Research Article

Respiratory function among sawmill workers in different areas of Sulaimani city

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Abstract

Background: One of the major health problems of sawmill workers is respiratory, which usually results from breathing in noxious or toxic chemicals such as wood dust.

Objective: To evaluate the respiratory functions of sawmill workers within the area of Sulaimani city.

Materials and Methods: This comparative cross-sectional study was carried out among 42 randomly selected sawmill workers in Sulaimani city from January to April 2015. Lung function test was performed to all participants and were also given modified British Medical Research Council questionnaire on respiratory symptoms. Seventeen healthy nonexposed subjects were included as control.

Results: The study demonstrated that lung function significantly reduced in sawmill workers compared with control subjects, and such impairment was poorly correlated with the duration of exposure. The most prevalent respiratory symptoms among workers were running nose (50%) and oral cavity irritation (4%).

Conclusion: Sawmill workers in Sulaimani city showed reduced pulmonary functions and higher prevalence of pulmonary-related symptoms compared with nonexposed subjects.

KEY WORDS: Sawmill workers, wood dust, lung function, respiratory symptoms

Introduction

Sawmilling is one of the oldest wood processing industries in Iraq, and most of them are small sized. The nature of the work done by workers in sawmills and the types of equipment and materials they handle are associated with many hazards, Many factors have been reported to increase exposure to the dust at sawmills, including use of old machines with inadequate maintenance if the ventilation systems at the work place.[2] The use of aging equipment, poor maintenance of the local exhaust ventilation systems, and leakage of dust from the joints of the central exhaust ventilation system into the working environment are other factors that enhance high dust exposures at sawmills.[3] Although the occupational hazards of sawmilling environments are multiple,[4] the respiratory effects are central in this regard. The respiratory health effects associated with wood dust come not only from the wood dust but also from the biological organisms such as endotoxins,[5] gram-negative bacteria (of the genus *Rahnella*),[6] and allergenic fungi and mold, which grow on the wood and from the chemicals such as formaldehyde, copper naphthenate, and pentachlorophenol used in the processing of some woods.[7] Processing plywood and fiberboard may cause exposure to formaldehyde, and asthmatic symptoms among woodworkers exposed to formaldehyde alone or in

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combination with wood dust have been documented.[8] Sawmill working-wood dust has a direct effect on the respiratory system. Many studies have confirmed that working in sawmilling was associated with an increased prevalence of asthma and cough symptoms and eye and nose irritation.[9] In addition, meta-analysis confirmed wood dust exposure as a risk factor for asthma.[10] Work-related asthma is the most common occupational respiratory disorder in the industrialized countries. It has been postulated that wood dust exposure may increase the risk of work-related asthma.[11] This study was designed to evaluate the effects of wood dust on respiratory system of sawmill workers within different areas in Sulaimani city.

Materials and Methods

Study Area

This study was carried out in Sulaimani city, Kurdistan region, Iraq. There are many officially registered and nonregistered sawmill industries in this district, which contain various departments with different job descriptions in sawmills. There is also an administrative staff who serves as the supervisor/manager of the sawmill industries. The laborers and machine operators are all exposed to wood dust throughout the work period, but the exposure of the manager/supervisor is minimal as they spend more time in the offices.

Study Design and Study Population

This cross-sectional study was carried out among sawmill workers (study group) and healthy nonexposed subjects (control group). Twenty-four sawmill workers who are exposed to wood dust (laborers and machine operators), have been working in sawmill industries continuously for at least 1 year, who is neither a current nor a past smoker, and who does not experience chronic respiratory problem(s) before working in the sawmill industry were recruited. Those excluded were administrative workers (managers/supervisors) in sawmills whose exposure to wood dust is minimal. In addition, 17 healthy subjects who have never worked in a sawmill industry or have a history of exposure to wood dust were recruited as control subjects. Data collection and analysis were from January to April 2015.

