

# Identifying Allostatics and Some of its Predictors in Spinning and Weaving Cotton Industry Workers

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## ABSTRACT

Textile workers are subjected to many health hazards. Identifying risk predictors at early stage help as a predictive and preventive measure that saves workers from critical health condition in the future. Allostatic load index (ALI) is a potential indicator of complex health conditions that may result in chronic diseases if not properly managed. A sample of 75 male workers in cotton textile weaving and spinning participated in the study. They were examined clinically for their blood pressure and pulmonary functions. They completed their socio-demographic and work-related questionnaire. Blood samples were also withdrawn from the study sample to analyze some biochemical markers. ALI was then calculated for the whole sample using six parameters: cortisol, thyroid stimulating hormone, body mass index, systolic and diastolic blood pressure and heart rate. Statistical analysis showed descriptive data and a multiple linear regression model was performed to detect the factors that mostly contributed to the sample deteriorated health as per ALI. Results showed good mean value for ALI (2.2), yet the long exposure duration showed significant positive correlation with allostasis. Pulmonary function test, expressed in terms of forced expiratory volume, and age also showed significant direct correlation with ALI. In conclusion workplace stressors and the late effects of particulate matter are potent hazards threatening the health of cotton textile workers.

## INTRODUCTION

Textile industries play a crucial role in the economic development of developed and developing countries [1]. In Egypt, the textiles and clothing industry contributes to both employment and foreign exchange earnings. cotton industry in particular, accounted for 25% of the Egyptian cumulative exports in 2008 possessing the third rank [2]. However, cotton industry workers are subjected to various occupational hazards that threaten their health and wellbeing.

Chronic respiratory symptoms and reduction in lung function has been described as common health problems among textile workers in low- and middle-income countries [3]. Particularly workers at weaving and spinning sectors represent the highest risk group due to increased dust levels that are related to the development of such respiratory symptoms [4] with some studies

ensuring the absence of safe level of exposure to particulate matter below which no negative health effects appear [5]. Besides, Smoking was reported as additive factor that aggravates disastrous effects of cotton dust exposure [6].

Duration of exposure of textile workers to environmental dust represents another risk factor of their debilitating health status especially those related to pulmonary diseases [7]. Moreover, the increase in age adds to health risk for textile workers since failure of cellular maintenance pathways allows various kinds of tissue damage [8].

The aforementioned predictors could greatly affect the general state of physical health of cotton textile workers that could also be reflected on their state of allostasis. One of the best explanations of allostasis has been introduced by Peters and McEwen's [9]

### Quick Response Code:



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**Received:** July 06, 2021      **Published:** July 15, 2021

**How to cite this article:** Nagat Mohamed A, Eman Essam S, Salwa Farouk H, Mai Sabry S. Identifying Allostatics and Some of its Predictors in Spinning and Weaving Cotton Industry Workers. 2021- 4(3) OAJBS.ID.000304. DOI: [10.38125/OAJBS.000304](https://doi.org/10.38125/OAJBS.000304)

who described it as an active process through which our bodies adapt to and defend the self against environmental threats and stressors in order to maintain homeostasis and secure survival. Allostasis is measured by what is called Allostatic Load Index (ALI) that is calculated in terms of a set of biomedical markers reflecting an individual's health state. Risk threshold is calculated for the different markers through one of the documented methods reported by literature [10] then an index is constructed where presence of more than three markers exceeding the risk threshold would indicate state of allostasis.

Research has greatly recommended determination of ALI for detecting the effect of environmental exposures on health [11]. Allostasis has also been detected for numerous occupationally exposed populations including those of an airplane manufacturing plant [12], industrial employees [13], teachers [14], health care and information technology professionals [15] and others [16].

In the present work, the aforementioned predictors have been investigated to identify their contribution to health risk among weaving and spinning cotton textile workers.

## SUBJECTS AND METHODS

The study sample included 75 male worker of weaving and spinning in one of the biggest cotton industry factors in Egypt. After completing approval consents to participate in the study, applicants were interviewed to record some socio-demographic and work-related data that included their age and total working years at time of performing the study. Weight and height of all participants was measured then used to calculate their body mass index (BMI).

Clinical examination was performed for participants in the form of heart rate and blood pressure measurements. Pulmonary function tests were also carried out using portable spirometer (Spirostik version 1.2.2).

A 5ml blood sample was taken and collected in plane tube to carry out the biochemical analyses. Serum was separated after centrifugation at 3000 rpm and blood was kept at -20 till analyzed within one month of collection and storage.

Cortisol and Thyroid Stimulating Hormone (TSH) were estimated by ELISA method using kit supplied from Perfect Ease Biotech (Beijing) Co., Ltd. Parameters chosen for calculation of AL were cortisol and TSH as primary markers and SBP, DBP, BMI and HR as secondary markers. High risk threshold was calculated as the value above the 75<sup>th</sup> percentile regarding the cut points as defined by the markers' normal ranges rather than the measurement's distribution within the study population. The ALI has got a range from 1 to 6 for each case where each reading exceeding the threshold takes the score of one and for each participant his scores on the six biomarkers are summed up. ALI score of three or more indicates unfavorable health state [10].

