APMB - Atti della Accademia Peloritana dei Pericolanti
Classe di Scienze Medico Biologiche
Vol. 109(2) 2021

ISSN 1828-6550

DOI: 10.13129/1828-6550/APMB.109.2.2021.SD1

The role of hormones during Equine-Assisted Activity and Therapy: a literature review

Adriana Ferlazzo, Esterina Fazio, Cristina Cravana, Pietro Medica

Department of Veterinary Sciences, Unit of Veterinary Physiology, University of Messina, Italy

Abstract

Recent acquisitions on human-animal interaction and on its use in complementary medicine are reported. The contribution of horses to one health concept and the effects of equine-assisted activity and therapy (EAAT) are evaluated, also in the light of need to monitor stress conditions in therapeutic horses. The role of hypothalamus-pituitary-adrenal axis' hormones and of total and free iodothyronines in stress coping of horses during therapeutic riding is critically discussed.

Key Words: cortisol, equine-assisted activity and therapy, hormones, human-animal interaction, total and free iodothyronines.

Corresponding Author: Adriana Ferlazzo - ferlazzo@unime.it

1. Human-animal interaction and therapy

The interest in human-animal interaction (HAI) is continuously and rapidly growing (1-6).

Moreover, systematic reviews and meta-analyses of literature evaluated the effectiveness of animal-assisted activity (AAA) and therapy (AAT) for children and adults suffering from psychic and physical disabilities (7-14).

Positive effects of HAI, AAA and AAT include increased social interaction and socio-emotional function, and reduced stress, heart rate (HR), heart rate variability (HRV), and blood pressure; they can also induce motor improvements (2,14-19).

It has been underlined that outcomes from studies on the efficacy of AAA for improving human health and welfare have not been uniformly positive. The reasons for the variability of results were recognized in the wide variety of methodologies and incorrect use of protocols and measures. Furthermore, the potential reason for this variability might be linked to the unique nature of HAI, involving two complex organisms, a human and an animal, interacting in dynamic ways (12). Therefore, the current implementation of studies aims to standardize the treatments and better evaluate the positive outcomes in a number of clinical populations (11,12).

From another point of view, it is strongly underlined the need of a more ethical approach towards therapeutic animals (4), suggesting evidence-based standards to ensure their welfare (20,21).

2. Equine-Assisted Activity (EAA) and Therapy (EAAT)

Horses are recognized as a crucial part in one health concept (22); and they represent an integral part of the treatment process of human disabilities, achieved through equine-assisted activity (EAA) and therapy (EAAT) (1-3).A variety of physical or psychological EAAT can facilitate awareness of personal skills and treat mental and physical difficulties (1-3). EAAT includes equine knowledge and handling, active horse's care interventions, therapeutic driving and equine-facilitated psychotherapy as well as hippotherapy (HPOT) and therapeutic horseback riding (TR). HPOT and TR are used to achieve physical goals, and psychological, cognitive, social, behavioral and communicative outcomes in humans. The movements of the horse can improve motor control, coordination, balance, attention, sensory processes, and performance in daily activities. Sensory processes, vestibular, proprioceptive, tactile, visual, and auditory systems are simultaneously targeted. HPOT also targets improvements in speech, language, cognitive and masticatory functions (17, 23-26).Many systematic reviews and clinical studies demonstrated the beneficial effects of HPOT and TR on children with attention-deficit/hyperactivity disorder (27), or suffering from cerebral palsy (26,28,29),spinal muscular atrophy (30), and autism spectrum disorders (31-33);or on adolescents disengaged from traditional school (34), by affecting their prosocial behavior (35).A large body of evidence also showed the efficacy of treatment for people with mental illness and neurological disorders (depression, schizophrenia and dissociative disorders, Alzheimer's disease, dementia, attention-deficit/hyperactivity and post-traumatic stress disorders) (36-39); and also with internet gaming disorders (40) or drugs' abuse (41).

3. Physical and mental challenges of therapeutic horses

The health challenges that patients afford during EAAT often result in increased horses' mental or physical stress. TR lessons would be more stressful for horses than a standard lesson program with an experienced rider, due to the physical and psychological challenges of the riders which could interfere with their ability to ride a horse (42).

