International Journal of Statistical Sciences Vol. 15 (Special Issue), 2016, pp 19-28 © 2016 Dept. of Statistics, Univ. of Rajshahi, Bangladesh

Direct and Indirect Losses Due to Occupational Health Hazards in Silk Industries: A Statistical Investigation

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[Received February 2, 2016; Accepted July 10, 2016]

Abstract

Textile and clothing industries are the main source of economic growth in Bangladesh. Despite numerous technical advances in textile industries worldwide, many occupational health hazards persist in silk industries. These include carbon monoxide poisoning due to the use of burnt coal to raise room temperature, handling of diseased worms and excreta with bare hands, use of formalin and bleaching powder for disinfection, use of bed disinfectants made from paraformaldehyde, use of organophosphates pesticides to control mealy bug, leaf roller and white fly, use of chlorpyrifos to control termites etc. Therefore, workers/employers suffer from various occupational health problems resulting absent in workplace and working disability. This paper aims to analyze direct and indirect losses due to occupational health hazards at silk industries using log-linear regression model. In this paper primary data has been used which has been collected from the workers/ employers at silk industries in Rajshahi City Corporation. In total one hundred and fiftyeight respondents were surveyed. Among the respondents, 46.80% were male and 53.20% were female. Among the respondents who suffered from any occupational health problems in the last 30 days, 89% had an average monthly direct loss of 540.41 taka per respondent and an average indirect loss of 474.55(taka) per respondent. Results from this study reveal that unaware workers/employers in silk industries have more loss. Giving priority to occupational health hazards in silk industries as public health problem, government or non-government organization should take some active and sustainable steps to minimize the loss.

Keywords: Occupational health hazards; Silk industries; Direct loss; Indirect loss; Statistical analysis, log-linear model.

AMS Classification: 62J02.

1. Introduction

Textile and clothing industries are the main source of economic growth in Bangladesh. Silk is a highly valued animal fiber used almost entirely for the production of high quality textiles. Occupational diseases reflect health hazards brought on by exposure within the work environment. Despite numerous technical advances in textile industries worldwide, many occupational health hazards persist in silk industries. These include carbon monoxide poisoning due to the use of burnt coal to raise room temperature, handling of diseased worms and excreta with bare hands, use of formalin and bleaching powder for disinfection, use of bed disinfectants made from paraformaldehyde, use of organophosphates pesticides to control mealy bug, leaf roller and white fly, use of chloropyrifos to control termites etc (Lim et al, 1990; Akter et al, 1998). As a result, workers/emplyers of these industries suffer from various health problems. Carbon monoxide toxicity consists of headache, vertigo and sometimes nausea and vomiting (Kubota, 2011).Grainage workers suffer from moth scales, which trigger asthma and conjunctivitis. While cocoons are put in hot water to loosen silk fibres for unwinding, the workers also put their bare hands in hot water, resulting in blisters in their hands leading to secondary infection, such as dermatitis. About 70 Benzidine based silk colorants such as azo dyes, release carcinogenic aromatic amines. Similarly, heavy metal complex dyes, are known to damage mental and central nervous function, lower energy levels and damage blood composition, lungs, kidneys and liver. Trivalent chromium used to fix silk dyes undergoes oxidation into hexavalent chromium, which leads to skin irritation, ulcers, sensitization and allergic contact dermatitis. Lead acetate used in dyeing silk cloth is a neurotoxin. It affects the human brain as well as reproductive system. Lead also affects reading and reasoning abilities in children. Dye factories across the world are dumping millions of tons of dye effluent into rivers without any effluent treatment. Pentachlorophenol, which is used in spray starch before ironing silk garment to protect from mould attack also, pose severe health problems. Formaldehyde resins routinely applied on silk to reduce shrinkage and wrinkling, cause eczematous rashes. Contact with silk cloth with a pH outside the accepted range (5.5), turns the skin flora out of balance and causes irritation. Dermatitis, narcosis, dizziness, fatigue, nausea, headache, eye irritation, adverse reproductive hazards including increased risk of miscarriage and serious neurological problems can all result from the processes of screen printing, where toluene, xylene and methyl ethyl ketone are used as solvents of the inks, thinners and clean up

