



OCCUPATIONAL HEALTH AND PHYSIOLOGICAL PROFILE OF SERICULTURE INDUSTRY WORKERS WITH RESPECT TO WORKPLACE ENVIRONMENT

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ABSTRACT

The sericulture industry is a labor-intensive agro based industry in India. The workforce is exposed to various occupational factors at the workplace and hence, they are susceptible to various occupational hazards. The present study was undertaken to correlate the physiological response of sericulture industry workers and their workplace environment. Demographic data of workers were collected by standard questionnaire. Data was analyzed by using standard statistical procedures. In the present study it was observed that, the workers were not aware of health and safety issues due to the majority of workers are illiterate. The workplace environment is characterized by the presence of various chemicals, noise, heat, spiteful smell and lime dust/biological dust in various activities of sericulture industry. Working environment is affecting on workers health and they were exposed to various types of health risk factors. Physiological profile of workers shows variation in body temperature, pulse rate, BP, Hand grip strength and Peak expiratory flow rate (PEFR) values.

KEYWORDS: Sericulture, workplace environment, occupational hazards and physiological profile.



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INTRODUCTION

Sericulture is an important labor-intensive and agro based cottage industry, providing gainful occupation to around 7.56 million persons in rural and semi-urban areas in India.^{1,2} India occupies second position in silk production next to China.^{3,4} Maharashtra is non-traditional silk producing state presently producing about 200 MT of raw silk, where mulberry and tasar silk activities are carried out.⁵ The success of the sericulture industry depends upon several variables, but environmental conditions such as biotic and abiotic factors are of particular importance.^{6,7} Agricultural production has its own unique ergonomic hazards and musculoskeletal injury problems. Although some hazards are similar throughout, each activity imposes unique and specific demands on the conditions of workers. Risk exposure analysis of farm workers related to different crops and commodities clearly demonstrates the involved risk factors, and available preventive methods in the form of work practices or labor aids.⁸ While industrial development have brought be obvious benefits, it also frequently increased risk of damage to the human health and the environment.⁹ The workers from rearing section were suffering health related problems particularly during bed cleaning.¹⁰ The major health problems in rearing section were observed.¹¹ The workers from grainage section were exposed to the occupational stresses such as respiratory problems, headache, and allergies.¹² The present study was undertaken to correlate the physiological status of workers and their workplace environment in silk and sericulture industry particularly rearing, reeling and seed production sections. Thus, the present work was aimed to monitor of physical fitness among the rearers and reelers of Kolhapur and Satara district of Maharashtra and assess the workplace environment of the workplace.

MATERIALS AND METHODS

Study area

The present study was undertaken in different rearing and reeling units of silk industry from Kolhapur and Satara district of Maharashtra.

Selection of subjects

In this cross sectional descriptive study sample size was randomly selected.¹³ Subjects were enrolled after explaining the nature of the study and obtaining written informed consent from each participant. Persons who were not working in the rearing house or any activity of sericulture were treated as control subjects (C). All adult subjects (≥ 18 years) giving consent to participate in the study would be included in the study. The study of human participants would be carried out according to ICMR guidelines 2006. Pregnant or nursing women and subject, declining to give informed consent would be excluded from the study. The Government Medical Collage, Miraj approved ethical clearance for present study.

Each worker was studied from following point of view

Personal interview and filling a pre-designed standard questionnaire which included an inquiry about: Personal data (name, age, residence, marital status, family size, experience, educational level, income, special habits and socioeconomic standard); Occupational history, including present health status, health problems and information related to the occupational history; Occupational stress was studied through personal interview and check list.

Physiological responses

General physiological responses and anthropological measurement (blood pressure, pulse, temperature, weight, height,) were recorded by the standard technique of occupational safety and health.¹⁴ The height and weight of participants was measured with the help of measuring tape and weighing machine. The blood pressures were recorded by sphygmomanometer. The pulse rate/min of subject was recorded from carotid pulse. The axial temperature of subject and body temperature were recorded by clinical thermometer.

