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Case Report

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Laboratory Rodents Negatively Affected by Construction Environment

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This report describes rodents in a laboratory animal facility that was adversely affected by a noisy environment during construction work. There was much noise and vibration as well as dust caused by the drilling and hammering. The noise levels, frequencies, and length of time when occurring in the drilling and hammering, were all measured. The drilling showed noise levels ranging from 50-90 decibels (dB) (A-filter, A), and the hammering presented 60-70 dB (A). Some researchers raised problems regarding animal experiments, including skin injuries resulted from self-mutilation, and increase of mortality. This gives useful information to people who plan to renovate laboratory animal facilities as it is a very rare case.

Key words: Adverse effect, animal welfare, construction, mouse, noisy environment, rat

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The laboratory animal research facility at Asan Institute for Life Sciences was renovated. The institute is a five-story building, and the facility was only on the fifth floor. The renovation plan was partially designed to improve the old facility and also to construct a completely new animal facility on the fourth floor of the building. As researchers did not want to stop animal experiments during the renovation, the construction work was carried out separately in two segments (Figure 1). First, the remodeling for the new facility on the fourth floor was begun first. Then, after finishing this remodeling, the animals housed on the fifth floor were moved to the new animal facility of the fourth floor. Then, the second remodeling for the old fifth-floor facility was started.

During the construction work, there was much noise and vibration as well as dust caused by the drilling and hammering, all of which usually occurred in the early stage of all the remodeling (Figure 1). We measured the noise levels throughout the facility using a simple sound meter (OS-11, ONSOKU, Japan). The noise levels, frequencies, and amount of time per frequency of the drilling and hammering, are summarized in Table 1. Drilling showed noise levels ranging from 50-90 decibels (dB) (A-filter, A) and was focused in the 60-80 dB level. Hammering presented lower noise levels ranging from 60-70 dB (A), compared with those of the drilling. The rodents housed in the animal research facility were adversely affected by the construction environment. Three weeks after beginning of the remodeling, some researchers raised problems regarding the animal experiments. The problems included skin injuries resulting from self-mutilation (Figure 2), and an increase of mortality (Table 2). Also killing and eating litters, increases in blood sugar levels, and infertility were found in some mice and rats (data not shown). The complaints were primarily when remodeling on the fourth floor.

To confirm the relationship between potentially infectious diseases and the construction-related problems, health monitoring tests were reviewed. We did not find any changes of infectious pathogens in the animal housing areas detected by the health monitoring reports conducted both before and during the construction (Tables 3 and 4). The health monitoring report summarized the results of tests performed at ICLAS Monitoring Subcenter Korea, KRIBB. The tests were screened annually with sentinel animals. The sentinel testing was conducted as follows: two of 4-week-old ICR mice or Sprague-Dawley rats were placed on each rodent rack as sentinels. Such sentinel animals were maximally exposed weekly to all of the other animals in the rack, typically using soiled

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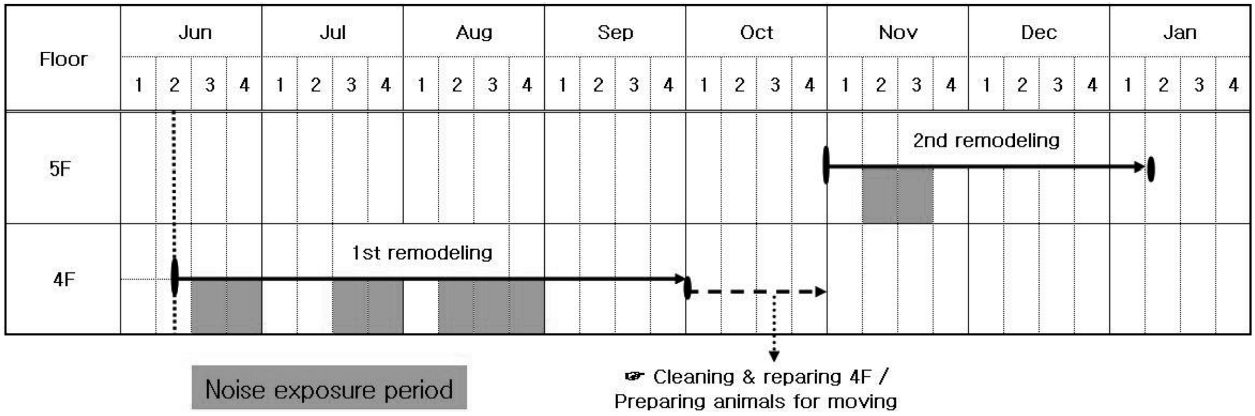

Figure 1. Diagram of remodeling schedule and noise exposure periods.

Table 1. The number of times for different noise levels and the exposure time at a noise caused by construction tools during the renovation

Tools	Noise levels (dB)				Time exposed (sec)[#]
	50-60	60-70	70-80	80-90	
Drilling	141*	775*	955*	25*	5-10
Hammering	-	530*	-	-	1

*Data show the number of times along with noise levels occurred by drilling and hammering.
[#]Exposure time at a drilling or hammering noise.

bedding transfer. After four weeks, the sentinel animals were submitted to the monitoring center for the tests. In addition, there had been no such problems over the past years in the animal facility.

