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A Study of Pulmonary Function Test in Workers Engaged in Processing of Natural Rubber

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ABSTRACT

Background : The rubber industries use a greater variety of chemicals than any other branch of industry. The processing area is the site at which workers are exposed to many atmospheric contaminants. The impact of health hazards of latex in this group of workers is highly under reported and it is in this regards that an attempt in this study was made to assess the influence of latex and other chemicals on pulmonary function of workers engaged in rubber processing.

Objective- To assess the pulmonary function of workers engaged in processing of natural rubber

Method – This is a descriptive cross-sectional study involving 50 rubber workers who were selected from camps conducted in different parts of Kottayam district, Kerala.

A portable vitalograph was used to assess the pulmonary functions- FEV1(Forced expiratory volume in 1st second), FEV1/FVC and FEF25-75%(Forced expiratory flow rate). Statistical analysis was done using excel and epi-info

Results- A statistically significant reduction was seen in the FEV1/FVC values among 80% of the rubber workers indicating obstructive airway disease. A statistically significant reduction was seen in the FEF 25-75% values among 26% of the rubber workers.

Conclusion- Rubber workers have a risk of developing obstructive and small airway diseases due to continuous exposure to latex and chemicals which are airway irritants. Health awareness and health promotion activities should be initiated among the workers to prevent and reduce the progress of pulmonary diseases.

Keywords- *FEF25-75%,Pulmonary function, rubber workers*

INTRODUCTION

Kerala has a long tradition in the cultivation of plantation crops. Presently 45 percent of the total area under plantation crops in India is in Kerala. 85 percent of the total cultivation and 93 percent of the natural rubber production in India is contributed by Kerala. The processing area in rubber industries is the site at which workers are exposed to many atmospheric contaminants. The ingredients are numerous and include primary and secondary accelerators, activators, antizonants, antioxidants, curing agents, fillers, pepticisers, plasticisers, protectives, reinforcing agents, and softeners. Most of these agents are in powder form but at processing temperatures, have enough vapour pressure to be liberated from the rubber matrix to be given off as fumes and vapours. Consequently, workers are exposed

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to various combinations of airborne contaminants. Many of these ingredients are potential respiratory agents with acute or chronic effects. They may be both broncho irritants, predisposing workers to chronic obstructive airway disease or sensitizers, predisposing to bronchial asthma. [1]

The impact of health hazards of latex and other chemicals in this group of workers is highly under reported from this part of the country and it is in this regards that an attempt in this study was made to assess the influence of latex and other chemical exposure on pulmonary function of workers engaged in rubber processing

MATERIALS AND METHOD

This study was conducted over a period of one year after obtaining clearance from Institutional Ethics committee. This was a descriptive cross sectional study. Based on the result of Mean and Standard deviation of pulmonary function tests in rubber workers done by Reddy et al(Lung function parameters, neck pain and associated factors among male rubber tapping workers in kerala) with 95% confidence and 80% power minimum sample size comes to 37,but we included 50 rubber workers and 50 controls in our study**.** Study subjects were recruited from the camps conducted in the Puthupally and Punjar Panchayats belonging to the district of Kottayam in Kerala. The basic demographic data was collected using a prepared proforma from all subjects. The necessary anthropometric measurements were recorded. The Spirometry was recorded using the portable compact vitalograph. The various indices of the spirometry that were recorded and used for analysis were FEV1(Forced expiratory volume in 1st second), FEV1/FVC and FEF25-75%(Forced expiratory flow rate). Rubber workers who attended the camps were counseled regarding the study protocol and the methodology of the spirometry and after the desired consent was obtained, were selected for the study. Healthy volunteers who were non-rubber workers and were non -smokers and had no prior illnesses were enrolled as subjects for the purpose of controls. Procedure of the test was demonstrated to them individually. It is essential that the subject performing the test is clearly instructed in the procedure prior to the commencement of each test. Care was taken to ensure maximum effort was made by the subject while carrying out the test.[2]

RESULTS

In the present study 50 subjects and controls were enrolled whose pulmonary function test (spirometry) was undertaken. FEV1, FEV1/FVC and FEF25-75% of rubber workers were compared with that of controls. Duration and exposure to chemicals were recorded as part of the analysis. Analysis was done using excel and epi-info.In our study, 14% of the cases had experience as a rubber worker of less than 10 years, 40% between 10 to 20 years and 46% more than 20 years. 86% of the rubber workers were exposed to latex, smoke and chemicals(Formic acid), 4% were exposed to chemicals alone and 10% had been exposed to both chemicals and latex.

Table 1: Mean of the different Lung function tests between case and controls

LUNG FUNCTION TEST	CASE(Mean±SD)	CONTROL (Mean±SD)
FVC	2.84±0.72	2.9±0.57
FEV1	2.24±0.69	2.25±0.5
FEV1/FVC	0.73±0.11	0.85±0.08
FEF25%-75%	2.62±0.72	3.42±0.7

The mean of the forced Vital Capacities of the cases and controls were analysed and no significant difference (p value 0.63) was found. There was no significant difference in FEV1 values between the cases and the controls (p value 0.036). Analysis of the FEV1/FVC ratio of the cases showed a significant decrease compared to the controls (p value <0.005). There was also a significant decrease in FEF 25-75% among the cases (P value <0.005).

The cases were divided into 3 groups depending on the number of years as a rubber worker to analyse if any correlation between FVC and the duration of exposure existed.

