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Impact of Dust Pollution on Worker's Health in Textile Industry: A Case Study of Faisalabad, Pakistan

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ABSTRACT

The textile industry in Pakistan has largest share in the manufacturing industry sector. The textile sector is one of the most polluting industrial sectors. Cotton dust is present in the air during the handling and processing of cotton which threatens the health of labours working in this industry. This study estimated the impact of the dust pollution on workers' health and cost of illness in the textile industry of the Faisalabad, Pakistan. This was the cross sectional research conducted among the 200 randomly selected textile workers. Both health and opportunity cost of textile workers estimated by using the structural equation model (SEM) with observed and latent variables. This paper used the confirmatory factor analysis (CFA) to interlink the latent factor diseases with their indicators symptoms. The results of the SEM model on age, respiratory diseases, overtime work, duration of employment, use of masks and dust level are significant. Study finds that 62 percent workers beard the cost of illness and 43 percent workers miss the work last two weeks. The 69 percent workers reported that due to the illness their work performance in industry is not normal, they suffered the problems during the work such as muscle aches, asthma, cough; respiratory allergy etc. It also calculated the prevalence of the respiratory diseases among the textile workers was high. Result revealed that 35.5 percent workers had wheezing, 65.5 percent phlegm, 58 percent chest tightness, 72 percent had a throat irritation problems. Paper concluded that there is a high prevalence of respiratory diseases among the textile workers due to the exposure of dust pollution and if successfully reduction in dust pollution occurs in textile industry; the worker will gained the benefits in term of the reduction in medical cost and gain in terms of wages.

Keywords: Dust Pollution, Health Cost, Opportunity Cost, Respiratory Diseases and Symptoms, Structural Equation Model (SEM), Confirmatory Factor Analysis (CFA), Faisalabad, Pakistan

1. INTRODUCTION

In the world the textile is the second largest industry after the agriculture [Sangeetha, *et al.* (2013)]. The textile industry in Pakistan holds the leading role in the manufacturing industry sector. This sector comprises almost 8.5 percent to the GDP, provides employment to more than 46 percent of the manufacturing sector labour force and contribute major share in foreign exchange earnings for the country. Further, Pakistan is the 8th largest exporter of textile products in Asia, 4th largest producer of cotton, with the third largest spinning capacity in Asia after China and India, and contributes 5 percent to the global spinning capacity. This textile sector has an overwhelming impact on the growth and development of the Pakistan's economy [Government of Pakistan (2015)].

The textile sector is one of the most polluting industrial sectors [Banuri (1998)]. The textile industry is also associated with a number of environmental problems such as water pollution, soil pollution, noise pollution and air/ dust pollution. Among the different textile pollution, cotton dust pollution is the most important in terms of health effects [Camici, *et al.* (1978); Beck, *et al.* (1983)]. Cotton dust pollution, lint, and particulates impact the working environment and affect the workers respiratory system. The dust level or quantity small particles of cotton lint infiltrate in to the respiratory system of the human beings and cause the respiratory diseases and symptoms among the workers. These respiratory diseases cause some limitations such as increase the doctor visit, loss in workdays and reduction in quality of work. Cotton mills are polluted with the different type of the cotton dust hazards. Workers which work in these mills are associated with the number of the respiratory diseases and symptoms e.g. chest tightness, shortness of breath, increased cough and phlegm, wheezing, asthma, tuberculosis, lung-function loss, eye sight problems and skin diseases [Salvaggio, *et al.* (1986)].

Due to such kind of the illnesses, the number of the problem arises for workers, such as the loss in income, the loss in the good health and suffering pain due to the illnesses, increase in the health care cost, poor work performance due to the bad health, medicine and doctor fees, loss in workers' productivity due to the cost of illness, increase the social conflicts in the workers families, reduction in the production, and negative impact occur on moral of the other workers. World Health Organisation showed that eight hundred thousand labour

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forces in the cotton and in rope making industries are suffering due to the dust pollution so in such situation there is the high probability of prevalence of the respiratory and byssinosis diseases [WHO (2008)]. Byssinosis is the name of the brown lung disease which is caused by the cotton dust.

Mostly, workforce in the developing countries is uneducated and most of them are involve in the cotton handling process in the textile industry. So, that there is the high probability of prevalence of the respiratory diseases like asthma, cough, fever and brown lung diseases. The intensity of these diseases among these workers is high due to their illiteracy and they are not aware of the use of the safety gadgets such as wearing the face masks, use of the respirator etc.

The long term exposure to dust pollution can cause the respiratory diseases [WHO (2008)]. Cotton dust exposure at textile industries adds considerably to the occupational burden of disease globally [Nafees, *et al.* (2013)]. The relationship between the cotton dust in the textile industries and the prevalence of the respiratory illnesses among the industrial workers has been well documented [Memon, et al. (2008); Farooque, *et al.* (2008); Anjum, *et al.* (2009); Nafees, *et al.* (2013)]. The objective of the study wasto provide the strong evidence of Byssinosis and other respiratory diseases in textile industry and to estimate the workers' cost of illness associated with dust pollution among textile workers in Faisalabad, Pakistan.