Figure 2. Various skin injuries caused by self-biting in nude mice (BALB/c nude, CAnN.Cg-Foxn1^{nu}/CrlCrlj, ORIENT BIO INC). They were five weeks old when admitted to the animal facility in the middle of June. Three weeks later injuries were found on the skin of the mice. They were used as the negative control group in a study and were separately housing in each cage operating by individually ventilated cage system.

Table 2. The problems of animal experiments raised by researchers

Species	Strain	Age (wks)	Construction*		Signs	Remarks
			Before	During		
Mouse	nude	8	-	4 / 10	Self-mutilations	Housed in each cages separately
Rat	SD	12	2 / 5	6 / 10	Increased mortality	Chronic lung injury model

*Data show values as affected/total animals.

Table 3. The health monitoring results conducted before the construction

	Organism	SPF barrier				Semi-barrier		
		1	2	3	4	1	2	3
Virology	Lymphocytic choriomeningitis (LCM) virus	NT	NT	0/2	0/2	NT	NT	0/1
	Ectromelia virus (Mouse pox)	NT	NT	0/2	0/2	NT	NT	0/1
	Sendai virus	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Mouse Hepatitis virus (MHV)	NT	NT	0/2	0/2	NT	NT	0/1
	Sialodacryoadenitis (SDA) virus	0/2	0/2	NT	NT	0/1	0/1	0/1
	Hanta virus	0/2	0/2	NT	NT	0/1	0/1	0/1
Bacteriology	*Mycoplasma* spp.	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Clostridium piliforme (Tyzzer's disease)	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Corynebacterium kutscheri	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Pasteurella pneumotropica	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Pseudomonas aeruginosa	0/2	0/2	NT	NT	0/1	0/1	0/1
	Salmonella spp.	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Citrobacter rodentium (*E. coli* O115a,c:K(B))	NT	NT	0/2	0/2	NT	NT	0/1
	Bordetella bronchiseptica	0/2	0/2	NT	NT	0/1	0/1	0/1
	Streptococcus pneumoniae	0/2	0/2	NT	NT	0/1	0/1	0/1
Parasitology	Intestinal protozoa	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Ectoparasite	0/2	0/2	0/2	0/2	0/1	0/1	0/2
	Syphacia spp.	0/2	0/2	0/2	0/2	0/1	0/1	0/2

Data are reported as positive/total tests performed.
NT: Not test.

Table 4. The Health monitoring results conducted during the construction

	Organism	SPF barrier			Semi-barrier
		1	2	3	1
Virology	Lymphocytic choriomeningitis (LCM) virus	NT	NT	0/1	0/1
	Ectromelia virus (Mouse pox)	NT	NT	0/1	0/1
	Sendai virus	0/1	0/1	0/1	0/1
	Mouse Hepatitis virus (MHV)	NT	NT	0/1	0/1
	Sialodacryoadenitis (SDA) virus	0/1	0/1	NT	NT
	Hanta virus	0/1	0/1	NT	NT
Bacteriology	*Mycoplasma* spp.	0/1	0/1	0/1	0/1
	Clostridium piliforme (Tyzzer's disease)	0/1	0/1	0/1	0/1
	Corynebacterium kutscheri	0/1	0/1	0/1	0/1
	Pasteurella pneumotropica	0/1	0/1	0/1	0/1
	Pseudomonas aeruginosa	NT	0/1	NT	NT
	Salmonella spp.	0/1	0/1	0/1	0/1
	Citrobacter rodentium (*E. coli* O115a,c:K(B))	NT	NT	0/1	0/1
	Bordetella bronchiseptica	0/1	0/1	NT	NT
	Streptococcus pneumoniae	0/1	0/1	NT	NT
Parasitology	Intestinal protozoa	0/1	0/1	0/1	0/1
	Ectoparasite	0/1	0/1	0/1	0/1
	Syphacia spp.	0/1	0/1	0/1	0/1

Data are reported as positive/total tests performed. NT: Not test.
The numbers of total tests in Table 4 were reduced comparing with those in Table 3 because the capacity of breeding animals was decreased for efficient animal transportation to the newly remoldeled animal facility.

It is well-known that rodent breeding colonies are adversely affected by noisy environments (Sales *et al.,* 1988; Milligan *et al.,* 1993). Animal noises, squeaky casters, personnel foot traffic, and heating, ventilation, and air-conditioning (HVAC) systems all add to the ambient noise level in laboratory animal facilities, and the ambient noise in cage-wash areas often ranges from 80-95 decibels (dB), depending on the number and types of cage-washing equipment (Carlton *et al.,* 2002). However, there have rarely been reports indicating that variable noise levels caused by construction environment gave rise to adverse consequences to laboratory rodents housed in animal facilities.

We recognize the possibility that the animals adversely affected by construction environment resulted from not only noise, but also vibration. However we did not prepare a vibration meter when remodeling. For the further understand on constructive environment in laboratory rodents, vibration caused by the drilling and hammering also need to measure additionally.

In conclusion, we estimate that these animal-related problems were caused by the construction environment. We also recommend that animal facilities where renovation is planned should consider construction work only after moving the housed animals to a quiet and safe area in order to prevent them from being housed in a noisy environment, as this effort would result in securing the animals' welfare.

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