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Breeding and Housing Laboratory Rats and Mice in the Same Room Does Not Affect the Growth or Reproduction of Either Species

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Few data exist regarding the effects of long-term housing of rats and mice in the same secondary enclosure. Historical reproductive and growth data were compared for colonies of mice and rats maintained in open-topped cages in either single-species or dual-species barrier rooms. This analysis included reproductive parameters (litter size at birth, litter size at weaning, and pups missing at weaning) collected from 33 colonies of mice comprising 500 to 38,500 breeding females and 28 colonies of rats totaling 350 to 4,600 breeding females, and representative samples from 28 colonies of each species were analyzed for weight gain from weaning to adulthood. The presence or absence of the other species was not associated with statistically significant differences in weight gain or any of the reproductive parameters. These results suggest that breeding colonies of rats and mice of the same health status can be housed in the same room without a negative effect on the growth and reproduction of either species.

The *Guide for the Care and Use of Laboratory Animals* suggests that animals should be physically separated by species.[22] This practice is recommended to prevent transmission of disease between species and to remove interspecies conflict as a source of anxiety or behavioral change. The *Guide* also suggests, however, that species that are "behaviorally compatible" and have similar health status may be housed in the same room. The *Guide* provides reasons and references for separating rabbits and guinea pigs, New World and Old World primates, and several species of New World primates, all based on the possibility of disease transmission. In these cases, 1 species is an asymptomatic carrier of a disease that may have serious consequences for the other.[22] However, the *Guide* does not specifically mention rats and mice, which are often housed together in the same room in breeding and research facilities.

Recommendations against housing rats and mice together typically do not refer to disease transmission as a primary consideration,[22] even though rats and mice are susceptible to some of the same bacterial and viral infections. However, rats and mice are generally of a similar health status in modern animal facilities, especially if purchased from a commercial breeder or reared in the same room in a research facility. Concern about housing these 2 species together generally is based on the observation that rats may prey on mice,[23] with the assumption that mice would find it stressful to live in the presence of rats, which could be predators. However, neither rats nor mice are primary predators; more accurately they are opportunistic generalists. They eat what is available, which may or may not include food obtained by predation. The suggestion that rats are stressed by the presence of mice or other potential prey has not been advanced. Most published reports of housing mice and rats together are short-term exposure studies, in which mice are housed in the same room or cage as rats for fewer than 30 d.[5,6,9,10,25,29,44] Published work evaluating the effects of long-term housing of rats and mice together was absent from the literature. Here we address this gap.

For many years at Charles River facilities, mice and rats have been bred and housed together in the same room as a routine production procedure. These colonies include breeders (up to approximately 9 mo of age) and stock animals (generally a maximum of 10 to 12 wk of age). Mice and rats are housed together primarily to facilitate the best use of available space while allowing stocks and strains with the same coat colors to be bred and raised in separate rooms to minimize the risk of genetic contamination. All animals within a particular barrier room share an identical health status, so transmission of infectious agents between species is not a concern. All barrier rooms discussed in this paper are maintained as closed colonies, in which animals remain in the room of their birth. A small number of breeders are introduced every few years as part of genetic management systems.

At Charles River, animal husbandry staff regularly collects production data for evaluation of colony performance and colony size management. In addition, weight studies are conducted regularly of animals from weaning to 15 wk of age. These metrics allow comparison of growth and reproduction of mice bred and reared either with or without rats in the same room and of rats bred and reared with or without mice in the same room. If stress levels are high (for example, due to the presence of a predator–prey relationship), reproduction and growth of animals are likely to be affected. If the population to be evaluated is sufficiently large, subtle behavioral effects can be expected to appear as differences in growth or reproduction, which would be found when gross measures of these complex behavioral chains are evaluated.