Data was collected, tabulated and manipulated using Excel sheets. Then statistical analyses were performed using the statistical package for social sciences, version 22 for windows (SPSS Inc., USA). Results included descriptive means and standard deviations, and linear regression with determination of Person correlation.

## RESULTS

Table 1 shows descriptive data of study sample represented by mean/standard deviation, minimum and maximum values of

study parameters. The whole sample was 75 representing 62.5% of the workers' force in the weaving and spinning section of textile industry factor under study. All were males whose age ranged between 23 and 53 years old with a mean of 38 years. Occupational exposure had the mean of 16.7 years and ranged between 6 and 29 years where participants worked solely in the textile industry. Cortisol level for the study sample exceeded above the normal range (50-230ng/ml) with indication of acute state of stress. While TSH mean level was within normal (0.26 - 4.2  $\mu$ IU/ml) as well as that of Systolic and diastolic blood pressure and heart rate.

**Table 1:** Descriptive statistics of study variables and measures.

	Mean $\pm$ SD	Minimum	Maximum
Age	38 $\pm$ 6	23	53
Occupational Exposure	16.7 $\pm$ 4.6	6	29
BMI	26.4 $\pm$ 4.4	19.5	43.6
Cortisol (ng/ml)	254.5 $\pm$ 72.3	89.6	400.4
TSH ( $\mu$ IU/ml)	1.9 $\pm$ 2.6	0.12	18.8
SBP	128 $\pm$ 19	90	180
DBP	82 $\pm$ 11	60	110
HR	79 $\pm$ 13	50	108
FEV <sub>1</sub> (L)	3.4 $\pm$ 0.6	1.6	4.6
FEV <sub>1</sub> /FVC (%)	90 $\pm$ 8	70	100
FEV <sub>1</sub> /VC (%)	81.7 $\pm$ 8.7	57	100
PEF (L/s)	6.5 $\pm$ 1.9	0	11.9
ALI	2.2 $\pm$ 1.0	0	5

**Table 2:** Linear multiple regression for variables predicting allostasis.

ALI					
	Beta	SE	Standardized Beta	T	P
Age	-0.013	0.028	-0.071	-0.445	0.658
Exposure	0.72	0.035	0.325	2.088	0.041
FEV <sub>1</sub>	-0.348	0.224	-0.192	-1.554	0.126
Smoking	-0.591	0.341	-0.217	-1.73	0.089

Multiple linear regression was performed with ALI as the dependent variable and age, duration of exposure, smoking and FEV<sub>1</sub> as the independent variables (Table 2). The model was not adjusted for other confounding factors like smoking habits, comorbidities and chronic disease due to lack of data. The model showed to be significant with  $p=0.027$ , 0.118 as adjusted R<sub>2</sub> and describing about 8% of the phenomenon under study. Duration of exposure represented the only significant predictor among study variables at  $p<0.05$  (Table 3). Pearson Correlation test showed direct association between ALI and each of age and duration of exposure that was significant in case of the later. Significant indirect association was detected between ALI and both smoking and pulmonary function test; forced expiratory volume (FEV<sub>1</sub>) (Table 3).

**Table 3:** Pearson Correlations between variables of the regression model.

	ALI	Age	Exposure	FEV <sub>1</sub>	Smoking
ALI	1				
Age	0.109	1			
Exposure	0.281*	0.612	1		
FEV <sub>1</sub>	-0.217*	-0.08	-0.019	1	
Smoking	-0.243*	0.16	0.021	0.11	1

## DISCUSSION

The present work aimed at determining the mostly contributing factors in the expected health deteriorations among weaving and spinning cotton textile workers. In fact, the obtained results ensured many of the study assumptions where the population were found to have mean cortisol level exceeding the upper normal limit which could indicate acute state of stress [17]. ALI is another stress marker that is a cumulative measure of the effect of multiple stressors and the process of responding to these stressors on the soma [18]. ALI normally increases among sample suffering from chronic stress which doesn't seem to the case in the present study. For that reason, a regression model was constructed to detect the most hazardous risk factors that are threatening the study population at their current situation. The studied predictors were age, exposure duration to textile particulates, smoking and pulmonary function test. The model indicated that the particulate exposure is the most to contribute to the long-term health deterioration of the textile workers which perfectly agrees with literature and with other studies for the authors on textile workers.

At the same time, significant negative correlation was detected between ALI and pulmonary function test. On their study on working females in an urban area of West Bengal, India, who perceived high levels of stress, adverse outcomes were reported in their pulmonary function test results. They had significantly lower values of FEV1 values and a negative correlation with perceived stress score [19]. Laboratory induced interpersonal stress, anger, and sadness have been linked to decreases in pulmonary function. Also, there is considerable evidence for a relationship between negative emotion of all sorts in asthma (anger, anxiety and sadness) and deterioration in pulmonary function [20].

Age on the other hand showed significant positive correlation with ALI which indicate increased health risk among the elderly as reported by many another research [10]. While unexpectedly, smokers showed to be associated with better ALI which could be explained in terms of the role of smoking in reducing acute stress signs that are manifested by people suffering from stressful conditions [21].

## CONCLUSION

In conclusion it is recommended to pay some more attention to eliminate hazards in any working environment to reduce the risk of health deterioration. Accumulation of health risk factors could be of great danger on the long term. Textile workers are particularly a vulnerable population due to the numerous sources of physical and psychological stressors.

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