A relationship between stress and equine behavioral changes has been assessed (43). Therefore, the observation of body language provides a noninvasive method to evaluate horses for acute or chronic stress. However, no standard evaluation methods are actually available (44,45).

Riding may impinge on chronic states, potentially leading to increased emotionality or stereotypies of horses (46).Human attitude towards horses can impact horse behavior, and, during EAAT, their behavioral response can differ between experienced riders and at-risk humans. It is very interesting to note that the human attachment style of at-risk humans with emotional and mental difficulties can influence the horse response; what is more, a low-stress response of therapeutic horses towards patients with emotional and behavioral difficulties may be mediated by a human insecure attachment style (1).The horse HR increased during and after exposure to mentally traumatized humans, suggesting that the behavioral response of therapeutic horses may rely on human physical traits and experience rather than affective traits (47).The transitions between successive handlers could induce distress conditions in therapeutic animals, probably due to the disruption of pre-existing social bonds (48).The presence of professional therapists and animal handlers during the therapeutic sessions affected the well-being or social stress in therapeutic horses (49).

4. The role of hormones in horses' stress coping during EAAT

The contribution of endocrine systems to horse welfare maintenance and response to different physical and mental challenges is known. Stress conditions are associated to the release of hormones of hypothalamus-pituitary-adrenal (HPA) axis: b-endorphin (b-END), catecholamines, corticotropin releasing hormone (CRH), adrenocorticotropin (ACTH), cortisol; and also of iodothyronines (50-53).The sensitivity of endocrine axes of horses to discriminate the emotional values of stimuli associated to physical and/or mental stress was studied (50-53). During exercise, the increases of catecholamines and ACTH appear dependent on the intensity, while a marked increase in plasma adrenaline occurs during activities with high emotional content (53). Cortisol and b-END changes do not occur in phase during stress with high emotional content; the response of cortisol is correlated with the duration of stress, while b-END changes are highly dependent on the type of sport activity performed and stress conditions (50,53).The impact of TR programs and of different types of riders on trained horses was evaluated. The mental influences of an equestrian session with psychomotor disabled children (affected by general diseases of growth, childhood autism, Rett's and Asperger's syndromes) led to not significant b-END and ACTH changes; while a significant cortisol decrease post therapeutic sessions, probably as a result of the repetitive exercise usually performed, was recorded (54).More recently, the HPA axis response of therapeutic riding horses ridden in the same setting by mentally-disabled adult and healthy adult riders was evaluated, showing differences in their stress degrees, with significantly lower cortisol concentration after the sessions with disabled than healthy riders. Thus, although sessions' workload stress was equivalent, the minor response of HPA axis was related to different horse-human interaction (55).Stress degree, as demonstrated by cortisol concentrations and HRV, did not change in horses involved with veterans affected by post-traumatic stress disorders (37). The lack of difference in salivary cortisol concentrations between exposure to post-traumatic stress disorders and control group has been explained on the basis that stress responses of horses was dependent exclusively on human experience with horses (47).Differences in stress related behaviors and serum cortisol concentrations of horses used in a TR program or university riding program were reported. Serum cortisol concentrations, although remaining within or below the normal range, decreased from before to after a riding lesson, and increased thereafter. Similar behavior scores were observed in horses ridden by novice and experienced riders; however, behavior scores differed in therapeutic horses ridden by disabled riders. A positive relationship between stress-related behavior and cortisol concentration changes was not clearly shown, probably due to the low stress environment (49). In trained horses, the mental aspects of an equestrian session with psychomotor disabled riders also led to significant decreases of cortisol concentrations post therapeutic sessions, indicative of their good exercise-stress coping (51). Different responses of glucocorticoid occurred according to the controllability of the stressor(55). Moreover, in TR programs the activities were carried out in the presence of professional therapists and side walkers (49) to protect horses' welfare, by stopping or modifying the session according to signs of horses' discomfort. The role of the hypothalamus-pituitary-thyroid (HPT) axis in Equines' stress coping is still under study (51-53). The iodothyronines are generally involved in the control of stress due to physical performances, as well as in the coping response to mental tasks of exercise or other stress conditions (51-53,58,59). Recently, a model of functional interactions between HPA and HPT axes during exercise stress has been proposed in Equines; a modulation of coping responses to different energy-demanding physical performances, required for peculiar sport activities, was hypothesized (51,58,59).Differences in iodothyronine changes after stress are related to the motor skills and energy required as the mental and emotional components in the exercise stress, like the competitive conditions or EAAT (51,53). Increased concentrations of total and free iodothyronines of horses after TR sessions for mental disabilities were recorded. As a prompt effect of the exercise, significant increases for thyroxine (T_4) and Triiodothyronine (T_3) were recorded, and successively also for fT_4 and fT_3, probably as a delayed effect of mental stress coping on thyroid secretion, due to the repetition of the rehabilitation procedures (51).Moreover, the horses' stress coping ability has been studied by monitoring the circulating total and free iodothyronine changes of therapeutic horses after exercise and checking the effect of different riders, psychic patients or healthy inexperienced subjects. Differences in the therapeutic horses' iodothyronine responses between groups of riders and at different weeks of observation were recorded. The lack of effects of the exercise on T_4, in both groups of riders and at all weeks of observation, showed that the thyroid gland maintained a steady-state condition during the moderate exercise performed by the therapeutic horses, without any influence when being ridden by both mentally disabled and healthy inexperienced riders. Moreover, T_3 and fT_3 changes over time showed an effect of the exercise and an effect of the different riders' group, thus probably confirming a role in supporting arousal processes to physiological stress conditions during EAAT (60).The evidence that T_3 and fT_3 changes were affected by the typology of the riders, as already reported (42), and by the timing and evolution of therapy treatment, could strengthen the hypothesis of the functional interactions between HPA and HPT axes, modifying circulating hormonal changes during stress conditions (51). The increase in T_3 concentrations at the beginning of exercise in both mentally disabled and healthy inexperienced riders could probably be interpreted as a consequence of the need to prepare the organism to modulate the coping response to stress. As the effect of exercise on T_3 concentrations was reduced with the repetition of exercise, it is possible presume that the exercise stress tended to be restrained in the course of EAAT, due probably to the central inhibitory role of T_3 on the TRHergic neurons of paraventricular nucleus (58); thereafter, on the contrary, still an effect of the riders' group could be demonstrated showing highest changes as effect of healthy inexperienced riders. Notwithstanding studies' limitations, a case can be made that using T_3 and fT_3 measures to assess the mental stress response in therapeutic horses should be further developed and studied.

