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Original Research Article

A study on behavioural effects of laboratory rats (albino wistar) after the sub-chronic noise stress

Bodhika J. A. P.*, J. R. I. A. Jayakody

Department of Physics, University of Ruhuna, Matara, Sri Lanka

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***Correspondence:**
Dr. Bodhika J. A. P.,
E-mail: jbodhika@phy.ruh.ac.lk

ABSTRACT

Background: Humans and animals can hear a wide range of sound frequencies. If the sense of hearing is impaired, both man and animal cannot fare well in their respective environments. Present study is aimed to investigate the behavioral effects following the sub-chronic noise stress of a rat species, Albino Wistar.
Methods: The sound source consists of a set of speakers, GWINSTEK AFG-2000 series function generator and an amplifier. Sound levels and frequencies were monitored by B and K type 2250 sound level meter. Six adult Albino Wistars were exposed to sound frequencies of 1-20 kHz, at intervals of 1 kHz at LAeq of 70-80 dB for 5minute periods and their behavior was recorded. In the second test four adult rats were randomly divided into control and test groups. The test animals were exposed to noise of 7, 8, 9 and 10 kHz for 4hrs daily while keeping the control group in same room for same period of time without exposing to the sound. Locomotive activity, increase of defection and decrease of social activities, of rats was assessed by open field test (OFT). Anxiety and depressive behavior were monitored by elevated plus maze test (EPM) and tail suspension test (TST).
Results: A different behavior in rats was observed in frequency range of 7-10 kHz. At the beginning of exposure, all rats were huddled in a group and then some were frozen into motionless stance. A less time spent and less number of entries in open arm was noticed in test sample compared to the controls in the EPM test. A tendency to move to open field compared to controls was identified in OFT. The TST revealed that a significant increase in immobility time, which indicates a depression like behavior of noise stressed rats compared to controls.
Conclusions: According to the study the most effective noise frequency range for rats is 7-10 kHzl.

Keywords: Albino wistar, Behavioral effects, Noise stress

INTRODUCTION

Humans and animals can hear a wide range of sound frequencies. A repeated exposure to loud sounds over longer time periods may lead to the development of a number of different effects. A common reaction is a feeling of disturbance of ongoing activities or interference with the quality of the environment. If the sense of hearing is impaired, both man and animal cannot fare well in their respective environments.[1]

Noise is defined as a displeasing and unwanted sound. Noise pollution is one of the major environmental problems in many cities with the rapid urbanization. Noise could cause annoyance, aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects.[2] Especially, the level of noise exposure and the period of noise exposure are very important in human health.

Mankind is exposed to a number of stressors in the daily routine life and among them noise is the most encountered stressor, produced by urban traffic, noise from work environment and house hold appliances.[3] Environmental noise induces alterations of different physiological responses in the exposed individuals.[4] Susceptibility of noise hearing is depended on the species. Animals have a different sensitive frequency range that may inaudible to human. Cattles hear high frequency sounds much better than humans; their most sensitive audible sound is at a higher frequency, at about 8 kHz.[5] According to literature birds have the greatest increase of auditory threshold in the higher frequency ranges after exposure to noise of 95-100 dB.[6] Mice and rats' sensitive hearing frequency lay between the ranges of 1 kHz to 50 kHz.[1] When comparing rat and human hearing sensitivity, sound intensity level of rats are 10-20 dB less than human's.[4]

Present study is aimed to investigate the behavioral effects following the sub-chronic noise stress of a rat species, Albino Wistar.

METHODS

Ten adult Albino Wistar animals were used for the study. They have been exposed to noise by keeping them in an acoustically insulated wooden cage. The noise source consists of a set of speakers, GWINSTEK AFG-2000 series function generator and an amplifier. The noise level intensity and frequencies were monitored by B and K type 2250 sound level meter. In the first experiment rats were kept in a cage having free access to food and water, exposed to sound frequencies of 1-30 kHz, at intervals of 1 kHz at LAeq of 70-80 dB for 5minute periods and their behavior was recorded. A significant different behavior in rats was observed in frequencies of 7-10 kHz. Therefore, the rest of the studies are mainly focused on this frequency range.