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Materials and Methods

Animals. This study was conducted by using historical data collected from a database, therefore approval from an institutional care and use committee was not sought for analysis of the data. All rats and mice discussed in this study were bred and housed in AAALAC-accredited facilities, and the overall protocol for breeding and production (Charles River, Wilmington, MA), which includes weight studies, was approved by the institutional care and use committee. Environmental conditions within rooms were maintained at 21° ± 1 °C (70° ± 2 °F) with 50% ± 20% relative humidity and ventilated at a minimum of 15 HEPA-filtered air changes per hour. Animals were kept on a 12:12 light:dark cycle and provided ad libitum access to water and feed (Lab Diet 5K52 or Lab Diet 5L79, Purina Mills, Richmond, IN). Breeding rooms analyzed in this study averaged approximately 2400 ft^2. Actual layouts of each room differed slightly, so a general description of a barrier room is provided. Mice and rats tended to be grouped within rooms because mouse and rat cages differ in size, therefore animals were not housed on the same rack within a room. Mice were housed in solid-bottomed cages, with wood-shaving or chipped-wood bedding. Rats were housed on either wire-bottomed cages (stock or breeding cages) or solid-bottomed cages (maternity cages) containing a wood-shaving product. All animals were housed socially in groups of 2 to 20, with the exception of female rats in late pregnancy and male rats or mice used in timed mating programs. Bedding for all cages was changed as needed, but at least weekly, and all cages were open to the room environment (that is, no microisolation or ventilated caging).

Mice were from colonies that tested negative for the following viral agents: Sendai virus, pneumonia virus of mice, mouse hepatitis virus, minute virus of mice, mouse parvovirus, mouse norovirus, Theiler murine encephalomyelitis virus, reovirus type 3, mouse adenovirus, polyoma virus, K virus, mouse cytomegalovirus, rotavirus, mouse thymic virus, lymphocytic choriomeningitis virus, hantavirus, lactate dehydrogenase elevating virus, and *Ectromelia* virus. All rats were from colonies that tested negative for the following viral agents: Sendai virus, pneumonia virus of mice, sialodacryoadenitis virus, Kilham rat virus, H1 virus, rat minute virus, reovirus, lymphocytic choriomeningitis virus, hantavirus, mouse adenovirus, rat respiratory virus, rat theilovirus, and rat parvovirus. In addition, colonies were free of the following bacterial and fungal agents: *Bordetella bronchiseptica*, cilia-associated respiratory bacillus, *Citrobacter rodentium*, *Clostridium piliforme*, *Corynebacterium kutscheri*, *Encephalitozoon cuniculi*, *Helicobacter* spp., *Mycoplasma pulmonis*, *Pasteurella pneumotropica*, *Salmonella* spp., *Streptobacillus moniliformis*, and *Streptococcus pneumoniae*. In addition, rats and mice were free of endoparasites and ectoparasites. The genetics of both inbred and outbred colonies are managed in reference to security colonies held at a central location in isolators, and colonies participate in a genetic standardization program.

Source of raw data. Data for the 2 parameters examined—reproduction and growth—were held in 2 different systems, thus explaining the differing data retrieval periods available. Reproductive data were collected from an inventory system that records colony performance and manages inventory of animals involved in the production of animals for sale. Weight data were collected from a system designed for the management of repeating weight studies performed regularly on breeding colonies. The data were not specifically recorded for this study.

Data were obtained on the breeding performance of 33 colonies of both inbred and outbred mice maintained either with or without rats in the same animal room (Table 1). There were no known systematic differences between colonies of the same strain or stock apart from the fact that the mice were bred either in the presence or absence of breeding colonies of rats. Data also were obtained for 28 colonies of outbred rats bred in rooms with or without mice (Table 2). The smallest mouse colony examined contained a breeding population of 500 breeding females, and the largest contained 38,500 breeding females. Rat colonies ranged in size from 350 to 4600 breeding females. All colony numbers are approximate.

For each colony, the numbers of litters born, number of pups born, number of litters weaned, number of pups weaned, and number of pups missing at weaning were obtained from colony breeding records, averaged over 13-wk periods during 2005, 2006, 2007, and 2008. From these data, the mean litter size at birth, mean litter size at weaning, and number of pups missing per litter at weaning were calculated. Pups missing per litter was calculated by dividing the number of litters born 3 wk prior by the number of pups missing at weaning. This calculation captures pups missing due to loss of entire litters in the preweaning period. The mean litter size at weaning does not capture missing litters, because litters missing entirely would not be recorded as weaned.

