Biochemical profile of gin women laborers in Tirupur

Abstract
Ginning factories discharge large amounts of cotton dusts that lead to decreased pulmonary function in the exposed subjects. An attempt was made to study the biochemical profile of women laborers employed in ginning factory located in Tirupur, a textile based city in Coimbatore district of Tamilnadu, India. The blood parameters that were analyzed were hemoglobin, total and differential count of leucocytes, erythrocyte sedimentation rate (ESR), total proteins, immunoglobulins, total and isozymic content of lactate dehydrogenase (LDH) and histamine. Student's 't' test was carried out to compare the results with the control women. Correlation analysis was done between/within the biochemical parameters and also between the pulmonary function parameters results reported earlier by Jannet and Jeyanthi. Significant changes in the levels of hemoglobin, ESR, immunoglobins and histamine were reported in this study. Correlation studies between the pulmonary function parameters and biochemical parameters revealed significant negative correlation of FVC, FEV1 and PEF with ESR ($P<0.05$). There was also positive correlation between immunoglobulin G and histamine. A significant negative correlation was observed between LDH1 and LDH3 and between albumin and $\gamma$ globulin. The study suggested that the ginning factory women laborers exhibited significant changes in the levels of certain biochemical parameters apart from the pulmonary functional changes.

Key words: Biochemical profile, gin laborers, pulmonary function parameters

INTRODUCTION
Cotton ginning and pressing have been identified as traditional industries under the unorganized sector which functions on a seasonal basis. Tirupur, a textile city in Coimbatore district of Tamilnadu, is the major exporter in cotton garments and ranks second to Coimbatore city where 18 ginning factories are situated employing 1500 laborers. Women are the major employees in these ginning factories. Studies have reported a high prevalence of pulmonary abnormalities together with respiratory symptoms in these ginning factories. No detailed study has been conducted so far in these ginning factory women laborers to assess their biochemical profile with relation to the pulmonary dysfunction. Blood is a part of the circulatory system of the body and has several functions. Much valuable information can be readily obtained from hematologic tests. A wide variety of pulmonary diseases like asthma and other lung dysfunctions may show signs or symptoms of a hematologic disease like anemia, eosinophilia and are highly associated with air pollutant hazards. Pulmonary function tests supported by blood picture might confirm the clinical conditions of an individual. So the present study was aimed to study the biochemical profile of women laborers in a selected ginning factory at Tirupur and to associate its possible correlation between pulmonary dysfunction.

MATERIALS AND METHODS
Selection of subjects
This study was carried out in continuation of the earlier work done by Jannet and Jeyanthi in a ginning factory located at Tirupur where 104 women laborers formed the experimental group and forty age and sex matched women of similar economic status were selected as controls. The mean age of the experimental group was 55 years with mean working experience of 12 years. Physical examination of respiratory health of workers and control group were conducted in accordance with recommendations outlined in the Declaration of Helsinki. According to Jannet and Jeyanthi study reports, among the 104 experimental group participants, 65.7% manifested...
by Jannet and Jeyanthi.\(^{(1)}\)

**RESULTS**

**Biochemical parameters**

**Hemoglobin and ESR**

The mean levels of hemoglobin and ESR of ginning factory women laborers is illustrated in Table 1.

The mean levels of hemoglobin in ginning factory women laborers \((10.5 \pm 1.892 \text{ g/dl})\) was significantly lower than control women at 1% level. Normal values of hemoglobin in women range from 12-16 g/dl. Seventy seven women laborers were found to have hemoglobin levels below 9.0 g/dl. Among them two were severely anemic \((5.6 \text{ g/dl} \text{ and } 7.7 \text{ g/dl})\). This might be due to their low dietary intake of protein and iron, menopausal state and the lowering of appetite due to the presence of mucus that would have secreted by the stimulatory effect of inhaled cotton dust.

