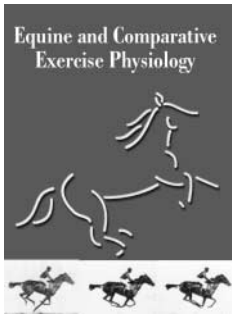
Equine and Comparative Exercise Physiology 2(4); 219–224 DOI: 10.1079/ECP200572



A field study on warm-up regimes for Thoroughbred and Standardbred racehorses

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Submitted 4 July 2005: Accepted 18 November 2005 **Short Communication**

Abstract

The exercise performed by Thoroughbred (TB) and Standardbred (SB) racehorses is similar. Nevertheless, warm-up regimes seem to differ between trainers of the two breeds. The aim of this study was to collect some preliminary results on warm-up strategies used by trainers of SB and TB in Sweden and the physiological response to two warm-up regimes of practical relevance. A questionnaire was answered by eight and nine SB and TB trainers, respectively, and showed that the SB trainers tended to perform longer warm-ups than TB trainers. In the exercise study, a long and a short warm-up (LWU and SWU) were designed by two trainers (SB and TB, respectively) and performed prior to an intensive exercise session. The study showed that the recovery period in the LWU trial in SBs was prolonged compared with the SWU trial and associated with increased body temperature (39.6 ± 0.3 *versus* 39.1 ± 0.1°C 15 min post-exercise), heart rate, and breathing frequency (66 ± 10 *versus* 55 ± 6 beats min^{-1} and 86 ± 11 *versus* 56 ± 6 breaths min^{-1} 15 min post-exercise). In addition, the body weight loss was increased by 129% compared with the SWU. In the TB trial, the post-exercise breathing frequency was higher following SWU compared with LWU (97 ± 7 *versus* 71 ± 8 breaths min^{-1} 15 min post-exercise), indicating increased anaerobic metabolism. Although this study involves few animals, it indicated that the LWU for TBs and the SWU for SBs was most beneficial.

Keywords: body weight loss; breathing frequency; exercise; recovery; trainer; track; trotters

Introduction

Warm-up strategies are used in athletic horses as well as in the human athlete. In horses, there is limited scientific information on the use, results, and benefits of a warm-up. However, Tyler *et al.*[12], McCutcheon *et al.*[5] and Geor *et al.*[2] have shown that a warm-up prior to intensive exercise accelerates the VO_2 kinetics, augments aerobic energy metabolism, and may even cause a longer run time to fatigue[5]. Studies on rabbits also indicate that a warm-up reduces the risk for muscle injury during strenuous exercise[8].

The Thoroughbred (TB) and the Standardbred (SB) racehorses have a close genetic relationship[13] and from a physiological point of view, the exercise performed by the two breeds is very similar. Both sports require work at maximal heart rate and maximal or near maximal speed at distances that take 1 to 3.5 min to complete. Nevertheless, warm-up regimes seem to differ a lot between trainers of the two breeds, where the trainers of TB racehorses seem to perform a much shorter and less strenuous warm-up than trainers of SB trotters. In contrast to TB trainers, SB trainers also seem to perform several warm-up heats.

Although an increase in muscle temperature might be beneficial for athletic performance[8], a too high body temperature probably contributes to the onset of fatigue. Therefore, it is also likely that warm-up strategies may either enhance or impair performance. There are only a few studies investigating different strategies of warm-up in horses and even fewer that resemble the strategies used by professional TB and SB racehorse trainers. It is therefore unclear how an optimal warm-up strategy is devised during field conditions.

The aim of the present study was to (1) collect some preliminary data on warm-up strategies used by trainers of SB and TB racehorses in Sweden, and (2) investigate the heat load and recovery response to intensive exercise following a long and a short warm-up in both TBs

and SBs in professional training during field conditions. The hypothesis was that a long warm-up, especially as performed by SB, might increase the time for recovery.

