

The Effects of Acute and Chronic Noise Stress on the Body Weight of Male Albino Rats

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ABSTRACT

Objective: To observe the effects of acute and chronic noise stress on the body weight of male albino rats.

Study Design: comparative and experimental study

Place and Duration of Study: This study was conducted at the Department of Anatomy, in Basic Medical Sciences, Institute of Jinnah Postgraduate Medical Center, Karachi for a period of 2 months.

Materials and Methods: 30 rats were put under observation to observe the effects of noise. 10 were put as a control, 10 were exposed to acute noise (24 hrs) and the remaining 10 were exposed to chronic noise for (4hrs/ day for 30 days).

Results: It was observed that the rats who were subjected to chronic noise showed more decrease in body weight as compared to the rats that were exposed to acute noise.

Conclusion: It was modulated that stress induced cortisol release in the blood has an effect on the body weight.

Key Words: Cortisol, Noise stress, Hypothalamo-pituitary-adrenocortical (HPA) axis, White noise

INTRODUCTION

Stress is a constant theme in our lives.¹ It is simply a fact of nature, forces from outside the world affecting the individual. Hence, all living creatures are in constant interchange with their surroundings (the Ecosystem), both physically and behaviorally. This interplay of forces, or energy, is of course present in relationships between all matters in universe, whether they are animate (living) or inanimate (non living).² Living is stressful.³ Hans Selye one of the pioneer stress researchers said, "The absence of stress is death". He stated that stress was not something that necessarily had to be avoided. It is an everyday fact of life.⁴ In our modern society, we are barraged with various forms of stress throughout the day. We are readily able to adapt to some of those stresses, yet others are or become seemingly insurmountable.⁵

The stress response of a body is meant to protect and support us. To maintain stability or homeostasis, the body is constantly adjusting to its surrounding.⁶ Homeostasis is the organism's capacity to withstand stress and maintains a stable, relatively constant environment.⁷ This maintenance of body steady state or homeostasis is essential for life. This complex dynamic equilibrium is constantly challenged by intrinsic or extrinsic adverse, real or perceived forces, the stressors.⁸

Noise is one of the stress factors, which is seemingly becoming a major problem in our population because of heavy traffic, generators and many more. However, an effective agent to counter the noise stress-induced biochemical alteration remains elusive. Noise can be defined as unwanted sound in the wrong place at wrong time.⁹ It is an unwanted sound without agreeable

musical quality. Thus, otherwise sound and noise can be taken to mean the same thing, but in considering our acoustic environment, we must differentiate between these two terms. It is only when the effect of sound is undesirable that it may be termed as noise.¹⁰

The word noise is derived from Latin word "Nausea" meaning "Sea sickness".¹¹ Its intensity is measured in decibel units. Noise level exceeding maximum permissible limits causes several physical ailments and social and emotional problems.¹² This environmental physical agent, in addition to hearing impairment, also causes behavioral, mental and wide spread disturbances at several levels in human organs due to chemical and physiological modification of endocrine, cardiovascular, nervous,¹³ respiratory¹⁴⁻¹⁵ and immune system.¹⁶⁻¹⁷

Noise is a growing concern all over the world. In the modern life almost everything around us can be a source of noise. 60-80% of noise in the city is emitted by auto transport.¹⁸ Traffic noise has emerged in recent years as ever present but often under estimated pollutant in our lives. In Europe, the population exposed to levels above 65db increased from 15% in 1980 to 26% in early 1990s. For comparison, speech can be understood fairly well with background noise levels up to 55dB.¹⁹

Pakistan is one country where urban sights and sounds resonate more with noise and air pollution than anything else.²⁰ Air, water and noise pollution level in Pakistan is one of the highest in the world and is causing serious health concerns. A recent survey carried out by the Columbia and Yale universities on environment performance has ranked Pakistan 127th of 133 countries assessed. This means that Pakistan is among first 7 countries that forced serious

environmental hazards.²⁰ According to a study conducted in 1994, noise levels from traffic in Lahore, Karachi, Hyderabad and Faisalabad range from 74-90dbA, 92-94dbA and 73-88dbA respectively. 6 places in Lahore, 7 places in Karachi, 6 places in Hyderabad and 2 places in Faisalabad were identified where the noise levels were greater than maximum permissible levels.²¹

A large number of people are exposed to potentially hazardous noise level during daily life, such as work environment, urban traffic, household appliances and discos. All of these noises are the combination of sounds of different frequencies and are known as White noise.²²⁻²³

Keeping in view, the above facts the current study is designed to observe the effects of noise stress on body weight of albino rats.

MATERIALS AND METHODS

Thirty normal, adult and healthy male albino rats of ages (90 - 120 days) weighing 220-350 grams were used. The animals were kept under observation for one week prior to the commencement of the experiment for assessment of their general state of health on the basis of weight gain or loss. Furthermore, this was also essential to acclimatize the animal to the environment of experimental room. All the animals were kept on standard laboratory diet and under closely controlled environmental conditions of 12 hour light / 12 hour dark cycle at room temperature.

All the animals were divided into three groups. The group A will serve as control, animals of group B were exposed to loud noise 100 dB for the period of 24 hours and received injection 0.9% normal saline intraperitoneally before the exposure to noise and then had been sacrificed after acute noise exposure of 24 hours and the animals of group C were exposed to loud noise 100 dB for 24 hours and received injection 0.9% normal saline before getting exposed to noise every day. The animals had been sacrificed at the end of 24 hours.

