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Voluntary Hind Limb Resistance Exercise with Obese Zucker Rats

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PURPOSE: Characteristics of fatty Zucker rats offer exercise physiologists unique avenues for research on the effects of obesity, diabetes, and hypertension on the physiological mechanisms associated with exercise-induced musculoskeletal adaptation and injury. The ability to use this strain of rats in volitional exercise models can further extend the research possibilities. Because volitional exercise models usually involve operant conditioning techniques that rely on dietary restrictions to sufficiently motivate voluntary behavior, a study was conducted to determine if obese Zucker rats could be trained to perform a voluntary weight-lifting movement without altering their diet.

METHODS: Using a custom-designed hind limb loading apparatus, four 6-week-old male genetically obese Zucker rats (fa/fa) were trained with positive reinforcement to enter a vertical tube, insert their head into a neck ring, and repeatedly lift and lower a 700-g load using a "heel raise" movement that targeted the plantar flexor muscle group.

Training sessions were conducted 5 days per week and each lasted approximately 1-hr or until at least 60 lifting and lowering movements were performed. Across training sessions, different schedules of reinforcement were studied to compare the effects of continuous versus intermittent reinforcement of responses. Reinforcers consisted of 45-mg nutritionally complete food pellets. Food and water were available in the home cage at all times. **RESULTS:** As expected, mean body weights increased rapidly from 201 g at 6 weeks old to 605 g at 15 weeks old. During the same period, all four rats successfully acquired and maintained the weight-lifting movement. A sufficient level of motivation to perform the lifting and lowering movement was maintained throughout the study period, even when the rats' size appeared to interfere with their movement in and out of the apparatus and when the number of responses required for each reinforcement increased across sessions. **CONCLUSIONS:** Results demonstrate that genetically obese Zucker rats can be trained to perform a voluntary, effortful movement with altering their diet or level of motivation. The present approach can be applied to a wide range of investigations involving volitional resistance exercise.

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