Materials and methods

Questionnaire

A questionnaire was sent to ten trainers of TBs and SBs, respectively, with categorical questions about their warm-up regimens before a regular intensive exercise session and before a race. Nine TB trainers (14% of the total numbers of TB trainers in Sweden) and eight SB trainers (2.5% of the total numbers of SB trainers) answered the questionnaire. The TB trainers had 3 to 35 horses in training (median 10) and 4 were amongst the 15 most successful trainers (earnings/horse; SGF[10]). The SB trainers had 7 to 150 horses in training (median 38) and 4 of them were amongst the 20 most successful trainers (earnings/start; STC[11]). The result from the questionnaire is presented as a percentage (rounded off to the nearest 5%) but not analysed statistically.

Exercise study

Two warm-up regimes were performed in SB and TB racehorses before an intensive exercise session. The horses were trained by a professional trainer for SB and TB racehorses, respectively, and housed at Seglinge farm (Sbs) or Täby race track (TBs) in Sweden. Both breeds performed a short warm-up (SWU) and a long warm-up (LWU). The LWU and the SWU were designed in cooperation with the trainers, and it was intended that they represent two warm-up strategies that are used among trainers of SB and TB racehorses in Sweden. Therefore, as a reflection of practice, the exercise schedule of the two warm-up regimes, as well as the following intensive exercise session, differed between breeds.

Four horses were used in the SB trial (DS, mare, 4 years, weight 480 kg; LHH, stallion, 2 years old, weight 457 kg; BS, gelding, 3 years old, weight 463 kg; H, gelding, 2 years old, weight 410 kg). A changeover design was used and on Day 1, one 2-year-old and one older horse performed the SWU_{SB} and the other two the LWU_{SB} (Table 1). Three days later, a new exercise test was performed and the warm-up regimes were switched. After both warm-up regimes and 10 min of rest, all horses performed a 2000 m trot in a predetermined velocity (Table 1).

In the TB trial, three healthy horses were used (1, I, gelding, 4 years old, weight 485 kg; 2, ES, mare, 3 years old, weight 440 kg; B, gelding, 3 years old, weight 480 kg). In this trial, a LWU_{TB} and a SWU_{TB} performed prior to 800 metres were full speed (Table 2). All horses performed both trials within a period of 14 days. The weather conditions were similar on the days of exercise in both the SB and the TB trial (14–17°C and 75–90% relative humidity, cloudy).

In the SB trial the rectal temperature, breathing frequency and heart rate were measured before the warm-up during the 10 min of rest between warm-up, and the intensive exercise session, 15 min and 30 min after the intensive exercise session. The horses were weighed before and after 10 min of rest after the warm-up and also after the intensive exercise session (U137, Trontec vågar och vägnings system, Stockholm, Sweden). The heart rate was measured with a stethoscope, the rectal temperature with a digital rectal thermometer, and the breathing frequency by counting the inspirations (nostril or abdominal movements).

The same parameters were measured in the TBs as in the SBs. Samples were taken before the warm-up, after 5 min of walk after the intensive exercise session (except the temperature), and after 15, 25, and 40 min of walk. The horses were weighed before and 5 min after the intensive exercise session on a scale at the track premises.

Statistical analysis

In the exercise study, all values are presented as means ± s.e. Exercise data were analysed by analysis

Table 1 Exercise session with long and short warm-up in Standardbred trotters

Long warm-up			Short warm-up		
	Distance (m)	Speed (m/s) 2-year-olds/older		Distance (m)	Speed (m/s) 2-year-olds/older
Before			Before		
Walk to the track	400	1.9/1.9	Walk	100	1.6/1.6
Trot 4	4000	6.5/7.9	Trot to the track	300	4.6/5.0
Trot 2	2000	10.1/10.7	Trot	2000	6.6/8.3
Trot to the stable	400	5.1/5.1	Trot to the stable	400	5.1/5.1
Rest 10 min			Rest		
Walk to the track	400	1.9/1.6	Walk to the track	400	2.1/1.7
Trot to start		3.6/5.5	Trot to start		
Trot	2000	10.6/11.1	Trot	2000	10.1/11.1
Trot to the stable			Trot to stable		
15 min after			15 min after		
30 min after			30 min after		

