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Assessment Of Lung Function Among the Workers in Plywood Industries

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ABSTRACT

This study aimed to assess the lung function and respiratory health of workers in the plywood industry, with a focus on the impact of workplace exposure to dust and fumes, smoking habits, and employment duration. A cross-sectional study was conducted on 51 exposed plywood workers and 23 age-matched controls. Lung function tests, including Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV1), and Maximum Voluntary Ventilation (MVV), were performed. In addition, respiratory symptoms were recorded using a standardized questionnaire. Statistical analysis included t-tests and regression analysis to assess the relationship between lung function parameters and factors such as age, smoking, and work duration.The results revealed a significantly higher prevalence of respiratory symptoms, including cough, phlegm, and nasal issues, among plywood workers compared to the controls ($p < 0.05$). Exposed workers exhibited significantly lower lung function values (FVC, FEV1, and MVV) than controls, with a strong negative correlation between lung function and both age and smoking duration. A regression model indicated that FVC could be predicted with a high degree of accuracy based on age and smoking duration ($R^2 = 0.73$).The study highlights the detrimental impact of exposure to wood dust and fumes in the plywood industry on workers' respiratory health. Smoking exacerbates the effects, leading to significantly reduced lung function. The lack of protective equipment and preventive measures at the workplace increases the risk of respiratory disorders. The study recommends the adoption of protective gear, worker education, and stricter enforcement of occupational health regulations to minimize these health risks.

KEYWORDS: plywood industries, respiratory disorders, lung function,vital capacity, occupational health legislation

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INTRODUCTION

Since the dawn of civilization industries have been established to meet the needs of human being. Over the course of time, almost all the industries were found to exert untoward effects on the health of man. Today air pollution is a very important occupational problem in various industries. Increasing amount of potentially harmful gases and particles are being emitted in the workplaces environment, resulting in damage to human health. Inhalation is probably the most important route of exposure in the workplace and is an unescapable route of exposure to toxin in the general environment as well. Wood is processed in many industries including saw mills with processing of fresh wood, plywood mills producing plywood from fresh wood, other types of mills producing wood composites, and furniture factories or smaller workshops using dry woods only. Workers can be exposed to wood dust at all stages of plywood manufacturing processes. For many years, wood dust was considered to be a nuisance dust that irritated the nose, eyes, or throat, but did not cause permanent health problems. Numerous recent studies, however have shown that exposures to wood dust can cause health problems (Workplace Health and Safety Bulletin, CH045-Chemical Hazards, Revised October 2004)

Wood is classified as either soft wood or hard wood. Softwoods come from coniferous trees such as spruce, pine and fir. More than 90 percent of the woods used in Plywood industries are soft woods. Hardwoods come from deciduous trees such as oak, alder and maple. Poplar and Arsen two important hardwoods are used in the manufacture of plywood and Pulp/Paper respectively. Toxic woods contain chemicals that may be absorbed into the body through the skin, lungs, or digestive system and cause effects in other parts of the body. Health effects can include headaches, giddiness, weight Loss, breathlessness, cramps and irregular heart beat. The health effects of exposure to wood dust are due to chemicals in the wood or chemical substances in the wood created by bacteria, fungi, or moulds. (Teschke et al., 1999, Marion et al 1999, Vaughan, et al., 1999, Morgan et al., 1999, Camp et al., 1999). Many hardwoods and softwoods contain chemicals that can irritate the eyes, nose and throat, causing shortness of breath, dryness and soreness of the throat, sneezing, tearing and conjunctivitis. Wood dust usually collects in the nose, causing sneezing and a runny nose (rhinitis). Other observed effects include nosebleeds, an impaired sense, and complete nasal blockage. Chemicals in many types of wood can cause dermatitis, a condition in which the skin can become red, itchy, or dry, and blisters may develop. Wood dust in direct contact with the skin can also cause dermatitis. With repeated exposures, a worker can become sensitized to the dust and develop allergic dermatitis. Once a worker becomes sensitized, exposure to small amounts of dust can cause a reaction that becomes more severe with repeated exposures. Allergic dermatitis is most often caused by exposure to tropical hardwoods such as obeche, mahogany, and rosewoods. Cases of allergic dermatitis resulting from exposure to Douglas fir and Red Cedar have been reported. Irritant dermatitis has also been reported with exposure to western hemlock, sitka spruce, pine and paper birch (Research et al., 1985)

