

# Exploring the Bond

## Stress-related behaviors among horses used in a therapeutic riding program

Lana Kaiser, MD, DVM; Camie R. Heleski, PhD; Janice Siegford, PhD; Katharine Ann Smith, BSN

**Objective**—To determine whether therapeutic riding resulted in higher levels of stress or frustration for horses than did recreational riding and whether therapeutic riding with at-risk individuals was more stressful for the horses than was therapeutic riding with individuals with physical or emotional handicaps.

**Design**—Observational study.

**Animals**—14 horses in a therapeutic riding program.

**Procedure**—An ethogram of equine behaviors was created, and horses were observed while ridden by 5 groups of riders (recreational riders, physically handicapped riders, psychologically handicapped riders, at-risk children, and special education children). Number of stress-related behaviors (ears pinned back, head raised, head turned, head tossed, head shaken, head down, and defecation) was compared among groups.

**Results**—No significant differences in mean number of stress-related behaviors were found when horses were ridden by recreational riders, physically handicapped riders, psychologically handicapped riders, or special education children. However, mean number of stress-related behaviors was significantly higher when horses were ridden by the at-risk children.

**Conclusions and Clinical Relevance**—Results suggest that for horses in a therapeutic riding program, being ridden by physically or psychologically handicapped individuals is no more stressful for the horses than is being ridden in the same setting by recreational riders. However, at-risk children caused more stress to the horses, suggesting that the time horses are ridden by at-risk children should be limited both daily and weekly. (*J Am Vet Med Assoc* 2006; 228:39–45)

From the Human-Animal Bond Initiative, College of Nursing (Kaiser, Smith); the Animal Behavior and Welfare Group, Department of Animal Science, College of Agriculture and Natural Resources (Heleski, Siegford); and the Department of Medicine, College of Human Medicine (Kaiser), Michigan State University, East Lansing, MI 48824.

Supported by the American Veterinary Medical Foundation and Families and Communities Together (FACT) at Michigan State University.

Presented at the Region 4 Conference of the North American Riding for the Handicapped Association, Hickory Corners, Mich, April 2004, and the Human-Animal Bond Initiative Conference, East Lansing, Mich, September 2004.

The authors thank Bonnie DePue, Kari Rodgers, and Kellie Anderson for assistance with the therapeutic riding program; Christine Kaiser for assistance with illustrations; and Megan Townsend, Adroaldo Zanella, Kerrie VandenBosch, Amy Shelle, and Dawn Mace for technical assistance.

Address correspondence to Dr. Kaiser.

Therapeutic riding programs involve the use of equine-related activities to contribute positively to the cognitive, physical, emotional, and social well-being of people.<sup>1</sup> Although therapeutic riding programs have proliferated in recent years and interest in animal welfare has increased, the welfare of horses involved in such programs has only recently been considered, and there is little scientific information on the effects of therapeutic riding programs on the behavior, stress level, or welfare of horses that are used.

From a welfare perspective, therapeutic riding programs should not cause undue stress or discomfort for the horses that are involved. Recent studies, however, suggest that there is a potential for both negative<sup>a</sup> and positive<sup>b</sup> effects. Therapeutic riding programs, by definition, involve riders with physical, psychologic, emotional, or social issues. Some of these issues may be problematic for the horses involved and result in high levels of stress or frustration. Individuals with balance issues, for instance, may tax the physical abilities of the horses, whereas individuals with severe psychologic problems may cause frustration or stress. Children at risk for antisocial behavior may display inappropriate behavior toward the horses they are working with, and this behavior may manifest as impulsive, antisocial, or violent acts.<sup>2</sup>

Because of the lack of scientific information, we wanted to evaluate the effects of a therapeutic riding program on both the horses and riders. In particular, in the study reported here, we wanted to determine whether therapeutic riding resulted in higher levels of stress or frustration for horses than did recreational riding and whether therapeutic riding with at-risk individuals was more stressful for the horses than was therapeutic riding with individuals with physical or emotional handicaps. Effects of the therapeutic riding program on the riders are reported elsewhere.<sup>3</sup>

### Materials and Methods

The study protocol was approved by the All-University Committee on Animal Use and Care and by the University Committee on Research Involving Human Subjects at Michigan State University.