Table 2 Exercise session with long and short warm-up in Thoroughbred horses

	Long warm-up		Short warm-up	
	Speed (m/s) or Time (s)	Distance (m)	Speed (m/s) or Time (s)	Distance (m)
Before				
Walk	720 (s)		720 (s)	
Trot	4.0	1200	4.1	500
Walk	60 (s)		60 (s)	
Canter	7.5	1200	7.4	600
Walk	60 (s)		60 (s)	
Gallop	16	800	16	800
Canter	8.0	400	8.0	400

of variance by the GLM procedure in the SAS package. The statistical model used was:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + (\beta\gamma)_{jk}(\beta\gamma)_{jk} + e_{ijk}$$

where Y_{ijk} is the observation, μ the mean value, α_i is the effect of the animal, β_j is the effect of treatment, γ_k is the effect of sample, $(\beta\gamma)_{jk}$ is the effect of interaction between treatment and sample, and e_{ijk} is the residuals: $\sim$IND (0, σ^2). The p value for significance within and between treatments was <0.05.

Results

Questionnaire – Standardbred racehorses

All trainers warmed up their horses before intensive exercise was performed. Additional pre-exercise routines were to have the horse in a paddock for 1 to 4 h before (60% of the trainers) and in a horse walker (20%). The rest of the trainers kept the horses in the stable before exercise. Some of the trainers (30%) checked the rectal temperature before exercise.

Most horses were walked for 5 to 15 min before they started to trot for 10 to 15 min or up to 8 km (Table 3). Some trainers (25%) mentioned that they increased the velocity continuously. The pause between the warm-up and the intensive exercise session varied from 0 to 60 min and most common was 20 min (40%). Forty percent of the trainers estimated that the warm-up corresponded to 30% or less of the horses' capacity, another 40% of the trainers estimated that it corresponded to 50 to 75% and the rest did not answer the question.

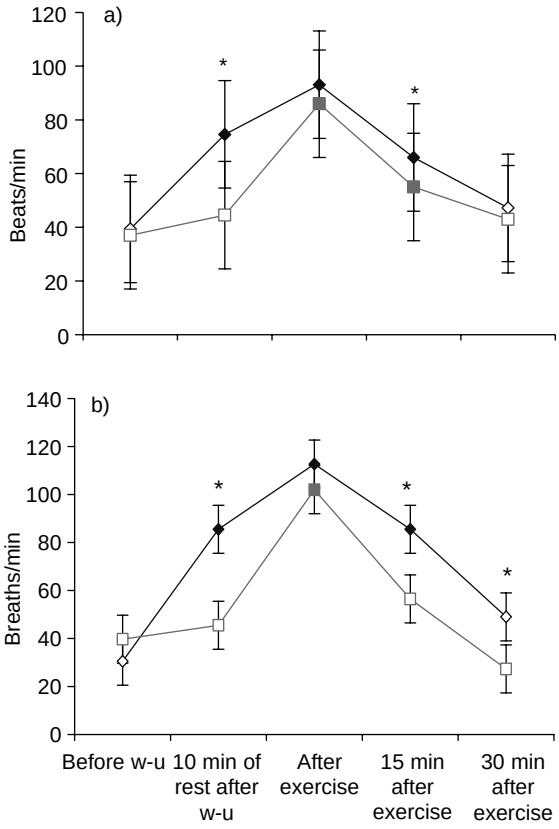

FIG. 1 Heart rate (beats/min) and breathing frequency (breaths/min) in Standardbred trotters before, during and after an exercise session with a long warm-up (black rhombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

Most of the SB trainers did the same warm-up before a race as before a regular training session (70%). The rest of the trainers performed a harder warm-up before a race. The time between the warm-up and the race varied between 5 min and 5 h, although most common was 1 h (60%).

