Horse Heart Rate and Behavioral Responses Towards Confinement and Turnout Condition.

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Abstract: Horses give poor response to confinement and demonstrated by increased in heart rate and changes in behavior response. Horse may develop stress which consequence to poor performance, health and behavioral problems. Therefore, this study focused on the response of horses towards confinement in a stable and outdoor turnout in an arena using behavioral indices and heart rate reading. Four horses were examined at 4-hour intervals over 24 hours in confinement condition and followed by 24 hours in an outdoor turnout condition. Behavioral assessment scoring form were used in this study to find score for behavioral responses. Reading of heart rates was taken using Polar Equine In-zone FT1 heart rate devices. Findings revealed fluctuate heart rate reading for both conditions. However, heart rate of the horse during turnout time (M=42.1, SD=3.7, n=4) obtained a higher inference score than the horse in confinement (M=38.0, SD=3.8, n=4). The Paired-samples T-test shows that the research result was significantly difference between confinement and turnout condition (t=-3.872, df=27, p<0.5). The findings might be due to horse's adaptation, excitement and type of workload. Hence, the fluctuate reading of heart rate in confinement and outdoor turn out condition do not give significant effects on horse's heart rate and behavioral responses. Thus, increase the number of the horse as the subjects would be one of the recommendations for further research. In addition, extend the research using other physiological measures such as saliva.

Keywords: Horse; Confinement; Outdoor turn out; Heart rate; Behavior

1. Introduction

Horses are free-ranging and grazing animals which adjusted for life on open fields (Pickett, 2009). Providing an adequate environment for domesticated horses is important to minimize the level of stress (Park et al., 2013). Physical confinement and social isolation are considered environmental stressors for animals (Mason et al., 2007). The horse response poorly to confinement and is likely to show physiological and behavioral distress responses (McGreevy et al., 2012). As herd animals, a horse that get lonely or under isolation might develop stress. Thus, horses need to be stable together and increased their turnout time so they have opportunities for socialize with other horses (What & Cause, 2013). The horse demonstrated abnormal behavior and increased heart rate as the effects of long or even short-term isolation and confinement (Harewood & McGowan, 2005). Thus, it is important to provide an adequate environment for domesticated horses to minimize level of stress (Park et al., 2013).

Concurrently, domestic horses are all being in a stable. Many horses are kept in social isolation, fed concentrate-based diets with little forage and given lack of opportunity for exercise. This environment is totally different from their nature which horses are adapted. This may lead to poor welfare and abnormal behavior (Pickett, 2009). Social isolation is stressful for horses. Horse will show behavioral reactions indicative of stress when they are individually stabled for the first time after previously living in groups. There is also evidence of physiological stress reactions with increasing time spent confined in stalls and in isolation (Mal, Friend, Lay, Vogelsang, & Jenkins, 1991). The heart rate of horses at rest depends mainly on the degree of relaxation and health. The heart rate of horses in rest is normally within the range of 25-40 beats per min. The sudden excitement, fear and expected training can quickly increase the heart rate (Mlyneková, Halo, Maršálek, & Starostová, 2016). Increased in heart rate high during confinement indicates the horse response poorly to confinement.

The findings of the study give scientific evidence to the horse industry. Previously, horse which experience stress are recognize by their action and behavior. Thus, this study contributes scientific evidence related to stress of the horse. Concurrent with the aim of this study to give deep understanding of welfare of the horse. Horse are known as athletic creatures which give benefits to human race. Thus, this study highlights the welfare of the horse that need to be put as

priority. Moreover, this study providing awareness to equine practitioner and horse industry regarding the stress-related aspects of the horse. Hence, the aim of this study was to assess the horse's heart rate and behavioral responses towards confinement and turnout condition.

2. Materials and Method

This research is a field test study and it involves the random assignment of participants. Those subjects undergo two types of treatment which are being confinement and turn out. In order to achieve the objective of this research, quantitative approaches were used (Chua Yan Piaw, 2014). A research design had been outlined as a reference for the researcher to conduct the stages of the research as to ensure the smoothness of the research. The main purpose of this section is to make a clear breakdown of the research structure.

Table 1. Phases of research outline that will be used in this study.