**Therapeutic riding program**—The therapeutic riding program evaluated was CHUM Therapeutic Riding Inc, which is located in the middle part of the lower peninsula of Michigan.

CHUM      Children and Horses United in Movement  
NARHA      North American Riding for the Handicapped  
                 Association

The goal of CHUM Therapeutic Riding is to bring the experience of horses to individuals of all ages with and without disabilities.<sup>4</sup> The facility hosting the program consisted of an indoor arena, 2 outdoor arenas, and multiple trails at 2 locations.

The president of and primary instructor at CHUM Therapeutic Riding is certified by the NARHA as a riding instructor and is a licensed occupational therapist, and all classes in the therapeutic riding program are taught by NARHA-certified instructors. The NARHA is a national, non-profit organization that fosters safe, professional, ethical, and therapeutic equine activities for people with and without disabilities through education, communication, standards, and research.<sup>1</sup> The NARHA certifies training centers and instructors and provides educational opportunities.

**Horses**—Fourteen horses involved in the CHUM Therapeutic Riding program were used in the study. Horses consisted of 11 geldings and 3 mares. Mean  $\pm$  SEM age was  $14.5 \pm 2.2$  years (range, 3 to 30 years).

**Horse management**—Each riding class in the therapeutic riding program was approximately 1 hour long. The program operated 4 days a week, but no horse was ridden more often than 3 days a week or longer than 3 hours a day. Horses received a massage on days that they were ridden and as deemed necessary by the primary instructor. Horses also received individual attention throughout the year from sponsored 4-H club members. Horses were fed alfalfa hay and a fortified grain mix,<sup>6</sup> and all horses had access to pasture. Horses received routine veterinary care, including routine dental care, and received chiropractic and acupuncture services as necessary.

On days that they were ridden, horses were transported 15 miles to the riding arena in a stock trailer that could hold 8 to 10 horses. Horses were tied to the side of the trailer when not being ridden, brushed, or massaged.

**Riders**—Behavior of the 14 horses was recorded as they were ridden by a total of 126 riders (not all horses were ridden by all riders). Riders were classified into 1 of 5 groups: riders with no handicaps, physically handicapped riders, psychologically handicapped riders, at-risk children, and special education children.

Riders classified as recreational riders had no handicaps and were able-bodied individuals in which no physical, psychologic, cognitive, or emotional disorders had been diagnosed. Physically handicapped riders were individuals in whom a specific physical problem had been diagnosed and for whom therapeutic riding had been prescribed by a health care provider, with specific therapeutic goals in mind. This group included individuals with cerebral palsy, multiple sclerosis, fibromyalgia, traumatic brain injuries, or visual impairment and individuals recovering from a cerebral vascular accident. Psychologically handicapped riders were individuals in whom a psychologic disorder or developmental delay had been diagnosed and for whom therapeutic riding had been prescribed by a health care provider, with specific therapeutic goals in mind. This group included individuals with autism, depression, and Down syndrome.

The group of at-risk children included children deemed to be at risk of poor performance or failure at school because of low socioeconomic status, living in a single-parent family, poor school performance, or disciplinary action. These children had not previously participated in any formal riding program, did not have a diagnosed physical or emotional disorder, were not being treated with any psychoactive drugs, and were not in the special education program in their school. The group of special education children included children receiving special education services from the school system. These children were classified as emotionally

impaired (ie, manifestation of behavioral problems primarily in the affective domain over an extended period that adversely affects the person's education to the extent that the person cannot profit from the regular learning experience without special education<sup>5</sup>) or learning disabled (ie, having a disorder in 1 or more of the basic psychologic processes involved in understanding or using language, spoken or written, which may manifest as an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations<sup>5</sup>).