Body Mass Index (BMI)

Body mass index (BMI) was calculated by Quetelet Index, which is a statistical measure of the weight of a person scaled according to height. It was developed in 1832 by the Belgian polymath Adolphe Quetelet.¹⁵ Body Mass Index (BMI) was calculated based on the formula-

$$\text{BMI} = \text{Weight in kg} / \text{Height in m}^2$$

Physical fitness Index %

The physical fitness of some randomly selected workers was carried out by the Harvard Modified StepTest.¹⁶

$$\text{PFI} = \text{Duration of exercise in Sec} \times 100 / \text{pulse } 1+2+3$$

Procedure

The subject was advised to step up on the modified Harvard steps of 33 cm height once every two seconds (30 per minute) for 5 minutes, a total of 150 steps. At one, three and five minutes during the test, pulse rate was recorded as (a) PR1 (Pulse Rate 1) – 1 min after exercise. (b) PR2 (Pulse Rate 2) – 3 min after exercise, (c) PR3 (Pulse Rate 3) – 5 min after exercise.

Grip strength study

Handgrip strength (HGS) was determined by using a hand grip dynamometer as the maximum voluntary contraction (MVC in kg) sustained for at least 3 seconds.

PEFR

Peak expiratory flow rate were recorded by Wrights peck expiratory flow meter.

Workplace environment

Temperature, humidity and light intensity in rearing houses were measured with the help of thermo-hygrometer and digital Lux meter respectively.

Data was analyzed by using Microsoft Excel and SPSS version 20.0 software. Whereas, statistical analysis was done using descriptive statistics, such as frequency percent, mean and standard error.

RESULTS

The sericulture industry, mainly classifies into pre-cocoon and post-cocoon technology. Many workers are working in different sections like mulberry cultivation, silkworm rearing, silkworm seed production, reeling, twisting and dying performing repetitive working cycle. The demographic study reveals that most of the workers working in sericulture industry are illiterate, alcoholic, tobacco chewer. Some of the peoples are farmer cum worker are earning well, but they have excess workload

and facing more stress. Most of workers from both sections were complained musculoskeletal discomfort like hand pain, shoulder pain, neck pain, back pain, etc. Some of the workers also complained eye irritation, headache, cough, common cold and vomiting, excessive heat in palm, stomach and feet. The occupational stress and hazards in these sections include temperature, noise, dust concentration, poor light, various fumes, spiteful smell and lifting and carrying mulberry shoots from garden to rearing house as well as the excessive work load. Rearing section workers working on all days of the month due to excess work load approximately 8-12 hours per day whereas reeling section workers work in 21 days out of one month for 8 hours per day.

Workplace environment in sericulture industry

The Survey showed that due to indoor and outdoor environment of silk industry it has adverse effect on the health of workers.

Table 1
Environmental factors at workplace.

Parameters	Rearing section	Reeling section
Temperature(^o C)	31.075±2.097	32.123±4.075
Humidity (%)	52.75±17.494	53±9.291
Noise(dB)	73.794±0.2433	109.210±0.571
Light(Lx)	119 ± 6.07	772.428±142.048

Data expressed as a mean ± SEM, with all values given in mean value of parameters. Table no. 1 shows the various environmental factors at work place. In rearing section mean temp and humidity is 31.075±2.097^oC, 52.75±17.494% respectively, while in reeling section temp is 32.0123±4.075^oC and humidity are 53±9.291%. Noise observed 73.794±0.2433 dB in rearing house were as in reeling unit it was 109.210±0.571 dB. Light intensity is also an important factor in present study observed values were 119±6.07 Lx in rearing house while in reeling it was 772.428±142.048 Lx.

Table 2
Anthropological measurements of workers.