Respiratory system effects due to wood dust exposure include decreased lung capacity and allergic reactions in the lungs. Two types of allergic reaction can take place in the lungs: hypersensitivity pneumonitis (inflammation of the walls of the air sacs and small airways) and occupational asthma. Decreased lung capacity is caused by mechanical or chemical irritation of lung tissues by the dust. This irritation causes the airways to narrow, reducing the volume of air taken into the lungs and producing breathlessness. It usually takes a long time to see a reduction in lung capacity. Studies showed that sawmill workers exposed to softwood dusts arising from Douglas fir, western hemlock, spruce, balsam, and alpine fir had reduced lung function (Demers et al, 1997). The 1995 study looked at a group of sawmill workers in Alberta who were processing pine and spruce for at least three years. The study found that workers who smoked and were exposed to wood dust were more greatly affected than workers who did not smoke. Wood dust is a known inducer of cancer in the nasal cavity and recent reviews have focused on this (Carton, Goldberg, Luce D et al., 2002). The International Agency for Research on Cancer (IARC) has classified wood dusts as carcinogenic to humans. (International Agency for Research on Cancer: Wood dust and formaldehyde. In: IARC monographs on the evaluation of carcinogenic risks to humans. Vol 62, IARC, Lyon 1995). A study completed in 1965 observed that large number of furniture workers and other workers exposed to wood dust in England developed a rare form of nasal cancer (adenocarcinoma). Since that time, many additional studies have shown that workers employed in logging, sawmills, furniture and cabinet making, and carpentry are at an increased risk of developing nasal cancer (Demers et al, 2000). The highest risks appear to be those workers exposed to hardwood dusts, most commonly beech and oak. Many of the studies looked at workers exposed in the 1940s and 1950s (the cancer can take more than 20 years to develop), and most of the exposure levels were much higher than those seen in today's industry. Most of the studies looked at workers who were exposed to unspecified types or mixtures of wood dusts. (Galea, Tongeren & Tongeren et al., 2009). A number of studies have reported that workers in wood processing industries are exposed to relatively high levels of dust in their working environment (Norrish et al., 1992; Mandryk et al., 1999; Teschke et al., 1999; Cormier et al., 2000; Demers et al., 2000) and that they report higher rates of both lower and upper respiratory tract symptoms than do non- exposed controls (Norrish et al., 1992; Demers et al., 1997). A recent study in New Zealand has reported an increased prevalence of asthma and cough symptoms and of eye and nose irritation for sawmill workers (Douwes et al., 2001). Whereas studies in the sawmill industry are plentiful, only a few studies have been conducted specifically in plywood mills. Previous studies in plywood mills have reported that workers are exposed to terpenes in the veneer drying process and to formaldehyde in the pressing section, causing irritation of eyes, nose and throat (National Institute of Safety and Health, 1981, 1982; Paustenbach et al., 1997) and that, in addition, exposure to formaldehyde is associated with decrements in baseline spirometric values and various respiratory symptoms (Malaka and Kodama, 1990; Makinen et al., 1999), as well as an increased risk of nasopharyngeal cancer (Vaughan et al., 2000). The relationship between respiratory symptoms and exposure to both bacterial endotoxin and abietic acid has not yet been studied in the plywood mill industry. However, previous studies in sawmills have shown that sawmill workers are exposed to both bacterial endotoxin (Mandryk et al., 1999; Cormier et al., 2000; Douwes et al., 2000) and abietic acid (Demers et al., 2000), which could both be related to the occurrence of respiratory symptoms.

Occupational pulmonary contaminants come in many forms. Some can be seen , smelled, or felt as irritant in the nose or throat. But others can only be detected with special equipment. Short term exposure to many toxicants can cause immediate or acute damage. However most contaminants take repeated or constant exposure over months or years to cause disease or permanent harm. The impact of pulmonary hazards is also influenced by workplace contaminants in general, age, smoking history, nutritional stalks and other factors such as genetics and stress. Health consequences of these hazards can simply be additive or worse, they can be synergistic.

