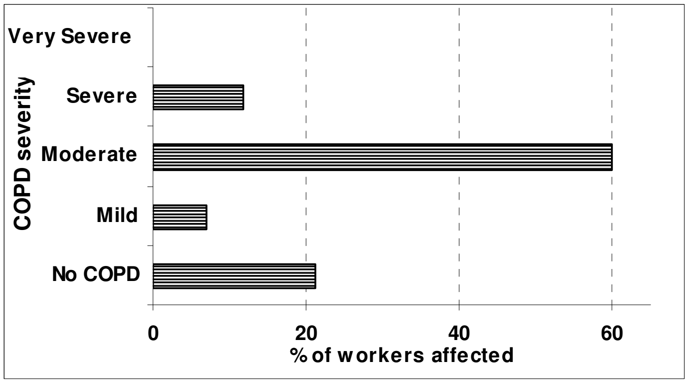
**Table VI Comparison of Mean, SD and Range of PEF value (lit./ min) of China clay mine workers with other workers.**

| Sl. No | Type of Workers | Mean (lit/min) | SD | Range |
|---|---|---|---|---|
| 1 | Stone Grinders [25] (n=28) | 363.1* | 67.67 | 230.0 – 480.0 |
| 2 | Jute mill workers [25] (n=25) | 420.4* | 48.36 | 320.0 – 490.0 |
| 3 | China clay mine workers (n=185) | 302.90 | 9.28 | 280 – 328 |

## Discussion

Numerous epidemiological studies have reported that increases in the daily incidence of cardiovascular mortality and morbidity are associated with increase in daily levels of work stress [5]. Evidences also suggested that high job strain or occupational stress is associated with work related cardiovascular diseases [26]. In the present study, the increased pulse rate during work as a result of cardiovascular responses might be due to physical [27] and also due to work related stress [28]. The higher work pulse in case of head carriers and spade operators might be due to the greater workload in a work shift than that of other groups of workers. It is evident that longer duration of work exceeds cardiac strain limit which may increase the cardiac cost [29]. In the present study it was revealed that workers engaged in head carrying and spade operation performed a longer duration of work compared to other tasks. The worker of these two groups required constant rigorous motion, which acted as sympathetic modulator, might be the cause of higher work pulse values [30]. Variation of work pulse with the advancement of working shift might be due to increase in physical and physiological stress. Both these are related with level of fatigue, aerobic strain and physical workload [31]. At 6th hour of work, after a food break of 1 hour, it was decreased.

**Figure 3. Prevalence of COPD of China clay mine workers.**




Such decrease in work pulse might be due to non-handling of loads during rest. During the break there was recovery from the work causing less cardiac strain as well as reduced cardiac cost.

From the comparative study of CSI of china clay mine workers with that of other industrial workers, it was noted that the stress was much higher in mine workers than that of the car assembly workers [32] and little higher than steelworkers [33]. Such variation of the CSI among different group of industrial workers might be due to difference in the degree of severity of job, environmental conditions and also duration of activity [22]. The china clay mine workers had to work under the direct sun. The environmental heat load might be one of the reasons for increased cardiovascular stress. There are several strong evidences regarding consistence of higher cardiovascular stress among underground hot workplace coal miners of German [34] and India [15].

PEF is another reliable parameter for the assessment of pulmonary health status of the human subject. More dust polluted area indicate increased amount of inhaled particulate load. There is an inverse relationship between lung function parameters and amount of increased concentration of inhaled particulate load [35].

China clay (Kaolin) is a soft white dust particle containing silicate, mica, and aluminium oxide [36]. Studies suggested that mica dust can cause pneumoconiosis [37], characterized by nodular and reticular infiltrates especially in the lower lung fields. Silicosis is another occupational pulmonary disease caused by silica exposure. In an investigation by Sakar et al. [38] showed that FEV1 and FVC were lower in the “silica” group than that of control group. In the present investigation, the lower values of these lung function parameters of the workers might be due to working in a highly dust polluted area. The low PEF among the china clay mine workers might be due to heavy particulate load in mine area. Dust exposure, duration of exposure and presence of morbid conditions were significantly associated with reduction of PEF [39]. Reduced PEF may also be due to narrowing of small airways in the lungs due to deposition of suspended particulate matters [40].

Chronic obstructive pulmonary disease (COPD) is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. Higher prevalence of COPD among china clay mine workers might be due to exposure of china clay dust for a long duration in the work place. A review made by Standring et al [41] on china clay reported that UK china clay workers were identified, who lead to a loss in FEV1 suggesting an increased risk of COPD.

In the present study, amount of dust or suspended particulate matters and their compositions were not measured. So it is difficult to explain the agent(s) which exactly caused lowering of pulmonary function parameters and higher prevalence of COPD. But it seems that china clay mine workers were badly affected in their work place. In some cases, symptoms were with developing shortness of breath (in case of moderate COPD) and in other, the condition becomes worse (severe COPD). Donoghue [42] reported that the risks are being controlled by dust suppression, ventilation and respiratory protection. As the china clay mines in the present investigation was an open cast mine, there was natural ventilation. But neither action was taken for dust suppression, nor do the workers have the habit of using respiratory protective devices. Usage of masks should be mandatory for these mine workers. This might improve the pulmonary volumes and capacities and also reduce the severity of COPD.