There are number of respiratory diseases and difficult to identify with clinical tests, therefore, the study identified the respiratory diseases through their symptoms. These latent respiratory diseases are linked with their indicators symptoms because which are verified by chest specialist. The chest specialist provided consultancy/expert views in identifying the related diseases that may be caused by the dust pollution in the textile mills. This is a social scientist study and adopting the medical test and professional is very expensive and time consuming, therefore, for the identification of the diseases study used the confirmatory factor analysis model.

So in this context, this study estimated the cost of illness. For the estimation of the cost of illness study use the structural equation models (SEM) with observed and latent variables. The estimation of the cost of illness by using the structural equation models (SEM) is different from other studies because costs are directly linked to the respiratory diseases but diseases are not predictable among the humans but its reflected with their symptoms (indicators), so for solving this causal problem we used the confirmatory factor analysis (CFA) model to predict the different latent factors diseases with their different symptoms indicators and then we estimate the impact of the respiratory diseases and different demographic variables on the endogenous variables health and opportunity cost.

Paper is organised as follow, Section 2 provides data description and methodology, Section 3 results and discussion and Section 4 is about conclusion and policy implication.

2. DATA DESCRIPTION AND METHODOLGY

2.1. Description of Study Area

Faisalabad is the big industrial town of Pakistan. Faisalabad is known as the “city of textile” because the numbers of the textile industry are clustered in the district Faisalabad. Textile industry is the backbone of the Faisalabad economy. Sitara Textile Mills and Lyallpur Cotton Textile Mills, Kohinoor Textile Mills, Crescent Textile Mills, Rahmania Textile Mills, Masood Textile Mills, Aasim Textile Mills and Nishat Textile Mills are the famous textile industries in the district Faisalabad. These industries have the major role in the development of the Faisalabad economy and 5 billion dollars are the annual textile exports arrive from the Faisalabad textile industries [Khan (2013)]. There are 612 large industrial units out of which 248 are textile units [Malik (2010)]. Due to the rapid development in the textile sector, Faisalabad is known the “Manchester of the Pakistan” [Khan (2013)]. At the same time, city has high energy utilisation and dense transport system which cause dust pollution. Dust pollution can lead to a variety of health as well as environmental problems. One of the main sources of dust pollution is the textile industry.

2.2. Data Collection and Survey Design

The objective of the paper is measuring the impact of dust pollution on workers’ health and related cost of illness, so for this purpose we needed to collect the primary data. The primary data collected through questionnaire and face to face interview with workers. The questionnaire was developed on the basis of the questionnaires of the health cost and respiratory symptoms studies [Gupta (2006); Murty, *et al.* (2003); Adhikari (2012); Chowdhury and Imran (2010); Bogahwatte and Herath (2008); Memon, *et al.* (2008); Farooque, *et al.* (2008); Nafees, *et al.* (2013); Hinson, *et al.* (2014)]. The questionnaire has two parts, the first part is the general workers survey questionnaire (socio-economic characteristics of workers) and second part is Health Diary Questionnaire [Kamat and Doshi (1987); Gupta (2006); Chowdhury and Imran (2010); Bogahwatte and Herath (2008)].

The general worker survey questionnaire includes information on work characteristics and socio-economic factors. Variable in socioeconomic characteristics are age, education, monthly income, gender and smoking history of workers in textile industry and variables in work characteristics are duration of employment, work section, mask use and working hours. A notable feature of this study is that it uses data from health diaries.

The second part of the questionnaire is health diary questionnaire. The health diary questionnaire includes the detail information on respiratory illnesses and symptoms of textile workers. Through Health Diaries we collected the data on respiratory diseases and symptoms, health cost, dust level, opportunity cost and data on workday lost in the last two weeks. Gupta (2006); Adhikari (2012); Chowdhury and Imran (2010); Bogahwatte and Herath (2008) used the similar health diary technique to collect the data on health and medical status of the respondents and associated cost.

Health cost data consist the expenditure on medicines, hospital stay, pathological tests, doctor fees and accompanying person cost. The opportunity cost includes the cost of the workday miss in the period of the last two weeks. The study used the multistage sampling technique to select workers. This is the cross sectional research conducted in the 3 spinning textile mills and randomly selected the 200 workers. These three spinning textile mills associated with the All Pakistan Textile Mills Association (APTMA) Faisalabad. The previous literature has shown that level of dust is much higher in the spinning section of the textile industry. “Spinning is a manufacturing process where fibres are converted into yarn”. Spinning is the twisting together of drawn out strands of fibres to form yarn.

The data was collected through the permission of the industry administration. The actual data on dust pollution is not collected, since it is not useful for the industry. The measurement of dust pollution in each factory and in each section of spinning mill is very costly and monotonous job. Further they do not allow outsider to do this kind of activity as it is against the industry. So here the data on variable dust level is available through the self-reported by the textile workers. Dust level is measured on a five point likert scale from high dust pollution to low dust pollution.