Growth rates of mice in the presence or absence of rats were obtained from 15 colonies bred in the absence of rats and 13 colonies bred in the presence of rats. Samples of at least 800 animals per colony had been weighed weekly until the age of 15 wk to gather information on normal growth of the animals. Available data were collected between 1999 and 2005 and came from strains BALB/cAnNCrl (BALB/c; 3 colonies housed with rats, 6 without), C57BL/6NCrl (B6NCrl; 5 with, 6 without) and stocks Crl:CF1 (CF1; 4 with, 2 without), and Crl:CFW(SW) (1 with, 1 without). Rat growth rates in the presence or absence of mice were obtained from 14 colonies bred in the absence of mice and 14 colonies bred in the presence of mice, including Crl:CD(SD) (CD; 9 colonies housed with mice, 8 without), Crl:LE (L/E; 2 with, 3 without), LEW/Crl (LEW; 1 with, 1 without), Crl:SD (1 with and 1 without), and Crl:WI (Wistar; 1 with, 1 without). These data had been collected between 1999 and 2007 to study normal growth.

Statistical analysis. ***Breeding data.*** The data on litter sizes at birth and weaning and pups missing per litter at weaning were summarized and subjected to a 2-way general linear model ANOVA, with strain and presence or absence of rats or mice as fixed-effect factors. Values were considered significant if the P value was less than or equal to 0.05. Residuals plots were used to ensure that the assumption of normality of the residuals and homogeneity of variance were met (as was the case). All calculations were done using the MINITAB package (version 13; MINITAB, State College, PA).

Body weight analysis. Mean body weight at weekly intervals was recorded separately for males and females for each strain or stock and then subjected to a general linear model ANOVA at 21, 42, 63, 84, 91, and 105 d of age, with the factors strain and presence or absence of the other species. Residuals plots were used to examine normality of the residuals and equality of variances in each group. Mean body weights were plotted separately for each strain of mice in the presence or absence of the other species because 1 stock showed anomalous results. For the rats, however, body weights were averaged across strains or stocks.

Table 1. Litter size and mortality among mouse strains housed with or without rats

Strain or stock	Housed with or without other species?	Mean no. of pups per litter at birth	Mean no. of pups weaned per litter[a]	Mean no. of pups missing per litter[b]
BALB/cAnNCrl	with	6.75	6.49	0.34
BALB/cAnNCrl	without	6.80	6.51	0.31
C57BL/6JN	with	5.33	5.43	0.51
C57BL/6JN	without	6.12	6.05	0.71
C57BL/6JN	without	5.92	5.51	0.92
C57BL/6JN	without	6.60	6.71	0.25
C57BL/6NCrl	with	7.41	7.34	0.17
C57BL/6NCrl	with	5.58	4.89	0.75
C57BL/6NCrl	with	5.99	4.78	1.11
C57BL/6NCrl	without	7.46	7.17	1.29
C57BL/6NCrl	without	7.17	7.09	0.17
C57BL/6NCrl	without	7.02	6.04	0.62
C57BL/6NCrl	without	6.77	6.54	0.58
C57BL/6NCrl	without	6.83	6.65	0.72
Crl:CD1(Icr)	with	10.90	11.12	0.52
Crl:CD1(Icr)	with	11.93	11.98	1.75
Crl:CD1(Icr)	with	12.42	12.00	0.10
Crl:CD1(Icr)	with	11.99	10.61	1.44
Crl:CD1(Icr)	without	15.00	14.99	0.11
Crl:CD1(Icr)	without	11.99	11.69	0.35
Crl:CF1	with	11.91	11.45	0.87
Crl:CF1	without	12.00	12.00	0.75
Crl:CFW(SW)	with	8.74	8.13	1.32
Crl:CFW(SW)	with	8.49	8.23	0.67
Crl:CFW(SW)	with	8.50	7.86	0.63
Crl:CFW(SW)	with	8.50	7.53	0.96
Crl:CFW(SW)	without	8.75	8.09	0.72
DBA/2NCrl	with	4.35	4.54	0.32
DBA/2NCrl	without	4.48	4.48	0.89
DBA/2NCrl	without	4.38	4.82	0.72
FVB/NCrl	with	10.83	10.45	0.46
FVB/NCrl	with	11.02	11.39	0.26
FVB/NCrl	without	8.67	8.63	0.79

[a]Excludes missing litters.
[b]Calculated from total born and weaned so includes missing litters.

Results

Mice bred in the presence of rats. Mouse colonies maintained with or without rats in the same room showed no significant differences in mean litter size at birth and weaning and pups missing at weaning (Table 3). As expected, mean litter size at birth and weaning differed markedly ($P < 0.001$) between strains and stocks. By contrast, comparisons of strains and stocks showed no significant difference ($P = 0.99$) in number of pups missing per litter, an indication of pups that died or were cannibalized. In addition, statistically significant interactions between strain or stock and presence or absence of rats were not detected for litter size at birth, at weaning, or pups missing ($P = 0.53$, 0.47, and 0.95, respectively), indicating no evidence for strain differences in response of mice to rats.