Questionnaire - Thoroughbred racehorses

All of the TB trainers warmed up their horses. Additional pre-exercise routines were to have the horse in a paddock for 1–4 h before exercise (40% of the trainers) or in a horse walker for 30–60 min (30% of the trainers). The rest of the trainers kept the horses in the stable before exercise. Ninety percent

Table 3 Warm-up walking and trotting routines of Standardbred (SB) and Thoroughbred (TB) racehorse trainers (%)

	Walk (min)				Slow trot (min or km)				
	5	10	15	20	5	10	15	4–5 km	6–8 km
SB	40	30	30			20	30	40	10
TB	20	50	20	10	20	70	10		

of the trainers checked the rectal temperature before exercise.

Before an intensive training session, 80% of the trainers walked the horses for 10 min or longer and most of them continued with 10 min in slow trot (Table 3). The length of canter varied from 500 m up to 2500 m. All of the trainers thought that the intensity of the warm-up corresponded to less than 30% of the maximum capacity of the horse.

With 50% of the trainers, the warm-up was performed immediately before the intensive exercise session. Forty percent of the trainers had a 1 to 2 min pause and 10% had a 10 min pause before the exercise.

In general, none of the TB trainers warmed up their horses in the same way before a race as during training. All of the trainers let the horses walk in the collecting ring for about 20 min and then the horses were cantered to the start. The warm-up before the race was estimated to correspond to 0 to 30% of the maximum capacity of the horse.

Exercise study – Standardbred racehorses

Heart rate and breathing frequency

There was a significant increase in the heart rate and breathing frequency following the LWU, which was not observed following the SWU (Fig. 1). There were no differences in heart rate and breathing frequency between treatments immediately following the intensive exercise session, but 15 min post-exercise, both heart rate and breathing frequency were significantly higher in the LWU trial compared with the SWU trial. In the LWU trial, the breathing frequency was still elevated 15 min post-exercise and significantly higher than in the SWU trial both 15 and 30 min post exercise.

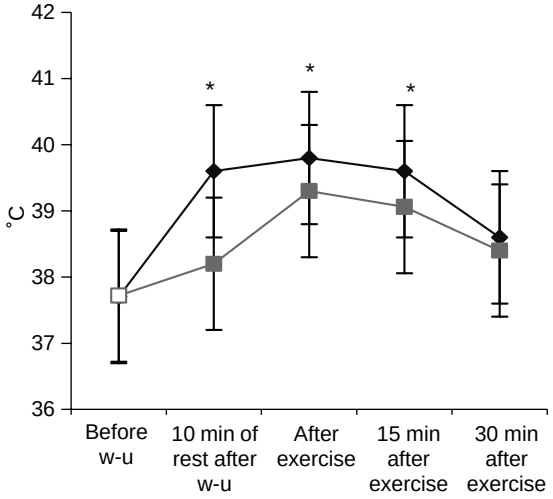

Fig. 2 Rectal temperature in Standardbred trotters before, during and after an exercise session with a long warm-up (black rombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

Rectal temperature and body weight loss

The rectal temperature increased following both warm-up regimes but was significantly higher in the LWU trial compared with the SWU trial (Fig. 2). An elevated rectal temperature was observed in both treatments throughout the study but, again, it was significantly higher in the LWU trial than in the SWU trial.

There was a significant body weight loss immediately following both warm-up regimes (Fig. 3), but the weight loss was significantly higher following the LWU compared with the SWU. In the LWU trial, the total weight loss was 8 ± 2 kg, which was significantly more than in the SWU trial (3.5 ± 2 kg).

Exercise study – Thoroughbred racehorses

Heart rate and breathing frequency

There was a significant increase in the heart rate following both warm-up regimes but there were no differences between treatments (Fig. 4). The breathing frequency was elevated throughout the study following both warm-up regimes, and 5 to 15 min post-exercise it was significantly higher in the SWU trial compared with the LWU trial.

Rectal temperature and body weight loss

There was a significant increase in the rectal temperature following both warm-up regimes that persisted throughout the study, but there were no differences between treatments (Fig. 5). The body weight loss was 5 ± 1.5 kg following both treatments (Fig. 6).

