Effect of noise stress on count, progressive and non-progressive sperm motility, body and genital organ weights of adult male rats

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ABSTRACT

AIMS: It was decided to investigate the effect of noise pollution on the body weight, genital organ weights, and also on sperm parameters. **SETTING AND DESIGN:** It is a prospective study designed *in vitro*. **MATERIALS AND METHODS:** A total 20 adult male wistar rats were used in this study. All rats were divided into 2 equal groups ($n = 10$): (1) control group and (2) experimental group. Animals of the experimental group were exposed to noise for 50 days with an intensity of 90-120 db and frequency of 300 - 350 Hz for 12 hours daily. After 50 days, at first, body weights of all animals were recorded, and then they were killed. The right epididymides were removed and also, sperm concentration and motility were determined. Each organ was weighed separately on an electronic balance. **STATISTICAL ANALYSIS USED:** Data are reported as mean ± SD and percentage. The statistical significance of difference between the control and experimental groups was determined by the unpaired *t*-test. **RESULTS:** The weights of the testes, epididymes, seminal vesicle, ventral prostate were found to be significantly decreased in rats exposed to noise pollution when compared with the weights of the same organs obtained from control group ($P < 0.05$). There was a statistical difference of $P < 0.05$ between the 2 groups in terms of sperm concentration. **CONCLUSIONS:** It is concluded that noise pollution has the bad effects on sperm concentration and motility; therefore, it is supposed that homes and places of working must be build far away of noisy of factories and other places with noise.

KEY WORDS: Hormone, infertility, pollution, pregnancy

INTRODUCTION

Stress is simply a fact of nature forces from the inside or outside world affecting the individual. The individual responds to stress in ways that affect the individual as well as their environment. There are different types of stress, which have negative effects on the different body parts. Many studies on the effect of stress on the sex hormonal and reproductive systems have been done. The results of these studies were shown that stress reduces testosterone and spermatogenesis levels.[1] Previous study have shown that prolactin secretion is increased, GH is decreased and FSH and LH responses are more complex after repeatedly carried from room to room of rats.[2] Previous study has shown that radio radiation stress caused an increase in the number of dead germ cells.[3] Many researchers have shown that the forced swimming stress caused the spermatogenesis significantly reduced in male rats.[4,5] It has been shown that stress has a bad effect on reproductive process in female such as maturation and development of oocytes.[6,7] Stress can cause various diseases such as, disturbed amount and quality of sleep.[8,9] harms the heart system, nervous system, and hearing system[10,11] and also affects the level of insulin, hormone,[12] morphology of testis,[13] function of testis and anterior Pituitary.[14] The purpose of the present study was to determine whether 50 days noise stress applied to adult male rats affects the genital organ weight, count, and motility of sperm.

MATERIALS AND METHODS

Animals

20 wistar male rats were purchased from AJUMS animal research center. All rats were

randomly divided into 2 equal groups (n = 10): (1) control and (2) experimental groups. All animals were housed individually per cage under a 12-h light/dark cycle, 20 ± 2°C temperature, and 60 - 65% humidity-controlled room with food and water *ad libitum*.

Experimental design

In this research, at first, the cage of experimental group was transported to the room, which had dimensions of 3 × 4 × 3 meter and was lagged by wood and acoustic segments (anti-loud voice). In the room that experimental group is located, the set of WHITE NOISE which produce noise was prepared at 19 O'clock in the case of the frequency of 300 - 350 HZ and intensity of 90 - 120 db.[15] And the set' timer was located in the way of that after 1 hour of operation and producing noise by speaker, for few minutes (From 15 to 60 minutes) will be turning off, and then operates. Of course, we must mention that this causes that non-compatibility of animal with the aperture itself in the period of 2 - 3 minutes changes the intensity and frequency of produced voice automatically in the district of minimum and maximum, and this helps to non-compatibility.[15] For to be sure of an amount and intensity of voice, the noise level meter was used and thus rate and intensity in this way is controlled. Turning on the aperture at the 19 O'clock, and turning it off at the 7 O'clock of morning for 50 days is continuing, which is period of Rat spermatogenesis. After passing this duration, at first, body weights of all animals were recorded, then they were killed and its right epididymides were removed and its sperm concentration and motility were determined. The genital organs also were extracted.[16]