Thus it is essentially to know what materials and process are used on the job to be able to evaluate , monitor and control potential pulmonary hazards. Respiratory symptoms and detecting pulmonary function are major cause of occupational exposures. Intensity of exposure , age, duration of employment and various non-occupational facts such as cigarette smoking, pollution, ethnic background, lifestyle and diet, may be assessed from respiratory symptoms, usually it is possible to reconstruct past exposure from work histories and to derive a dose response relationship. Occupational lung hazards data depend on so many intangible and assumptions that accurate inferences can not be drawn. In any workplace settings workers who are exposed to pulmonary hazards produce varieties of symptoms including cough, dyspnea and phlegm.

Many chemicals are known to cause respiratory irritants, sensitizers and occupational asthma. In view of the facts mentioned above a study have been undertaken in two different workplaces like plywood manufacturing industry and construction industries where there are large number of workforces are regularly exposed to dust fumes gases etc during processing. The purpose of this present study was to determine the effect of airborne contaminants on the respiratory system.

A detailed descriptive study was undertaken in plywood industries in West Bengal with a focus between July 2014 and April 2015. Random sampling was employed targeting the workers and management of the plywood enterprises. The objective of the study is Assessment of different lung function tests along with the recording of different symptoms being experienced by the workforces and to determine the different lung parameters in relation to the age and length of smoking.

METHOD AND MATERIAL

A detailed descriptive study shall be undertaken in the plywood factory. Random sampling shall be employed targeting the workers and management of the plywood manufacturing company. The samples shall be drawn from the total employees of the company selected. Following are the method and material:

SELECTION OF SITES

In order to decide on a suitable site for conducting this field study, a general survey was made of the places where large number of workers were exposed to airborne contaminants being generated at the work place while processing the materials. Obviously these places were around different foundry, big construction sites, cement industries, wood processing industries, jute mills, textile mills, etc. The management of each place was then approached. Most of the management did not agree to our proposal on fear of disclosing the personal data to others. Out of five managements only two managements responded to the proposal. These were big construction and plywood industry. The managements were then briefed about the objectives of the study.

SELECTION OF SUBJECTS

A meeting was organized among the workers with the permission of the management of both workplaces where the workers were brief about the objectives of the study and how they could cooperate in collection of data. The workers were then randomly selected where inclusion criteria in the study were workers between the ages of 20 years and 50 years and those who had spent at least one year in continuous engagement at the same workplace. 20 age matched controls with similar socioeconomic background as the subject were used. They were not employed in or resident close to any of the workplace. They consisted of some staff of our college, teachers and non-teaching staff. Therefore, a total of 63 subjects and controls were studied after obtaining informed consent. They were then interviewed with a questionnaire on respiratory symptoms. Respondent answered questions. They were recorded. Similarly the characteristics of the study population were also recorded.

PARAMETERS RECORDED

The different parameters of lung functions have been recorded using model no.: . Before conducting the tests the subjects were given proper instruction in performing the tests.

STATISTICAL ANALYSI

Statistical Analysis of data was done by using excel. Statistical Significance was considered at ≤ 0.5. for all values of 't' tests. Regressional analysis was done based on least square principle and best fitting curve was done.

PROCESS OPERATION SEQUENCE OF PLYWOOD MANUFACTURING

Plywood is a building material consisting of veneers (thin wood layers or plies) bonded with an adhesive. There are two types of plywood: softwood plywood and hardwood plywood. The most commonly used softwoods for manufacturing plywood are firs and pines. Softwood plywood is used for wall siding, sheathing, roof decking, concrete form boards, floors, and containers. Hardwood plywood is made of hardwood veneers bonded with an adhesive. Hardwood plywood may be pressed into panels or plywood components (e.g., curved hardwood plywood, seat backs, chair arms, etc.). Hardwood plywood is used for interior applications such as furniture, cabinets, architectural millwork, paneling, flooring, store fixtures, and doors. However, most hardwood plywood and veneer plants either produce hardwood plywood or hardwood veneer. Hardwood veneer plants cut and dry hardwood veneers. Hardwood plywood plants typically purchase hardwood veneers and press the veneers onto a purchased core material.

