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How does the running wheel affect the behaviour and reproduction of golden hamsters kept as pets?

Sabine G. Gebhardt-Henrich *, Evelyne M. Vonlanthen [1], Andreas Steiger

Division of Animal Housing and Welfare, Institute of Animal Genetics, Nutrition and Housing, Vetsuisse Faculty of the University of Bern, P.O. Box, CH-3001 Bern, Switzerland

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Abstract

Although there are many studies on the running wheel in laboratory animals, it is not clear if a running wheel should be provided for golden hamsters kept as pets. Unlike laboratory animals, golden hamsters kept as pets usually have larger cages, more varied food, and are kept singly. In this study, 10 sister-pairs of golden hamsters were kept singly in large enriched cages with a functional or a non-functional large running wheel. Using video-recordings, the behaviour of hamsters of both groups was compared. Hamster females with a functional wheel showed significantly less climbing and stereotypical bar-mouthing than females with non-functional wheels.

In order to compare the physical condition of the females, they were regularly mated and raised up to four litters before they stopped reproducing. Body masses did not differ between the groups, but females with functional wheels had significantly larger litters. Offspring growth did not differ, probably because the females decreased running in the wheel during pregnancy and stopped running completely during lactation. Therefore, we conclude that a large well-constructed running wheel will have no detrimental effect on golden hamsters kept in large and enriched cages with ad libitum access to adequate food and water. On the contrary, the running wheel may have had a beneficial effect on the well-being of the hamsters since it significantly decreased stereotypic bar-mouthing.

Keywords: Golden hamster; Running wheel; Reproduction; Behaviour; Stereotypy; Pet animal

* Corresponding author. Tel.: +41 31 631 2366; fax: +41 31 631 2640.
E-mail address: sabine.gebhardt@itz.unibe.ch (S.G. Gebhardt-Henrich).
[1] Present address: Ausserdorfstr. 80A, CH-5054 Moosleerau, Switzerland.

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1. Introduction

The running wheel has been the subject of many scientific studies (see the thorough review by Sherwin, 1998). Positive and negative effects on rodents under captive conditions have been found (Sherwin, 1998). The results of these studies may be largely dependent on the diet and husbandry condition of the laboratory animals and bear little resemblance to conditions for golden hamsters kept as pet animals. Laboratory kept hamsters have smaller cages than are recommended for pets, lack a dark shelter, and are often kept in groups which causes stress in the hamsters (Gattermann and Weinandy, 1996). Therefore, it is unclear if a running wheel can or cannot be recommended for the pet hamster based on laboratory studies alone.

The measurement of animal welfare is difficult and includes physical and psychological aspects (Mason and Mendl, 1993). Therefore, in this study the behaviour and the lifetime reproductive success (Darwinian fitness) were measured. Stereotypies are often used as an indication of poor welfare (e.g. Mason, 1991; Würbel, 2001) and evidence on how the running wheel influences stereotypies in golden hamsters has been lacking. It is conceivable that the difference in physical condition of the females with and without wheels will be seen as differences in litter sizes and offspring growth. Likewise, infant mortality was correlated with minimum natural home ranges of zoo-kept animals which correlated with the rate of stereotypies (Clubb and Mason, 2003). The running wheel had to be evaluated as negative if it decreased fitness. To our knowledge, there have been no studies so far that investigated the effect of the running wheel on reproductive success.

2. Methods

2.1. Animals and housing conditions

The room temperature was constantly 21 °C and the light cycle was 12-h light:12-h dark. At 28 days of age, 20 females (Laklbm: FUME from RCC Ltd. at Füllingsdorf, Switzerland) were placed singly into a commercially available hamster cage (length × width × height: 95 cm × 57 cm × 45 cm). All cages were furnished with a wooden nestbox (20 cm × 14 cm × 14 cm), litter, hay, paper towel, cardboard tubes, branches, and a running wheel (diameter: 30 cm, width of wire bottom: 10 cm). Pet hamster food (Witte Molen®, NL-Meeuwen) and water were offered ad lib. This diet was augmented by dry cat food, vitamin and mineral supplements, and fresh fruits. From an age of 90 days onwards, females were mated. Young remained with their mothers for 28 days. Thirty days after weaning, females were mated again. Matings were stopped after a female had not become pregnant after three ‘successful matings’.

2.2. Analyses

Revolutions of the running wheels were registered (Chronobiology Kit™, Stanford Software System).

Six 5-min long video sequences spaced equally over the 3-h recording were analysed using Observer^{TM} Version 3.0 (Noldus).

Data were checked for normality and equality of variances. If appropriate, transformations or non-parametric tests were used (as mentioned in the text).

3. Results

3.1. Body mass and longevity

Body masses before and during reproduction and adult body masses after reproduction (ages 450 and 500 days of age) did not differ between the female hamsters with and without functional wheels (Gebhardt-Henrich et al., 2005). The power to detect a significant difference in a repeated measures analysis was low (0.12). There were no significant differences in causes of death or longevity between the groups.