## Conclusion

The china clay mine workers were exposed to high extent of cardiopulmonary stresses. This stress might be related to the job pattern and environmental condition of work place. Modification of work rest cycle and ergonomic intervention to work place design and workers habit might be helpful for reducing the physiological stress.

## References


1. Väänänen, A., Koskinen, A., Joensuu, M., Kivimäki, M., Vahtera, J., Kouvonen, A., Jäppinen, P. Lack of Predictability at Work and Risk of Acute Myocardial Infarction: An 18-Year Prospective Study of Industrial Employees. American Journal of Public Health; 2008, 98 (12): 2264-2271.
2. Song, Y.K., Lee, K.K., Kim, H.R., Koo, J.W. Job Demand and Cardiovascular Disease Risk Factor in White-collar Workers. Ind Health. 2010, 48(1): 12-17.
3. Gonzales, J.U., Thompson, B.C., Thistlethwaite, J.R., Scheuermann, B.W. Association between exercise hemodynamics and changes in local vascular function following acute exercise. Appl Physiol Nutr Metab.2011, 36 (1): 137-44.
4. Levy, D., Sheppard, L., Checkoway, H., Kaufman, J., Lumley, T., Koenig, J., Siscovick, D., Levy, D. A case-crossover analysis of Particulate matter air pollution and out of hospital primary cardiac arrest. Epidemiology (Cambridge, Mass) 2001, 2(12): 93-99.
5. Kivimäki, M., Leino-Arjas, P., Luukkonen, R. Riihimäki, H. Vahtera, J. Kirjonen J. Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees. BMJ 2002, 325(7369): 857.
6. Santo Tomas, L.H. Emphysema and chronic obstructive pulmonary disease in coal miners. Curr Opin Pulm Med 2011, 17(2): 123-5.
7. Cohen, R.A., Patel, A., Green, F.H. : Lung disease caused by exposure to coal mine and silica dust. Semin Respir Crit Care Med.; 2008, 29(6): 651-661.
8. Pande, B. N., Krysinska-Traczyk, E., Prazmo, Z., Skorska, C., Sitkowska, J. and Dutkiewicz, J. Occupational biohazards in agricultural dusts from India. Ann. Agric. Environ. Med.2000, 7(2): 133-139.
9. Kirkhorn, S. R., Garry, V. F. Agricultural lung diseases. Environ. Health Perspect.2000, 108(4): 705-712.
10. Schenker, M. Exposures and health effects from inorganic agricultural dusts. Environ. Health Perspect.2000, 108(4): 661-664.
11. Chattopadhya, B. P., Alam, J., Dawn, D. K., Nayak, K., Majumdar, P. K., Chakraborty, M., Gangopadhyay, P. K. and Saiyed, H. N. Study of prevalence of respiratory diseases among tea estate workers. Ind. J. Physiol. and Allied Sci 1995, 49(3): 121-131.
12. Jaakkola, M.S., Sripaiboonkij, P., Jaakkola, J.J. Effects of occupational exposures and smoking on lung function in tile factory workers. Int Arch Occup Environ Health.2011, 84(2): 151-8.
13. Mamuya, S.H., Bråtveit, M., Mashalla, Y.J., Moen, B.E. Airflow limitation among workers in a labour-intensive coal mine in Tanzania. Int Arch Occup Environ Health 2007, 80 (7): 567-575.
14. Schlunssen, V., Schaumburg, I., Taudorf, E., Mikkelsen, A., Sigsgaard, T. Respiratory symptoms and lung function among Danish wood workers. J. Occup. Environ. Med. 2002, 44: 82-98.
15. Saha, R., Dey, N.C., Samanta, A., Biswas, R. A comparison of cardiac strain among drillers of two different age groups in underground manual coal mines in India. J Occup Health.2008, 50(6): 512-520.
16. Dey, N.C., Samanta, A., Saha, R. A study of the workload of underground trammers in the Ranigang coal field area of West Bengal, India. Int J Occup Saf Ergon. 2006, 12(4): 399 -407.
17. Paul, P.S., Dey N.C., Banik A.K., Postural Problems and Workload Analysis of Loader, Shovellers and Trammers in Underground Coal Mine. The Indian Mining & Engineering Journal 2003, 42(11-12): 27-32.
18. Maiti, R. Workload assessment in building construction related activities in India. Applied Ergonomics; 2008, 39 (6):754-765..
19. Trites, D.G., Robinson, D.G., Banister, E. W. Cardiovascular and muscular strain during a tree planting season among British Columbia silviculture workers. Ergonomics 1993, 36: 935-949.
20. Chatterjee, S., Saha, D., Chattopadhyay, B.P. Pulmonary function studies in healthy non-smoking men of Calcutta. Annals of Human Biology; 1988, 15: 365-374.
21. American Thoracic Society. Lung function testing: Selection of reference values and interpretative strategies. Am Rev Respir Dis 1991, 144:1202-1218.
22. Dey, N. C., Samanta, A., Saha, R. Assessment of cardiac strain amongst underground coal carriers—A case study in India. International Journal of Industrial Ergonomics 2007, 37(6): 489-495.
23. Chaudhuri, S.K. Concise Medical Physiology. 2nd Ed., New Central Book Agency (P) Ltd, India, 2001
24. Milanowski, J., Gora, A., Skorska, C., Traczyk, E. K., Mackiewicz, B., Sitkowska, J., Cholewa, B., Dutkiewicz, J. Work-Related Symptoms Among Furniture Factory Workers In Lublin Region (Eastern Poland). Ann Agric Environ Med; 2002, 9: 99–103.
25. Debray, P., Misra, J. and Ghosh, C. Peak expiratory flow rate and cardio-respiratory fitness of Bengali workers exposed to dust and plant source particulate matters. Ind. J. Community Medicine 2002, XXVII (4): 171-176.
26. Park, J., Kim, Y., Hisanaga, N. Work-related cerebrovascular and cardiovascular diseases (WR-CVDs) in Korea. Ind Health. 2011, 49(1): 3-7.
27. Kivimäki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Väänänen, A., Vahtera, J. Work stress in the etiology of coronary heart disease—a meta-analysis. Scand J Work Environ Health; 2006, 32(6): 431-442.
28. Savonen, K.P., Lakka, T.A., Laukkanen, J.A., Halonen, P.M., Rauramaa, T.H., Salonen, J.T., Rauramaa, R. Heart rate response during exercise test and cardiovascular mortality in middle-aged men. Eur Heart J. 2006, 27(5): 582-588.