Instruments

Pretested semi-structured questionnaires with modified British Medical Research Council questionnaire on respiratory symptoms and peak flow meter were used as instruments in this study. Peak expiratory flow (PEF) of respondents was measured with MIR MiniSpir PC-Based Spirometer. All tests were carried out at SHAR Hospital Respiratory Center in Sulaimani city. The lung function parameters were obtained in the upright sitting position, and the highest of three readings per respondent was taken.

Ethical Consideration

Ethical clearance for the study was obtained from the local research ethics' committee, University of Sulaimani, Faculty of Medical Sciences, Sulaimani, Iraq. Permission was also taken from the sawmill workers association. Written, signed consent was obtained from each subject after explaining the objectives of the study to them.

Statistical Analysis

Data were analyzed using GraphPad Prism 6.0 software (GraphPad Software, Inc, San Diego, CA). The main measures and indicators used for analyzing the results were frequency distributions, sample means, and percentages for the variables. Continuous variables that were normal in distribution such as age, PEF values, and respiratory rates were expressed as means ± SD. The arithmetic means of the study and control groups were compared using the *t*-test. Association between the values of lung function and duration of exposure was estimated with Pearson correlation. Statistical significance was set at $P < 0.05$ for all values.

Results

Table 1 shows that there was no significant difference between the mean ages of sawmill workers and healthy controls. Table also indicates that all lung function parameters of sawmill workers were significantly different ($P < 0.05$) compared with that of healthy control subjects, except for the ratio forced expiratory volume 1/forced vital capacity (FEV1/FVC), which was not significantly different compared with that of control subjects ($P > 0.05$). In Figure 1, a weak negative and nonsignificant correlation is observed between duration of exposure to work environment in sawmill workshops and FVC. Similar results were obtained regarding the correlation of duration of exposure with FEV1 and the ratio FEV1/FVC, respectively (Figures 2 and 3). In Figure 4, weak positive and nonsignificant correlation is reported between duration of exposure to work environments and PEF in sawmill workers. Regarding the reported signs and symptoms associated with exposure to work place environment, Figure 5 indicates that running nose was reported in 50% of sawmill workers, while irritation of eyes and oral cavity were reported in 25% and 4% of workers, respectively.

Table 1: Age range and lung function parameters of sawmill workers and healthy controls in Sulaimani city

Parameters	Control ($n = 17$)	Workers ($n = 24$)
Age (years)	36.2 ± 8.9	42.0 ± 12.5**
FVC (L)	8.9 ± 0.5	7.3 ± 0.91*
FEV1 (L)	8.9 ± 0.6	7.4 ± 0.8*
FEV1/FVC	1.008 ± 0.03	1.033 ± 0.09**
PEF (L/s)	8.7 ± 0.6	7.1 ± 1.0*

FEV, forced expiratory volume; FVC, forced vital capacity; PEF, peak expiratory flow.
Values expressed as mean ± SD.
*Significantly different compared with control subjects ($P < 0.05$).
**Not significantly different compared with control subjects ($P > 0.05$).

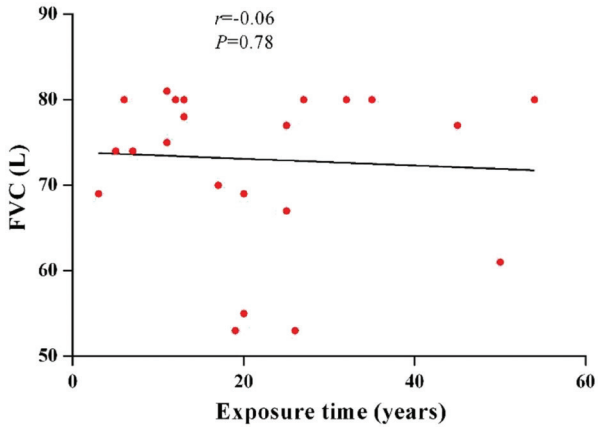

Figure 1: Correlation between duration of exposure (Yr) with the forced vital capacity (FVC) in exposed workers; number of workers = 24; *r* = correlation coefficient; significance set at $P < 0.05$.

