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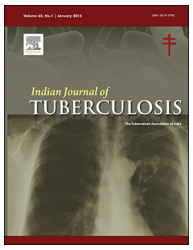

Original Article

Lung health and heart rate variability changes in salt workers

M.I. Glad Mohesh [a,*], A. Sundaramurthy [b]

[a] Assistant Professor, Department of Physiology, Shri Sathya Sai Medical College & Research Institute, Ammapettai, Kancheepuram District, 603108, Tamilnadu, India
[b] Department of Pulmonary Medicine, Shri Sathya Sai Medical College & Research Institute, Ammapettai, Kancheepuram District, 603108, Tamilnadu, India

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ABSTRACT

Background: India is the third largest salt producing country in the World, with a global annual production of 230 million tonnes. Large number of salt workers get employed in these salt milling plants risking their life from the effects of salt. Recent foreign evidences reported that these salt workers are exposed to aerosol salt particles that disturb their lung and cardiovascular autonomic control.

Objectives: To compare the status of lung health, cardiovascular autonomic control and biochemical changes in a group of salt industry workers with that of the age-matched normal subjects.

Methodology: Volunteers of both sexes (25–35 years) were divided into Group I ($n = 10$) controls and Group II ($n = 10$) non-brine salt workers in salt milling plants. From fasting blood sample, complete blood count, plasma electrolyte and lipid profile estimation were done. After resting for 15 min, blood pressure and lead II ECG were recorded. Spirometry was done using RMS Helios spirometer. Data collected were later analysed using GraphPad Prism 5.0 with statistical significance set at $p < 0.05$.

Results: Blood pressure recorded showed a slight elevation in the subjects than that in the controls. Significant rise of plasma sodium (141.9 ± 0.4, 138.7 ± 1.0, $p < 0.008$) and chloride (113.9 ± 1.3, 107.7 ± 1.4, $p < 0.005$). Spirometric tests showed mild obstructive airway disease in the subjects with FEV_1 and FEV_1/FVC significantly lower than the controls (81.11 ± 3.8, 92.0 ± 3.3, $p < 0.049$), (37.4 ± 4.0, 112.8 ± 1.7, $p < 0.0001$), $FEF_{25–75\%}$ (123.3 ± 5.6, 101.0 ± 5.6, $p < 0.01$). Heart rate variability parameters also showed statistically significant variation.

Conclusion: Exposure to salt aerosols by the workers in the salt industry has shown a little or no impact on the respiratory system, however there are changes in the blood and cardiovascular system, which need to be further studied to understand the long-term influences of salt in this population.

* *Corresponding author*. Tel.: +91 044 27440346.
E-mail address: gladmohesh@gmail.com (M.I. Glad Mohesh).

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1. Background

Salt milling industries were seen across the coastal India. We are the third largest salt producing country in the world, with global annual production of 230 million tonnes.[1] Large number of salt workers do get employed in these salt milling plants risking their life from the effects of salt. Very less studies have been done on these workers on their lung health and cardiac autonomic health status. In Tamilnadu, the districts of Kancheepuram, Cuddalore, Nagapattinam, Ramanathapuram, Kanniyakumari and Tuticorin are well known for their salt pans and salt milling plants. All evidences to prove the association between dietary salt and hypertension are available, and also studies that showcases if the intake of sodium is lowered in these hypertensive's, the possible extent of lowering blood pressure that could be achieved are also documented.[2] A study on the influence of dietary salts' role on hypertension in Dahl rats has mapped the sympathetic neural mechanism's role of afferent baroreceptors, central neural and peripheral adrenergic mechanisms. This study has proved the role of altered sympathetic on salt induced hypertension.[3] Inhaled respiratory irritants such as chlorine can cause chronic airway disease was highlighted.[4] Harbour workers are exposed to the salt aerosols coming directly from the sea, in whom the existence of arterial hypertension is of a serious concern.[5] Authors from India in their study have concluded that inhalation of salt particles by workers in the non-brine areas of the salt milling plants results in increased blood pressure. They have suggested these,

1. Salt particles may be inhaled and can be absorbed in the airway surface of epithelium.
2. Inhaled salt particles may be carried away from the lungs into the blood.
3. Inhaled salt particles may be even carried by the upward mucociliary current to the throat, where they can be swallowed. This in turn could increase the blood pressure and also increases the risk of hypertension in these salt workers.[6] It was also reported that, other than the regular ophthalmic, dermatological and joint problems, prevalence of hypertension was about 12% among the salt workers.[7] Recently some authors have explained how aerosols from sea would contribute significantly to the tropospheric chloride content. This in turn would be available in the atmosphere as an irritant for the lung to cause lung diseases.[8] With more evidences to say that salt workers are exposed to aerosol salt particles, and hence their lung and cardiovascular autonomic control is getting affected, here in this study we used the following testing methods to understand our objectives mentioned below: (a) Spirometry is a standard test to understand, if someone is suffering from obstructive or restrictive lung disease. With the ease of non-invasive approach, the subject's lung health can be assessed. (b) Short-term heart rate variability is an advanced derivative of the 5 min lead II ECG acquired from a subject to record and analyse his cardiovascular autonomic derangements. Biochemical parameters such as plasma sodium, potassium and chloride content can help us in estimating the elevated levels if any.

2. Objectives

To compare the status of lung function, cardiovascular autonomic control status and plasma electrolyte changes in a group of salt workers and age matched normal subjects.

3. Materials and methods

This study was started after getting permission from the Institutional Ethics Committee. Convenience sampling of subjects who were working in salt milling plants for a period of 1 year and between 25 and 35 years of age were included in the study (Group II, $n = 10$). Age matched subjects who do not work in salt milling plant served as controls (Group I, $n = 10$). Smokers, alcoholics and persons with chronic illness or medications for any illness are excluded from the study. Subjects were asked to come to the Medical College Hospital on a particular day and time after fasting overnight between 7 and 8 am. 5 ml of blood was taken in the central lab of the hospital under sterile conditions to estimate the plasma sodium, potassium and chloride. After that, subjects were allowed to take breakfast (given free) with no caffeinated drinks. They were taken to Physiology research lab to record anthropometric data such as height and weight using a fixed stadiometer and Krups weighing machine. After 15 min of supine resting, blood pressure was measured using OMRON HEM 4021 semiautomatic digital sphygmomanometer. Lead II ECG recording was made after the stabilisation of respiratory rate to around 12–18 breaths/min (RMS Polyrite). With the stabilised ECG wave a 5 min continuous ECG recording was made and data were stored in a database (computer) for analysis. Lung function testing was done using RMS Helios 401 spirometer; three attempts were made on each recording. Graphs were checked for acceptability and reproducibility. Printouts of the results were obtained and stored. Following analysis on the data collected was done: (1) Blood pressure (systolic/diastolic) was used to calculate MABP and pulse pressure. (2) Spirometric results to find whether the lung functions are normal/obstructive/restrictive. (3) Interbeat intervals picked up from the 5 min lead II ECG recording were used to derive the various HRV variability measures using Kubios HRV software v 2.1. (4) Biochemical test results from the lab gave an estimation of plasma sodium, potassium and chloride. Statistical significance of the data collected was analysed using Student ''t'' test using GraphPad Prism software with significance set at $p < 0.05$.

4. Results

Our study aimed at the occupational hazards the workers of the salt milling plants who are exposed to a high amount of salt aerosol in the air. Table 1 explains the anthropometric details of the participants. Table 2 showcases the differences

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