Study used the health diary data based on the “upcoming two weeks”. Same two weeks health diary data used the Bogahwatte and Herath (2008) in their study but their health diary data based on the “two week recall”.

This study collected the data in two phases:

- In the first phase, the data collected on the “upcoming two weeks” based health diary questionnaire.
- The second phase was the collection of the information on general worker survey.

The data on health diary questionnaire has collected through the following procedure. The first health diary was translated in to Urdu language. Then the health diary questionnaires were dropped to the workers and requested them to fill the Urdu health diary questionnaire for the upcoming fifteen days. In health diary questionnaire workers mentioned the information on respiratory diseases, cost of illness and workday lost. But the general worker survey data was collected through face to face interview.

2.3. Methodology

To estimate the cost of illness we used the Structural Equation Model (SEM).

2.3.1. *Structural Equation Modelling (SEM) with Observed and Latent Variables*

To test the cost of illness of the textile workers we employ structural equation model (SEM) with observed and latent variables. SEM is a "statistical technique for testing and estimating causal relationships amongst the variables, some of which may be latent using a combination of statistical data and qualitative causal assumptions. Latent variables (also known as unobserved variables, hypothetical variables or hypothetical constructs) are variables that are not directly observed but are reflected from other variables that are observed and directly measurable."

SEM deal with the latent and observed variable. The observed or measured variables are those variables which is directly measurable. Latent variables are not directly measured able but it is inferred from the observed variables and confirmatory factor analysis (CFA) deal the latent variables.

The structural equation model (SEM) basically consist two parts, one part is the measurement model (confirmatory factor analysis) which shows the relationship between the latent variables with their component indicators and second part is structural model which assign the causal relationships among the latent variables [Toma, *et al.* (2009)]. So for this purpose this study used the structural equation model (SEM) in two stages,

- Stage 1: is measurement model or confirmatory factor analysis (CFA).
- Stage 2: is structural model or structural regression model (SRM).

Stage 1

2.3.1.1. *Confirmatory Factor Analysis / Measurement Model*

Diana (2000) stated that Confirmatory factor analysis (CFA) is "a statistical technique used to verify the factor structure of a set of observed variables. CFA allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists".

In Confirmatory factor analysis (CFA) we identify the number of the different factors which fundamentals in the data set and measured those variables which is related to the latent variable. Mueller and Hancock (2007) evaluate that the variation in dependent variables typically is not completely explicable by the amount of variation in their particular causes or independent variable. Confirmatory factor analysis (CFA) of the model is the part which links each of the indicator variables with designated latent variable. In CFA, indicators are specified to load on a single factor and consistent factor loading are estimated correlations among the factor and its indicators and indicators are generally correlated with each other but errors terms of the different indicators are uncorrelated. In CFA per factor is fixed at least on one loading. Each set of indicators are loaded onto a separate factor is given in the Figure 3.1.

The CFA is defined by the following system of the equations in Table 2.1

Table 2.1

Measurement Model (Confirmatory Factor Analysis)

Endogenous Variables	Structural Equation	Exogenous Variables
SBDW (X11)	$X11 = \varphi_{X11} AST + E1$	Asthma
SBODO (X12)	$X12 = \varphi_{X12} AST + E2$	
SBOT (X13)	$X13 = \varphi_{X13} AST + E3$	
SBOA (X14)	$X14 = \varphi_{14} AST + E4$	
Weaz (15)	$X15 = \varphi_{15} AST + E5$	
CT (16)	$X16 = \varphi_{16} AST + E6$	
LC (X21)	$X21 = \psi_{21} BYS + E7$	Byssinosis
Fever (X22)	$X22 = \psi_{22} BYS + E8$	
Swet (X23)	$X23 = \psi_{23} BYS + E9$	
MA (X24)	$X24 = \psi_{24} BYS + E10$	
Phl (X25)	$X25 = \psi_{25} BYS + E11$	
Head (X26)	$X26 = \psi_{26} BYS + E12$	
EI (X31)	$X31 = \zeta_{31} RA + E13$	Respiratory Allergy
TI (X32)	$X32 = \zeta_{32} RA + E14$	
NI (X33)	$X33 = \zeta_{33} RA + E15$	
CFT (X41)	$X41 = \chi_{41} Coug + E16$	Chronic Cough
CMT (X42)	$X42 = \chi_{42} Coug + E17$	

Table 2.1 implies a set of 17 structural equations from the measurement portion of the model or confirmatory factor analysis (CFA). Here the X11= shortness of breath during work, X12= shortness of breath one day off, X13= shortness of breath other time. X14= shortness of breath always, X15= wheezing, X16= chest tightness, X21= lung cancer, X22= fever, X23=sweating, X24= muscle aches, X25= phlegm, X26= headache, X31= eye irritation, X32= throat irritation, X41= cough few times and X42= cough many times. The measured and latent variables in the current models are labelled X11 through X42 and AST through Coug respectively.