The experimental group women recorded significant increase \((P<0.1)\) in ESR \((23.99 \pm 4.580 \text{ mm/hour})\) compared to control group. The normal limits of ESR is 0-20 mm/hour. ESR is also increased in chronic infectious diseases like asthma and in anemia, which favour the rouleaux formation of erythrocytes.\(^{(8)}\)

Forty three woman who had decreased levels of hemoglobin also have shown high ESR. Contaminated cotton dust might be one of the reasons for the development of infections. Out of 104 women labourers 93 had ESR values higher than the normal limits. Among them five had ESR values above 30 mm/hour. The high ESR values were more prevalent among chronic bronchitis and asthmatic workers compared to byssinotics and other workers in this study.

**Total and differential count of leucocytes**

Table 2 shows the mean levels of total and differential count of leucocytes in ginning factory women laborers.

Normally the values of total count range from 4000-10,000 x 10\(^6\)/L. The normal distribution of the different types of leucocytes are Neutrophils - 62.0%, Lymphocytes 30%, Eosinophils - 2.3% and Monocytes - 5.3%.\(^{(8)}\) Although the total count and differential count of leucocytes were within

<table>
<thead>
<tr>
<th>Groups</th>
<th>Hemoglobin (g/dl)</th>
<th>Erythrocyte sedimentation rate (mm/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginning factory women laborers</td>
<td>(n=104)</td>
<td>10.5 (\pm) 1.892</td>
</tr>
<tr>
<td>Control women</td>
<td>(n=40)</td>
<td>11.49 (\pm) 1.102</td>
</tr>
<tr>
<td>t value</td>
<td></td>
<td>3.13**</td>
</tr>
</tbody>
</table>

\(^*\text{Significant at 5\% level, **Significant at 1\% level}\)

**Statistical analysis**

Student’s ‘t’ test was carried out to compare the above biochemical parameters between the ginning factory women laborers and the control women. Correlation analysis was done between/within the biochemical parameters and also between the pulmonary function parameters results reported earlier...
the normal limits, the mean levels of total count (9692.98 ± 1840.905), percentage of Neutrophil, (62.55 ± 7.034%) and Eosinophil (5.13 ± 2.081%) were significantly greater in the ginning factory women laborers at 1% level and the percentage of lymphocytes (32.15 ± 7.842%) was significantly decreased in the ginning factory women laborers at 1% level compared to the control group. A non-significant increase in total count was also observed by Cooper et al.,[10] when aqueous extract of cotton bracts were administered to normal volunteers. The mean percentage of neutrophil (62.50 ± 7.034%) in ginning factory women laborers was significantly greater at 1% level than the control women. This is in agreement with the findings of Rylander and Haglind,[11] who reported an increased neutrophil content in cotton dust exposed workers. According to Rastogi and Husain,[12] this infux represents an increase of the body’s defenses toward inhaled agents. The mean eosinophil percentage of ginning factory women laborers (5.13 ± 2.081) was also found to be significantly increased at 1% level compared to the control group. This increase in eosinophils compared to controls suggested an allergic process commonly found in asthma and pulmonary eosinophilia.[13] The cotton dust inhaled by these women would have induced the allergic response in them. Increased eosinophil content (above 7%) was observed in all the four asthmatic cases compared to the rest of the clinical symptoms.

Immunoglobulins

The mean immunoglobulin levels (Immunoglobulin A, M, G and E in ginning factory women laborers) is illustrated in Table 3.

Normal values of Ig A is 71 to 360 mg/dl, Ig M - 40 to 260 mg/dl, Ig G - 620-1840 mg/dl and Ig E- upto 200 IU/ml. The levels of different immunoglobulin reported in ginning factory women laborers were within the normal limits. But a significant increase in Ig A (217.13 ± 90.937 mg/dl) at 1% level, Ig M (141.9 ± 56.616) mg/dl at 5% level and Ig G (1626.6 ± 582.0 mg/dl) at 1% level were seen in the ginning factory women laborers when compared to the control women. No significant change was noticed in Ig E levels although the value was higher.