Sultana, Rokonuzzaman, Kabir, Parvin et al.: Direct and Indirect Losses ...

materials. Several health hazards are also associated with weaving and related activities, which cause stress and strain to weavers (Pandey, 2014). In addition, noise exposure can reach harmful levels for workers at machines spinning and winding the silk threads, and at looms where fabric is woven

Some studies have investigated exposure to insecticides in sericulture (Akter et al, 1998; Sing and Saratchandra, 2002; Wernli et al.2008), some with the sensitization to silk and side effects (Juan et al, 2001) etc. But, no study has considered direct and indirect losses due to health hazards at silk industries in Bangladesh. This study is the first one that investigated pattern of direct and indirect losses statistically due to exposure to health hazards at silk industries in Bangladesh.

2. Data and methodology

Data has been collected from the workers/employers of all sericulture and silk factories in Rajshahi City Corporation, Bangladesh using structured questionnaire in Bangali language and trained surveyors during August-November, 2015. Ethical approval has been taken from Institutional Animal, Medical Ethics, Biosafety and Biosecurity Committee (IAMEBBC), Institute of Biological Sciences, University of Rajshahi before starting the survey. List of sericulture and silk industries was obtained from Association of Silk Industries Owners, 2012 and Bangladesh Sericulture Development Board, Rajshahi, Bangladesh. According to the list, there were 32 silk factories in Rajshahi City Corporation. Among them 18 small silk knitting factories were closed due to high price of raw silk and other materials, lack of order from big factories, etc. Data was collected from rest 14 silk factories. However, eleven workers from knitting section of Sopura silk factory denied taking part in the survey. Also, surveyors may missed to take information from some workers/employers of Sopura silk factory and sericulture due to three shift working system. Ultimately, 162 respondents take part in the survey. Four of the survey questionnaires were with missing/inconsistent information. Therefore, this study is based on sample size 158. Data has been coded in Microsoft Excel 2010. Treatment cost for occupational health problems has been considered as direct cost and number of days absent in workplace converted in taka (BDT) proportionate to salary has been considered as indirect loss due to occupational health problem in this study. Those were measured for last 30 days of the study.

For statistical analysis, descriptive analysis has been performed to know the characteristics of the study subjects. For that frequency with percentage has been reported for categorical variable and mean with standard deviation has been reported for continuous variable. A comparison of socio-demographic and economic characteristics of study subjects to gender has been performed. To compare variables chi-square test (Pearson Chi-square or Likelihood Ratio Chi-square) has been used for categorical variable and t-test has been used for continuous variable. These tests have been performed at 5% level of significance. To analyze the socio-demographic and economic predictors to total loss log-linear regression model and max-min-normalized linear regression have been used coefficient and p-value has been reported. Results of goodness of fit test have been reported, too. SPSS version 20 has been used to carry out statistical analyses.

3. Results

We have observed that 5.70% respondents have permanent job, 82.90% respondents have temporal job and 11.40% respondents have daily basis job [Table 1]. Among the respondents 46.80% are male and 53.20% are female. The average age is 32.92 years with standard deviation (SD) 11.55, the average height is 156.90 centimeter with SD 10.18, the average weight is 59.73 kg with SD 11.24. It has been observed that respondents with no education is 17.10%, followed by primary school completed 19.60%, below secondary school completed 39.20%, secondary school completed is 10.80% and higher secondary completed and above is 13.30%. Among the respondents 61.4% are married, 27.8% are unmarried and 10.8% are of others. Average monthly income is 4911.39 (taka) with SD 2935.31(taka) and average total family income is 10128.48 (taka) with SD 10283.67. Among the respondent 13.30% work in sericulture and tut gardening section, 34.80% work in swing and printing section and 51.90% work in others sections. It has been also found that the average number of days absent due to occupational health problems in the last one month is 3.20 days with SD 2.42, the average of direct loss in the last one month is 540.41 (taka) with SD 620.41, the average of indirect loss in the last one month is 474.50(taka) with SD 408.77. Therefore, the average of total loss in the last one month is 734.79 (taka) with SD 852.91.