The riders with no handicaps, physically handicapped riders, and psychologically handicapped riders were regular clients of CHUM Therapeutic Riding and rode throughout the year. The at-risk children and special education children were specifically recruited to participate in the present study and rode during July and August 2003 (at-risk children) or July 2004 (special education children).

**Riding classes**—During the fall, winter, and spring, riding classes were held every Monday, Wednesday, Friday, and Saturday in the indoor arena. During the summer, classes were held Monday through Thursday and generally were held in the indoor arena, although on occasion they were held in one of the outdoor arenas.

Horses and riders were matched by the primary instructor of CHUM Therapeutic Riding. Decisions regarding which rider would ride which horse were made on the basis of specific therapeutic goals for individual riders, the daily and weekly work schedules for the horses (including weekend shows), and rider preference. Researchers had no input into how horses and riders were matched. Of the 14 horses enrolled in the study, 7 were ridden by individuals from all 5 groups of riders. Six horses were ridden by individuals from 4 of the groups of riders. One of these 6 horses was euthanized in spring 2004 and consequently was not available for riding by the special education group, and 1 was obtained after summer 2003 and consequently was not available for riding by the at-risk group. Two of the 6 horses participated in frequent shows during 2003 and were not ridden by the at-risk group, and 2 were simply not observed when ridden by the physically handicapped or psychologically handicapped group. The remaining horse in the study was used infrequently during 2004 because of West Nile Virus infection the previous year and was not observed with riders from the psychologically handicapped or at-risk group.

In addition to the person observing the horses' behavior, at least 1 member of the research team was present at all times when the at-risk children or children in special education programs were on the premises of CHUM Therapeutic Riding. On occasion, riders were assisted by other individuals; these were leaders, side walkers, or back riders. Assistance was provided to the riders during 67 of the 398 riding classes that were observed (recreational riders, 7 of 76 classes; physically handicapped, 46 of 98 classes; psychologically handicapped, 12 of 42 classes; at-risk children, 0 of 70 classes; and special education children, 2 of 112 classes).

**Behavioral observations**—To create an ethogram of equine behaviors, horses at CHUM Therapeutic Riding were observed by a single individual for 15 hour-long sessions, and all behaviors were recorded. With these recorded behaviors as a guide, additional observations were made for 10 hour-long sessions. A list of specific behaviors was then developed on the basis of these observations, results of previous studies<sup>6-9</sup> of equine behavior, and the collective experience of the investigators (**Appendix**).

For purposes of the present study, the 14 horses were observed and behaviors were recorded during 1-hour riding classes between July 2003 and July 2004. Each horse in a class was observed for 2 minutes, and after all horses in that particular class were observed for 2 minutes, the observa-

tions were repeated in the same order. A single observer recorded all equine behaviors.

**Stress behaviors**—Seven specific equine behaviors were considered to indicate stress, irritation, or frustration on the basis of results of previous studies<sup>6-9</sup> and the experience of the investigators (Appendix; Figure 1). This included having the ears pinned back, raising the head, turning the head to the left or right independent of the actions of the rider, tossing the head, shaking the head, holding the head down, and defecating. The names and descriptions of specific behaviors were adapted from McDonnell<sup>6</sup> and Waring<sup>7</sup> and modified, in some instances, to better describe behaviors seen in horses being ridden. More extreme behaviors indicative of stress, such as bucking or rearing, were never observed and were not included in the present study. In addition, none of the horses ever attempted to bite, strike at, or kick a rider, a leader, or a side walker; therefore, these behaviors were also not included in the present study. Exaggerated movement of the tail was initially included as a stress-related behavior; however, it was eventually excluded because of difficulties in differentiating tail swishing as an irritation behavior from tail swishing as a response to flies.<sup>6,7,9,10</sup> Chomping the bit was also initially included as a stress-related behavior; however, not all horses wore bridles with bits during therapeutic rid-

