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# Work-load in the Horse during Vaulting Competition

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ABSTRACT. In order to answer the question whether work-load imposed on horses during vaulting competitions is strenuous, 8 Dutch Warmblood horses experienced in vaulting were studied. After a warming up period, the horses were lunged for 15 min at a quiet canter on a good firm surface with and without vaulters, and on a loose sand surface without vaulters. No significant differences were found in mean heart rates during exercise between mounted ($113 \pm 7$) and not-mounted horses ($117 \pm 7$) lunged on a good firm surface ($p > 0.05$). However, heart rates did increase ($159 \pm 20$) in horses cantering at the same speed on a loose sand surface ($p < 0.01$). No serious lactate accumulation (4 mmol $l^{-1}$), dehydration or muscles damage was demonstrated in any of the horses during the tests. The conclusion is that the work performed by vaulting horses during competition is not strenuous when working on a good firm surface, and is influenced more by a loose sand surface than by the weight of the vaulters.

*Key words* Vaulting; standardized exercise test; blood lactate; horses; lungeing.

## INTRODUCTION

In the relatively young equestrian sport of vaulting, a horse canters to the left (anticlockwise) on a circle with a minimum diameter of 13 metres, lunged by a lungeur whilst 1, 2 or 3 vaulters from a group of 8 perform their exercises on the horse (Fig. 1). In the official regulations for vaulting, the horse is required to canter quietly for 15 min, during which vaulters give their performances.[5] The first 10 min of competition are used for the compulsory test and the last 5 min for the free test. In the compulsory test all 8 vaulters have to undertake 6 compulsory exercises. During the free test the vaulters have the opportunity to perform single, double and triple free-style exercises in an original programme. The work-load imposed on vaulting competition horses is being queried within equestrian and animal welfare organisations.

The majority of exercise tolerance tests are based on heart rate (HR) and blood lactate concentration (LA) measured either during exercise or after work.[8] The HR/work relationship is precise and reproducible, provided strict standardization of the test procedure is observed. Blood lactate accumulation in response to exercise reflects dependence on anaerobic metabolism and is generally regarded as an inverse indication of fitness.[8] Blood lactate levels following exercise also reflect the work-load performed by the horse.

Heart rate, LA, packed cell volume (PCV) and muscle-derived enzyme activity in relation to fitness and work-load have been investigated in Thoroughbred and Standardbred horses.[7,8,12] In saddle horses standardized exercise tests have also been carried out.[3,9] However, no information on work-load was available in horses during vaulting.

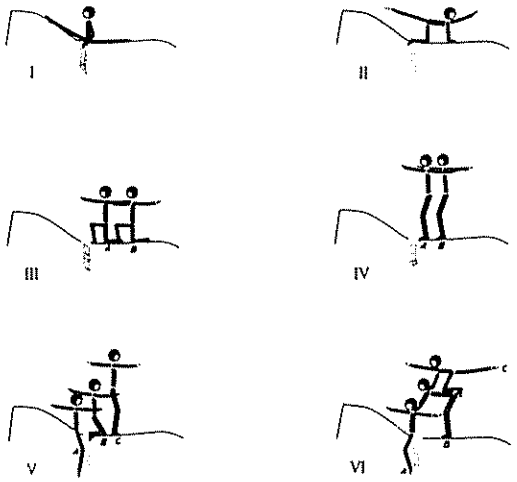


*Fig 1* Some examples of vaulting exercises, performed by 1 vaulter (I and II), by 2 vaulters (III and IV) and 3 vaulters (V and VI) (FEI Rules for vaulting events, 1986). I = split, II = reverse flag on croup, III = double prince, IV = double stand, V = triple cross, VI = seat and half flag on high bench.

The total work-load imposed on these horses is influenced by the duration of exercise, the weight to be carried and the condition of the surface on which they are exercised. There is a marked difference between a "good firm surface" usually found in a riding school and a "loose sand surface" as sometimes seen in competition arenas.

