

# Study of the prevalence of tinnitus in agricultural workers and non-agricultural workers

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## Abstract

**Background:** Occupational exposure to agrochemicals has increased considerably now-a-days. These agrochemicals are potentially ototoxic causing damage to inner ear. Constant exposure to these chemicals can cause tinnitus, with or without sensorineural hearing loss. This cross-sectional analytical study aims to find out the prevalence of tinnitus among agricultural and non-agricultural workers and to find out whether there is an increased prevalence of tinnitus among agricultural workers compared to non-agricultural workers. **Methods:** The study group consisted of patients with tinnitus attending a tertiary care centre in Central Travancore, Kerala, India during the period January 2015 to December 2018. A questionnaire was developed and distributed among patients with tinnitus to enquire about their demographical and occupational status with years in present job. After analysing the questionnaire, 373 patients were selected for the study. They were divided into two groups based on their occupational status. 224 patients were included in the group of agricultural workers and 149 as non agricultural workers. Detailed ENT examination and Pure tone audiometry was done. Severity of tinnitus was assessed by Tinnitus Handicap Inventory developed by Newman. **Results:** Bilateral tinnitus was more common in agricultural group than non- agricultural group. Majority of Agricultural workers had a moderate hearing loss while the non-agricultural group had mild hearing loss. On analysing the THI score, the agricultural group had more distressing symptom than non-agricultural group and using chi- square test, the THI score was statistically significant with  $p < 0.01$ . **Conclusion:** Agrochemicals do cause significant damage to inner ear which can lead to distressing symptom like tinnitus with or without sensorineural hearing loss.

**Key Words:** Agricultural workers, Inner ear damage, Non-agricultural workers, Pure tone audiometry, Tinnitus, Tinnitus handicap inventory,

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## INTRODUCTION

Tinnitus or ringing sensation in ear is a very distressing symptom to the patient. Various studies showed a prevalence of 5-25 % of tinnitus in general population.<sup>1-3</sup>. Tinnitus can be subjective or objective. Subjective tinnitus is most common. Recent study showed that 7.4 % to 20% of tinnitus patients may have a hearing loss at

high frequencies which might be taken as an evidence for its cochlear origin. The decreased activity of receptor neurons in the cochlea downregulates inhibitory process in higher auditory centres thereby increasing spontaneous activity in auditory cortex causing tinnitus<sup>4</sup>.

Injudicious use of agrochemicals for pest and weed control is increasing nowadays. Often the workers are exposed directly to the chemicals without any personal protective equipment. In a Brazilian study there was 32% prevalence of tinnitus in agrochemical sprayers.<sup>5</sup> The agrochemicals are neurotoxic and ototoxic which contains chemicals like carbon disulfide, butyl acetate, ethyl acetate, transfluthrin and d- trans allethrin which can damage hair cells and central connections. These substances cause excessive glutamate release and intracellular calcium overload which could be the basis of tinnitus by increases cellular electrical activity<sup>6</sup>. This is a cross-sectional analytical study to estimate the prevalence of tinnitus among the agricultural and non-agricultural

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population. The study also aims to find out whether there is an increased prevalence of tinnitus in agricultural workers compared to non-agricultural workers.

### MATERIALS AND METHODS

A cross-sectional study among patients attending a tertiary care centre in Central Travancore, Kerala, India during the period of January 2015 to December 2018. A questionnaire was developed and distributed among all the patients to enquire about their demographical and occupational status and years in present job after taking proper written informed consent. The questionnaire contained details of tinnitus including type, duration, involved ear, associated hearing loss, previous history of any ear diseases or ear surgeries, vertigo and frequent exposure to loud sound. The severity of tinnitus was assessed by THI (Tinnitus Handicap Inventory). After analyzing the questionnaire, 373 patients were selected for the study.

#### Inclusion Criteria

- Age-20 to 50 years
- Ringing sensation in ear as major symptom.

