

Study of Pulmonary Functions in Goldsmith Workers: A Cross-Sectional Study

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Abstract:

Introduction: The occupational hazards reported in jewellery workers are due to the exposure to chemicals during jewellery making like cyanide, lead, zinc, cadmium, palladium, iridium, sulphuric acid, nitric acid, chalk moulds containing high percentage of silica, etc. Spirometry lung functions were assessed in goldsmith workers and compared with the control group.

Methods: Twenty males working as goldsmith workers since last 10 years and above with period of exposure to chemical fumes > 5 hours/day were tested for spirometry lung function parameters of Forced Vital Capacity (FVC), Forced Expiratory Volume at the end of one second (FEV1) and Maximum Voluntary Ventilation (MVV). The results were compared with matched controls.

Results: The Mean \pm Standard Deviation (SD) of FVC was $63.95 \pm 9.77\%$ in cases and 76.95 ± 8.1 in controls. The Mean \pm Standard Deviation (SD) of FEV1 was $67.25 \pm 7.65\%$ in cases and 73.3 ± 8.31 in controls. The Mean \pm Standard Deviation (SD) of MVV was $61.8 \pm 10.54\%$ in cases and 81 ± 5.04 in controls. All the parameters studied were significantly less in goldsmith workers.

Conclusions: The spirometry lung function parameters were found to be significantly lesser in goldsmith workers when compared to the matched controls.

Keywords: Forced Vital Capacity, Goldsmith workers, Maximum Voluntary Ventilation, Occupational hazard

I. Introduction

Indian people especially women are very much crazy about golden ornaments, which is highlighted by the fact that India contributes significantly to the total gold sold worldwide. However, most of the people are blissfully unaware that the goldsmith workers who are manufacturing the jewellery maybe doing so at the cost of their health. Commonly used chemicals during jewellery making are cyanide, lead, zinc, cadmium, palladium, iridium, sulphuric acid, nitric acid, chalk moulds containing high percentage of silica, etc. The occupational hazards reported in jewellery workers due to the exposure to above chemicals are anemia, digestive problems, nerve disorders, memory loss, concentration problems, cancer and so on. Raj A et al [1] have reported that jewellery workers by way of their occupation are at increased risk of developing gastric cancer. Mehta V et al [2] have reported persistent nodular contact dermatitis to gold although it is presumed that gold is an inert element. There is lack of literature regarding the lung function parameters among the goldsmith workers. With this perspective, the present study was undertaken to evaluate the pulmonary functions in goldsmith workers of Aurangabad city.

II. Materials And Methods

Study Design: Cross-sectional study. The present study was conducted in Pulmonary Function Tests (PFT) laboratory of Department of Physiology at Government Medical College, Aurangabad in Maharashtra.

Cases: 20 males aged 25 years & above were recruited as study cases. All the study cases were employed as goldsmith workers since last 10 years or above with a period of exposure to chemical fumes more than 5 hours per day.

Controls: 20 males aged 25 years & above were recruited as controls and care was taken that age, height, weight of the controls was comparable and similar to the study cases. Matching with socioeconomic status was done by recruiting salesmen of similar background who were working in jewellery shop but were not exposed to chemical fumes.

All the study participants were clinically examined to rule out history of smoking, acute/chronic respiratory disorders, cardiovascular, hepatic or renal impairment. Lung functions were recorded on Body Plethysmograph (Med-Graphics) USA Elite-DX model of PFT machine. All spirometry parameters were done on subjects sitting comfortably in up-right position. All recordings were done at Body Temperature and Pressure Saturated (BTPS). Recordings were done between 3 to 5 p.m. for all the study participants to avoid diurnal variation. To eliminate the effect of age, sex, height, weight on different parameters of lung function the percent

predicted value for the subjects with respect to their characteristics as per the Breeze Suite software was taken into consideration for statistical analysis. Unpaired 't' test was applied for comparison between two groups.

III. Results

Table-1: Demographic Variables

Parameter	Cases (Mean ± SD)	Controls (Mean ± SD)
Age (years)	31.6 ± 5.3	32.7 ± 6
Height (centimetres)	164 ± 5.8	163.6 ± 7
Weight (kilograms)	60.3 ± 12.8	61.6 ± 12.9

Table – 2: Spirometry Lung function values in cases and controls

PARAMETER	CASES (MEAN ± SD)	CONTROLS (MEAN ± SD)	p value
FVC (Percent predicted values)	63.95±9.77	76.95±8.1	0.001*
FEV ₁ (Percent predicted values)	67.25±7.65	73.3±8.31	0.02*
MVV (Percent predicted values)	61.8±10.54	81±5.04	<0.0001**

*statistically significant

** statistically highly significant

IV. Discussion

In the present study, the results of spirometry in the subjects showed a decline in lung volumes and capacities. This decline in lung function is probably due to the factors such as exposure to the hazardous fumes, silica moulds, and some metals during jewellery moulding, making, casting, and polishing. Jewellery making process includes following steps: Silver soldering including pickling, Soft soldering, Lost wax casting, Electroforming & electroplating, Anodizing, Surface design, Finishing. Silver solders are commonly used with gold and silver. The lowest melting silver or brazing solders typically contain the metal cadmium to lower the melting point of the solder, in addition to silver. Pickling is the process of removing flux and oxide from the surface of gold. It includes either a solution of sulphuric acid or nitric acid in water or commercially prepared sparex (sodium bisulphate). High airborne concentrations of metal fumes including cadmium can be expected with silver soldering. Cadmium-containing fumes are extremely toxic, and acute overexposure can cause chemical pneumonia and be fatal. Chronic exposure can cause lung tissue damage, kidney damage, lung cancer, and prostate cancer. Cadmium fume has poor warning properties and excessive exposure will occur before symptoms are noted. Fluxes used in silver soldering can also create toxic fumes, especially fluoride-containing fluxes. Possible decomposition products are hydrogen fluoride gas and fluoride fumes. These materials are very toxic and highly irritating to the skin, eyes, and respiratory tract. The sulphur oxide gases that can result from heating the pickling bath are respiratory irritants. [3] Exposure to nitric acid vapours and nitrogen oxide can damage mucosa of lungs and causes pneumonitis, cough, dyspnoea and chronic bronchitis. [4] Study by Beltrami V et al [5] has reported occupational asthma in goldsmith workers. Study by Sakurai H et al [6] have reported that the percentage of the predicted function values of the highly exposed workers to cadmium was significantly deteriorated for FVC, FEV₁, PEF_R, and respiratory impedance, whereas those of the slightly exposed workers were reduced only for FVC and FEV₁. Bodo M et al [7] have reported in their study in relation to silicosis in gold jewellery workers that each silica sample promoted a profibrotic lung microenvironment in a different manner and also elicited different Fibroblast Growth Factor-2 signalling pathways. Their data confirmed that different micro-morphology of silica particles affects the fibrogenic potential and the molecular mechanisms of dust pathogenicity. The present study revealed significant decline in FVC, FEV₁ and MVV in goldsmith workers. This study can be used as basis for planning longitudinal or cross-sectional studies with a larger sample size. So, more extensive and detailed research is suggested. So, we can conclude with a statement: "All that glitters can cause much harm"

V. Recommendations

1. All soldering should be done with local exhaust ventilation (e.g. slot hood or window exhaust fan at work level 1-2 feet away).
2. Suitable masks should be used to minimise exposure to chemical fumes.
3. As chemical fumes has poor warning properties and excessive exposure will occur before symptoms are noted, hence, it is recommended to have periodic health check up including PFT , chest X ray of goldsmith workers once in a year.

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