All the animals were numbered, weighed and kept in proper cages, under natural environment. Diet and water were supplied ad libitum. All the experimental procedures were performed between 8:00 am to 12:00 pm in order to avoid circadian variations. General appearance, i.e. activity, behavior and their food intake were monitored daily.

NOISE STRESS INDUCTION PROCEDURE:

Broad band noise (white noise) was produced by a white noise generator (which can generate sound of different frequencies) and amplified by an amplifier which was connected by loud speakers installed at a distance of 40cm at two opposite sides of the animal cage. The intensity of the sound was measured by precision sound level meter (TES -1351). Noise level was set at 100 dB uniformly through out the cages. The

noise level of 100 dB is chosen because it is comparable with the noise level detected in discos, some industrial places and noise produce by some pressure horns used in most of the metropolitan cities of Pakistan.

RESULTS

A total of 30 rats were included, which were divided into 3 groups. The mean body weights of animals in different groups are summarized in figure 1 & table 1. The mean body weight of control animals was found to be 292.5 ± 12.82 grams.

The mean body weight of animals exposed to 24hours noise stress was 289.4 ± 6.39 grams before the commencement of experimental procedure and was 279.55 ± 5.58 grams at completion of experimental procedure. A significant decrease in weight was observed ($P < 0.0001$) when weight of animals before and after the induction of 24hours noise stress was compared. There was 3.36% loss in weight was observed before & after induction of noise stress.

The mean difference in the initial and final weight of rats in acute exposure is 9.85 (3.40%) as compare to the mean difference in initial and final weights of rat in chronic response which is 32.6 (11.9%) as stated in table 1.

Table No. 1: Variable

	Control (A)		Acute Noise Stress (B)		Chronic Noise Stress (C)	
	Ini (g)	Fin (g)	Ini (g)	Fin (g)	Ini (g)	Fin (g)
Mean	292.3	292.3	289.4	279.55	274.5	241.9
SEM	12.83	12.83	6.39	5.58	11.74	10.49

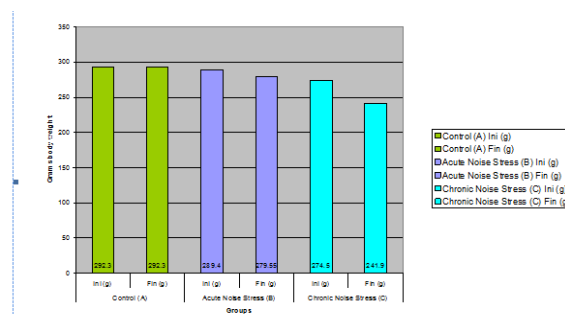


Figure 1: Body weight of animals

A highly significant decrease ($P < 0.0001$) in mean final body weight (241.8 ± 10.49 grams) in animals exposed to 30 days (chronic) noise stress was observed when compared with mean initial body weight (274.40 ± 11.74 grams). A 11.9% decrease in final body weight was observed in comparison to initial body weight in same group.

DISCUSSION

Noise is a significant environmental problem²⁴ and has potential to cause stress reaction.²⁵ WHO regards noise as a major threat to human well being.²⁶

Among different sources of noise, road traffic noise is far more pervasive and the leading source of community noise.²⁶ Traffic noise is a dominant source of annoyance in the living environment of many Asian and European countries.²⁷ Over 96 million persons are estimated to be exposed in and around their homes, to undesirably high traffic noise levels.

According to the organization of Economic Corporation and development study 1991 state of the Environment Publication, people consider noise to be the main local environmental problem, sometimes even more important than air pollution or the quality of drinking water.²⁸

According to permissible level document by environmental protection agency, the level of 55dB outdoor and 45dB indoor are identified as preventing activity interference and annoyance.^{12, 29} The noise level above 76dB is considered as moderate to high risk.³⁰

In the present study, the effects of high intensity noise level (100 dB) applied for shorter duration (acute) and for longer duration (chronic) on the body weight of rats were observed. The exposure of animals to noise stress (100 dB) causes highly significant reduction in body weight, whether subjected to acute or to chronic noise stress. More marked weight loss was observed in animals exposed to 30 days (chronic) noise stress with 11.9% reduction was observed in final body weight. This is found in accordance with a study conducted by Nagaraja et al., 2006³¹ where more weight loss seen in animal subjected to 14 days isolation stress. According to Vallès et al., 2000 this stress induced weight loss is due to decrease food intake due to stress induced anorexia.³² Verma et al., 1999 has reported that exposure to surgical stress causes disrupted cyclical and diurnal rhythm in food intake.³³ Weisinger et al., 2000 conclude that stress induced decrease food intake is due to increased CRH secretion which becomes the cause of weight loss.³⁴ Jalali M et al, 2012 has also reported a significant reduction of final body weight of animal ($P < 0.05$) when exposed to noise pollution as in comparison with the control group which also showed decrease in weight but not significant. This finding is in agreement with the present study which reveals that the noise stress leads to a significant reduction of body weight.³⁵ Chen J et al, 2008 revealed that there were no significant effects on water intake but significant effects were found on food intake and body weight of animal leading to reduction of body weight when animals were exposed to restraint stress. This finding is also comparable to this study which also reveals the reduction of body weight.³⁶ It is beneficial to do more research with different forms of noise to better understand the intense effect of noise on the body weight.

CONCLUSION

It was modulated that stress induced cortisol release in the blood has an effect on the body weight.

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