[Insert Table 1 here.]

Sultana, Rokonuzzaman, Kabir, Parvin et al.: Direct and Indirect Losses ...

We have observed that 8.30% of male and 2.70% of female respondents are working in permanent basis, 79.80% of male and 86.50% of female respondents are working in temporal basis, 11.90% of male and 10.80% of female respondents are working in daily basis and the variation is not statistically significant (pvalue=0.273) [Table 2]. It has been observed that average age of male respondents is 34.13(years) with SD 12.53 and average age of female respondents is 31.54 (years) with SD 10.25 and the difference is statistically insignificant (pvalue=0.160). The average of body mass index (BMI) of male respondents is 23.67 with SD 3.65 and the average of body mass index of female respondents is 25 with standard deviation 4.49 and the difference is statistically significant (pvalue=0.041). Male respondents with no education is 6% and female is 29.70%; male respondents with primary school completed is 17.90 % and female is 21.60%; with below secondary school, male is 41.70% and female is 36.50%; with secondary school completed, male is 16.70% and female is 4.10%; with higher secondary completed and above, male is 17.70% and female is 8.10%. The difference is found to be statistically significant (p-value=0.001). It is also found that 72.60% of male respondents and 48.60% of female respondents are married (p-value<0.001). Average of monthly income is 5928.57(taka) with SD 3445.92 for male and the average of monthly income 3756.76(taka) with standard deviation 1577.16 for female. It is found that there is significant difference of monthly income to male and female respondents (p-value<0.001). Average monthly family income for male respondent is 11472.62 (taka) with SD 12268.98 and that for female respondent is 8602.70 (taka) with SD 7201.16 (pvalue=0.080). Among the male respondent 14.30% work in sericulture and tut gardening section, 25% work in swing and printing section and 60.70% work in other sections. Among the female respondent 12.20% work in sericulture and tut gardening section, 45.90% work in swing and printing section and 41.90% work in other sections. It has been also found that gender variation to job sections is statistically significant (p-value=0.002). Among the male respondents, average direct loss is 459.57 (taka) in the last 30 days due to occupational health problem with SD 541.37 and that for male respondents is 611.90(taka) with SD 685 .40 and the difference is statistically insignificant (p-value=0.397). Among the male respondents, average direct loss is 361.90 (taka) in the last 30 days due to occupational health problem with SD 139.35 and that for male respondents is 535.13 (taka) with SD 493.44 and the difference is statistically insignificant (pvalue=0.380). Therefore, among the male respondents, average total loss is 563.79

(taka) in the last 30 days due to occupational health problem with SD 584.56 and that for male respondents is 879.49 (taka) with SD 1016.41 and the difference is also statistically insignificant (p-value=0.205).

[Insert Table 2 here.]

Relationship of various sociodemographic factors to direct loss, indirect loss and total loss in the last 30 days using log-linear regression model have been reported in Table 3. The log-linear model shows that the female respondents have less total loss than male respondents, although it is not found to be statistically significant (co-efficient=-0.214, p-value=0.596). Respondents with higher secondary education and above have 6 times more total loss than respondents with secondary level of education and the difference is statistically significant (co-efficient=-1.868, p-value=0.009). Respondents of other educational levels don't have significant different total loss than respondents with higher secondary education and above. Unmarried/widow/divorcee persons have 2 times more total loss than married person (co-efficient=-0.715, p-value=0.067). Respondents who are working in sericulture and tut gardening section have 2.6 times more total loss than respondents working in other sections (co-efficient=0.97, p-value=0.080). Respondents have 10 times more total loss than 10 years younger counterparts (co-efficient=-0.017, p-value=0.345). Respondents have 10 times more total loss than 10 years less experienced counterparts (co-efficient=-0.034, p-value=0.304). On the other hand, respondents have 10 times less total loss than counterparts with 10 years less profession period (co-efficient=0.057, p-value=0.052).