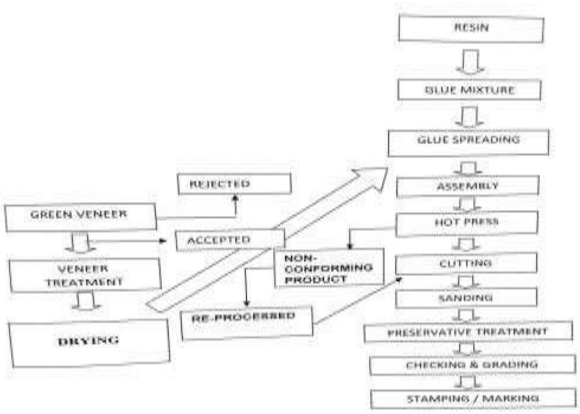

Fig 1: Plywood Manufacturing Flow Diagram

MANUFACTURING OF PLYWOOD

After heating, the logs are processed to generate veneer. For most applications, a veneer lathe is used, but some decorative, high quality veneer is generated with a veneer slicer. The slicer and veneer lathe both work on the same principle; the wood is compressed with a nosebar while the veneer knife cuts the blocks into veneers that are typically 3 mm thick. Decorative hardwood veneers are usually sliced much thinner than 3 mm thick.

There are two types of slicers. These are Horizontal slicers and vertical slicers. Greatest care has to be taken while the knives are ground and fitted on the machine. The grinding is such an important operation that the correct bevels and correct knife angles are to be maintained. Knives are ground slowly, so that heat is not created while grinding After heating, the logs are processed to generate veneer. For most applications, a veneer lathe is used, but some decorative, high quality veneer is generated with a veneer slicer. The slicer and veneer lathe both work on the same principle; the wood is compressed with a nosebar while the veneer knife cuts the blocks into veneers that are typically 3 mm thick. Decorative hardwood veneers are usually sliced much thinner than 3 mm thick.

Veneers are taken from the clipper to a veneer dryer where they are dried to moisture contents that range from around 1 to 15 percent, dry basis. There are two types of dryers used by the industry. These are roller type and band type. Band type dryers are suitable for drying sliced veneers. It does not mean that roller type is not suitable. But these dryers are tedious to dry sliced veneers.

Band dryers will dry the veneers in sequence at the receiving end without much trouble. The veneers so dried are to have a moisture content between 8 percent and 10 percent. The veneers dried are to be preserved in conditioning chambers where the moisture content is maintained within 10 percent. These chambers are called humidity control chambers. Face veneer moisture contents can range up to 25 percent, dry basis. Target moisture content depends on the type of resin used in subsequent gluing steps. The typical drying temperature ranges from 150° to 200°C.

Veneer dryers typically have one to three heated zones followed by a cooling zone or section. Each heated zone has a hot air source, fans to move the warm air, and an exhaust vent or stack. The cooling section circulates ambient air over the veneer to reduce the veneer temperature just before it exits the dryer. The veneers must be cooled to prevent glue from curing on the veneers during the lay-up and glue spreading operations before they reach the plywood press. After drying, veneers sometimes are glued together on the edges to form larger sheets of veneer. This process is called composing. Narrow veneer slices must be composed before they are used in plywood panels or other products requiring wider veneer sheets. When the veneers have been dried to their specified moisture content, they are conveyed to a lay-up operation, where a thermosetting resin is spread on the veneers. The drying of veneer, to between two and ten percent moisture content, is to aid the gluing process during the manufacture of the plywood. The assembly of the plywood prior to pressing entails the jointing of the narrow strips of veneer, which are edge-glued so as to make sheets of the required size. Glue is then applied to the inner plies or core, which in turn, are laid between the outer veneers ready for bonding. This operation accounts for a large share of the manual labour employed in the production process. Assembly of the plywood panels must be symmetrical on either side of a neutral center in order to avoid excessive warpage. For example, a five-ply panel would be laid up in the following manner. A back, with the grain direction parallel to the long axis of the panel, is placed on the assembly table. The next veneer has a grain direction perpendicular to that of the back, and is spread with resin on both sides. Then, the center is placed, with no resin, and with the grain perpendicular to the previous veneer (parallel with the back). The fourth veneer has a grain perpendicular to the previous veneer (parallel with the short axis of the panel) and is spread with resin on both sides.

The two main types of resins are phenol-formaldehyde, which is used for softwood plywood and exterior grades of hardwood plywood, and urea-formaldehyde, which is used to glue interior grades of hardwood plywood. The resins are applied by glue spreaders, curtain coaters, or spray systems. Spreaders have a series of rubber-covered grooved application rolls that apply the resin to the sheet of veneer. Generally, resin is spread on two sides of one ply of veneer, which is then placed between two plies of veneer that are not coated with resin.