When comparing the immunoglobulin levels among ginning factory women laborers exhibiting different clinical symptoms, the levels of Ig A was high in grade 2 byssinotics compared to other grades of byssinoic, chronic bronchitis, asthma and other. The levels of Ig M were high in Grade 2 byssinotics and chronic bronchitis cases. Ig G levels were increased only in all grades of byssinosis especially Grade 2 byssinotics. Ig E was seen increased only in all the asthmatic cases four cases and in one chronic bronchitis worker. One asthmatic worker showed very high Ig E levels of 2185 IU/ml. Changes in serum immunoglobulins in workers exposed to cotton dust have been suggested to precede or accompany the development of byssinosis – a cotton dust related disease.[14] Karnik et al.[14] have observed a significant increase in Ig G level in byssinotics (1720.6 ± 450.6 mg/dl) and non byssinotics (1610.5 ± 288.7 mg/dl) a non significant rise in Ig A levels in byssinotics and nonbyssinotics (294.3 ± 132.7 mg/dl) and (213.1 ± 75.5 mg/dl) and Ig M in byssinotics and non byssinotics (161.7 ± 73.3 mg/dl and 148.1 ± 45.6 mg/dl). Taylor et al.[15] suggested an interaction between cotton dust antigen and serum antibody complex. The antigen reacted with Ig G by precipitation and passive agglutinations. Katmar et al.[16] have previously reported a significant rise in Ig G by byssinotics. According to Parkes[17] precipitating Ig G antibody against an antigen in cotton is present in cotton workers. Our findings agreed with this fact that the antibody titre is highest in workers with byssinosis, lower in those without byssinosis and lowest in the unexposed subjects. The fact that symptoms of grade 2 and grade 3 byssinosis disappeared while the workers were still exposed to the dust could be explained on the grounds that, as long as exposure continues, antibody is progressively removed from the circulation leaving insufficient to produce a reaction; whereas

### Table 2: Mean total and differential count of leucocytes in ginning factory women laborers

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total count of leucocytes x 10^6/Litre</th>
<th>Neutrophil</th>
<th>Lymphocyte</th>
<th>Eosinophil</th>
<th>Monocyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginning factory women laborers</td>
<td>n=104</td>
<td>9692.98 ± 1840.905</td>
<td>62.55 ± 7.034</td>
<td>32.15 ± 7.842</td>
<td>5.13 ± 2.081</td>
</tr>
<tr>
<td>Control women n=40</td>
<td>8747.50 ± 1299.80</td>
<td>60.75 ± 6.717</td>
<td>37.40 ± 7.092</td>
<td>1.80 ± 1.652</td>
<td>1.12 ± 0.00</td>
</tr>
<tr>
<td>t value</td>
<td>2.97**</td>
<td>1.39**</td>
<td>3.69**</td>
<td>9.09**</td>
<td>-</td>
</tr>
</tbody>
</table>

**Significant at 1% level

**Table 3: Mean immunoglobulin levels in ginning factory women laborers

<table>
<thead>
<tr>
<th>Groups</th>
<th>Ig A mg/dl</th>
<th>Ig M mg/dl</th>
<th>Ig G mg/dl</th>
<th>Ig E IU/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginning factory women laborers</td>
<td>n=104</td>
<td>217 ± 91</td>
<td>142 ± 57</td>
<td>1627 ± 582</td>
</tr>
<tr>
<td>Control women n=40</td>
<td>116 ± 20</td>
<td>98 ± 14</td>
<td>798 ± 117</td>
<td>134 ± 32</td>
</tr>
<tr>
<td>t value</td>
<td>3.45**</td>
<td>2.38*</td>
<td>4.41**</td>
<td>-</td>
</tr>
</tbody>
</table>

**Significant at 5% level, **Significant at 1% level
after a period away from the dust, during which antibody is not removed, its titre has increased by the time the worker is re-exposed as suggested by Massoud and Taylor.[18] The elevated Ig G antibody titres are probably markers of exposure to cotton dust rather than indicators.[19] A non-significant increase in IgE levels of textile workers was also reported by Zuskin et al.[20]

**Serum proteins**

Our study reported no significant change in the levels of total proteins, albumin globulin ratio, percentage of albumin and globulin levels in the serum of ginning factory women laborers [Table 4].