In CFA system of model Asthma is the unobserved exogenous latent variable which we cannot measure directly so we estimate it with the different symptoms as X11, X12, X13, X14, X15 and X16. So through this system of the CFA we estimated the one respiratory disease Asthma and similarly we estimated the other unobserved latent respiratory diseases like a byssinosis, respiratory allergy and chronic cough.

Stage 2

2.3.1.2. *Structural Regression Model (SRM)*

The structural model or structural regression model screening the prospective causal dependence among endogenous and exogenous variables. In this study we measured the cost of illness (OC and HC) through the help of the SRM model because cost is directly associated with the dust pollution illnesses but these diseases are unidentified. The actual data on these diseases are not available from the textile workers. After consultation of the Doctors and according to their advice then study interlink the respective diseases with symptoms. Diseases are latent factor so that these diseases are reflected by their symptoms. Medical studies show that respiratory illnesses especially byssinosis are not directly observable but we reflect these diseases with their cause (symptoms) and textile workers are not aware about these diseases so we find these diseases among workers through their symptoms. Memon, *et al.* (2008) and Manthur, *et al.* (2005) observed that byssinosis is such respiratory disease which occur among the textile workers in minimum of the 10 years of the work in the textile industry and its symptoms among the workers occur within the 3-5 years duration of the work in textile industry.

So for solving this causal problem first we predicted the different latent diseases with their different symptoms indicators and then estimated the impact of the respiratory diseases and different demographic variables on the endogenous variables health and opportunity cost.

The SRM is defined by the following system of the equations in Table 2.2.

The structural regression model consists of two endogenous variables, opportunity cost (Cost of workday miss) and health cost (medication cost) and the number of the exogenous variable. We estimated the health and opportunity cost with the help of the number of latent and other variables of the model. Table 2.1 and 2.2 lists the all 19 structural equations and connected dependent and independent variable that evaluate the path model in Figure 3.2.

Table 2.2

Structure Regression Model

Endogenous Variable	Structure Equation	Exogenous Variable
Health cost Opport- unity cost	$HC = \zeta_1 AST + \zeta_2 BYS + \zeta_3 RA + \zeta_4 Coug + \zeta_5 Age + \zeta_6 Inc + \zeta_7 Edu + \zeta_8 DL + \zeta_9 DW + \zeta_{10} UM + \zeta_{11} OT + \zeta_{12} Sm + \nu$..................1 $OC = \alpha_1 AST + \alpha_2 BYS + \alpha_3 RA + \alpha_4 Coug + \alpha_5 Age + \alpha_6 Inc + \alpha_7 Edu + \alpha_8 DL + \alpha_9 DW + \alpha_{10} UM + \alpha_{11} OT + \alpha_{12} Sm + \varepsilon$..................2	Asthma, Chornic Cough, Byssinosis, Respiratory Allergy Age, income, education, overtime, use of mask, dust level, duration of work, smoking

3. RESULTS AND DISCUSSION

This section of the study describes the results obtained from structural equation modelling, which is generally categorised as two stages modelling first stage is CFA and second stage is SRM. As in this study we have the different number of the unobserved latent variables so at first stage we apply the CFA as a measurement model approach to specify the reflection of asthma, byssinosis, respiratory allergy, and chronic cough in terms of their relevant indicators (symptoms). Once the CFA has been estimated then we in the second stage SRM is applied to shows the effect of the latent factors and different socio-economic variables on endogenous variables health and opportunity cost.

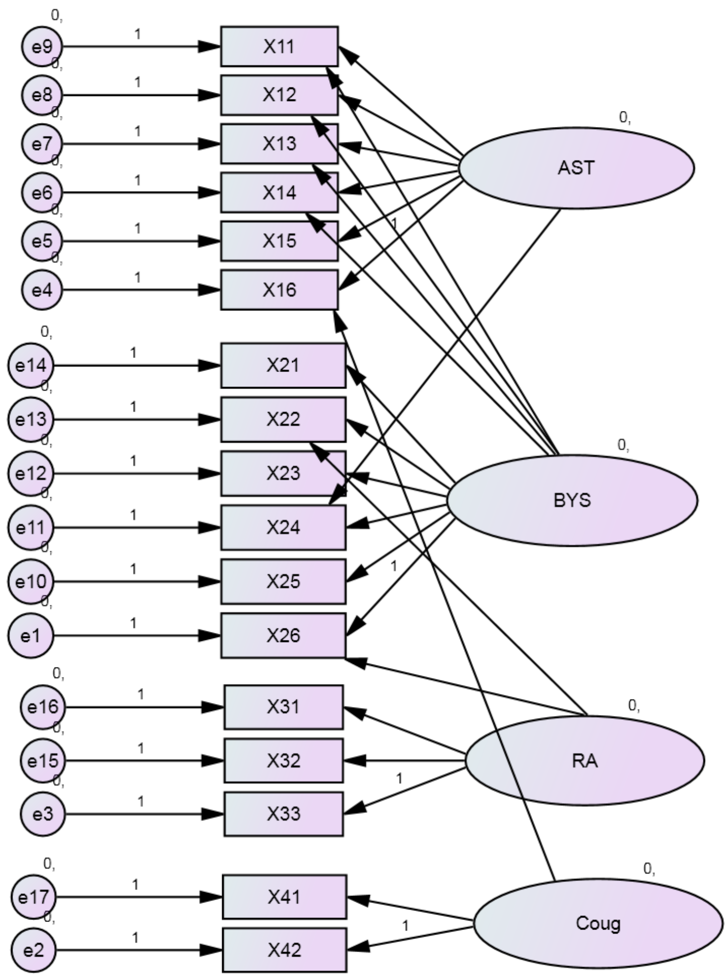
3.1. Results of Confirmatory Factor Analysis