RESULTS AND DISCUSSION

The subject in the present investigation were comparable in their demographic characteristics as can be seen in Table 1, which summarize the values of mean ± SD of the physical characteristics of the subjects under study. It can be seen from the table that average values of Body weight, height BSA were 59.0± 4.1 kg, 161.1± 3.85 cm. and 1.61± 0.06 m2 respectively. These values are quite comparable with the data of national level. In the present study 11 out of 72 workers were have the values below 18.5 kg/m2 . This indicates that 15.3% subjects were identified as under nutrition as per recommendation proposed by National Pilot Programme on micro nutrition (1999). But the average values of BMI amounting to 22.8± 1.64 kg2/m2 were normal for Indian population.

Table 1: Physical Characteristics of the Subjects

Particulars	Average	STD
Age	27.5	4.07
Height	161.1	3.86
Weight	59	4.18
BMI	22.8	1.64
BSA	1.6	0.07

Table 2 shows the prevalence of respiratory symptoms among the two groups. (The exposed group had a significant (P<0.05) higher prevalence of respiratory symptoms compared to the controls.) As it is clear from the table that the higher percentage of respiratory symptoms prevalence, cough, phlegm regular running nose regular sneezing with 29.4%, 29.4%, 44.1%,

Table 2: Percentage Prevalence of Work related symptoms among Plywood workers

	Exposed (n=51)	Control (n=23)
Age	29.5 ±11.2	28.5±7.6
Yrs of Experience	5.6 +4.4	-----
Smoking	48%	16%
Cough	29.4%	2%
Phlegm	29.4%	2%
Bronchitis	11.8%	3%
Breathlessness	8.8%	0%
Wheezing	8.8%	0%
Chest Tightness	11.8%	0%
Regular Running Nose	44.1%	1%
Regular Sneezing	48.1%	0%
Eye Irritation	29.4%	0%
Throat Irritation	11.8%	0%
Skin Problem	5.9%	0%

48.1% were in the employees who had a exposure with harmful materials. The greatest respiratory symptoms were shown regular runny nose and sneezing followed by production of cough and phlegm. In addition to these respiratory symptoms, the exposed group had eye irritation, throat irritation and skin problem in terms of percentage these values are29.4%, 11.8% and 5.9% and they are statistically significant with controls at a significant level P<0.05.

Table 3 and Table 4 summarize the mean ± SD Values of FVC, FEV1 FEV1%, PEF and MVV. It can be seen from the table that the average values of all the parameters particularly FVC and

Table 3: Lung Function Status of Exposed Subjects

		FVC		FEV1		FEV1/FVC		MVV	
		Observed	Mean	Observed	Mean Ob	Observed	Mean	Observed	Mean
Upto Years	Mean	2.9	3.8	2.1	3	58.3	84.7	93.2	98.2
	SD	±0.4	±0.6	±0.7	±0.4	±12.4	±2.3	±22.6	±24.4
Above Years	Mean	2.8	3.1	1.6	2.3	47.1	79.01	81.4	87.2
	SD	±0.4	±0.5	±0.5	±0.3	±12	±0.8	±21.7	±26.4

FEV1 were higher than the predicated values corrected with age and highest for the controls. But in case of exposed groups this is not true where predicted values were more than the control. This indicates the observed values were lowered than normal.

Table 5 represents the comparison of different parameters between controls and exposed groups. In the statistical comparisons it was found that the difference between the control groups and the exposed group were significant for all the parameters observed and these differences were significant at higher level where the P values amounted to be < 0.001 levels.

Table 4: Lung Function Status of Control Subjects

		FVC		FEV1		FEV1/FVC		MVV	
		Observed	Mean Ob	served	Mean	Observed	Mean	Observed	Mean
Upto 35 Years	Mean	4.6	3.7	3.1	2.6	67.3	70	108.2	112.4
	SD	±1.4	±0.7	±1	±0.5	±16.1	±1.7	±30.6	±31.2

Above 35 Years	Mean	4.4	3.2	2.5	2.5	65.6	79	110.2	113.2
	SD	±0.9	±0.3	±0.8	±0.2	±17	±1.2	±32.7	±36.2

Table 6 conveys the different parameters of lung functions between smoker and non smoker among the exposed group. As expected all the values are higher in smoker than nonsmoker and the difference between their means were significant as a level of 0.01 and 0.02 which can be seen in Table 7. But in case of MVV, these differences were not significant as P=0.1. This seems to indicate that smoking had a positive effect on lung parameters.