Although it is impossible to prove a negative (that is, that the presence of rats has no effect at all), the 95% confidence intervals and colony sizes analyzed suggest that any differences must be quite small. For example, mean litter size at birth has a 95% probability that the true difference between colonies with or without rats lies somewhere between 0.42 pup more per litter when rats are present to 0.78 fewer pups per litter in the absence of rats. Therefore, despite a slight suggestion that litter size is greater in the absence of rats, the possibility that litter size could be greater in the presence of rats cannot be ruled out. A similar argument holds for litter size at weaning and missing pups per litter.

Rats bred in the presence of mice. Similar results were seen with rats bred in the presence of mice (Table 4). Therefore there was no evidence that the presence of another species altered litter size at birth and weaning, or the number of pups missing per litter at weaning ($P > 0.05$ in each case).

Body weights of mice growing in rooms with rats. Plots of mean body weight of male and female mice for 4 strains in the presence or absence of rats (that is, multispecies housing) are shown in Figures 1 and 2. Differences between those bred in the presence or absence of rats were not statistically significant for BALB/cAnNCrl, C57BL/6NCrl, and Crl:CF1, but were large with Crl:CFW(SW), which had greater growth (for example, $P < 0.01$ at 91 d) in the presence of rats. However only 2 colonies

Table 2. Litter size and mortality among rat stocks housed with or without mice

Strain or stock	Multispecies?	Mean no. of pups per litter at birth	Mean no. of pups weaned per litter[a,b]	Mean no. of pups missing per litter[c]
Crl:CD(SD)	with	11.25	14.01	0.20
Crl:CD(SD)	with	12.22	11.43	0.36
Crl:CD(SD)	with	11.96	13.86	0.13
Crl:CD(SD)	with	12.18	13.86	0.14
Crl:CD(SD)	with	11.88	13.12	0.27
Crl:CD(SD)	with	12.93	13.65	0.40
Crl:CD(SD)	with	12.02	14.12	1.19
Crl:CD(SD)	with	12.51	13.17	0.46
Crl:CD(SD)	with	14.25	13.11	0.20
Crl:CD(SD)	with	12.46	13.91	0.12
Crl:CD(SD)	without	11.60	12.18	1.31
Crl:CD(SD)	without	11.29	13.94	0.28
Crl:CD(SD)	without	12.65	13.83	0.19
Crl:CD(SD)	without	12.98	13.80	0.25
Crl:CD(SD)	without	11.69	13.76	0.27
Crl:CD(SD)	without	11.06	13.89	0.43
Crl:CD(SD)	without	12.42	13.69	0.32
Crl:CD(SD)	without	12.41	13.97	0.54
Crl:LE	with	14.60	12.69	0.52
Crl:LE	with	14.19	12.38	0.61
Crl:LE	without	13.61	12.04	0.55
Crl:LE	without	15.67	12.33	0.33
Crl:LE	without	12.79	13.15	0.66
Crl:WI	with	14.27	12.37	1.83
Crl:WI	with	13.70	12.46	1.30
Crl:WI	with	13.64	14.15	0.46
Crl:WI	without	12.11	13.72	0.16
Crl:WI	without	14.30	13.85	0.26

[a]Litter sizes were adjusted to a consistent number of pups per female soon after birth, therefore litter size at weaning may be higher than at birth.
[b]Excludes missing litters.
[c]Calculated from total numbers of pups born and weaned, therefore includes missing litters.

of Crl:CFW(SW) were included in the analysis (1 with and 1 without rats)

Body weight of rats growing in rooms containing mice. The growth curves of rats growing in the presence or absence of mice is shown in Figure 3, pooled across strains. Statistical analysis at 21, 42, 63, 84, and 105 d showed no evidence of any differences in growth between the 2 groups although, as expected, there were highly significant strain differences at all ages (data not shown).