Statistical techniques such as factor analysis, explanatory or confirmatory have been widely used to examine the number of latent constructs underlying the observed respondents and to evaluate the adequacy if individual item or variables as indicator for the latent constructs they are supported to measure. In our case we have four factors, asthma, byssinosis, respiratory allergy and chronic cough. Each factor is reflected with list of indicators.

The indicators are generally correlated with each other but errors terms of the different indicators are uncorrelated. In CFA per factor is fixed at least on one loading. Each set of variables loaded onto a separate indicator is presented in the Figure 3.1.

Medical literature on respiratory illnesses reported that respiratory diseases are not directly observed this study observed it by the different symptoms through the confirmatory factor analysis factor loading.

Fig. 3.1. Confirmatory Factor Analysis of Respiratory Diseases



In Figure 3.1 the measured variables are point out by in rectangular form (X11to X42) and latent variables are point out by ellipses (BYS, AST, COUG, and RA). There are four endogenous latent variable as AST (asthma), BYS (byssinosis), RA (respiratory allergy) and Coug (chronic cough) and we loaded these variables with their symptoms because these diseases are not directly observable its depend on different factors or indictors. As AST (asthma) is indicated with the following set of indicators X11, X12, X13, X15, X16, X17 and X24. In this Figure, the one headed arrows show the direct causal effect hypothesised from one variable effect to another variable. In Figure 3.1, the residual terms (e) point out that reflection to indicators is influenced by the causes other than the latent variables.

There is nonzero covariance may exist between e1 to e5. The analysis of covariance is based on the implicit assumption that indicators are measured as deviations from their means (i.e., all indicator means equal zero). It seems that CFA model justifiable the causes with latent factors and it allow the residual terms of resultant respiratory symptoms to freely covary. Covariance exit between the two headed arrows among the two variables. In SEM, the latent variables are the free of error term. Factor loadings estimate the direct effect of factors on indicators. This factor loading shows that we estimate the respiratory disease asthma through the following symptoms. This factor loading is doing for this purpose to access the impact of this factor loading on the opportunity and health cost because diseases are not directly identified and also not statistically significant on health and opportunity cost. The study also aims to know about the health status of the textile workers.

The Table 3.1 shows the results of number of the respiratory illness and symptoms. The results indicate that the relationships between the latent and observed variables diseases and symptoms have the significant positive relationship. In SEM model the variables are supposed mean centred, so eradicating the requirement for the intercept term in the mean centred data, the indictors X16, X26, X33 and X42 are used as the indication variable for their respective variable loading and their factor or variable loading are not freely statistical measured but we fixed to 1. It is sufficient condition for the identification of the measurement model and AMOS software automatically fixed the one indicator. Asthma, byssinosis, respiratory allergy, and chronic coughing are statistical significant at 5 percent level.

This shows that the textile workers are suffering these diseases due to the exposure of the dust pollution. This setup is called confirmatory factor analysis. This explains that the relationships between these variables are driven by underlying latent variables.

The results of the Figure 3.1 and in the Table 3.1 shows that standardised factor loading was statistically significant, it similarly shows that the correlations between error terms and among latent variables these factor loadings were also statistically significant.

3.2. Results of the Structural Regression Model

Structural regression model is the second stage of the structural equation model (SEM). In structural regression model (SRM) we estimated the SRM with the measurement model proven in first stage but with the different other exogenous variable of the SRM.

Table 3.1

Results of the Measurement Model (Confirmatory Factor Analysis)