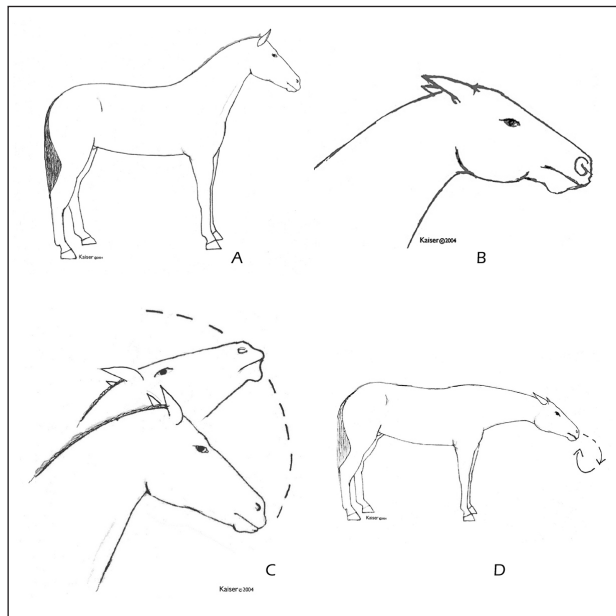


Figure 1—Diagrams of selected behaviors in horses. A—Relaxed horse without any evidence of stress. Notice that the horse appears alert, with its ears forward and the eyes and mouth having a soft expression. B—Horse with its ears pinned back; the eyes and mouth indicate irritation, annoyance, or aggression. C—Stress-related head shaking is characterized by repeated rhythmic flipping motions of the head. D—Stress-related head tossing. The head is lowered with the ears pinned back, and there are sharp tossing or rotating gestures of the head.

ing sessions. Therefore, this behavior could not be measured in all horses and was excluded.

In horses, having the ears pinned back is a mild form of aggression that is usually the first sign of displeasure or aggression.<sup>6-8</sup> Horses laying their ears back and stomping while being saddled may be signaling their objection to being ridden.<sup>7,9</sup> Lowering and extending of the head can also be seen as a mild aggressive signal, as this behavior may accompany threats to bite, strike, or kick.<sup>7</sup> During head tossing, the ears are pinned back and the neck is lifted to its full height while the head goes from fully flexed to extended. The portion of this sequence during which the head is elevated above horizontal and the neck is extended also fits the definition of raising the head<sup>7,9</sup> and supports inclusion of this behavior as a stress-related behavior during riding. Head shaking may indicate the presence of something unwelcome, as it can occur in response to annoyances around the head and ears and is common when unreceptive mares are approached by a stallion.<sup>7</sup> Head turning<sup>6</sup> has been described as occurring when the horse orients toward something annoying or in an attempt to avoid pressure, as could arise from a rider or side-walker. Defecation can occur as a result of stimulation or arousal and therefore could indicate a stressful situation.<sup>7</sup> To validate that horses in the study were capable of demonstrating the various behaviors determined to indicate stress, frustration, or irritation, these same horses were observed when ridden in competition at the county fair.

To determine whether stress was associated with skill level of the rider, we observed a separate group of 7 horses that were in training or retraining while they were being ridden by advanced riders. Advanced riders were defined as riders affiliated with CHUM Therapeutic Riding for > 1 year who had been deemed by the primary instructor to be capable of handling horses in need of additional training; many of these riders were involved in the county 4-H program. These horses were not ridden in the therapeutic riding program, but were housed with those horses. Instructors for the therapeutic riding program also taught the advanced riders

**Statistical analysis**—Because riding classes varied in size, the number of 2-minute observation periods per class per horse also varied. Therefore, data were compressed such that each horse was represented once for each hour of riding that was observed by taking the total number of stress-related behaviors per hour of observation and dividing by the number of 2-minute observation periods to obtain mean number of stress-related behaviors per 2 minutes. Consequently, 2,065 observation periods were compressed into 398. Data are reported as mean  $\pm$  SEM number of stress-related behaviors per 2 minutes.

A mixed-design ANOVA followed by the Tukey post hoc test was used to compare mean number of stress-related behaviors per 2 minutes among the 5 groups of riders. To determine whether there was a relationship between age of the horse and number of stress-related behaviors per 2 minutes, we performed a bivariate correlation. A Student *t* test was used to determine whether mean number of stress-related behaviors per 2 minutes for the 7 horses ridden only by

Table 1—Characteristics of riders in a study of stress among horses in a therapeutic riding program.