#### Exclusion criteria

- Age: less than 20 years or more than 50 years
- Previous ear diseases like COM, Secretory otitis media
- Tinnitus with organic lesions like glomus tumor, Cerebellopontine angle tumor, Meniere's disease
- Pulsatile tinnitus due to vascular cause
- Ear surgeries in the past
- Previous or constant exposure to loud sound in workplace
- History of previous radiation to head and neck region
- Previous history of head injury
- History of treatment with any ototoxic drugs

The study population of 373 patients were divided into two based on their occupational status and environmental status as belonging to agricultural and non-agricultural workers. Of this, 224 patients were included in the study group and consisted of agricultural workers and those residing in the proximity of paddy fields. The other group consisted of 149 patients who were in the non-agricultural sector and not in close proximity to any paddy fields. A detailed ENT examination was carried out. Pure tone audiometry was done in all patients. Severity of tinnitus was assessed by Tinnitus Handicap Inventory. Data were analysed using SPSS. Descriptive statistics were calculated for all study variables using means and standard deviations for continuous variables and frequencies and percentage for categorical variables. T test for continuous variables and Chi-Square test for categorical variables were used to compare characteristics of each study group.

### OBSERVATIONS AND RESULTS

In agricultural population (n=224) The lower age limit among the agricultural workers were 21 years, and upper age limit was 50. Of the 224 patients in the study group, 178 were males (79%) and 46 were females (21%). 163 patients had bilateral tinnitus (73%) and the remaining 61 had unilateral tinnitus (27%). The minimum duration in the present job was 2 years and maximum was 30 years. Pure tone audiometry showed 76 patients (34%) with moderate sensorineural hearing loss followed by 24% which had a moderately severe hearing loss. 43 patients (19%) with tinnitus had a normal hearing [Table 1]. Graphical analysis of PTA showed 149 patients (67%) with high frequency sensorineural hearing loss and the remaining 75 patients (33%) with a uniform increase in threshold in all frequencies.

Table 1

| PTA GRADING       | NO.OF PATIENTS | PERCENTAGE |
|-------------------|----------------|------------|
| Normal            | 43             | 19%        |
| Mild              | 43             | 19%        |
| Moderate          | 76             | 34%        |
| Moderately severe | 54             | 24%        |
| Severe            | 6              | 3%         |
| Profound          | 2              | 1%         |

THI scores showed a majority of 83 patients (37%) with moderate THI score followed by 25% with discrete score [Table 2].

Table 2:

| THI score    | No of patients | Percentage |
|--------------|----------------|------------|
| Discrete     | 56             | 25%        |
| Mild         | 50             | 22%        |
| Moderate     | 83             | 37%        |
| Severe       | 28             | 13%        |
| Catastrophic | 7              | 3%         |

**In non agricultural population (n=149)**

Lower age limit was 23 years and upper age limit was 50 years. 78 patients (52%) were males and 71 patients (48%) were females. The shortest duration in present job was 2year and longest was 28 years. 96 patients (64%) had unilateral tinnitus and 53 patients (36%) had bilateral tinnitus. Majority 27% had normal hearing and 24% had mild sensorineural hearing loss. 76 patients (51%) had high frequency sensorineural hearing loss and 73 patients (49%) had an increase in threshold in all frequencies [Table 3].

**Table 3**

| PTA grading       | No of patients | Percentage |
|-------------------|----------------|------------|
| Normal            | 40             | 27%        |
| Mild              | 36             | 24%        |
| Moderate          | 32             | 21%        |
| Moderately severe | 22             | 15%        |
| Severe            | 12             | 8%         |
| Profound          | 7              | 5%         |

Majority 30% had mild THI score followed by 26% with moderate [Table 4].

**Table 4:**

| THI SCORE    | NO.OF PATIENTS | PERCENTAGE |
|--------------|----------------|------------|
| Discrete     | 21             | 14%        |
| Mild         | 45             | 30%        |
| Moderate     | 39             | 26%        |
| Severe       | 33             | 22%        |
| Catastrophic | 11             | 7%         |