Discussion

In the wild, the Norwegian rat and house mouse occupy a similar ecological niche. Both are rodents that can be found in association with humans and their dwellings, leading to both their categorization as vermin and their eventual domestication. Both rats and mice are dietary generalists, eating almost anything they come across but also preying on invertebrates, cold-blooded vertebrates, and animals smaller than themselves. In the case of rats, predation may include killing and consuming mice. The first detailed description of mouse killing by wild and domesticated rats under laboratory conditions in the literature[23] has led to many studies of the mouse-killing response in rats. However, mice elicit a number of behavioral responses in rats, including killing, sniffing, carrying, mothering, manipulating, grooming, and disinterest. Not all rats kill mice, and mice are not preferred over other prey species. When offered a choice of prey, mice elicited a killing response in 12% to 25% of laboratory rats tested, whereas frogs and turtles were killed at a rate of almost 100%, as were cockroaches.[2,23,24] These rates of killing differ between strains or stocks,[16,28,36,39,42] but generally do not differ between males and females within a strain or stock[23,42] and can be modified by a wide variety of environmental, pharmacologic, surgical, and behavioral manipulations.[15,18,19,30,31,35,41] Housing large numbers of mice and rearing them from birth in proximity but not direct contact with rats, as was the case in this study, may also be such a modifier.

Rats will act as foster mothers to baby mice, and weanling rats reared in the same cage with weanling mice are not reported to have damaged the mice in any way.[11-14,38] In addition, close exposure of mice to rats both before and after weaning affects the mice's behavioral patterns. These mice preferred rats and displayed lower intraspecies aggression.[11] In another study, mice reared by rats or in the presence of a rat 'aunt' had a decreased stress response to a novel stimulus, but this decreased response was dependent on direct physical contact between the 2 species.[11,14]

A relatively recent review of the effects of predator odors on mammalian prey species does not mention the effects of rat odors on mice, but the odors of other more strictly predatory

Table 3. Least-squares (weighted) means ± SEMs, confidence intervals, and *P* values for mice housed with or without rats

Type (and number) of colonies	No. of pups per litter at birth (mean ± SEM)	No. of pups per litter at weaning (mean ± SEM)	No. of pups missing per litter at weaning (mean ± SEM)
With rats (17)	8.24 ± 0.20	7.98 ± 0.26	0.614 ± 0.131
Without rats (16)	8.43 ± 0.21	8.25 ± 0.26	0.615 ± 0.133
Difference between colonies with or without rats	0.18	0.26	0.001
95% confidence interval	−0.42 to 0.78	−0.51 to 1.40	−0.394 to 0.395
P values			
Multispecies housing	0.53	0.47	0.95
Strain	<0.001	<0.001	0.99
Multispecies housing × strain	0.09	0.21	0.68

Table 4. Least-squares (weighted) means ± SEMs, confidence intervals, and *P* values for rats housed with or without mice

Type (and number) of colonies	No. of pups per litter at birth (mean ± SEM)	No. of pups per litter at weaning (mean ± SEM)	No. of pups missing per litter at weaning (mean ± SEM)
With mice (15)	13.54 ± 0.28	12.98 ± 0.23	0.701 ± 0.116
Without mice (13)	13.08 ± 0.28	13.31 ± 0.23	0.389 ± 0.118
Difference between colonies with or without mice	−0.46	0.32	−0.312
95% confidence interval	−1.28 to 0.36	−0.34 to 0.99	−0.655 to 0.031
P values			
Multispecies housing	0.25	0.33	0.26
Strain	<0.001	0.04	0.07
Multispecies housing × strain	0.94	0.64	0.03

Litter sizes were standardized soon after birth, therefore litter size at weaning may be larger than at birth.

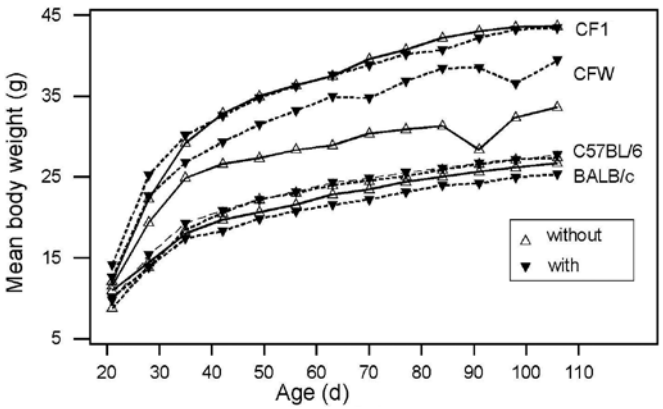

Figure 1. Mean growth curves for male mice of 2 inbred and 2 outbred stocks reared in rooms either with or without rats. See Materials and Methods section for details of the number of groups measured for each strain or stock.