Group	Total No.	Children		Adults	
		Male	Female	Male	Female
Recreational riders	34	5	24	0	5
Physically handicapped	35	5	13	13	4
Psychologically handicapped	15	6	5	2	2
At-risk children	20	7	13	0	0
Special education children	22	11	11	0	0
<b>Total</b>	<b>126</b>	<b>34</b>	<b>66</b>	<b>15</b>	<b>11</b>

Table 2—Mean number of stress behaviors among 14 horses in a therapeutic riding program when ridden by various groups of riders and among 7 horses ridden by advanced riders.

Group	No. of stress-related behaviors/2 min			
	Mean	SEM	Range	No. of sessions
Recreational riders	0.94	0.1	0–4.4	76
Physically handicapped	0.80	0.1	0–3.6	98
Psychologically handicapped	1.0	0.2	0–5.5	42
At-risk children	2.3*	0.2	0–8.0	70
Special education children	1.1	0.1	0–7.8	112
Advanced riders	3.7†	0.4	0–6.1	15

Number of sessions represents number of 1-hour riding classes observed for each group of riders. Mean number of stress-related behaviors/2 min was determined for each riding class by dividing the total number of stress-related behaviors observed during the class by the number of 2-minute observation periods during that class.

\*Significantly ( $P < 0.05$ ) different from values obtained when horses were ridden by individuals with no handicaps, physically handicapped individuals, psychologically handicapped individuals, or special education children. †Significantly ( $P < 0.05$ ) different from value obtained for all other groups of riders.

Table 3—Classification of stress-related behaviors among 14 horses in a therapeutic riding program when ridden by various groups of riders.

Group	Percentage of stress-related behaviors	
	Head movements	Ears pinned back
Recreational riders	85	15
Physically handicapped	64	36
Psychologically handicapped	84	16
At-risk children	88	12
Special education children	91	9
All riders	82	18

Head movements classified as stress-related behaviors included raising the head, turning the head to the left or right independent of the actions of the rider, tossing the head, shaking the head, and holding the head down.

Table 4—Mean number of stress behaviors among 14 horses in a therapeutic riding program.

Horse No.	Breed	No. of stress-related behaviors/2 min			
		Sex	Age (y)	Mean	SEM
1	Arabian-Saddlebred	Gelding	30	0.22	0.07
2	Pony	Gelding	25	0.24	0.05
3	Arabian-Quarter Horse	Gelding	24	0.95	0.28
4	Lipizzan	Gelding	22	1.03	0.14
5	Arabian	Gelding	20	1.86	0.38
6	Arabian	Gelding	19	1.47	0.20
7	Arabian	Female	16	1.86	0.23
8	Arabian	Gelding	14	0.92	0.09
9	Haflinger crossbred	Female	10	1.13	0.34
10	Thoroughbred	Gelding	10	1.23	0.29
11	Spanish Mustang	Gelding	9	1.82	0.27
12	Pinto	Female	7	1.47	0.14
13	Draft crossbred	Gelding	4	1.40	0.35
14	Quarter Horse	Gelding	3	0.39	0.14
All horses	NA	NA	NA	1.10	0.14

NA = Not applicable.

the advanced riders was significantly different from mean number for the 14 horses in the therapeutic riding program. For all analyses, values of  $P < 0.05$  were considered significant. Data were analyzed by use of standard software.<sup>d</sup>

## Results

**Stress-related behaviors for horses in the therapeutic riding program**—The 14 horses in the therapeutic riding program were observed while ridden by a total of 126 riders (Table 1). Mean number of stress-related behaviors per 2 minutes for horses in the ther-

apeutic riding program varied with rider group, ranging from 0.8 to 2.3 (Table 2). No significant differences in mean number of stress-related behaviors were found among the recreational riders, physically handicapped, psychologically handicapped, and special education groups. However, mean number of stress-related behaviors was significantly higher when horses were ridden by the at-risk group. Results were the same when data only for the 7 horses ridden by all 5 groups of riders were analyzed. For all 5 groups of riders, stress behaviors related to head movement represented

a higher percentage of all stress-related behaviors than did having the ears pinned back (Table 3). Defecation occurred only rarely.