Table 5: Significance Test of Different Lung Parameters between Exposed & Controls

Plywood vs Control		
Parameter	**T Value**	**P Value**
FVC	3.5	0.001
FEV1	6.3	0.001
MVV	6.5	0.001

Table 6: Mean ±SD Values of Different Lung Parameters of Smokers & Nonsmokers

		FVC	**FEV1**	**MVV**
Smokers	Mean	3.1	2.1	82.1
	SD	±0.6	±0.5	±22.5
Non Smokers	Mean	4	2.4	98.4
	SD	±0.7	±0.7	±27.1

Table 7: Significance Test (t test) of Three Different Lung Parameters between Smoker vs Nonsmoker

Smoker vs Non Smoker		
Parameter	**T Value**	**P Value**
FVC	2.7	0.01
FEV1	2.4	0.02
MVV	6.5	0.1

Figures 1, a, b and c have been drawn to show the degree of association between age and different lung function parameters namely FVC, FEV1 and MVV among the exposed groups. It is seen from the Figures that there are definite relationship between age and FVC, FEV1 and MVV. There relationship are negative in all those cases and indicates that with age the lung function parameters starts decreasing. The r values between age and FVC, age and FEV1, and age and MVV are 0.05, 0.34 and 0.31 respectively. An attempt has also been made to work out a multiple regression among three variables where FVC, being an important parameter could be predicted with the known values of age and duration of smoking.