5. Conclusions

Reported data reinforce the need of improving welfare of animals used in EAA and EAAT, as well as the importance of taking into account the individual stress response and the adequate control of environment within equestrian therapeutic activities. They suggest the need of evaluation of behavioral, functional and hormonal markers of welfare of therapeutic horses. This type of evaluation could also represent an adequate strategy in the selection of therapeutic horses, concerning their ability to maintain mental and physical homeostasis during EAA and EAAT. Hence, the complementary medicine, treating human mental and physical pathologies, could take the greatest advantage from equines as co-therapists.

Conflicts of Interest: The Authors declare no conflict of interest

References

1. Arrazola, A., Merkies, K.A. (2020**)** Effect of human attachment style on horse behavior and physiology during Equine-Assisted Activities – a pilot study. Animals, 10:1156-1169. doi:10.3390/ani10071156.

2. Garcìa-Gòmez, A., Guerrero-Barona, E., Garcìa-Peña, I., Rodrìguez-Jimenèz, M., Moreno-Manso, J.-M. (2020) Equine-assisted therapeutic activities and their influence on the heart rate variability. A systematic review. Complement TherClinPract, 39:101167

3. Pálsdóttir, A.M., Gudmundsson, M., Grahn, P. (2020) Equine-Assisted Intervention to improve perceived value of everyday occupations and quality of life in people with lifelong neurological disorders: a prospective controlled study.Int J Environ Res Public Health, 17(7):2431

4. Galardi, M., De Santis, M., Moruzzo, R., Mutinelli, F., Contalbrigo, L. (2021) Animal Assisted Interventions in the green care framework: a literature review Int J EnvironRes Public Health, 18:9431.

5. McDonald, S.E., Tomlinson, C.A., Applebaum, J.W., Moyer, S.W., Brown, S.M., Carter, S., Kinser, P.A. (2021) Human–animal interaction and perinatal mental health: a narrative review of selected literature and call for research. Int. J. Environ. Res. Public Health, 18:10114.