Sections	Sr. No.	Age (years)	Height (cm)	Weight (kg)
Control	C	39.30±2.970	160.2368±2.150	62.450±2.050
	M	39.11±1.277	167.1484±1484	64.468±1.5938
Rearing	F	36.92±1.754	150.5407±1.694	52.496±1.8966
	F	34.25± 1.845	158.2160±1.191	55.958±2.093

M-Male, F- Female, C-Control. Data expressed as a mean ± SEM, with all values given in mean value of parameters. Table no. 2 shows anthropological measurements of workers from rearing and reeling sections. It indicates average age, height, weight and hand grip strength. The minimum age is 18 years and maximum is 60 years. Mean body height ranges from 150.5cm to 167.1cm with a mean weight ranges 55.9 kg to 64.4 kg.

Table 3
Physiological response of workers

Sections	Sr. No.	Body temp ^o C	Pulse rate /min	S.B.P. mmHg	D.B.P. mmHg	P.E.F.R. L/min	Hand Grip strength (Kg)	
							RH	LH
Control	C	37.1280±0.476	74.40±2.647	124.20±2.973	82.50±2.746	581.00±17.854	22.2±2.707	22.2±2.852
	M	35.775±0.167	76.21±1.207	129.93±1.453	83.02±1.792	349.29±11.204	32.98±1.325	30.18±1.267
Rearing	F	35.1228±0.247	80.80±2.630	121.96±2.234	78.92±1.772	254.0±17.301	19.56±1.781	17±1.428
	F	36.554±0.121	74.65±1.182	125.25±3.937	78.00±3.310	281.75±19.852	17.85±1.069	16.70±1.054

M-Male, F- Female, C-Control. Data expressed as a mean ± SEM, with all values given in mean value of parameters. The mean physiological responses in present study like body temp, pulse rate, systolic blood pressure (S.B.P.) and diastolic blood pressure (D.B.P.) are shown in table no. 3. The mean pulse rate ranges from 74.4 to 80.8/min., mean S.B.P. ranges from 121.96 mmHg to 129.93 mmHg and D.B.P ranges 78.00 mmHg to 83.02 mmHg. Physiological response were recorded in working condition. The values of peak expiratory flow rate (PEFR) in workers ranges from 581.00 L/min to 281.75 L/min. The maximum right hand (RH) grip strength ranges from 17.85 kg to 32.98 kg and left hand (LH) grip strength ranges from 16.70 kg to 30.18 kg.

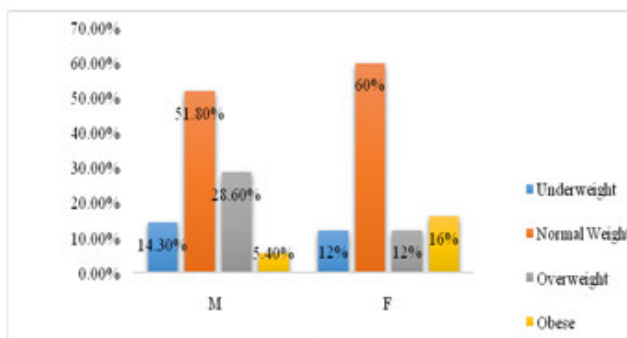


Figure 1
Body mass index (BMI) of male and female workers from rearing section

Figure no. 1 BMI of workers of rearing section showed that 60% female and 51.80 % males belong normal category, 12 % females and 28.60 % male belong to overweight category, 16 % females and 5.40 % male obese category and 12 % females and 14.30% male underweight category in the rearing section of sericulture industry.

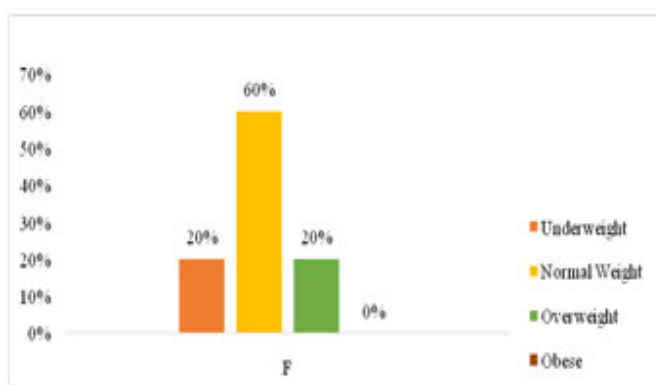


Figure 2
Body mass index (BMI) of female workers from reeling section.