But the levels of total proteins in all grades of byssinotics were found to be decreased. Similarly non-significant decrease in albumin globulin ratio, increase in β and γ globulins was also observed in byssinotics by Karnik et al.[14]

**LDH**

The normal range of LDH in serum is 230-460 IU/L.[21] Normal serum is richest in LDH1 and LDH2 with less of LDH3 and least of LDH4 and LDH5 which sometimes may even not be detected. Changes in isozymes may be seen even when total LDH activity is still within normal limits.[21] The present study aimed to estimate the total LDH level in serum and to assess LDH isozyme patterns particularly LDH3 levels which is the primary LDH isozyme of the lungs.

The serum LDH levels and its isozymes distribution are portrayed in Table 5.

There was no significant change in total LDH level and in LDH1, LDH2, LDH3 levels in serum among the ginning factory women laborers compared to control women. But a non-significant increase in LDH1 and non-significant decrease in LDH3 was observed in the ginning factory women laborers. The increase in LDH1 and decrease in LDH3 was seen more in the case of byssinotics compared to other group. A significant alteration in LDH1 and LDH3 isozymes in byssinotics was also observed by Karnik et al.[14]

**Histamine**

Cotton dust extract induces the release of histamine from samples of human lung tissue *in vitro*. Therefore it is believed that histamine release is responsible for the major symptoms of byssnosis, viz, "chest tightness".[7]

The mean blood histamine in ginning factory women laborers (9.4223 ± 5.844 µg/ml) significantly increased at 1% level compared to the control women. Bhatt et al.,[22] have also reported significantly high histamine levels (6.02 ± 4.79 µg/ml) in cotton dust exposed textile workers at Ahmedabad. Likewise Patel et al.[24] have also observed significantly increased histamine levels in cotton mill workers (Byssinotics 10.24 ± 2.15 µg/ml). Similar results were also observed in the present study where byssinotics showed increased histamine levels compared to other clinical symptoms. Increased histamine level on the first working day is in agreement with Monday morning syndrome. One grade 1 byssinotic worker showed highest blood histamine level (23.0 µg/ml).

Nowier et al.[24] have also reported higher blood histamine levels in cotton dust exposed workers. This increased level of blood histamine in ginning factory women laborers might be due to the histamine liberating factor of cotton extracts namely endotoxins of gram negative bacteria.[25] It may also be due to the release of leucocytes mainly basophils contain histamine granules and respond to agents that cause release of histamine.[25] This was also supported by the work of Ellisade et al.[26] and Panchal et al.[27] who suggested that mast cell degranulation with its release of histamine had been strongly implicated in the acute symptoms in cotton textile workers.

**Table 4: Mean serum protein levels in ginning factory women laborers**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total proteins g/dl</th>
<th>Albumin globulin ratio</th>
<th>Albumin %</th>
<th>α₁</th>
<th>α₂</th>
<th>β</th>
<th>γ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginning factory women laborers n=104</td>
<td>7.53 ± 0.567</td>
<td>1.43 ± 0.261</td>
<td>64.64 ± 7.148</td>
<td>2.96 ± 0.973</td>
<td>10.90 ± 3.640</td>
<td>11.90 ± 3.640</td>
<td>9.77 ± 4.073</td>
</tr>
<tr>
<td>Control women n=40</td>
<td>7.73 ± 0.383</td>
<td>1.57 ± 0.051</td>
<td>67.05 ± 2.886</td>
<td>3.76 ± 0.257</td>
<td>9.52 ± 0.331</td>
<td>10.39 ± 1.006</td>
<td>9.34 ± 2.578</td>
</tr>
<tr>
<td>t value</td>
<td>1.02</td>
<td>1.73</td>
<td>1.00</td>
<td>2.50</td>
<td>1.05</td>
<td>1.27</td>
<td>0.30</td>
</tr>
</tbody>
</table>