Mean number of stress-related behaviors in the 7 horses ridden by advanced riders was significantly higher than mean number of stress behaviors for the 14 horses in the therapeutic riding program (Table 2).

**Stress-related behaviors of individual horses—**For the 14 horses in the therapeutic riding program, mean number of stress-related behaviors per 2 minutes ranged from 0.22 to 1.86 (Table 4). There was no significant correlation between age of the horse and mean number of stress-related behaviors. Mean number of stress-related behaviors per 2 minutes for the 7 horses ridden by advanced riders ( $3.7 \pm 0.25$ ; range, 2.5 to 4.3) was significantly higher than mean number for the 14 horses in the therapeutic riding program.

## Discussion

Results of the present study suggest that for horses in a therapeutic riding program, being ridden by physically or psychologically handicapped individuals is no more stressful for the horses than is being ridden in the same setting by individuals without any handicaps. Thus, the stress and frustration levels of horses used in therapeutic riding programs may not be any greater than that experienced by the horses when used for recreational riding. These findings are important for the equine industry in light of the fact that some groups are promoting the concept that the welfare of horses in therapeutic riding programs is jeopardized. That said, however, the wide variation in programs and equine management must be considered when evaluating the stress level of horses, and results of the present study may not be applicable to all therapeutic riding programs. Nevertheless, the notion that therapeutic riding is inherently stressful to participating horses is not supported by results of the present study.

In the present study, horses in training demonstrated more stress-related behaviors when ridden by advanced riders than did horses in the therapeutic riding program. In contrast, many horsemen have suggested, on the basis of anecdotal evidence, that novice riders cause more stress to horses than do advanced riders. However, advanced riders would likely ask their horses to perform more advanced skills, which would be expected to elicit more stress and frustration, particularly when the horses were in training and being asked to learn new tasks. Horses ridden by the advanced riders were asked to make multiple rapid gait and direction changes, whereas horses in the therapeutic riding program were rarely asked to change gait or direction. During training, there is generally considered to be an optimum level of stress, above which learning is greatly inhibited.<sup>11</sup> Whereas horses ridden by advanced riders in the present study might have experienced stress at or above the level optimal for learning, it is unlikely that horses in the therapeutic riding program experienced stress at this level.

At-risk children caused more stress to horses in the present study than did the other groups of riders in the therapeutic riding program. This concurs with the notion

that at-risk children may be more likely to act out against an animal with which they are interacting.<sup>2</sup> These data should not be taken to mean that at-risk children should not be involved in therapeutic riding programs, but rather that the time each horse is ridden by at-risk children should be limited both daily and weekly. Interestingly, at-risk children caused more stress to the horses than did the special education children. Because both groups rode the horses during the summer, this difference cannot be explained by a lack of structure related to being out of school or by the horses behaving differently during the summer. Our observations suggested that the special education children were as disadvantaged or more so than were the at-risk children. However, our casual observations of riders in the program suggested that the at-risk children seemed to view the horses as tools, whereas the special education children seemed to develop a more meaningful relationship with the horses. These children may have had greater empathy for the horses and consequently have been less likely to act out toward the horses. Although no overt aggressive or acting-out behaviors were observed among the at-risk children, subtle signs of impatience, aggressive disposition, or displeasure toward the horses would be more challenging to document, and doing so was outside the scope of the present study.