Phases	Description
Phase 1: Research background	Problems identification, determine research objectives and research questions
Phase 2: Preparatory	Horse selection, familiarization process, and set up fix routine
Phase 3: Confinement	Data collection – heart rate and behavioral responses to confinement condition
Phase 4: Turn out	Data collection – heart rate and behavioral responses to turn out condition
Phase 5: Documentation	Attainment of the results and discussion on overall findings

2.1 Sampling Procedure

Non-probability sampling method will be use in this research work by using a convenience sampling procedure. In this study, there is no declaration of the criteria for the subjects. No specific characteristics were driven for this study. This study has been conducted at Raspelana Sisek Stable. A total of 4 horses involved in this study. The purpose and workload of the horse are the same which are used for leisure riding. Various gender and ages included in this study. The breed involves are Thoroughbred. The ages rank from 5 to 20 years old horse. Table 2 stated the details of the horse's background. All horses were controlled by 3 conditions: pre-condition, confinement and turnout.

Table 2. Horse's demography and selection.

Horse	Age	Sex	Breed	Type of workload	Average Resting Heart Rate
A	15 years old	Mare	Thoroughbred	Leisure ride	42
B	9 years old	Gelding	Thoroughbred	Leisure ride	34
C	8 years old	Mare	Thoroughbred	Leisure ride	37
D	18 years old	Gelding	Thoroughbred	Leisure ride	40

2.2 Test and Measurement

In order to minimize the disturbance of the reading heart rate, this study set up an environmental standard. The surrounding environment reading during the procedure were taken and recorded using android application. These standard reading were drawn from weather scales' standard in Kota Tinggi area. The environment in the surrounding area of the stables were controlled by the following criteria:

Table 3. Environment control.

Feeding routine	Normal
Standard mean temperature	79.8F or 26.6C
Standard humidity of surrounding	Average annual humidity: 80%
Normal range in weather scale	'windy', 'cloudy', 'clouds and sun' are acceptable, not rain

2.3 Data Collection

Data collection was conducted according to the procedure which clearly shown on Table 4 below. This study assessed horse heart rate and behavioral responses towards the confinement and turn out condition. Four horses were examined at 4-hour intervals over 24 hours in confinement condition followed by 24 hours in an outdoor turn out condition (adopted: Harewood & McGowan, 2005). Familiarization process was conducted a week prior before data collection were run. The following are the schedule for horse's heart rate reading and behavioral assessment throughout the procedure.

Table 4. Horse routine during data collection.

Day	Condition	Activities
Day 1	Pre-condition (normal routine)	Subjects were given exposure back to their nature and basic need. **Exercise** (lunging) for 20 minutes at 9.00 a.m. **Turnout in arena** (twice) for 45 minutes at 10.00 a.m. and 4.00 p.m. **Grazing in paddock** 30 minutes at 5.00 p.m.
Day 2	Confinement	**24 hours confinement in a stable** Normal feeding routine at 7.00 a.m., 11.00 a.m., 6.00 p.m. and 10.00 p.m. *no heart reading and behavioral assessment were run during feeding time.
Day 3	Confinement (heart rate reading)	**24 hours confinement in a stable** Normal feeding routine at 7.00 a.m., 11.00 a.m., 6.00 p.m. and 10.00 p.m. *no heart reading and behavioral assessment were run during feeding time.
Day 4	Pre-condition (normal routine)	Subjects were given exposure back to their nature and basic need. **Exercise** (lunging) for 20 minutes at 9.00 a.m. **Turnout in arena** (twice) for 45 minutes at 10.00 a.m. and 4.00 p.m. **Grazing in paddock** 30 minutes at 5.00 p.m.
Day 5	Turn out (heart rate reading)	**24 hours turnout in an arena** Normal feeding routine at 7.00 a.m., 11.00 a.m., 6.00 p.m. and 10.00 p.m. *no heart reading and behavioral assessment were run during feeding time.

2.4 Heart rate reading

Heart rate reading were collected seven times per day. Heart rate is the physiological measures that will be use in this research. Hence, horse's heart rate was examined at 4-hour intervals over 24 hours in an outdoor group paddock followed by 24 hours in indoor individual housing. Behavioral observations and scores and heart rates were recorded.