**Table 5: Mean serum lactate dehydrogenase levels in ginning factory women laborers**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Lactate dehydrogenase IU/L</th>
<th>Lactate dehydrogenase isozymes %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LDH1</td>
<td>LDH2</td>
</tr>
<tr>
<td>Ginning factory women laborers n=104</td>
<td>367.3 ± 58.596</td>
<td>41.3 ± 1.691</td>
</tr>
<tr>
<td>Control women n=40</td>
<td>372.6 ± 23.381</td>
<td>40.7 ± 0.877</td>
</tr>
<tr>
<td>t value</td>
<td>0.27</td>
<td>1.03</td>
</tr>
</tbody>
</table>
Correlation studies

Correlation studies between the pulmonary function parameters and biochemical parameters revealed significant negative correlation of FVC, FEV1, and PEF with ESR (P<0.05). PEF was significantly negatively correlated with total protein and total count of leucocytes at 5% level. Correlation within the biochemical parameters is shown in Table 6.

The existence of high correlation of IgG with histamine was also reported by Kamat et al.,[16] in byssinotic cotton textile workers. The significant increase in LDH1 associated with decrease in LDH3 (negative correlation), negative correlation of albumin with β and γ globulin was also in concordance to the results reported by Karnik et al.,[14] in cotton textile workers.

DISCUSSION

The present study suggested that the ginning factory women laborers exhibited significant changes in the levels of certain biochemical parameters apart from the pulmonary functional changes, which was reported in earlier studies. Routine analysis of pulmonary function parameters in these women supported with biochemical analysis will help to frame the medical treatment for the affected women. Change in the levels of ESR, LDH3 and Histamine may be used as indicators to assess pulmonary dysfunction in the women those are exposed to cotton dust. The elevated Ig G antibody titres can be probably used as markers of exposure to cotton dust. It was suggested that the low hemoglobin and poor immunity against diseases may also predispose the out come pulmonary dysfunction at an earlier stage.

The following recommendations were suggested for controlling the occupational lung diseases and the associated biochemical changes caused by cotton dust in the ginning factory women laborers:

1. Periodic health surveillance to be made essential to control both pulmonary abnormalities and biochemical changes.
2. Proper treatment to be given to the affected women.
3. Awareness to be created among the proprietors and the workers.
4. Some low cost iron rich foods like greens, drumstick leaves and jaggery were recommended to be added in their diet.

Table 6: Pairs of biochemical parameters showing significant correlation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Correlation</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ig G / Histamine</td>
<td>Positive</td>
<td>0.6995*</td>
</tr>
<tr>
<td>Ig G / β globulin</td>
<td>Positive</td>
<td>0.5748*</td>
</tr>
<tr>
<td>Ig M / α globulin</td>
<td>Negative</td>
<td>-0.5748*</td>
</tr>
<tr>
<td>Albumin / β globulin</td>
<td>Negative</td>
<td>-0.9081**</td>
</tr>
<tr>
<td>Albumin / γ globulin</td>
<td>Negative</td>
<td>-0.5739*</td>
</tr>
<tr>
<td>LDH1 / LDH3</td>
<td>Negative</td>
<td>-0.8120*</td>
</tr>
</tbody>
</table>

*Significant at 5% level, **Significant at 1% level

ACKNOWLEDGEMENT

We deeply acknowledge the Management of Karunya University, Coimbatore, Department of biochemistry, Avinashiingam University, Coimbatore and Dr. Mahadevan, Pulmonologist, KG Hospitals, Coimbatore, for their encouragement and support in this study.

REFERENCES


Source of Support: Nil, Conflict of Interest: None declared.