Table 2 Group wise distribution of the cases as per the number of years as a rubber worker along with their respective mean FVC values and FEV1/ FVC values.

Years	Number	Mean FVC	FEV1/ FVC Mean
Group I (Less than 10 years)	7	2.83	0.734
Group II (11-20 Years)	20	2.71	0.82
Group III (> 21Years)	23	2.96	0.73

The statistical significance of the 3 means of FVC were tested using Anova and was found not to be significant (P value- 0.54).The means of FEV1/FVC were also tested using Anova and was found to be not significant(P value: 0.53). No co-relation was found between FVC and duration of exposure (P value >0.05). Among the study group, 9 had normal FEV1/FVC, while 41 had abnormal FEV1/FVC values.

Table 3 Distribution of cases as per FEV1/FVC values

FEV1/FVC	Cases	Control
Normal	9	35
Abnormal	41	15

Analysis of FEV1/FVC values of the cases using the Chi-square test showed a significant change (p value: <0.005; Odd's ratio: 17.11). This shows that the rubber workers have increased risk of developing obstructive airway disease.

Table 4 FEV1/FVC as per the Group wise distribution

	Normal	Abnormal	Total
Group I	2	5	7
Group II	2	18	20
Group III	2	21	23

The analysis of the FEV1/FVC values showed no significant change (P value: 0.041) within the 3 groups. The co-relation between FEV1/FVC and the number of years as a rubber worker was analyzed and was found to be not significant(P value: >0.05) indicating that the obstructive airway disease did not become worse with increasing years of exposure .

Table 5: FEF 25-75% of the cases and controls

	CASE	CONTROL
Normal	37	50
Abnormal	13	0

The FEF 25-75% values (Table 5)showed 26% of the cases to have abnormal values and were statistically significant (P value: <0.0001). No co-relation was found between FEF 25-75% and the duration of exposure (P value: > 0.05).

DISCUSSION

Of the total cases, 46% had more than 20 years of experience as a rubber worker. The mean FVC values of subjects and controls did not show any significant difference. The cases were divided into 3 groups depending on the number of years as rubber workers. Among the groups, no correlation was found between FVC and duration of exposure. The mean values for FEV1/FVC for cases and controls were also calculated and it showed a significant decrease among the cases. The mean values for FEF25-75% were also calculated for cases and controls and it showed a significant decrease in the values among the cases.

In our study we observed obstructive airway disorders in 80% of the cases. In comparison with the study done by Governa et al, it was noted that no evidence of chronic obstructive pulmonary disease was found and in most cases no significant decline in FEV1 was observed [(1)]. Zuskin et al had conducted a similar study among rubber workers. Their results showed a significantly higher prevalence of all chronic respiratory symptoms except asthma in rubber workers [(3)]. In another study by FineLJ, there was significant decrease in FEV1/ FVC ratio in rubber workers with more than ten years of exposure[(4)]. Williams et al showed that air-borne rubber particles if inhaled, aggravated the latex sensitization, irritated the respiratory tract and induced asthma [(5)]. A study conducted by Gopathy Sridevi etal showed that impact on the pulmonary function was dependent on duration of exposure -less in short time-exposure and more in long time-exposure.[(6)] Use of acids for the coagulation of the latex may cause various inflammation

and lung function abnormalities (Danwanichakul *et al*., 2011)[6].In a study conducted by V.Devender Redy etal a borderline significant decrease in FVC and FEV1 was observed in workers group compared with controls (p=0.05) and a positive correlation was observed with increase in working years and decrease in the FEV1. A statistical significant decrease in FVC, FEV1 and FEV1/FVC was also observed with increase in BMI among rubber tappers (r=0.89, p<0.000), reflecting the increased restrictive pattern in these patients. A statistically significant difference was observed in FEV1/FVC as duration (years) of tapping) increased[7]. In our study the cases who were exposed to latex, smoke and chemicals had an abnormal FEV1/FVC. However it was not statistically significant. Duration of exposure to chemicals, smoke and latex did not have any effects on the pulmonary function of our cases. The reason for these may be attributed to the small sample size of our study. Another reason being that the past history of smoking in these patients was not enquired into and so they may already be having an underlying undiagnosed obstructive airway disease. A reduction in FEF 25-75% was noted in 26% of the rubber workers who were tested indicating a small airway disease. This however was not found to have any co-relation with duration of exposure to latex, chemicals or smoke.

CONCLUSIONS

A statistically significant reduction was seen in the FEV1/FVC values among 80% of the rubber workers . A similar reduction was seen in the FEF 25-75% values among 26% of the rubber workers. No co-relation was seen between the FEV1/FVC, the duration of exposure and the type of exposure to the various pollutants that were studied. No co-relation was seen between the FEF 25-75% with the duration of exposure and the type of exposure to the various pollutants that were studied. FEV1/FVC was low in 80% of the workers indicating obstructive airway disease. The cases who were exposed to latex, smoke and chemicals had an abnormal FEV1/FVC, however it was not statistically significant. Duration of exposure to chemicals, smoke and latex did not have any effects on the pulmonary function of our cases, the probable reason for this being a small sample size of our study. Thus studies involving a larger cohort would be needed to reason the cause of the obstructive airway disease.

Conflict of Interest: None

Source of Funding: None

Ethical Clearance- The study protocol conforms to ethical guidelines of the"World Medical AssociationDeclaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects" adopted by 18th WMA General Assembly, Helsinki,Finland,June 1964,as revised in Tokyo 2004

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