Discussion

Although the present study involves few trainers and horses, it has indicated that (1) Swedish SB trainers tended to perform longer warm-ups than Swedish TB trainers, and (2) warm-up regimes used by the trainers affect the response to exercise and alter the time

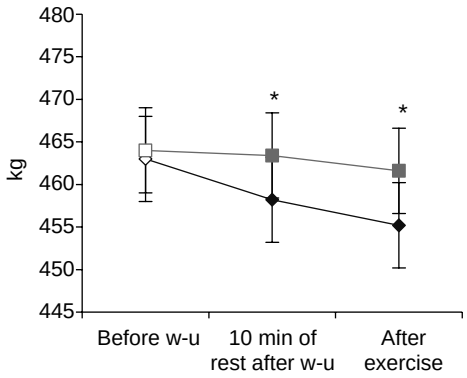

Fig. 3 Body weight in Standardbred trotters before, during and after an exercise session with a long warm-up (black rombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

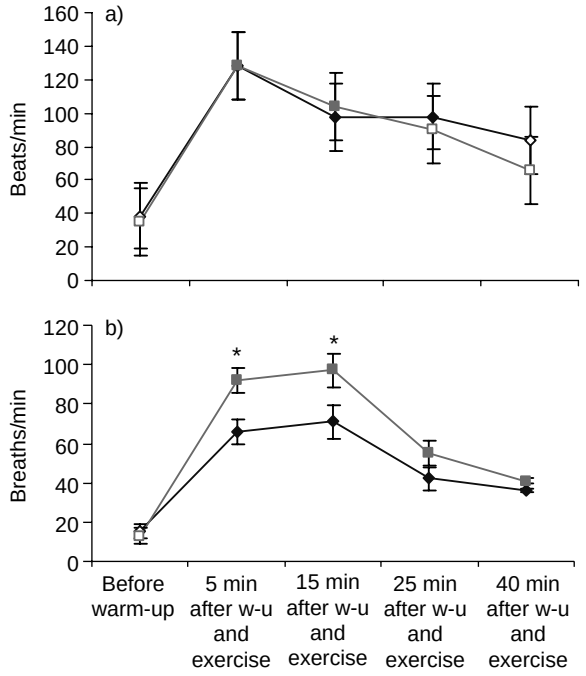

FIG. 4 Heart rate (beats/min) and breathing frequency (breaths/min) in Thoroughbred racehorses before and after an exercise session with a long warm-up (black rombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

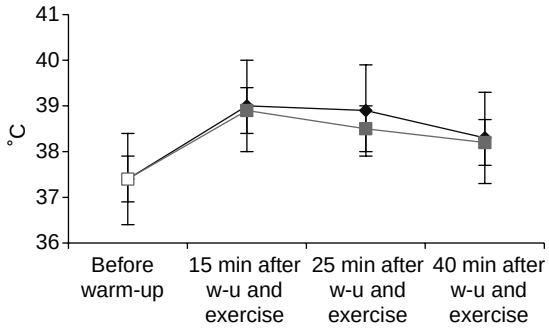

FIG. 5 Rectal temperature in Thoroughbred racehorses before and after an exercise session with a long warm-up (black rombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

required for recovery. In the SBs, the rectal temperature had not recovered 30 min post-exercise following either of the warm-ups, and in the LWU_{SB}, both heart rate and breathing frequency were elevated until that time. This indicates a high heat load on this treatment. Rectal temperatures near 40°C, which were observed during this trial, may correspond to muscle temperatures of 42 to 43°C[3,7] which, in turn, can be associated with signs of fatigue[6,9]. It is likely that an optimal warm-up leaves a wide potential for heat accumulation and therefore the LWU_{SB} may have been too long and intensive. The LWU_{SB} was 4 km (around 7 m s^{-1}) longer than SWU_{SB}. In addition, following LWU_{SB}, the body weight loss was 2.3 times higher than that following SWU_{SB}, and exercise-induced dehydration has been shown to impair performance[1]. To recover rapidly from sweat loss, horses need to be supplemented instantly with sodium[4] and, accordingly, in the LWU_{SB} trial, the need for sodium was higher.