[Insert Table 3 here.]

4. Discussion

In this cross-sectional study, it has been found that about equal number of male and female workers/employers involved in various sections of silk industries. Respondents with higher secondary education and above have more total loss than respondents with secondary level of education and have equal total loss to respondents with other levels of education. It might be due to the fact that most of the respondents with higher secondary education and above may work as permanent basis; their working hour may be longer than other group of respondents etc. Respondents working in sericulture and tut gardening section have more total loss than respondents working in other sections indicating that there are more occupational hazards in this section than other sections of silk industry (Akter et al, 1998; Sing and Saratchandra, 2002; Wernli et al.2008). Like other public health concerns, married persons are more aware in the working place about occupational health hazards resulting less total loss than unmarried/ widow/ divorcee persons.

This is the first attempt in Bangladesh to work with the direct and indirect loss due to occupational health problems in silk industries. The survey covers whole Rajshahi City Corporation. However, if data can be collected covering whole Bangladesh, real scenario of the pattern of loss can be predicted.

In conclusion, the results from this study reveal that aware (e.g, higher educated and of shorter profession period) workers/employers in silk industries have significantly less total loss. Giving priority to occupational health hazards in silk industries as public health problem, government or non-government organization should take some active and sustained steps to minimize the loss.

Acknowledgement

This research was partially supported by special allocation of National Science and Technology, Bangladesh, 2014-2015 (7 Phy's).

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Characteristics	N=158
Type of job (%)	
Permanent	9(5.70)
Temporal	131(82.90)
Daily Gender (%)	18(11.40)
Male	74(46.80)
Female	84(53.20)
Age (years) (mean,sd)	32.92(11.55)
Body mass index (mean,sd)	24.29(4.11)
Waist circumference in cm (mean,sd)	82.15(10.45)
Arm circumference in cm (mean,sd)	26.67(4.40)
Education (%)	
Illiterate	27(17.10)
Primary	31(19.60)
Below secondary	62(39.20)
Secondary	17(10.80)
Higher secondary and above	21(13.30)
Marital status (%)	
Married	97(61.4)
Unmarried	44(27.8)
Other	17(10.8)
Number of Son (median, IQR)	1(0,1)
Number of Daughter (median, IQR)	1(0,1)
Monthly Personal Income(taka)	4911.39(2935.31)
(mean,sd)	
Total Family income(taka) (mean,sd)	10128.48(10283.67)
Job section (%)	
Sericulture and tut gardening section	21(13.30)
Swing and printing section	55(34.80)
Other sections	82(51.90)
Suffered from occupational health	54(34.18)
problems in last 30 days (%)	
Work experience in yrs (mean,sd)	8.31(7.79)
Earning period in yrs (mean,sd)	10.26(8.96)
Number of absent days in last 30 days	3.20(2.42)
for diseases (mean,sd)*	540 41(600 41)
Direct monthly loss(taka) (mean,sd)*	540.41(620.41)
Indirect monthly loss(taka) (mean,sd)*	474.50(408.77)
Total monthly loss(taka) (mean,sd)*	666.11 (831.42)

 Table 1: Characteristics of the study subjects.

*Statistic is computed for sufferers of occupational health problem(s).