Figure no. 2 BMI of workers of reeling section showed that 60% female belongs to normal category, 20% females belongs to overweight category, 20% female underweight category in the reeling section of sericulture industry.

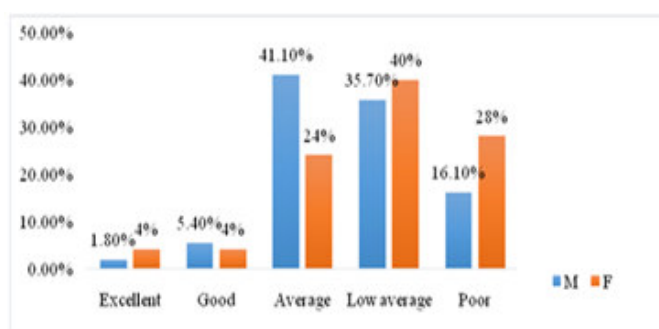


Figure 3
Physical fitness score of male and female workers from rearing section.

Figure no. 3 revealed that physical fitness score of workers from rearing section. 1.80% females and 4% males with excellent score, 5.40% females and 4% males with good score, 41.10% females and 24 % male average score, 35.70% females and 40% males with low average and 16.10% females and 28%males with poor score.

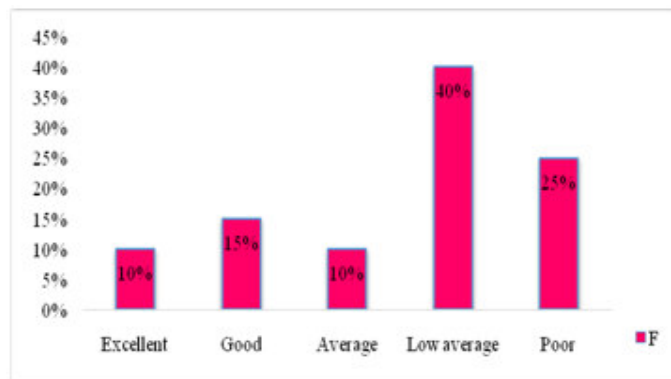


Figure 4
Physical fitness score of female workers from reeling section

Figure no. 4 revealed that physical fitness score of workers from reeling section. 10% females with excellent, 15% females with good score, 10% females with average score, 40% females with low average and 25% females with poor score. Body mass index (BMI) is an important tool to distinguish underweight, overweight, normal weight, obese or category which showed in Fig. no.1 and 2. In a rearing section, 60% female and 51.80% males belong normal category, 12% females and 28.60% male belongs to overweight category, 16% females and 5.40% males obese category and 12% females and 14.30% males underweight category, where in reeling section, 60% female belongs normal category, 20% females belongs to overweight category, 20% females underweight category in reeling section of sericulture industry. BMI is the most appropriate simple indicator by which weight-for-height can be related to health outcome, therefore, proposed the use of BMI to monitor both under nutrition and overweight.¹⁷ Other studies examining the relationship between occupational attainment and a range of human capital variables.^{18,19} The pulse rate response of workers in different section was different, but recovery time was shorter that indicates good physical fitness of the workers and number of workers indicated a steady pulse rate. Fig. no. 3 and 4 indicates physical fitness score (PFS) of workers from rearing section and reeling section. PFS of rearing section, 1.80% females and 4% males with excellent score, 5.40% females and 4% males with good score, 41.10% females and 24 % male average score, 35.70% females and 40% males with low average and 16.10% females and 28% males with the poor score. Whereas PFS of workers from reeling section shows 10% females with excellent, 15% females with good score, 10% females with average score and 40% females were with low average and 25% females with poor score. It is observed that physical fitness score shows much variance in different sections, maximum workers has good physical fitness from both the sections. Physical fitness is defined as the ability to carry out daily tasks with vigor and alertness without undue fatigue with ample energy to enjoy leisure time pursuits, to meet unusual situations and unforeseen emergencies.²⁰ The determination of the Physical Fitness Index (PFI) is one of the important criteria to assess the cardiopulmonary efficiency of a subject.²¹ In the present study a significant observation is that the physiological responses like heart rate, blood pressure