29. Biswas, R., Samanta, A. Assessment of physiological strain in inland fishing activity. Indian Journal of Occupational and Environmental Medicine 2006, 10(1): 19-23
30. Soares-Miranda, L., Sandercock, G., Valente, H., Vale, S., Santos, R., Mota, J. Vigorous physical activity and vagal modulation in young adults. Eur J Cardiovasc Prev Rehabil.; 2009, 16(6): 705-711.
31. Kadoya, M., Izumi, H., Kubota, M., Yamashita, T., Kumashiro, M. The influence of physical workload patterns and breaks on heart rate recovery. Sangyo Eiseigaku Zasshi; 2010, 52(1): 12-20.
32. Goldsmith, R., O'Brien, C., Tan, G.L.E., Smith, W. S., Dixon, M. (: The cost of work on a vehicle assembly line. Ergonomics 1978, 21: 315–323.
33. Vitalis, A., Pournaras, N. D., Jeffrey, G. B., Tsagarakis, G., Monastiriotis, G., Kavvadias, S. Heart rate strain indices in Greek steelworkers. Ergonomics 1994, 37: 845-850.
34. Kalkowsky, B., Kampmann, B. Physiological strain of miners at hot working places in German coal mines. Ind Health 2006, 44(3): 465-73.
35. Gupta, P., Makhijani, S.D., Meenakshi, C. Pulmonary function tests on rubber factory workers exposed to polynucelar aromatic hydrocarbons. Ind. J. of Physiol. 1998, 52(2): 71-75.
36. Edenfield, R.W. (A clinical and roentgenological study of kaolin workers. Arch Environ Health 1960, 1: 392–403.
37. Kobayashi, H., Ohara, I., Kanoh, S., Motoyoshi, K., Aida, S., Kohyama, N. Clinicopathological features of pure mica pneumoconiosis associated with Sjögren syndrome. Am J Ind Med. 2004, 45(3): 246-250.
38. Sakar, A., Kaya, E., Celik, P., Gencer, N., Temel, O., Yaman, N., Sepit, L., Yildirim, C.A., Dagyildizi, L., Coskun, E., Dinç, G., Yorgancioglu, A., Cimrin, A.H. Evaluation of silicosis in ceramic workers.. Tuberk Toraks; 2005, 53: 148-155.
39. Nishimuta, T., Ma L, Shima M, Yoda Y, Yamamoto H, Nakai S, Tamura K, Nitta H, Watanabe H. Effects of airborne particulate matter on respiratory morbidity in asthmatic children. J Epidemiol. 2008, 18(3): 97-110.
40. Prieto, L., Gutiérrez, V., Morales, C., Perpiñan, J., Inchaurraga, I. (Variability of peak expiratory flow rate in allergic rhinitis and mild asthma: relationship to maximal airway narrowing. Ann Allergy Asthma Immunol. 1998, 80 (2): 151-158.
41. Standring, P., Ogden, T.L., Phillips, A.M., Darvill, M.: Kaolin: Criteria document for an occupational exposure limit. EH65/13. Health and Safety Executive. HSE Books. ISBN 0-7176-0762-3, 1994
42. Donoghue, A. M. Occupational Health Hazards in mining: an overview. Occupational Medicine 2004, 54(5): 283-289.