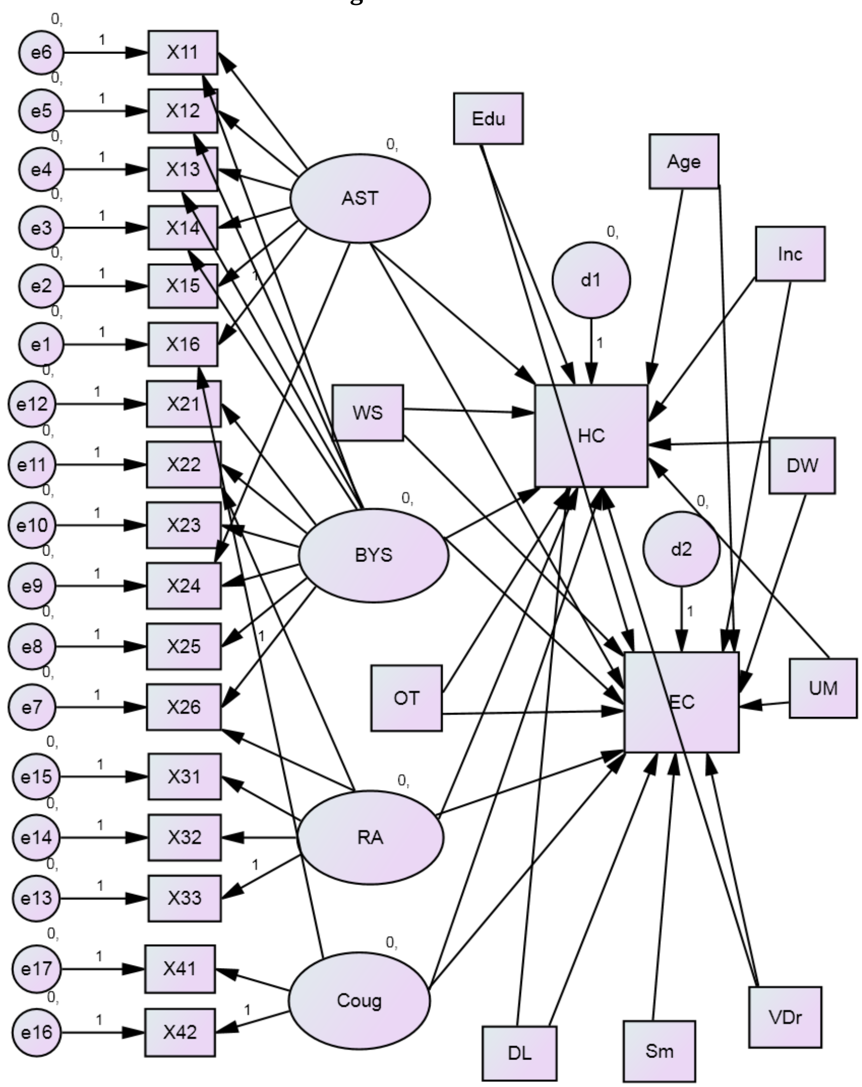
Indicators			Estimates AST	Estimates BYS	Estimates RA	Estimates Coug
X16	<---	AST	1.000			
X15	<---	AST	0.924* (.163)			
X14	<---	AST	1.207* (.197)			
X13	<---	AST	0.309* (.125)			
X12	<---	AST	0.531* (.127)			
X11	<---	AST	0.317* (.119)			
X24	<---	AST	0.251* (.129)			
X26	<---	BYS		1.000		
X25	<---	BYS		2.053* (.388)		
X24	<---	BYS		1.306* (.290)		
X23	<---	BYS		1.674* (.416)		
X22	<---	BYS		0.526* (.197)		
X21	<---	BYS		2.012* (.382)		
X12	<---	BYS		1.422* (.295)		
X11	<---	BYS		1.208* (.265)		
X13	<---	BYS		1.362* (.291)		
X15	<---	BYS		0.886* (.214)		
X33	<---	RA			1.000	
X32	<---	RA			0.910* (.083)	
X31	<---	RA			0.952* (.211)	
X22	<---	RA			0.634* (.164)	
X26	<---	RA			0.486* (.147)	
X42	<---	Coug				1.000
X41	<---	Coug				0.918* (.217)
X16	<---	Coug				0.441* (.109)

CMIN=470 d.f = 111 CMIN/DF = 4.236 CFI = 0.691 , SE in parenthesis.

So we estimated the structural Equations (1) and (2) in Table 2.2 through the structural regression analysis. The diagrammatic representation of the structural model is given in Figure 3.2 and estimates are presented in Table 3.2

In below in the Figure 3.2 which presents the path diagram for the estimated model on the health and opportunity cost. This path diagram includes the set of 17 structural equations from the confirmatory factor analysis (Table 2.1) and two equations from the structural model or SRM (Table 2.2).

Fig. 3.2. Path Diagram for Estimated Model Cost of Illness / Structural Regression Model



In Figure 3.2 path diagram include the two endogenous variable as health and opportunity cost and twelve exogenous variable, namely asthma (AST), byssinosis (BYS), respiratory allergy (RA), cough, age, income (Inc), education (Edu), duration of work (DW), smoking (Sm), use mask (UM), dust level (DL) and overtime work (OT).