Characteristics	Male	Female	P-value
Type of job (%)			
Permanent	7(8.30)	2(2.70)	
Temporal	67(79.80)	64(86.50)	0.273
Daily	10(11.90)	8(10.80)	
Age(years) (mean,sd)	34.13(12.53)	31.54(10.25)	0.160
Body mass index (mean,sd)	23.67(3.65)	25(4.49)	0.041
Waist (mean.sd)	82.96(8.56)	.56) 81.23(12.23)	
Arm circumference	27.90(3.21)	25.26(5.07)	< 0.001
(mean.sd)		· · · ·	
Educational status (%)			
Illiterate	5(6.00)	22(29.70)	
Primary	15(17.90)	16(21.60)	
Below secondary	35(41.70)	27(36.50)	0.001
Secondary	14(16.70)	3(4.10)	
Higher secondary	15(17.70)	6(8.10)	
and above	10(11110)	0(0110)	
Marital status (%)			
Married	61(72,60)	36(48,60)	
Unmarried	23(27.40)	38(51.30)	<0.001
Monthly income(taka)	5928 57(3445 92)	3756 76(1577 16)	<0.001
(mean sd)	5720.57(5445.72)	5750.70(1577.10)	<0.001
Total family income (taka)	11472 62(12268 98)	8602 70(7201 16)	0.080
(mean sd)	11172.02(12200.90)	0002.70(7201.10)	0.000
Iob category (%)			
Sericulture and tut gardening	12(14 30)	9(12.20)	
section Swing and printing	21(25,00)	34(45.90)	0.002
section Others	51(60.70)	34(43.90) 31(41.00)	0.002
Work experience(years)	S1(00.70) 8 40(7 86)	31(41.90) 8 11(7 77)	0 757
(mean sd)	0.49(7.00)	0.11(7.77)	0.757
(mean, su) Earning pariod(years)	10.86(0.31)	0 58(8 56)	0 374
(mean sd)	10.80(9.51)	9.38(8.30)	0.374
(mean,su)	2.14(1.07)	(770)	0 157
20 days for disassas	2.14(1.07)	5.77(2.77)	0.157
(mean cd)*			
$(\text{Ineall,su})^{*}$	450 57(541 27)	(11.02)(695.40)	0.207
(mean ad)*	439.37(341.37)	011.92(085.40)	0.397
(mean,sd) ^{**}	2(1,00(120,25))	525 12(402 44)	0.200
(many ad)*	301.90(139.33)	JJJ.13(493.44)	0.380
$(\text{mean}, \text{Sd})^*$		970 40/101C 41	0.205
i otal monthly loss(taka)	202./9(284.20)	8/9.49(1016.41)	0.205
(mean,sd)*			

Table 2: Comparing characteristics of the study subjects to gender.

*Statistic is computed for respondents suffer from occupational health problem(s).

Variable	Direct loss		Indirect loss		Total loss	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Gender Female Male (RC)	-0.204	0.599	0.217	0.677	-0.214	0.596
Educational status Illiterate Primary Below secondary Secondary Higher secondary and above (RC)	0.541 0.394 0.040 -1.639	0.391 0.551 0.938 0.017	-1.271 -0.563 0.187 -	0.133 0.493 0.812	-0.114 0.519 0.268 -0.186	0.862 0.450 0.616 0.009
Marital status Married Unmarried/ot her (RC)	-3.52	0.348	-0.043	0.937	-0.715	0.067
Job category Swing and printing section Sericulture and tut gardening sections Other sections (RC)	0.110 0.826	0.811 0.122	0.215 1.163	0.731 0.093	-0.185 0.970	0.699 0.080
Age Experience	-0.015 -0.034	0.376 0.273	$0.005 \\ 0.076$	0.831 0.070	-0.017 -0.034	$0.345 \\ 0.304$
(years) Earning period (years)	0.042	0.132	0.031	0.399	0.057	0.052
Body mass index	0.060	0.137	-0.034	0.610	0.048	0.259 tio Chi
Goodness of fit test (Omnibus test)	square=13.112 df =12 P-value=0.361		square=10.020 df =11 P-value=0.529		square= 17.344 df = 12 P-value= 0.137	

Table 3: Correlates of loss due to exposure of occupational health hazards using log-linear regression.