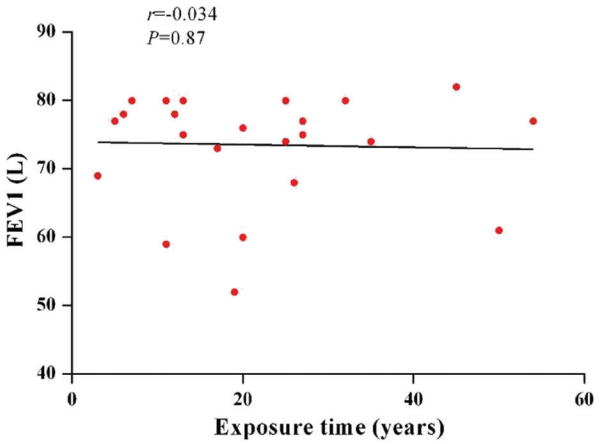

Figure 2: Correlation between duration of exposure (Yr) with the forced expiratory volume 1 (FEV1) in exposed workers; number of workers = 24; *r* = correlation coefficient; significance set at $P < 0.05$.

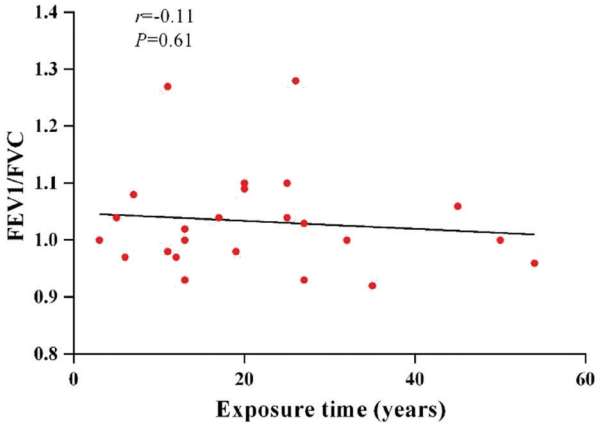

Figure 3: Correlation between duration of exposure (Yr) with the forced expiratory volume 1/forced vital capacity (FEV1/FVC) ratio in exposed workers; number of workers = 24; *r* = correlation coefficient; significance set at $P < 0.05$.

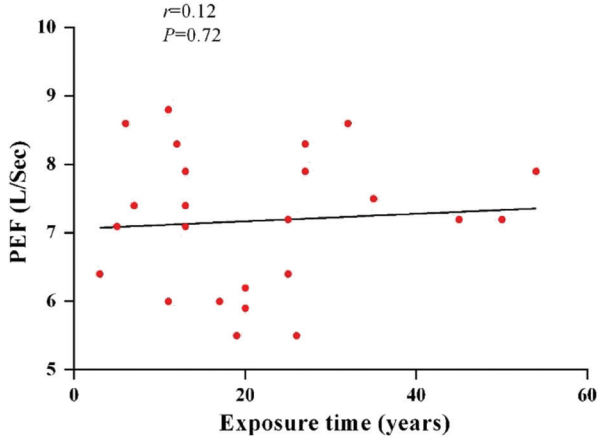

Figure 4: Correlation between duration of exposure (Yr) with the peak expiratory flow (PEF) in exposed workers; number of workers = 24; *r* = correlation coefficient; significance set at $P < 0.05$.