Table 3.2

Results of Structural Regression Model

	Health Cost	Opportunity Cost
AST	742.74	490.5
	(0.002)	(0.000)
BYS	250.32	485.49
	(0.008)	(0.137)
RA	798.18	579.15
	(0.000)	(0.000)
Coug	407.14	164.93
	(0.000)	(0.000)
Sm	178.74	28.01
	(0.000)	(0.249)
Age	2.08	7.14
	(0.074)	(0.000)
Inc	0.012	0.010
	(0.098)	(0.002)
Edu	5.14	0.019
	(0.481)	(0.995)
DW	9.87	6.43
	(0.044)	(0.003)
OT	6.895	6.03
	(0.041)	(0.000)
UM	0.626	46.55
	(0.09)	(0.05)
DL	105.4	4.3
	(0.000)	(0.758)

CMIN =1864, d.f[1] =382, CMIN/DF=4.8, CFI=0.635 P-values in parenthesis.

In Table (3.2) shows the results of structural regression model (SRM) which measured the impact of latent diseases and other variables on health and opportunity cost. The latent variable chronic diseases, Byssinosis, chronic

[1]d.f= P(P+1)/2-K.
P= number of items, K= number of parameters.

cough, asthma and respiratory allergy have positive coefficients are significant at one percent level, meaning thereby that workers with these conditions have higher medical and opportunity costs.

One respiratory disease byssinosis are statistical significant to health cost (HC) but not significant to opportunity cost (OC) with expected positive sign (P=0.137). However byssinosis is significant with the OC at the univariate level but it is insignificant at the multivariate level when we attached the other variables in the structural equation model (SEM). Byssinosis is brown lung disease which occurs due to the dust pollution exposure [Hinson (2014)]. As workday lost is one censored variable so the present study results shows that may worker not miss the work last two weeks due to the byssinosis and so not bear the opportunity cost. Study has the some policy and time restrictions so collected the data only for last two weeks, thus the impact of this limitation occurs on results.

Age is significant at one percent level (P = 0.000) to OC but at ten percent to HC with the expected positive sign and age coefficient has the positive sign which shows that old age workers have the more medication and opportunity cost because they have work in the same industry from the number of the years as survey data shows that some workers have the 20–25 years work experience and also these old age workers are mostly uneducated. The uneducated workers are not follows the safety health measures so these workers suffer the number of the respiratory diseases and bear the cost of illness. It is well established fact that age has dominant effect on the health and working capacity of a man. A young person can work for more time and not much susceptible to diseases than old one. Old people are highly affected from respiratory diseases. So, working capacity of different age group workers is different. Age group of respondents is given an important position in the present study.

The coefficient income has the positive sign which is statistical significant at five percent (P=0.002) and ten percent level (P=0.09) in both opportunity and health cost respectively. The positive sign of the coefficient income mean higher income and higher income or positive income associated with the higher medical and economic expenditure. Adhikari (2012) reported the same results about positive income effect on mitigation cost. Literatures highlight that which workers have the higher income they spend more income on their health. Same results proposed by the Chowdury and Imran (2010) that better standard of living and positive income have positive effect on the medical expenditure.

The variable smoking has a significant positive relationship on health cost of the textile workers. Smoking is injurious to health is a very well-known proverb. Smoking is has very bad effect on the respiratory system of a human body. It causes various diseases like asthma, shortness of breath, cough, T.B, and lungs carcinoma. Ghasemkhani, *et al*. (2006) also described that smokers have the higher prevalence of the respiratory diseases and symptoms.

So smoking has the significant impact on the health cost of the workers which mean smoker workers tolerate more medical expenses as compared to the non-smoker workers. As a result, smoking affects the working capacity of workers thus they bear the additional cost. The results of the SEM indicate that smoking is not significant to opportunity cost since opportunity cost is workday miss cost may workers not miss their work last two weeks due to the effect of the habit of the smoking. A same result was declared to the Gupta (2006) in his study he did not found the significant relationship between cost and smoking habit.

The duration of employment in the textile industry also significant at the 5 percent level on both opportunity and health cost. The prolonged period of employment in the dusty section of the textile industry have the negative impact on the worker health [Vays (2000)].

Ghasemkhani, *et al.* (2006) and Memon, *et al.* (2008) indicate that long duration of employment in the textile industry have the major role in the development of the respiratory diseases among the textile workers. Ghasemkhani, *et al.* (2006) described that the incidence of the respiratory diseases increased with the age and duration of employment. Farooque, *et al.* (2008) observed that those workers had the more respiratory illnesses which work in the same industry last 10 to15 years. The present study pragmatic that around the 62 percent workers had the duration of employment in the textile industry between 6 to 15 years. Therefore the long period of the employment in the textile industry has the impact on the worker health and thus worker bear the more health and opportunity cost.

The relation of use mask with opportunity and health cost is significant at 5 percent (P=0.05) and at 10 percent level (P=0.09) respectively but it coefficient positive sign is surprised for the study. Use of mask is very good habit during work in textile industries. It helps to overcome the allergy and other respiratory illness in workers but the results of the survey data shows that 77 percent workers not used the mask during the work.