6. Ng, Z., Griffin, T.C., Braun, L. (2021) The new status quo: enhancing access to human–animal

interactions to alleviate social isolation & loneliness in the time of COVID-19.Animals,11(10): 2769.
7. Charry-Sànchez, J.D., Pradilla, I., Talero-Gutìerrez, C. (2018) Animal-assisted therapy in adults: a systematic review. Complement TherClinPract, 32:169–180.
8. Ein, N., Li, L., Vickers, K. (2018) The effect of pet therapy on the physiological and subjective stress response: a meta-analysis. Stress and Health, 34(4):477–489.
9. Waite, T.C., Hamilton, L., O'Brien, W. (2018) A meta-analysis of animal assisted interventions targeting pain, anxiety and distress in medical settings. Complement TherClinPract, 33:49–55.
10. López-Cepero, J. (2020) Current status of Animal-Assisted Interventions in scientific literature: a critical comment on their internal validity. Animals, 10:985-997.
11. Rodriguez, K.E., Herzog, H., Gee, N.R. (2021) Variability in Human-Animal Interaction Research. Front Vet Sci, 7:619600.
12. Hediger, K., Wagner, J., Künzi, P., Haefeli, A., Theis, F., Grob, C., Pauli, E., Gerger, H. (2021) Effectiveness of animal-assisted interventions for children and adults with post-traumatic stress disorder symptoms: a systematic review and meta-analysis. Eur J Psychotraumatol, 12(1):1879713.
13. Fine A.H., Andersen, S.J. (2021) A commentary on the contemporary issues confronting animal assisted and equine assisted interactions. J Equine Vet Sci, 100:103436.
14. Friedmann, E., Son, H. (2009) The human-companion animal bond: How humans benefit. Vet Clin North Am: Small AnimPract, 39(2):293–326.
15. Wells, D.L. (2009) The effects of animals on human health and wellbeing. J Social Issues, 65(3):523–543.
16. O' Haire, M.E. (2010) Companion animals and human health: Benefits, challenges, and the road ahead. J Vet Behav: ClinAppl Res, 5(5):226–234.
17. Kendall, E., Maujean, A., Pepping, C.A., Wright, J.J. (2014) Hypotheses about the psychological benefits of horses. Explore (NY). 10:81-87.
18. Cabiddu, R., Borghi-Silva, A., Trimer, R., Trimer, V., Ricci, P.A., Monteiro, C.I., Maniglia, M.C.M., Pereira, A.M.S., das Chagas, G.R., Carvalho, E.M. (2016) Hippotherapy acute impact on heart rate variability non-linear dynamics in neurological disorders. PhysiolBehav, 159:88–94.
19. Quintavalla, F., Cao, S., Spinelli, D., Caffarra, P., Rossi, F.M., Basini, G., Sabbioni, A. (2021) Effects of dog-assisted therapies on cognitive mnemonic capabilities in people affected by Alzheimer's disease. Animals, 11:1366.
20. Clark, S.D., Martin, F., McGowan, R.T.S., Smidt, J.M., Anderson, R., Wang, L., Turpin, T., Langenfeld-McCoy, N., Bauer, B.A., Mohabbat, A.B. (2020) Physiological state of therapy dogs during Animal-Assisted Activities in an outpatient setting. Animals, 10:819-833.
21. Barker, S.B., Gee, N.R. (2021) Canine-Assisted Interventions in hospitals: best practices for maximizing human and canine safety. Front Vet Sci, 8:615730.
22. Lönker N.S., Fechner K. and Abd El Wahed A.Horses as a Crucial Part of One Health. Vet. Sci. 2020, 7, 28-45.
23. Meregillano, G. (2004) Hippotherapy. Phys Med RehabilClin N Am, 15:843–854.
24. Champagne, D., Dugas, C. (2010) Improving gross motor function and postural control with hippotherapy in children with Down syndrome: case reports. Physiother Theory Pract, 26:564–71.
25. Silkwood-Sherer, D.J., Killian, C.B., Long, T.M., Martin, K.S. (2012) Hippotherapy-- intervention to habilitate balance deficits in children with movement disorders: a clinical trial. PhysTher, 92:707–17.
26. Stergiou, A., Tzoufi, M., Ntzani, E., Varvarousis, D., Beris, A., Ploumis, A. (2017) Therapeutic Effects ofhorseback riding interventions: a systematic review and meta-analysis. Am J Phys Med Rehabil, 96(10):717-725.
27. Jang, B. Song, J., Kim, J., Kim, S., Lee, J., Shin H.-Y., Kwon, J.-Y., Kim, Y.-H., Joung, Y.-S. (2015) Equine-Assisted Activities and Therapy for treating children with attention-deficit/hyperactivity disorder. J Altern Complement Med, 21(9):546-553.
28. Benda, W., Mc Gibbon, N.H., Grant, K.L. (2003) Improvements in muscle symmetry in children with cerebral palsy after equine assisted therapy (hippotherapy). J Altern Complement Med 9:817–825.
29. Lightsey, P., Lee, Y., Krenek, N., Hur, P. (2021) Physical therapy treatments incorporating equine movement: a pilot study exploring interactions between children with cerebral palsy and the horseJ NeuroengRehabil, 18(1):132.
30. Lemke, D., Rothwell, E., Newcomb, T.M., Swoboda, K.J. (2014) Perception of equine-assisted activities and therapies by parents and children with spinal muscular atrophy. PediatrPhysTher ,26, 237-244.
31. Harris, A., Williams, J.M. (2017)The impact of a horse-riding intervention on the social functioning of children with autism spectrum disorder. Int J Environ Res Public Health, 14:776-795.