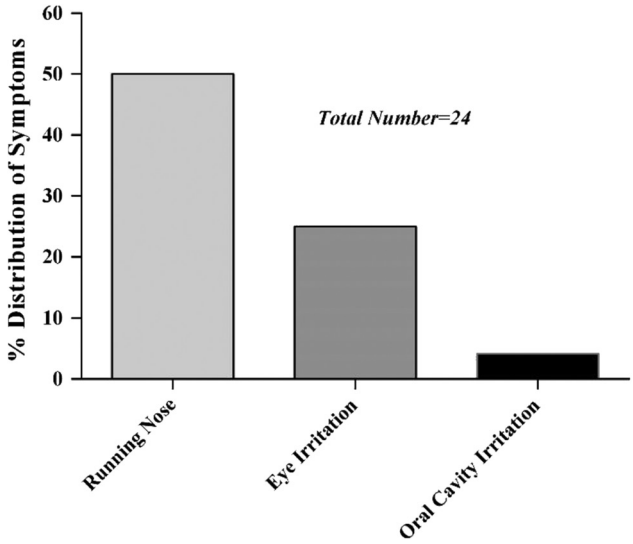

Figure 5: Incidence of certain respiratory signs and symptoms reported in sawmill workers within Sulaimani city; number of workers = 42.

Discussion

Occupational exposure to wood dust and other associated chemical and biological materials is considered as one of the issues that needs continuous revision according to the currently adopted safety guidelines and regulations, which, although not indicated maximum exposure limit, suggested limits have been published for guidance.[12] Many reports have well-documented the effects of wood dust exposure on lung function.[13,14] Exposure duration–effects relationships were reported regarding lung function parameters and cumulative wood dust indices,[15] and the decrease in lung function with the duration of wood dust exposure.[16] In this study, continuous wood dust exposure was associated with a significant decline (»19%) in lung function, of both an obstructive (FEV1

and PEF) and restrictive (FVC) nature. This was in tune with previous data in sawmill workers who dealt with different types of wood in their working places,[2,17] although some studies in pine sawmill workers showed no effects on FVC and FEV1.[18] Reduced FEV1 and FVCs have also been documented in furniture workers exposed to dry pine dust.[19] One limitation of this study was the small sample sizes of sawmill workers and control subjects included in the study, which may limit the ability to report the exact pulmonary effects really existed in the targeted area. In addition to wood dust exposure, sawmill workers are highly exposed to a variety of natural chemicals, fungi, and bacteria in raw barks and woods, and they are also exposed routinely to mixtures of synthetic chemicals used in these wood and wood-related enterprises.[20] Accordingly, the decline in pulmonary function reported in this study cannot be attributed to a single factor, and multifactorial bases only can be of value to interpret the outcomes of studies in this regard. Long-term exposure to wood dust impairs pulmonary function,[21] and duration of this exposure mostly determines the extent of the existed pulmonary problems.[22] About 83% of the workers included in our study had been working in the sawmill workshops for more than 10 years. Although exposure time was poorly correlated with the decline in pulmonary function, previous data reported that the decrease in pulmonary function was correlated with the time spent working in sawmill industry.[22] Mean years of exposure to wood dust in our study is similar to the mean years of exposure to wood dust in a previous study where some workers who worked for such duration were already experiencing pulmonary and other signs and symptoms.[23] Many reports indicated that health effects of exposure to wood dust were associated with allergic respiratory symptoms.[14,24] The results of our study indicated that sawmill workers permanently practiced many respiratory symptoms that are not currently reported in the control group, which was in tune with many previously published studies.[21,25] Running nose and eye irritation were parts of the most prevalent symptoms among participants. Half of the sawmill workers in our study revealed running nose that was not reported by any of the control subjects. The apparent limitation of small sample size of this study was mostly attributed to unawareness of the workers about the importance of such studies; however, the reported data shed a light on an important public health problem in such field, and further wide-range study is highly recommended. Finally, a healthy workforce is critical for increased productivity at work; hence, the productivity of sawmill workers with reduced pulmonary functions will not be optimal. In conclusion, our results showed that sawmill workers in Sulaimani city have reduced pulmonary functions and higher prevalence of pulmonary-related symptoms compared with nonexposed subjects. Thus, the level of wood dust should be regularly monitored in wood-related industry.

Conclusion

Sawmill workers in Sulaimani city have reduced pulmonary functions and higher prevalence of pulmonary-related symptoms compared with nonexposed subjects.

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