2.5 Behavioral Assessment

The behavior of each horse was recorded at each heart rate reading were taken. The camera will be hand held and located at a distance of approximately 4m from the horse. The video will be viewed and scored by 30 respondents. A behavior assessment scoring form will be distributed to all respondents. Then, the respondent will assess the behavior of 4 horses and fill up the form. Respondents are needed to fill up this form and assess the behavior of the horse based on the video records shown on screen. The video record using Sony HDR-PJ440 Handy cam Video Camera Camcorder. The following are the scores and associated behavior.

Table 5. Behavior score. Source: (Hall et al., 2014)

Score	Type of response	Associated behaviors
1	Very relaxed	No movement apart from mouth. Minimal ear movement. No attempt to avoid procedure.
2	Quite relaxed	Slow movements of head/ears. No attempt to avoid procedure.
3	Alert/interested	Ears forward. Head raised. Looking toward handler/procedure. Interest but not attempt to avoid.
4	Anxious	Head and neck moving away. Ears back/moving rapidly. No body movement. Initial attempt to avoid procedure.
5	Frightened/avoidance	Movement of head, neck, and body. Abrupt movement away. Repeated attempts to avoid procedure.

2.6 Respondent selection

The respondent selection criteria for this research work are mainly people who are working closely with horses. All respondent will be required to assess the behavior of the stress horse by observing and judging through video records. A behavior assessment scoring form will be distributed to all respondent. They need to fill up the form and assess the behavior of the horse. The following are the distribution of respondents.

**Table 6**. The distribution of the respondent in this study

Participant	Criteria	Number
Equine expert	-Equine professional which are staff associated with the university and academic institution -They could be veterinarian	3
Equine practitioner	-The equine practitioner whom had experience in ridden or trained horses for at least 10 years -A person who have Qualification for Introductory Riding and Coaching or level 1 or level 2 coach	3
Horse handler	-A horse handler could be a person who work with horses as a daily routine. -They also riding on a regular basis or almost every day.	4
Equine students	- Undergraduate students of an equine degree course	20
Total:		30

2.7 Data Analysis

Data analysis was performed using IBM SPSS Statistics version 24 and Microsoft Excel version 2016. The horse heart rate was recorded using Polar Equine In-zone FT1. The horse's heart rate reading obtained from confinement and turnout condition was stated by descriptive analysis using parametric test analysis. Heart rates recorded from the outdoor turnout and confinement were compared using a Paired-samples T-test. The test was used in order to find the significant difference in heart rate level between confinement and turnout horses. The behavioral scores from the outdoor turn out horses and confinement were asserted by descriptive analysis.

3. Results and Discussion

Figure 1 shows the descriptive analysis of heart rate reading during confinement and turn out condition. All horses appeared to show fluctuated heart rate reading for both conditions. However, for this research sample (n = 4), significantly, heart rate of the horse during turn out condition (M = 42.1, SD = 3.7, n = 4) obtained a higher inference score than the horse in confinement (M = 38.0, SD = 3.8, n = 4). Horse B and C clearly demonstrate a contrast reading with both heart rate was higher during turn out condition. While Horse A and Horse D vary in heart rate reading for confinement and turn out condition.

(a)   (b)