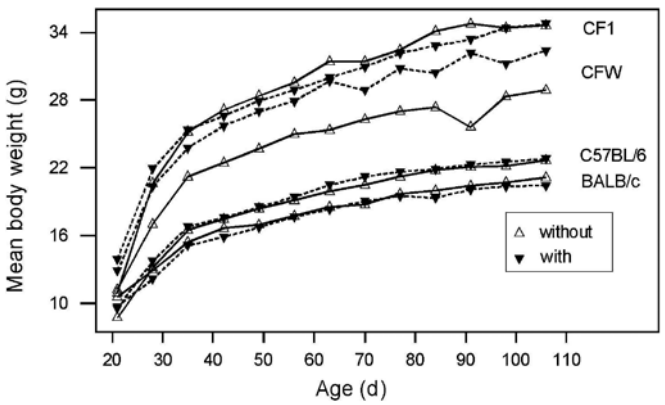

Figure 2. Mean growth curves for female mice of 2 inbred and 2 outbred stocks reared in rooms either with or without rats. See Materials and Methods section for details of the number of groups measured for each strain or stock.

species do have a suppressive effect on rodent reproduction.[1] Work directly examining the effect of rat exposure on pregnancy in mice found a decline in reproductive performance as measured by number of pups produced when a female mouse was exposed to a rat during the first 7 d after mating.[10] Exposure in the cited study consisted of 1 of 3 conditions: housing a newly mated mouse in the same cage as a nonkilling male rat; housing a newly mated mouse in the same cage as a nonkilling male rat but separating the 2 with a wire grid; and exposure of a newly mated mouse to rat urine. Both outbred and inbred (CD1 and C57, the nomenclature used in the study cited) mice were tested; outbred mice were less affected by the presence of the rat.[10] Exposing female mice directly to odors of male rats may act through pathways other than those associated with stress, because the presence of a male mouse in the cage of a recently impregnated female mouse removed the effect of rats entirely.[25] The Bruce effect (failure of implantation in female mice exposed to a strange male) is well-documented, and pheromones produced by male rats may affect female mice in this fashion. Because our study was not prospective, we cannot argue against the idea that a decline in reproductive performance might occur if a mouse colony naïve to rats is moved to a room with rats or if a new room is established with small colonies of both mice and rats. The colonies examined in this work were well-established as described and had been stable for several years at the time of data collection.

The growth of animals is another physical parameter affected by stress. Rats and mice stressed prenatally show deviations in growth. Depending on the level of stress, type of stress, and

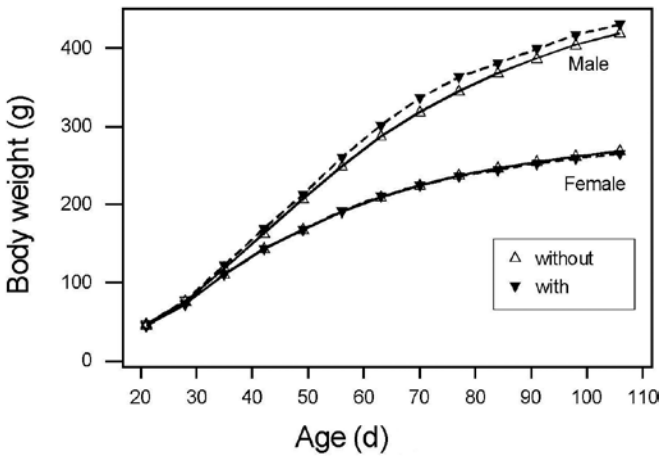

Figure 3. Mean growth curves averaged across 5 stocks and strains of rats, consisting of 14 groups with and 14 groups without mice in the same rooms. See Materials and Methods section for details of the number of groups measured for each strain or stock.

point in gestation at which the stress is administered, dams and offspring may show either growth retardation or augmentation of growth.[20,26,34] Stress has been shown to decrease body weight in both rats and mice,[21,32] but certain types of stress have also been shown to increase body weight.[33] The lack of difference in the growth rates of both rats and mice in the current study argues that animals are experiencing similar levels of stress, regardless of whether other species are present. Thus, some factor other than the presence of rats may have accounted for the unusually large intercolony variation detected in our analysis.