3.2. Reproduction

Females with wheels had larger litters than females without wheels (repeated measures, $F_{1,17} = 4.27$, $P = 0.05$) (Table 1) but lifetime reproductive success (total number of offspring that lived at least 4 weeks) did not differ significantly between the groups ($F_{1,18} = 2.23$, $P = 0.15$, power (0.05) = 0.29) (Table 1).

Offspring growth was negatively affected by litter size ($F_{3,27} = 17.31$, $P < 0.0001$), but neither by parity nor by the presence/absence of a functional wheel.

3.3. Behaviour

All females with a functional wheel used it. During pregnancy, hamsters ran less in the wheel and stopped using the wheel from parturition until 10 days after parturition (Fig. 1). Prior to mating, hamsters ran differently according to their 4-day sexual cycle and they reduced the amount of running with increasing parity (age) (repeated measures ANOVA: cycle: $F_{3,43} = 3.29$, $P = 0.03$, parity: $F_{1,43} = 14.61$, $P = 0.0004$).

Table 1
Litter sizes of females with and without functional wheels, mean ± standard error of the mean (*N*)

	Wheel	No wheel	*P*-value
Litter 1	9.1 ± 0.9 (10)	7.1 ± 1.4 (10)	NS
Litter 2	6.7 ± 1.3 (9)	5.4 ± 1.7 (9)	NS
Litter 3	6.5 ± 1.0 (8)	2.4 ± 1.0 (8)	0.013
Litter 4	2.5 ± 0.9 (6)	1.2 ± 1.2 (5)	NS
Total number	21.8 ± 3.3 (10)	14.5 ± 3.7 (10)	NS

Litters with 0 offspring were included, if body mass loss and/or traces of blood indicated that the female had given birth. Matings that did not lead to an increase in body mass were not included and occurred during the fourth litter, only.

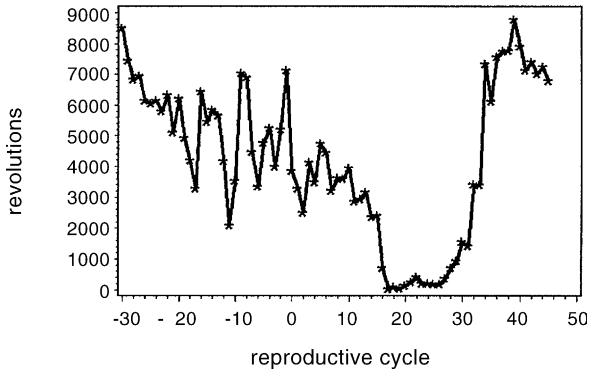

Fig. 1. Mean daily revolutions of female golden hamsters during reproduction (second parity): day 0 denotes mating, parturition was on day 17. The high values after day 35 resulted because the offspring also used the running wheel.

The 90-day-old hamster females with the functional wheel showed significantly less bar-mouthing than their sisters with non-functional wheels (duration in s/30 min ± standard error, non-functional: 283.9 ± 284.9, functional: 57.2 ± 122.2, $P < 0.05$). The shorter duration of bar-mouthing was due to fewer bouts (with wheel: 1.8, without wheel: 8.8, $F_{1,18} = 7.0$, $P = 0.016$) and not shorter bouts (with wheel: 8.89 s, without wheel: 7.9 s, $F_{1,18} = 0.12$, NS). Bouts of bar-mouthing lasted significantly longer than chewing at branches or other objects (mean bout length of bar-mouthing: 8.24 s, of chewing: 0.43 s, $F_{1,38} = 18.55$, $P < 0.0001$).

Only four hamsters in the wheel group and six hamsters in the non-functional wheel group climbed during the observation period around day 90. Of these hamsters, hamsters without a functioning wheel climbed significantly more often than hamsters with a wheel (Wilcoxon test, $P = 0.035$, $N = 10$) and for a longer time (Wilcoxon test, $P = 0.037$, $N = 10$).

4. Discussion

In short, the presence of a running wheel had no significant influence on body mass, but it significantly influenced litter size and the behaviour of female golden hamsters. The absence of an influence of body mass might be due to the low power.

There was no indication that females with access to a running wheel devoted resources for running that could have been devoted to the growth of offspring or herself instead. Rather, as in Fritzsche (1987), females decreased their running activity during pregnancy and stopped it altogether during early lactation. This may suggest that running in the wheel mimicked natural locomotory behaviour and was not purely an *artefact of captive environments* (Sherwin, 1998). In the wild, females hoard food and probably do not venture out of their burrows during early lactation (Lochbrunner, 1956). Litter sizes among hamsters with access to a functional wheel were significantly larger which might indicate a positive effect of the wheel on reproduction due to a better physical condition. Hamster

females with access to a functional running wheel showed less bar-mouthing and climbing activity than females with a non-functional wheel. Less climbing was also observed in mice with access to a running wheel (Harri et al., 1999). Bar-mouthing and climbing might indicate the attempt to leave the cage and explore (Würbel et al., 1996) and wheel running might reflect exploratory behaviour. Bar-gnawing is widely recognised as a stereotypy indicating poor housing conditions (e.g. Würbel et al., 1996) and anything leading to a reduction of this behaviour might be taken as beneficial.

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