(c)   (d)
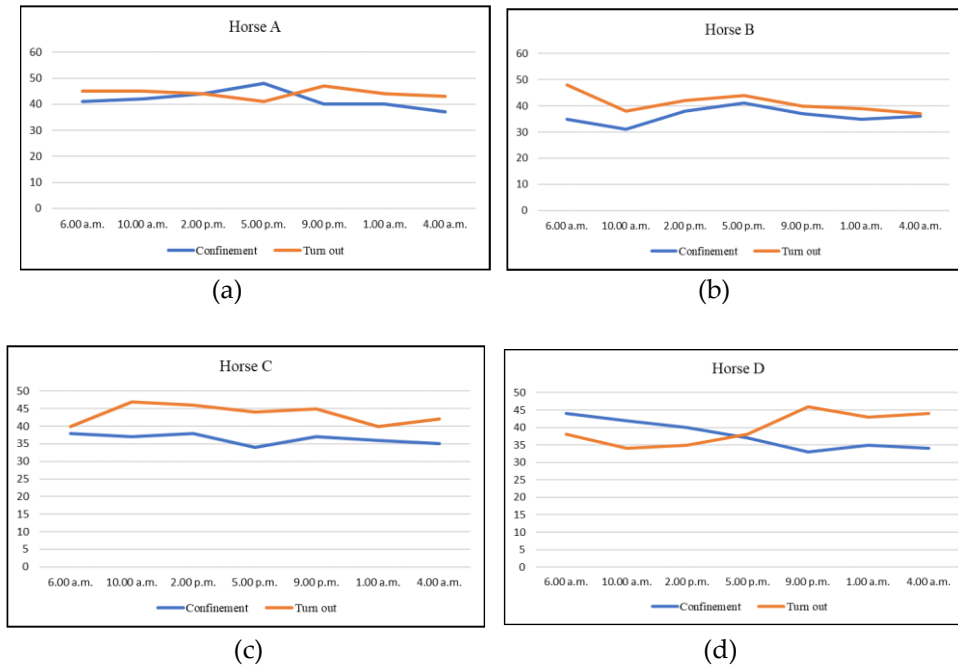
Figure 1. This is a figure of descriptive analysis which show the findings of the heart rate for both condition, confinement and turn out. (a) Heart rate reading for Horse A; (b) Heart rate reading for Horse B; (c) Heart rate reading for Horse C; (d) Heart rate reading for Horse D.

In addition, The Paired-samples T-test shows that the research result was significantly different from confinement and turn out condition (t = -3.872, df = 27, p < 0.5). Table 7 explains the obtained result for the statistical analysis to compare heart rate result for both conditions. Meanwhile, the behavior score and responses shown by the horse during procedure were varied for all horses according to both conditions. General behavior patterns displayed by horses in confinement and turn out condition were almost similar. All horses appeared calm and stood quietly during sampling period. General behavior observed became more variable during turn out condition. Horses seemed to become excited and restless frequently but somehow looked relaxed during procedure.

Paired Samples Test

					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Confinement - Turnout	-4.07143	5.56396	1.05149	-6.22891	-1.91395	-3.872	27	.001

Figure 2. The statistical analysis that show significant difference in heart rate reading between confinement and turn out horses.

Abnormal behavior and increased in heart rate demonstrated by the horse as the effects of confinement (Harewood & McGowan, 2005). Thus, increased in heart rate in confinement indicates the horse response poorly to confinement. Contrary to the findings, heart rate of the horse is high during turn out condition compared to confinement. The subjects include in this study were likely become accustomed to adaptation. The psychological and biological of the horse need to perform adaptive behavioral responses (Cooper & Albentosa, 2005). The horses involved in this study get used to confinement and already adopted to the surroundings.

Moreover, heart rate reading in turn out condition was higher than confinement due to excitement and anxious. Any excitement or fear by the horse will increase the pulse rate (Visser et al., 2002). Since the horses were familiarize with confinement, the subjects became arousal and restless during the turn out condition. Thus, alter their heart rate level. The subjects were not used to turn out and it was not their regular routine. The horse was coping a standard normal routine and response poorly to sudden changes.

Throughout evolution, the horse was an extraordinary athlete in view of the physical and physiological qualities, the horse has a natural preference for use in sport (Bartolomé & Cockram, 2016). Hence, exercise was important and part of a basic need for a horse. The four horses involve in this study were a leisure ride horse. Their type of workload was just for a leisure riding and not a performance horse (refer Table 2. Horse's demography and selection). These specifies that the distress in confinement that alters normal behavior and increased heart rate reading may related to type of workload of the horse.

4. Conclusion

In conclusion, the confinement and outdoor turn out condition do not give significant effects on horse's heart rate and behavioral responses. The results of this study highlight that a combination of behavioral and physiological measures allow better understanding of response of the horse towards certain condition, somehow proved that one measurement may be misleading. According to Kang and Lee (2016), there are several methods to assess stress levels in horses including heart rate, lactate density, and cortisol (Marc et al., 2000). Thus, other physiological measures should be obtained for example cortisol and lactate density. In addition, increase the number of the horse as the subjects would be one of the recommendations for further research. Then, another recommendation would be run a study with two group into two different conditions to have better understanding and accurate findings. The results of this study should be applied to development of horse management techniques used at horse farms and riding and breeding facilities.

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