Although various aspects of equine behavior, temperament, and personality have been studied,<sup>6-8,12-14</sup> equine behavior while being ridden has only rarely been investigated,<sup>9,10,15</sup> and stress behaviors among horses in therapeutic riding programs have only recently been explored.<sup>a,b</sup> For instance, in 1 study,<sup>a</sup> behavior and heart rate were evaluated in 4 therapeutic riding horses interacting with 7 patients with brain disorders and 7 control riders. Horses ridden by patients demonstrated more signs of discomfort, as evidenced by increased time chewing the bit and moving their head up and down. As time passed and riders became more autonomous, horses obeyed less and had higher heart rates. The authors concluded that therapeutic riding horses showed some discomfort behaviors in response to patients, and their reactivity became more evident as patients became more independent riders. Equine management, scheduling, and instructor knowledge or qualifications were not mentioned.

The impact of therapeutic riding on horses was also investigated in a study<sup>b</sup> of 28 horses from 4 different equine-assisted therapy programs. This study involved various disciplines (equine-assisted mental health, therapeutic riding for children and adults, and equine-facilitated psychotherapy). Five of the horses participated in 2 sessions for a total of 33 observations. Serum cortisol concentration was measured before and after a riding session, and videotapes were reviewed to assess behavior. Cortisol concentration decreased in 27 horses, suggesting that the activity may not have been stressful to these horses. Cortisol concentration increased in 6 horses, but the authors found there were extenuating circumstances in some cases. For instance, one of the horses was described as new to the herd and involved in horse-to-horse contact, and a second had been seen cribbing prior to the sessions. A third horse was described as being ridden by an individual with extreme

emotional problems, and the authors suggested that the increased cortisol concentration was likely a result of interactions unrelated to therapeutic riding. Results of the behavioral assessments have not yet been reported. Although equine management, scheduling, and instructor knowledge or qualifications were not mentioned, results of this study appear to support the notion that therapeutic riding per se may not be stressful to horses.

Therapeutic riding is ideally a partnership between horse and rider that results in psychologic, physical, or social benefits for the rider. Clearly, for therapeutic riding to benefit humans, it must occur in a setting that does not cause undue stress or frustration for the horses. Results of the present study suggest that it is possible for horses to participate in therapeutic riding programs without adverse consequences, in that therapeutic riding was not significantly more stressful than recreational riding. Thus, therapeutic riding has the potential to provide meaningful work for horses, while not being unduly stressful or detrimental to their well-being. However, at other therapeutic riding centers, where horse care and management is different, these results may not apply, and horses may be subject to undue stress and frustration related not to therapeutic riding itself but to the overall approach of the center. It appears prudent to recommend that the time each horse is ridden by at-risk children be limited both daily and weekly.

- 
- a. Minero M, Dassi M, Martelli A, et al. Behaviour and heart rate of therapeutic riding horses interacting with patients (abstr), in *Proceedings*. 37th Int Soc Appl Ethol Cong 2003;54.
  - b. Suthers-McCabe MH. Veterinary care for therapy and service animals: tips from Virginia Tech (abstr), in *Proceedings* [CD-ROM]. 141st Annu Am Vet Med Assoc Conv 2004.
  - c. Buckeye supreme horse pellets, Buckeye Nutrition, Dalton, Ohio.
  - d. SPSS, version 11.5, SPSS Inc, Chicago, Ill.
- 