In the TB trial, the breathing frequency was increased following SWU_{TB} but there were no differences in rectal temperature, heart rate and body weight loss, indicating that the heat load was similar to that following LWU_{TB}. This was not surprising, since the difference in workload between LWU_{TB} and SWU_{TB} was small. Exercise with LWU_{TB} was only 1300 m (trot and canter) longer than exercise with SWU_{TB}. However, the breathing frequency was markedly elevated (around 30 breaths min^{-1}) 5 to 15 min post-exercise with LWU_{TB} and might therefore indicate a greater oxygen deficit. Earlier studies have shown that if exercise was performed with no prior warm-up, it increased the anaerobic energy supply and increased the oxygen deficit[2,5,12]. However, there is a lack of studies on the effects on breathing frequency. If the anaerobic energy supply was increased following SWU_{TB}, a warm-up regime such as in SWU_{TB} must be considered too short or too light. It could be argued that information on the plasma lactate levels following the warm-ups could increase the understanding of the present study. In prior studies, there has been no correlation between absolute blood lactate values and oxygen deficit[5,12], indicating that blood lactate response is not an effective way of understanding the contribution of anaerobic energy metabolism.

In this study, the LWU for TBs and the SWU for SBs seemed most beneficial. Interestingly, these warm-ups were very similar, and indicate that SBs and TBs could benefit from a similar warm-up regime.

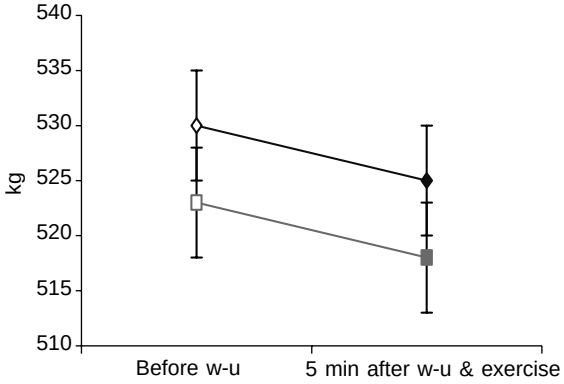

FIG. 6 Body weight in Thoroughbred racehorses before and after an exercise session with a long warm-up (black rombs) and a short warm-up (grey squares). Values represented by solid symbols are significantly different from before warm-up (before w-u). *Significant difference between warm-ups, $P < 0.05$

The LWU_{TB} and SWU_{SB} covered a distance of 2400 to 2700 m in 4 to 8 m s^{-1} for SBs and TBs, respectively, and contained no sprints. It has previously been shown that a warm-up including sprints near maximal VO_2 does not improve total running time to fatigue compared with a lighter warm-up[5].

According to the questionnaire, the trainers of SBs tended to trot the horses more before a training session than TB trainers trotted and cantered, whereas TB trainers walked more. However, there was a great variation and, in some cases, the warm-up regimes before a training session seemed quite similar. The major difference in warm-up strategies between TB and SB trainers seemed to be before a race, when TB trainers performed almost no warm-up and SB trainers performed a similar or even tougher warm-up than before training. The reason among TB trainers for having no or a very limited warm-up was mainly because the track was closed. They also mentioned that the horses would get so excited and perhaps be fatigued before the race. Some trainers considered their horses already warm due to transportation to the track. When preparing a SB trotter, the warm-up regime may not only serve as a physiological preparation for maximal exercise but also as a psychological preparation and as a control on the horse's locomotion pattern. If a trotter is too excited, it might be difficult to control the velocity and it may also gallop. Therefore, in the SBs the warm-up might induce a conflict between the physiological needs for maximal exercise performance and the psychological. However, in conclusion, a warm-up consisting of a short walk (100 to 350 m) followed by 2500 m at velocities between 4 to 8 m s^{-1} seems to be useful for both SBs and TBs prior to a regular training session.

Acknowledgements

Thanks to Satu Tikkaja for assistance during this investigation. Many thanks also to Göran Lång and Erna van Doorn for providing horses for this study and to all trainers who answered the questionnaire.

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