32. Srinivasan, S.M., Cavagnino, D.T., Bhat, A.N. (2018) Effects of Equine Therapy on individuals with autism spectrum disorder: a systematic review. Rev J Autism Dev Disord, 5:156–175.
33. Zoccante, L., Marconi, M., Ciceri, M.L., Gagliardoni, S., Gozzi, L.A., Sabaini, S., Di Gennaro, G., Colizzi, M. (2021) Effectiveness of Equine-Assisted Activities and Therapies for improving adaptive behavior and motor function in autism spectrum disorder. J Clin Med, 10:1726.
34.Norwood, M.F., Lakhani, A., Maujean, A., Downes M., Fullagar S., Barber, B.L., Kendall, E. (2021) The horse as a therapist: effects of an Equine program without ‘‘therapy’’ on the attention and behavior of youth disengaged from traditional school. J Altern Complement Med, 27(8):678-687.
35. Pelyva, I.Z., Kresák, R., Szovák, E., Tóth, A.L. (2020)How Equine-Assisted Activities affect the prosocialbehavior of adolescents.Int J Environ Res Public Health 17:2967
36. Corring, D., Lundberg, E., Rudnick, A. (2013) Therapeutic horseback riding for ACT patients with schizophrenia. Community Ment Health J 49:121-126.
37. Yoo, J.H., Oh, Y., Jang, B., Song, J., Kim, J., Kim, S., Lee, J., Shin, H-Y., Kwon, J.-Y., Kim Y.-H., Jeong, B., Joung, Y.-S. (2016) The effects of equine-assisted activities and therapy on resting-state brain function in attention-deficit/hyperactivity disorder: a pilot study. ClinPsychopharmacolNeurosci, 14:357-364.
38. Malinowski, K., Yee, C., Tevlin, J.M., Birks, E.K., Durando, M.M., Pournajafi-Nazarloo, H., Cavaiola, A.A., Mc Keever, K.H. (2018) The effects of equine-assisted activities therapy on plasma cortisol and oxytocin concentrations and heart rate variability in horses and measures of symptoms of posttraumatic stress disorder in veterans. J Equine Vet Sci, 64:17-26.
39. Shelef, A., Brafman, D., Rosing, T., Weizman, A., Stryjer, R., Barak, Y. (2019) Equine Assisted Therapy for patients with posttraumatic stress disorder: a case series study. Mil Med, 184(9-10):394-399.
40. Kang, K.D., Jung, T.W., Park, I.H., Han, D.H. (2018) Effects of equine-assisted activities and therapies on the affective network of adolescents with internet gaming disorder. J Altern Complement Med, 24:841-849.
41. Sudmann, T.T. (2018) Equine-facilitated physiotherapy – devised encounters with daring and compassion. In: Gibson,B., E., Nicholls E.,D., A., Setchell, J., Groven, K., S. (Eds.), Manipulating practices: a critical physiotherapy reader. Oslo: CappellenDamm. Akademisk., pp. 14-32.
42. McKinney, C., Mueller, M.K., Frank, N. (2015) Effects of therapeutic riding on measures of stress in horses. J Equine Vet Sci, 35:922-928.
43. Young, T., Creighton, E., Smith, T., Hosie, T. (2012) A novel scale of behavioural indicatorsof stress for use with domestic horses. Appl Anim Behav Sci, 140:33-43.
44. Kaiser, L., Heleski, C.R., Siegford, J., Smith, K.A. (2006) Stress-related behaviors amonghorses used in a therapeutic riding program. J Am Vet Med Assoc, 228:39-45.
45. Collins, A., Hovey, M.R., Chen, S., Zhao H., Davis, A., Porr, C.A.S. (2017) Development of an ethogram for evaluating riding horses. J Equine Vet Sci, 52:41.
46. Hausberger, M., Gautier, E., Biquand, V., Lunel, C., Je´go, P. (2009) Could work be a source of behavioural disorders? a study in Horses. PLoS ONE 4(10): e7625
47. Merkies, K., McKechnie, M.J., Zakrajsek, E. (2018) Behavioural and physiological responses of therapy horses to mentally traumatized humans. Appl Anim Behav Sci, 205:61–67.
48. Serpell, J.A., Coppinger, R., Fine, A.H., Peralta, J.M. (2010) Welfare considerations in therapy and assistance animals. In: Fine, A., H. (Ed), Handbook on animal-assisted therapy: theoretical foundations and guidelines for practice, 3rd ed., Academic Press, San Francisco, CA, USA. pp. 481-502.
49. Jorgenson, J. (1997) Therapeutic use of companion animals in health care. Image J NursSch, 29:249-254.
50. Ferlazzo, A., Fazio, E., Cravana, C., Medica P. (2018a) The role of circulating β-endorphin in different stress models in Equines: a review.J Equine Vet Sci, 71:98-104.
51. Ferlazzo, A., Cravana, C., Fazio, E., Medica, P. (2018b) Is there an interplay between the hypothalamus-pituitary-thyroid and the hypothalamus-pituitary-adrenal axes during exercise-stress coping in horses? J Equine Vet Sci, 62:85-97.
52. Ferlazzo, A., Cravana, C., Fazio, E., Medica, P. (2018c) The contribution of total and free iodothyronines to welfare maintenance and management stress coping in ruminants and equines: physiological ranges and reference values. Res Vet Sci, 118:134–143.
53. Ferlazzo, A., Cravana, C., Fazio, E., Medica, P. (2020) The different hormonal system during exercise stress coping in horses. Vet World, 13(5): 847-859.
54. Fazio, E., Medica, P., Cravana, C., Ferlazzo, A. (2013) Hypothalamic-pituitary-adrenal axis responses of horses to therapeutic riding program: effects of different riders. Physiol Behav, 118:138-143.
55. Cravana, C., Fazio, E., Ferlazzo, A., Medica, P. (2021) Therapeutic Riding Horses: using a