## References

1. North American Riding for the Handicapped Association Web site. Available at: [www.narha.org](http://www.narha.org). Accessed Jun 7, 2005.
2. Tapia F. Children who are cruel to animals. *Child Psychiatry Hum Dev* 1971;2:70-77.
3. Kaiser L, Smith KA, Heleski CR, et al. Effects of a therapeutic riding program on at-risk and special education children. *J Am Vet Med Assoc* 2006;228:46-52.
4. CHUM Therapeutic Riding Web site. Available at: [www.chumtherapy.net](http://www.chumtherapy.net). Accessed Jun 7, 2005.
5. Ingham Intermediate School District. *A handbook for parents, 2002-2003*. Ingham, Mich: Ingham Intermediate School District, 2002;31-36.
6. McDonnell S. *A practical field guide to horse behavior: the equid ethogram*. Lexington, Ky: The Blood-Horse Inc, 2003;33-46, 74, 92-95, 110-112, 1187.
7. Waring GH. *Horse behavior*. 2nd ed. Norwich, NY: Noyes Publications, William Andrew Publishing, 2003;41-47, 118, 120, 133, 144-148, 157, 270-284, 331, 350-357, 369-384.
8. Houpt KA, Eggleston A, Kunkle K, et al. Effect of water restriction on equine behaviour and physiology. *Equine Vet J* 2000;32:341-344.
9. Weeks J, Beck AM. Equine agitation behaviors. *Equine Pract* 1996;18:23-24.
10. Rivera E, Benjamin S, Nielsen B, et al. Behavioral and physiological responses of horses to initial trailering: the comparison between pastured versus stalled horses. *Appl Anim Behav Sci* 2002;78:1-19.
11. Yerkes RM, Dodson JD. The relation of strength of stimulus to rapidity of habit-formation. *J Comp Neurol Psychol* 1908;18:459-482.
12. Visser EK, Van Reenen CG, Engel B, et al. The association between performance in show-jumping and personality traits earlier in life. *Appl Anim Behav Sci* 2003;82:279-295.
13. Visser EK, Van Reenen CG, Hopster H, et al. Quantifying aspects of young horses' temperament: consistency of behavioural variables. *Appl Anim Behav Sci* 2001;74:241-258.
14. Anderson MK, Friend TH, Evans JW, et al. Behavioral assessment of horses in therapeutic riding programs. *Appl Anim Behav Sci* 1999;63:11-24.
15. Odberg FO. Chronic stress in riding horses. *Equine Vet J* 1987;19:268-269.

Appendix on page 45.

## Appendix

Ethogram of behaviors observed in horses while being ridden in a therapeutic riding program.

Behavior	Description
Head toss*	Head lowered with the ears pinned back interrupted with momentary sharp tossing or rotating gestures of the head.
Ears pinned back*	Ears pressed caudally against the head and neck.
Head raised*	Head held higher than the normal carriage with nose extended upward and with slight extension of the neck.
Head down*	Head held lower than the normal carriage; neck may be stretched out with nose pushed forward.
Ears turned (listening)	Ear movement from pointing forward to pointing backward; may be unilateral or bilateral.
Head shake*	Repeated rhythmic, mild flipping motions of the head.
Head turn*	Moving head left or right independent of the rider.
Moving tail	Any exaggerated movement of the tail, usually more of a wringing motion than a rhythmic or directed swishing.
Chomping bit	Any mouth or tongue manipulation of the bit independent of the rider's use of the reins.
Whinny (neigh)	Loud, prolonged (typically 1 to 3 seconds) call beginning high pitched and ending lower pitched; head is elevated and the mouth opened slightly.
Moving backwards	Backwards movement of the horse in a 2-beat gait with diagonal pairs of legs working together (trotting in reverse).
Halt	Cessation of movement of all 4 feet.
Walk	An even 4-beat gait in which the sequence of beats is lateral in that both feet on 1 side strike the ground before the feet on the opposite side strike the ground.
Trot	A 2-beat gait in which diagonal pairs of legs strike and leave the ground simultaneously.
Canter	A 3-beat gait in which the first and third beats are made by 2 legs striking the ground independently and the second beat is made by 2 limbs striking the ground simultaneously.
Defecation*	Expelling of feces; the anal sphincter contracts rhythmically, and the tail is raised and may be lashed vertically at the completion of defecation.
Urination (male)	With forelimbs slightly extended forward and hind limbs extended backward and slightly spread, expelling of urine.
Urination (female)	With the back arched, the tail raised, and the hind limbs extended backward and slightly spread, expelling of urine.

\*Behaviors classified as stress-related behaviors. More extreme behaviors indicative of stress while being ridden, such as bucking or rearing, were never observed, and none of the horses ever attempted to bite, strike at, or kick a rider, a leader, or a side walker. Movement of the tail was not classified as a stress-related behavior because of difficulties in differentiating tail swishing as an irritation behavior from tail swishing as a response to flies. Chomping the bit was not classified as a stress-related behavior because not all horses wore bridles with bits during therapeutic riding sessions.