**Table 5: Statistical analysis**

|       |                     | Correlations |        |        |        |
|-------|---------------------|--------------|--------|--------|--------|
|       |                     | Age          | Years  | PTA    | THI    |
| Age   | Pearson Correlation | 1            | .810** | .382** | .209** |
|       | Sig. (2-tailed)     |              | .000   | .000   | .000   |
|       | N                   | 402          | 402    | 400    | 402    |
| Years | Pearson Correlation | .810**       | 1      | .260** | .130** |
|       | Sig. (2-tailed)     | .000         |        | .000   | .009   |
|       | N                   | 402          | 402    | 400    | 402    |
| PTA   | Pearson Correlation | .382**       | .260** | 1      | .428** |
|       | Sig. (2-tailed)     | .000         | .000   |        | .000   |
|       | N                   | 400          | 400    | 400    | 400    |
| THI   | Pearson Correlation | .209**       | .130** | .428** | 1      |
|       | Sig. (2-tailed)     | .000         | .009   | .000   |        |
|       | N                   | 402          | 402    | 400    | 402    |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**DISCUSSION**

Tinnitus originates from the Latin word 'tinnier' meaning to ring. Mc Fadden's described tinnitus "as the conscious expression of a sound that originates in an involuntary manner in the head of its owner or may appear to him to do so"<sup>7</sup>

Prevalence of persistent spontaneous tinnitus in adult population varies from 5- 25% in various study. In an Indian study, the prevalence was 7%<sup>8</sup> Tinnitus is classified into two categories, objective and subjective. Subjective tinnitus is more common. They arise due to pathologies within the cochlea or in the central auditory pathway. According to Henry *et al* <sup>9</sup>, limbic system and

the autonomic nervous system are activated by the tinnitus signal which causes the irritation felt by the tinnitus patient. In this study severity of tinnitus is assessed by Tinnitus Handicap Inventory proposed by Newman. Females perceive the symptoms more distressing than males. Tinnitus may be the just warning symptoms of inner ear damage. Those patients with tinnitus and normal hearing initially can progress to higher threshold shift in hearing later on. Injudicious use of agrochemicals for pest and weed control is increasing nowadays. Often the workers are exposed to these chemicals without any personal protective equipments. Although occupational noise exposure and tinnitus has

been studied widely, the impact of pesticide induced tinnitus and hearing loss has not been studied widely. In Brazilian study there were 32% prevalence of tinnitus in agrochemical springlers. The agrochemicals are neurotoxic and ototoxic. They contain chemicals like carbon disulphide, butyl acetate, ethyl acetate, transfluthrin and d-trans allethrin which can damage outer hair cells. These chemicals produce biologically active oxygen free radicals which damage transmembrane ion channels in outer hair cells <sup>10</sup>. These causes excessive glutamate release and calcium overload which could be the basis of tinnitus by increasing cellular electrical activity <sup>11</sup>. Increased spontaneous firing further damage inner hair cells thereby decreasing activity of auditory nerve and downregulates inhibitory process in higher auditory centres. The increasing spontaneous activity in the auditory cortex cause the sensation of sound. In the present study in both agricultural and non- agricultural group the number of males were more than females, as male population were more involved in occupation. The age distribution was comparable in both groups. In agricultural group more patients (73%) had bilateral tinnitus. This explains the fact that ototoxic agrochemicals damage both the ear simultaneously. Also the audiometrical analysis in this group shows more patients with high frequency hearing loss substantiating the theory that the basal turn of cochlea is more affected. PTA grading in the agricultural group showed more patients with a moderate hearing loss 34%, while 19% had normal hearing. Tinnitus with normal hearing patients can in future develop deterioration in hearing due to further damage to the outer hair cells. So tinnitus can be an initial symptom of impending hearing loss. THI Scores in the agricultural group showed a majority with a moderate score followed by discrete. Though the hearing loss is subtle, patient's tinnitus can be very distressing. In the non-agricultural group more patients had a normal hearing. THI score in majority of patients in this group showed a mild handicap 30%. The results showed increased level of hearing loss and THI Score in agricultural population than in non agricultural population as the cited references points out. Statistical analysis using T-test for equality of means shows statistical significance for THI grading, PTA <0.01 Pearson Chi

Square test was used to compare characteristics of each study group and THI score, PTA found to be statistically significant with p-value of < 0.01.

## CONCLUSIONS

The study showed that agrochemicals had caused significant inner ear damage leading to troublesome tinnitus and sensorineural hearing loss.

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