In the second test rats were randomly divided into control and test groups. The test animals were exposed to noise of 7, 8, 9 and 10 kHz for 4hrs daily for continuous 12 days period.[3] Speakers were located 10 cm above the cage. The control group of rats was kept in same environment for the same period of time without exposing to the noise. All rats were undergone for three tests, Open Field Test (OFT), Elevated Plus Maze test (EPM) and Tail Suspension Test (TST).[7] Setups used for each test are shown in the Figure 1. The behavioral responses of rats were assessed by OFT. As shown in the Figure 1 the floor of the testing box is a rectangle (100 x 80 cm), divided into 80 equal squares. Numbers of squares crossed by each animal were counted for 5 min period.[2]

The common assessment for anxiety like behavior in Albino Wistar is the elevated plus maze test (EPM).[8] The setup used in this experiment consisted of two open arms crossed with two closed arms. The arms were connected with a central square, which makes plus sign appearance of the setup. As shown in Figure 1, setup was elevated 50 cm above the floor. In the experiment each rat was placed in the central square facing the closed arm. The time spent and number of entries to the open arm by the rat was monitored.[2]

Figure 1: Behavioural observation box, open field test box, elevated plus maze and tail suspension box.

The method used here to monitor the depression behavior of rats is tail suspension test (TST).[9] In this the rat was suspended from his tail for a short period of time (5min) in a wooden box as illustrated in last photograph of the Figure 1 and the immobile time was recorded. The rat was suspended at the center of the roof by tail from the hook with a glue tape.

RESULTS

Behavioral observation

In first experiment just after starting the noise exposure, all rats were gathered in a group and then some were stationary in the motionless stance. Rats get exhausted

within 6 hours. If the testing exceeds 6 hours they tend to sleep. From the beginning 6 rats were fed with 2 cups of food pellets per day. But at the last few days food pellets were left in the cups without consuming.

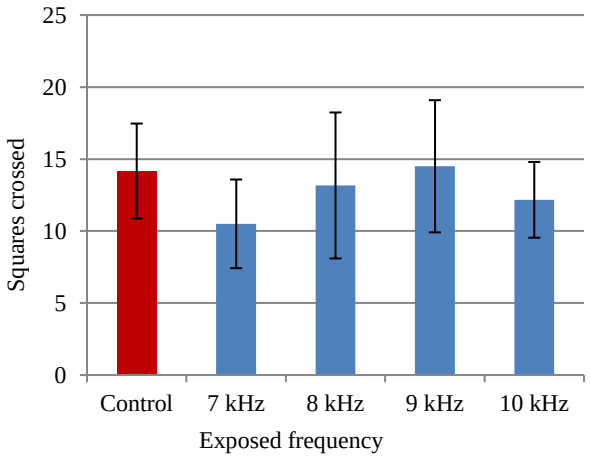

Figure 2: Comparison of average number of squares crossed by a rat in open field test.

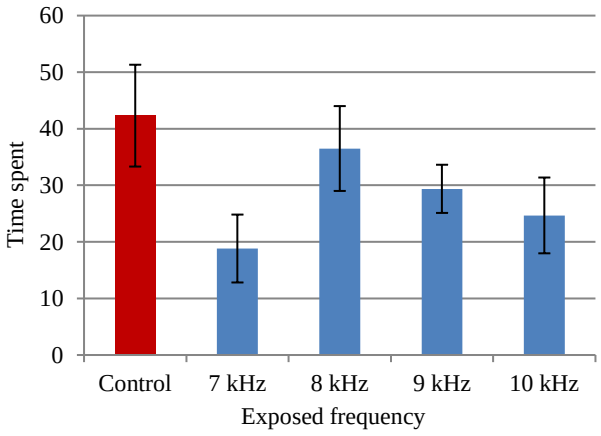

Figure 3: Comparison of average time spent by a rat in elevated plus maze test.