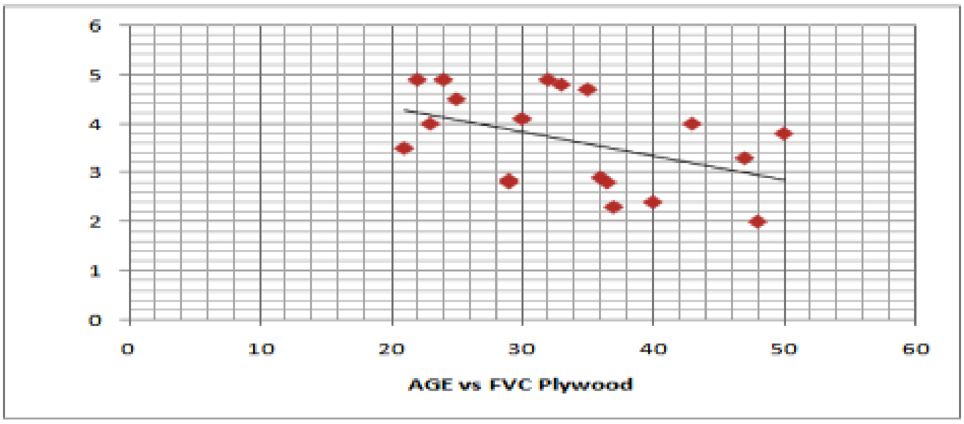

Figure 1 (a): Relation between FVC with Age

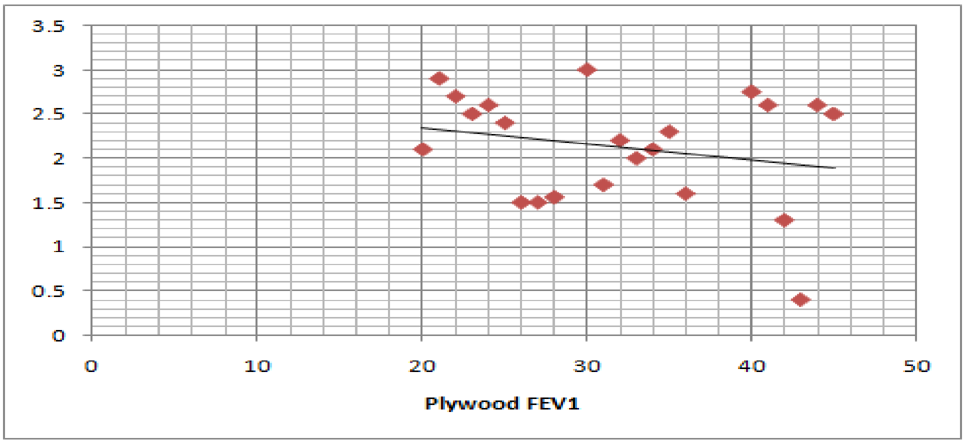

Figure 1 (b): Relation between FEV1 with Age

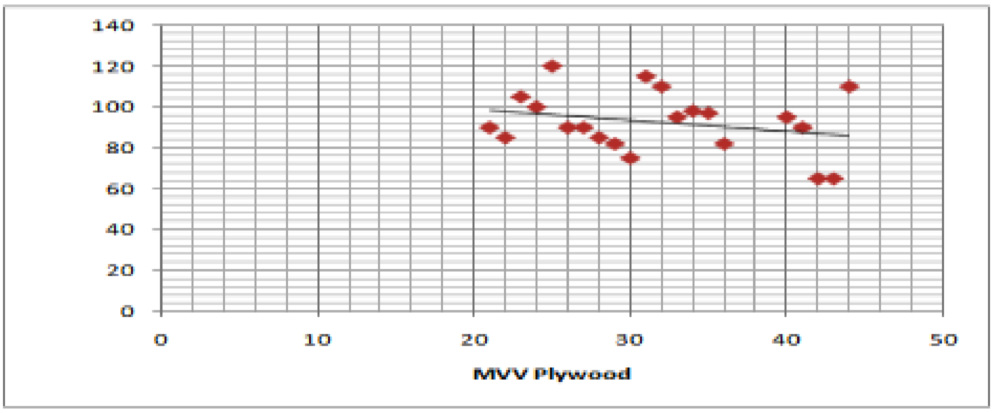

Figure 1 (c): Relation between MVV with Age

The equation as worked out to be:

$Y = 6.24-0.03524\ X_1\ -0.063\ X_2$ where

Y=FVC (Liter) X_1=Age in years
X_2=Length of Smoking [no. of cigarette per day X duration of years]

This relation holds good as the values of $R^2 = 0.73$and standard error = 0.56. This indicates 73% variability is explained.

DISCUSSION

The relationship between occupation and occupational pulmonary contaminants and respiratory symptoms in the community based studies have been initiated since 1960s. In many of these general population studies, an association with experience to dust, gases and fumes has been found with odd ratios ranging from 1.3 to 2.5 for exposed versus non- exposed workers.(Vermeulen et al 2002)

The results of this present study showed that prevalence of respiratory symptoms were such as cough (29.4%0, phlegm (29.4%), Bronchitis (11.8%) , chest tightness (11.8%0, running nose (44.15%), regular sneezing (48.1%) along with eye irritation (29.4%) and skin problem (5.9%). In studies similar of respiratory symptoms among workers at saw mill workers reported recurrent cough, bronchitis along with other risk of developing respiratory disorders compare to control group.. This is in agreement with the studies of Fatusi and Erhabar (1996), Ige and Onadeko (2000), Okojie (2003), and Okwari (2005)

The observation that the plywood workers had low FVE, FEV1, and MVV values than the control groups may be due to the fact that since saw dust is an inert particle, its chronic deposition in the lungs leads to alveolar thickening resulting in chronic hypoxia from ventilation-perfusion imbalance. This ultimately leads to low value of all lungs parameters in exposed groups than the controls. Another causes of reducing the lung volume in terms of FVC, FE V1 and MVV may be due to the expose of formaldehyde used in different process of plywood work (Fransman, 2003).

CONCLUSION AND RECOMMENDATIONS

Age, duration of employment, concentration of dust, fumes and smoking habit can be the cause of respiratory symptoms and are related to the prevalence of different respiratory symptoms. The risk of respiratory disorder was significantly higher than the controls. This also reflected in the significantly reduced values of different lung parameters. The association between different lung parameters with age showed a good degree of negative correlation and multiple correlation among FVE, age and Length of smoking would help to predict FVC in a large scale studies with a quite good degree of accuracy.

This study has shown that plywood industry workers are at risk of developing lung disorders and the risk is more pronounced in a situation where the worker is also a smoker. Although the plywood industry were polluted with dust and fumes, none of the workers wore no face masks or other protective devices In this respect the employees and employers need to be adequately educated about the need to take necessary control measure. It is necessary to enforce legislation in order to protect the health of these workers.