Sperm preparation

Male rats in 2 groups of study were scarified in animal lab of anatomical sciences of AJUMS by cervical dislocation. Then, the cauda epididymis removed and immediately inserts into a 150 μL drop of TYH medium + 5 mg mL^{-1} Bovine Serum Albumin (BSA) under mineral oil (Sig., embryo-tested, cat. No. M8410). The epididymis contents were squeezed out.[17]

Sperm analysis

Sperm count and motility of the 2 studied groups were determined using a Makler chamber. All counts were performed at 37°C in T6 medium. The sperm motility was assessed and classified as progressive and non-progressive. Initial sperm motility was manually assessed by a single individual in duplicate for each sample by evaluating 100 sperms. Total motility was defined as any movement of the sperm head, and progressive motility was defined as the count of those spermatozoa that moved in a forward direction.[18]

Body and organ weights

The initial and final body weights of the animal were recorded. The reproductive tract was trimmed off of fat, and each organ was weighed separately on electronic balance. The reproductive organs taken into account for study in male included testes, epididymes, ventral prostate, seminal vesicle, and vas deferens.

Statics analysis data are reported as mean ± SD and percentage. The statistical significance of difference between the control and experimental groups was determined by the unpaired *t*-test. Differences between the means were considered to be significant when $P < 0.05$ was achieved.

RESULTS

The number of sperm and percentage of spermatozoa showing progressive motility, non-progressive are showed in Table 1. The sperm concentration of male rats in the control and experimental groups were 63.7 ± 6.910^6/ml and 29.7 ± 4.910^6/ml, respectively. There was statistically difference between the 2 groups of study in terms of sperm concentration ($P = 0.001$). The percentage of sperm with progressive motility was 61.26 ± 5.42 in the control group and 33.89 ± 3.56 in the group exposed to noise stress. The difference was highly significant ($P = 0.005$). The percentage of sperm with non-progressive motility was 30.79 ± 4.59 in the control group and 46.32 ± 2.17 in the group exposed to noise stress. Statistical analysis showed that the percentage of non-progressive sperm motility significantly increased in the experimental group ($P = 0.002$).

As shown in Table 2, the noise pollution caused a reduction in final body weight of animal experimental group when final body weight (180 ± 5.7 g) was compared with controls (213 ± 7.6) ($P < 0.05$). The body weight in control group was 223 ± 8.9 g and 213 ± 7.6 g in initial and final of study, respectively. Statistical analysis showed that the weight of body did not change significantly during 50 day of study ($P > 0.05$). In experimental group, the final body weight

Table 1: Effect of noise stress on count, Progressive sperm motility, and non-progressive sperm motility of sperm in adult male rats

Animal study variable	Control group (n = 10)	Experimental group (n = 10)	*P* value
Sperm count (10^6/ml)	63.7 ± 6.9	29.7 ± 4.9	0.001
Progressive sperm motility (%) (mean ± SD)	61.26 ± 5.42	33.89 ± 3.56	0.005
Non-progressive sperm motility (%) (mean ± SD)	30.79 ± 4.59	46.32 ± 2.17	0.002

Table 2: The different between control group and experiment group in term of body and genital organ weights