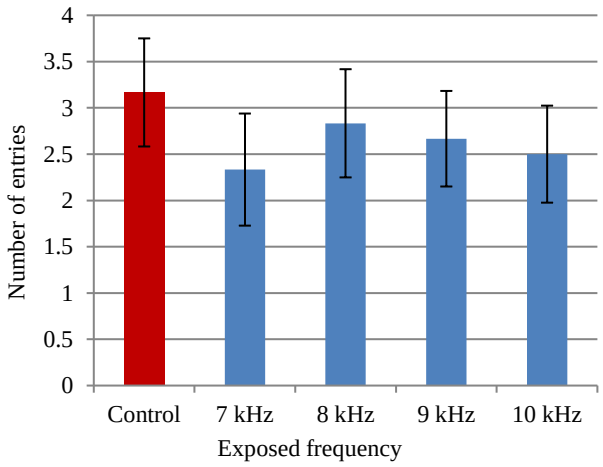

Figure 4: Comparison of average number of entries to open arms in elevated plus maze test.

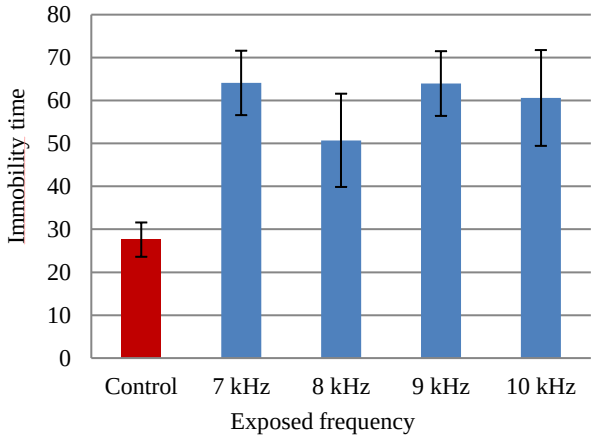

Figure 5: Comparison of average time spent immobilized in tail suspension test.

Open Field Test (OFT), Elevated Plus Maze test (EPM) and Tail Suspension Test (TST). The results of analysis of tests of OFT, EPM and TST are shown in the Figures 2, 3, 4 and 5.

DISCUSSION

The results of the first test done to investigate the behavioural observations of noise stressed animals, evidence that the sound exposure tends to decrease the food consuming behaviour also. Quiet high difference (continues scratching of ears and neck) could be observed in the behavior in 7 kHz-10 kHz frequency range. In behavior observation, continuous noise of 70-80 dB was shown to increase defection and reduction of social activities. Therefore, the second step of the experiment was followed in the frequency range of 7-10 kHz.

Analysis of open field test showed that, significant tendency to move in open field to explore novel environment by rats exposed to the 7 and 10 kHz. Analysis of elevated plus maze activity of rats showed significant decreases in time spent in open arm for frequencies 7 and 10 kHz and number of entries in open arm decreases in rats exposed to noise compared to control. Analysis of tail suspension test showed a significant increase in immobility time indicating a depression like behavior of rats exposed to noise of frequency 7 and 10 kHz compared to controls. The noise exposed rats exhibited increase in immobility compared to controls. A less time spent and less number of entries in open arm was noticed in test sample compared to the controls in the EPM test. A tendency to move to open field compared to controls was identified in OFT. The TST revealed that a significant increase in immobility time, which indicates a depression like behavior of noise stressed rats compared to controls.

In general noise disrupts the activity of human and animal life and causes psychological and physiological effects in people.[10] Noise in farm animal environments

cause detrimental factors on their health. Especially long-lasting noise is more effective. Noise directly effects on energy consumptions of animals.[11] Noise may have indirect effects on changes in habitat use, courtship and mating, reproduction and parental care.[12]

CONCLUSION

In behavior observation, continuous noise level of 70 - 80 dB of frequency range 7 kHz-10 kHz was shown to increase the defection and reduction of social activities of tested animals.

Analysis of open field test showed significant tendency to move in open field to explore novel environment by rats exposed to the 7 and 10 kHz. Analysis of elevated plus maze activity of rats showed significant decreases in time spent in open arm for frequencies 7 and 10 kHz and number of entries in open arm decreases in rats exposed to noise compared to control. The noise exposed rats exhibited increase in immobility compared to controls. According to this study the most effective noise frequency for rats is 7 and 10 kHz and which agreed with the findings of Fizza N et al.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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