One limitation of this study was the small sample size of exposed as well as control of populations which may limit the ability to detect real effects should they exist.

REFERENCES

1. Bean, A., & Butcher, A. (2006). Occupational health hazards in wood processing industries. International Journal of Industrial Hygiene, 52(3), 149-155.
2. Carton, M., Goldberg, M., Luce, D., & Demers, P. A. (2002). Wood dust exposure and cancer: A review. Occupational Environmental Medicine, 59(2), 100-105.
3. Chingofa, M. (2010). Occupational hazards in the wood industry in Zimbabwe. Journal of Occupational Safety, 34(4), 89-92.
4. Demers, P. A., Cormier, Y., & Douwes, J. (2000). Bacterial endotoxin and wood dust exposure in plywood mills. Occupational and Environmental Medicine, 57(4), 264-269.
5. Demers, P. A., Teschke, K., Davies, H. W., & Kennedy, S. M. (1997). Respiratory health effects of exposure to wood dust. American Journal of Industrial Medicine, 31(4), 400-406.
6. Douwes, J., McLean, D., & Slater, T. (2001). Increased prevalence of asthma and respiratory symptoms among sawmill workers. Occupational and Environmental Medicine, 58(5), 309-313.
7. Fransman, W. (2003). Occupational exposure to wood dust in the plywood industry: Implications for respiratory health. Journal of Occupational Health and Safety, 43(2), 157-163.
8. Galea, K. S., Tongeren, M., & Tongeren, M. (2009). Risk of nasal cancer from wood dust exposure: A long-term cohort study. Occupational Medicine, 59(3), 105-112.
9. Ige, S. T., & Onadeko, A. (2000). Respiratory effects of wood dust exposure among workers in sawmills. Journal of Community Medicine, 27(1), 38-43.
10. International Agency for Research on Cancer (IARC). (1995). Wood dust and formaldehyde. In: IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 62. IARC, Lyon, France.
11. Makinen, M. M., Teschke, K., & Vaughan, T. L. (1999). Exposure to wood dust and its effects on respiratory health. American Journal of Industrial Medicine, 36(2), 213-218.
12. Malaka, M., & Kodama, K. (1990). Formaldehyde exposure in the plywood industry: Health effects and regulations. International Journal of Occupational Safety and Health, 6(3), 213-220.
13. Mandryk, J. E., Cormier, Y., & Teschke, K. (1999). Exposure to wood dust in sawmills: Implications for respiratory health. Environmental Health Perspectives, 107(8), 621-625.
14. Norrish, A. E., Mandryk, J. E., Teschke, K., & Cormier, Y. (1992). Respiratory symptoms and lung function among sawmill workers exposed to wood dust. American Journal of Respiratory and Critical Care Medicine, 146(6), 1572-1578.
15. Okojie, P. M. (2003). The prevalence of respiratory diseases among workers exposed to wood dust. African Journal of Environmental Health, 15(3), 105-110.
16. Okwari, M. (2005). Respiratory health effects of wood dust exposure among workers in timber processing industries. Nigerian Journal of Medical Sciences, 44(2), 98-103.
17. Paustenbach, D. J., Makinen, M. M., & Kodama, K. (1997). Formaldehyde exposure in plywood manufacturing: Health effects and risk assessment. Journal of Occupational and Environmental Medicine, 39(11), 903-908.
18. Teschke, K., Marion, S., Vaughan, T. L., Morgan, D., & Camp, J. (1999). Health effects of wood dust exposure: A review of the literature. Workplace Health and Safety Bulletin, CH045-Chemical Hazards, Revised October 2004.
19. Vaughan, T. L., Kaufman, D., & Luce, D. (2002). Occupational exposure to wood dust and nasal cancer. Journal of Occupational Health, 44(1), 1-7.
20. Vermeulen, R., & Kromhout, H. (2002). Occupational exposure to dust, gases, and fumes: Implications for respiratory health. American Journal of Public Health, 92(5), 748-752.
21. Zeyede, K. Zeleke. (2010). Cement dust exposure and acute lung function: A cross-shift study. BMC Pulmonary Medicine, 10(1), 1-8.