Animal study variable	Control group (n = 10)	Experimental group (n = 10)	*P* value
Body weight (g) (initial)-Final	(223 ± 8.9) 213 ± 7.6	(213 ± 6.5) 180 ± 5.7	(*P* = 0.09) *P* = 0.04
Weight of testis (mg.100 g-1 body weight)	704 ± 15.3	615 ± 12.8	*P* = 0.01
Weight of pididymies (mg.100 g-1 body weight)	290 ± 17.8	240 ± 11.3	*P* = 0.03
Weight of seminal vesicle (mg.100 g-1 body weight)	305 ± 12.3	250 ± 9.9	*P* = 0.02
Ventral prostate (mg.100 g-1 body weight)	220 ± 8-6	160 ± 9.1	*P* = 0.01
Vas deferens (mg.100 g-1 body weight)	98.6 ± 3.8	87.7 ± 7.9	*P* = 0.07

(180 ± 5.7 g) significantly changed when compared with an initial weight (213 ± 6.5 g) ($P > 0.05$). In present study, the weights of the testes, epididymes, seminal vesicle, ventral prostate, and vas deferens were 704 ± 15.3, 290 ± 17.8, 305 ± 12.3, 220 ± 8.6, 98.6 ± 3.8 in control and 615 ± 12.8, 240 ± 11.3, 250 ± 9.9, 160 ± 9.1, 87.7 ± 7.9 in experimental groups. The weights of the testes ($P = 0.01$), epididymes ($P = 0.03$), seminal vesicle ($P = 0.02$) and ventral prostate($P = 0.01$) were found to be significantly decreased in rat exposed to noise pollution when compared with the weights of the same organs obtained from control group. The weight of vas deferens in 2 groups of study was not different ($P = 0.07$).

DISCUSSION

Today, noise pollution has been recognized as one of the problems of human societies, and studies about the effect of stress on human life seems essential. The role of noise pollution as one stress in terms of different diseases was studied and its effects on the body hormones, pregnancy, abnormal child birth, premature child birth and even weight and the number of children is being reviewed.[11,15,19] The present data demonstrated that sperm count and also progressive motility significantly decreased after 50 days of noise exposure. Complete sequence of spermatogenesis constitutes 48 - 53 days in the rat.[4] Many studies showed that spermatogenesis has been inhibited in response to various stressors.[20,21] The major part of controlling of sexual actions in males and females by secreting gonadotropin releasing hormone (GnRH) is done by hypothalamus. This hormone, in turn, stimulates anterior hypophisis and causes the increasing of two other hormones such as LH and FSH. LH hormone is the major stimulator for secreting testosterone of testicle, but FSH stimulates spermatogenesis. Previous study showed that using of traffic voice with an intensity of 100 db caused that the amount of testosterone level in the male Albino rats have been significantly reduced.[22] In another study, it was demonstrated that reduction of testosterone level is accompanied by significant reduction of the sperms count.[23] Therefore, according to previous studies, it can be concluded that the cause of reduced sperm count in this study is concerned to reduce testosterone production. Present study has shown that progressive motility of male rat sperm significantly decreased after 50 days of noise stress, which may highlights the harmful effect of loud voice on motility of rat sperm. Sperm motility was obtained by making cross epididymis. It is suggested that the reduction of the sperm motility, due to noise, seems to have negative impact on epididymis. In present study, the weights of the testes, epididymes, seminal vesicle, and ventral prostate were found to be significantly decreased in rats exposed to noise pollution when compared with the weights of the same organs obtained from control group. This data is in agreement with the previous studies. It is well-known that the weight and size of testes, epididymies, seminal vesicles, and ventral prostate are closely regulated by androgen hormones.[24,25] In this study, weight loss of testicles and other sex organs may be due to decreased testosterone hormone or due to direct effects of noise pollution. To better understand the mechanism of noise pollution on the male reproductive system, it is recommended that further studies to be done in this area.

CONCLUSION

The present data demonstrate that noise pollution after the period of time necessary to complete an entire cycle of the spermatogenesis, between 48 and 53 days when applied to adult male rats, the number of sperm as well as motility of sperm will significantly decrease. Therefore, it is supposed that homes and the places of working must be build far away of loud voices of factories and other places with noise.

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