hypothalamic-pituitary-adrenal axis measure to assess the physiological stress response to different riders. J Vet Behav, 46:18–23.
56. Hovey, M.R., Davis, A., Chen, S., Godwin, P., SheaPorr, C.A. (2021) Evaluating stress in riding horses: part one. behavior assessmentand serum cortisol. J Equine Vet Sci, 96:103297.
57. Myers, B., Mc Klveen, J.M., Herman, J.P. (2014) Glucocorticoid actions on synapses, circuits, and behavior: implications for the energetics of stress. Front Neuroendocrinol, 35:180-196.
58. Fliers, E., Kalsbee, A., Boele, A. (2014) Mechanism in endocrinology: Beyond the fixed setpoint of the hypothalamic-pituitary-thyroid axis. Eur J Endocrinol 171: R197-208.
59. Joseph-Bravo, P., Jaimes-Hoy, L., Charli, J.L. (2015) Regulation of TRH neurons and energy homeostasis-related signals under stress. J Endocrinol, 224: R139-R159.
60. Cravana, C., Fazio, E., Ferlazzo, A., Satué,K., Medica, P. (2021) Total and free iodothyronine responses to different riders in Therapeutic Riding Horses, unpublished results.

Communicated and Received October 30, 2021, revised and accepted November 5, 2021, published on line November 17,2021