and body temperature with respect to working conditions. Recovery heart rate comes to normal level quickly, but blood pressure shows sustained increased condition according to work exposure. With respect to PEFR in present study it is found that, the workers from rearing section shows average PEFR in females 254.0 ± 17.301 L/min and in males 349.29 ± 11.204 L/min, where from reeling section average PEFR of female workers were 281.75 ± 19.852 L/min and average PEFR of control subjects was 581.00 ± 17.854 L/min. In the present study it was observed that PEFR of workers from rearing section and reeling section was significantly low as compared to their control subjects. Working in dusty, smoky workplace environment reduces the lung function in sericulture industry workers. Dust exposure appears to interact with gases/fumes to reduce PEFR.²² As the age increases chest expansion and PEFR values were reduced.²³ In an earlier clinical survey in reeling units, it was observed that 36.2% of reeling workers suffered from bronchial asthma, and 16.9% of the workers from asthma of occupational origin, and thus, 19.3% of the workers had asthma of non-occupational origin.²⁴ A high frequency of sensitization to *Bombyx mori* in a selected population of patients with respiratory allergic disease in Brazil.²⁵

DISCUSSION

As defined by the World Health Organization (WHO) occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. Occupational health hazards among the persons exposed to various organic dusts have been known for many centuries. Incidences of acute change in respiratory tract illness and occupational asthma, musculoskeletal injury, headache among silk industry workers have been reported. The majority of the rearers were suffering from health problems like eye irritation, injuries, back pain, allergies, respiratory problems and headache.¹¹ Sericulture industry involves the use of natural resources working in a unit like marketing, grainage, post cocoon technology areas are exposed to occupational health hazards.²⁶ Silkworm rearing involves picking, disinfection of rearing room and equipments by formalin/bleaching powder, bed cleaning, etc. There are many chemicals, pesticides and fertilizers used in different stages of sericulture activities, including plantation, rearing, grainage and

weaving. These chemicals have deleterious effects on the human ecosystem if not handled properly. In most of the rearing houses, the disposal of the chemicals and solid wastes is a neglected issue. Rearers are not aware about the hazardous effects of these chemicals on their health and environment.¹¹ Potential hazards as well as obvious benefits to the public health result from the manufacture and use of agricultural chemicals.²⁷ In the statistical study of health and safety in the microelectronics industry, presents some evidence of potential health hazards in the semiconductor manufacturing process.²⁸ The health of the workers is mainly affected by nature of the working environment and adverse working conditions.²⁹ Respiratory diseases are on the rise worldwide, especially allergic diseases such as asthma and rhinitis.³⁰ Biological pollutants in the indoor environment are those of allergens has been estimated that more than half of asthma cases in the USA can be attributed to allergic sensitization.³¹ Respiratory allergens such as dust, gases/fumes, and hay, smoke, which are frequently present in agricultural settings, can cause or aggravate asthma.³² In the present study it was observed that workers are exposed to various chemicals and work in dusty, smoky workplace environment in reeling and rearing section. Many workers were complained of musculoskeletal discomfort, headache, vomiting, eye irritation, respiratory problems during bed cleaning and other activities in rearing section. According to the survey conducted by institute of Social and Economic Change

(ISEC) workers complained of excessive heat, i.e. burning sensation in the eyes, palm, nose, stomach and feet, during the rearing and particularly during bed cleaning the burning feeling were attributed to contact with silk worm litter. Use of formalin and bleaching powder without certain precautionary measures causes burning of eyes, mucus secretion and peeling of skin. Bleaching powder solution of higher concentration (>50%) also causes similar effects as formalin.¹⁰

CONCLUSION

In sericulture industry workers are exposed to occupational stress causing occupational health hazards among the workers. It is essential to create awareness among the workers regarding various health hazards in sericulture.

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CONFLICTS OF INTEREST

Conflicts of interest declared as none.

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