The literature and general evidence shows that there is positive association between dust level and prevalence of the respiratory diseases. Dust level has the positive relation with the health and opportunity cost. It is statistical significant at 1 percent with the HC (P=0.000) but not significant with OC (P=0.758). The positive sign of the coefficient shows that higher the dusts level higher the health cost of the textile workers. Su (2003) highlighted that high prevalence of the byssinosis among workers significantly associated with the high dust level, 45 percent workers had the symptoms of byssinosis due to high dust exposure. The above Table result shows that dust level is not statistical significant to opportunity cost but it has positive sign (P = 0.758). The positive sign of the coefficient of dust level indicate that higher the level of dust is positively associated with the opportunity cost (high level of dust→ increase the cost).

Some our demographic variables like gender, education and heat or temperature are not significant to the cost of illness. Gender and temperature are also not significant in Gupta (2006) study. In present study, the frequency of female workers in textile industry is very less as compared to the male workers, so for this reason the variable gender is insignificant.

Structural regression models are usually evaluated in term of how well they fit the data. The goodness of fit of the models measured by the usually chi square statistics.

In order to check to check the overall goodness of fit in SEM model usually we are using the two criteria of chi-squared statistic one is the CMIN/DF[2] and second is the comparative fit index (CFI).In general CFI ranges from 0 to 1and the larger value of CFI is indicating good model fit, the acceptable range of the CFI is between 0 to 1 and it is good fit model if CFI is near to 0.9 or 1. In our study CFI =0.63 is close to 0.9 or 1 which indicated that model good fit the data and CMIN/DF=4.8 which is the less than to the table value 5, the table value roughly is closed to 5 thus H0[3] is acceptable so the calculated value should be less than the table value. When considered the following indices then data model fit is considered acceptable.

4. CONCLUSION AND POLICY IMPLICATIONS

4.1. Conclusion

This study is conducted in the textile industry of the Faisalabad. The primary goal of the study was to assess the impact of dust pollution on worker health, productivity and cost. This study found the high prevalence of the respiratory diseases and symptoms among the textile workers. This shows that workers lose their productivity and working capacity in the textile industry. The 69 percent workers reported that due to the illness their work performance in industry not normal, they suffered the problems during the work such as muscle aches, wheezing, chronic cough, asthma, respiratory allergy etc. This indication that workers are exposed to the dust pollution illnesses. Study also measured the prevalence of the respiratory diseases among the textile workers. Study revealed that (35.5 percent) workers had wheezing, (65.5 percent) phlegm, (58 percent) chest tightness, (72 percent) had a throat irritation problems.

Study observed that almost 30 percent workers suffered the health cost (HC) between the 1 to 500 rupees, 15 percent in the range of 600 to 1000 rupees, 15 percent among Rs 1100 to 2000 and 2.5 percent between 2100 to 2500 rupees in the last two weeks. Due to the last two weeks workday lost 41 percent workers beard the opportunity cost in the range of Rs 500 to 1500.

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[2]CMIN : Chi-Square minimum, CFI: Comparative fit index, d.f: degree of freedom.

[3]In SEM , H0: model fit the data.

H1: model does not fit the data.

The research paper provided the conclusive evidence on the opportunity and health cost. The reduction in dust pollution positively impact on the health and opportunity cost status of the workers. The results evidently show that reduced in dust will reduced the respiratory diseases and due to the reduction in respiratory diseases will reduced the health and opportunity cost.

4.2. Policy Implications

The safe workplace environment gives the indication of the good health, increase in productivity of the workers and also enhances the production of the industry. The Govt. should to take such inventiveness measure which reduced the dust from the textile industry and promote the safe and clean environment and also take such initiative to measure the dust level within the industry on overtime.

Govt. should to give the subsidy in polluted industries such as textile; construction industries etc. for the installation of the modern technology and make the law and policies for such type of industries to check the level of dust in these industries on the daily or weekly basis. If clean working environment promote in our industries we observed the great change in the health status of the worker and change in economic condition of the worker.

Factory owners must needed to adopt such technologies in industry which automatically abate the dust pollution during the work. Factory owner also should to compensate the affected workers for their health losses in terms of the reduction in the opportunity cost which they bear due to absent from work due to the dust pollution sickness. Industry administration has to arrange the programmes and training workshop about awareness of the dust pollution hazards among the workers.

The textile industry worker should to follow the preventive safety measures; they must wear the mask during the work and adopt such useful measures which prevent them from the dust during the work.

The industry proprietors have the great indication on the business as usual basis to potentially increase their savings in terms of the provision of the healthy work environment. When workers have the less prevalence of the respiratory diseases, they will have the more working capacity and they will increase the production level of the industry. Industry owner should to increase their economic performance in terms of the safe provision of the working environment and this effort of the firms mean they play a vital role in the sustainable development of the country. The evidence shows that safe environment have the significant positive impact on the workers health as well as on their social life. The healthy and mentally relax workforce play the vital role in the sustainable development of the country.

The purpose of the present study is to aware the policy makers, Govt and other stakeholders about the tangible opportunity and health costs that workers bear due to the dust pollution in the textile industry so the policy-makers should to adopt such interventions which tackle the dust pollution from the textile industries of the Pakistan.

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