When taken alone, the early work[23] documenting a theoretical predator–prey relationship between rats and mice has led researchers to posit that mice find the presence of rats stressful. When exposure to rats is used as a source of stress for mice, paradigms include singly housing naïve mice for a limited time period (less than 30 d) in open-topped cages in a room containing male rats,[6,9] placing mice in the same cage as rats,[10] exposing singly housed mice to a rat in a separate compartment,[5,44] or exposing singly housed mice to a rat fecal bolus or rat urine.[25,29] Based on the results of these studies, some authors draw the conclusion that exposing naïve mice to or housing mice with rats is stressful.

Two factors, however, confound that conclusion. The assumption of mouse naïveté in relation to rat exposure may be incorrect. In at least 1 rat exposure study, outbred CD1 mice were obtained from a facility where mice and rats are reared together in the same room, and whether mice were obtained specifically from a room not containing rats is not mentioned.[29] Mice born and reared in the presence of rats may experience different stress levels when exposed to rats than those introduced later in life. The second factor relates to the social nature of mice. Rat exposure studies often use singly housed mice and rarely use group-housed or group-exposed experimental or control groups. One study that used group-housed unexposed controls, measured sympathetic neurotransmitter release in mice exposed to rats.[9] The response of mice housed in groups and exposed to rat odors and vocalizations was not different from the control group, whereas both mice singly housed and mice singly housed and exposed to rats differed significantly from the control.[9] Single housing for a social species such as mice can itself be a stressor[4,8] and could predispose these animals to an exaggerated response to the presence of predators[3] or even result in the changes seen.[9] Because strain-dependent responses to stress are well-documented in the literature,[27,37] the response to rat exposure could also vary between strains and stocks of mice.

The common assumptions are that a predator–prey relationship always occurs between rats and mice due to their difference in size and their wild-ancestral behavioral tendencies and that mice cannot acclimate to the presence of rats. Even ignoring the fact that laboratory rodents are domesticated (not wild) animals and that they may preserve many behaviors of their wild ancestors, this idea seems to be false. For example, rats and mice appear to acclimate to the presence of humans, a noteworthy, albeit perhaps not 'natural,' predator of both species. In fact, early exposure to humans reduced the rate of muricide in rats.[17] Perhaps other factors in a production environment allow for acclimation or adaptation. Many strains of mice are blind, visually impaired, or deaf.[7,40,43] Rats and mice are not housed together in the same cage, so their chief experience of rats would be via scent. In the facilities giving rise to the data evaluated herein (Charles River), the cages are open-topped, but animals are separated by meter-wide aisles, and differing cage sizes for each species means that rats and mice are not housed on the same rack. The scents of thousands of other conspecifics may overwhelm the scent of rats in the same room. These factors may mitigate odor exposure. Alternatively, if mice housed with rats in the same secondary enclosure can detect rat odors, perhaps the large number of conspecifics is a protective factor, offering the perception that the risk to any particular mouse is reduced. In production conditions, animals are rarely singly housed, which may also provide a protective effect. One study showed that closer olfactory, auditory, and visual contact than that which is present in standard Charles River mouse and rat housing did not result in changes in the corticosterone response of mice to a novel stimulus,[14] indicating that housing animals in the same room would not tend to potentiate changes in fear- or stress-based behavior. In many research facilities, rodents are housed in ventilated racks, theoretically further reducing olfactory and auditory exposure to other rodents. Before housing recommendations are made by governing bodies or institutions, further studies should investigate housing modalities in use and attempt to determine whether housing type affects potential interaction between mice and rats in a significant and reproducible way.

A final question is raised by this examination of housing rats and mice together: Do rats find the presence of mice stressful? Because rats appear to behave and perform similarly whether housed in a room alone or together with mice, the present study shows that, at least for growth and reproductive parameters, the data do not support any direct effects.

The lack of consistency in findings of other studies coupled with the relatively small numbers of both animals and stocks and strains examined in those previous studies does not support a ban on housing rats and mice of the same health profile in the same secondary enclosure. The results of the present study, which used large numbers of animals, further the contention that housing rats and mice in the same secondary enclosure is not a harmful practice. Housing breeding rats and mice in the same room does not have an effect on the growth or reproduction of either species, and data collected in this study do not support the contention that such housing is stressful.

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