The objectives of this study were: To assess the work-load of a 15 min canter as required in competitions and to investigate the influence of the vaulters' weight and the surface (a good firm surface vs loose sand) on this work-load.

## MATERIALS AND METHODS

Eight Dutch Warmblood horses from four different vaulting groups (Table 1) were used in this study. All horses were trained regularly for vaulting and were experienced in vaulting competitions. A standardized lungeing test was carried out under three conditions: 1) without vaulters, on a good firm surface ($n=8$); 2) with vaulters, on a good firm surface ($n=8$); and 3) without vaulters, on a loose or very loose sand surface ($n=6$). Although all horses were tested at their own riding schools, the surfaces of the exercise arenas were comparable. However, the loose sand surfaces were different: Horses A and B were tested on a sandy plain, Horses C and D in a loose sandy arena, whilst Horses E and F were tested on a beach with very loose sand (Table 1). As all horses were experienced in vaulting, they cantered under the three different conditions at their own, individually established pace.

At the start of each lungeing test the horses were exercised for approximately 10–15 min at walk, trot and canter. After this warm up the horses were cantered for 15 min at their own, individually set, quiet pace. During the lungeing test with the vaulters mounted, the first 10 min of the canter were used for compulsory exercises and the last 5 min for freestyle exercises with 1 to 3 vaulters (Fig. 1). The weight of the vaulters varied between approximately 35 and 65 kg. The horses were subsequently walked for 10 min and taken back to their stables.

Blood samples were collected from the jugular vein immediately before exercise, and 2 and 30 min after the end of the canter. In each blood sample the LA and PCV were determined. Before and after each test creatine phosphokinase (CPK) and aspartate aminotransferase (AST) activities were determined. Blood sampling and analysis were carried out as described earlier.[9]

The HR was measured with a HR meter (Horse Tester, Polar Electro, Finland).[10] One electrode from the HR meter was placed on the left withers under surcingle and the other on the sternum under the girth. The transmitter was attached to the pad with the receiver nearby.

All data were analysed using a statistical computer program (Statistix, PC Dos version 2.0, NH Analytical Software) in a one-way-AOV or a paired *t*-test comparison of means; $p<0.05$ was considered to be statistically significant. Figures are expressed as mean ± SD.

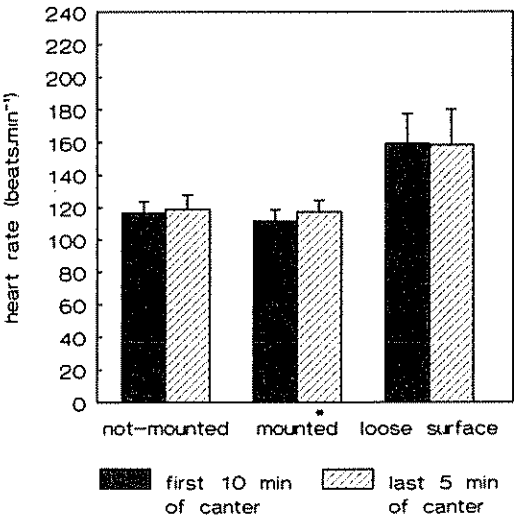


*Fig. 2* Mean heart rates ± SD (beats $min^{-1}$) of Dutch Warmblood vaulting horses during the first 10 min (compulsory exercises by 1 vaulter) and the last 5 min (free-style exercises by 1, 2 or 3 vaulters) during a 15 min canter. * Statistically significant difference between the mean HR of the first 10 min and the last 5 min of canter (paired *t*-test, $p=0.001$).

## RESULTS

All horses cantered under the three test conditions at their individually established pace. The HR at rest was $34 \pm 6$ beats $min^{-1}$ and ranged from 25 to 44 beats $min^{-1}$ (Table 1). Mean HR during the 15 min canter in the not-mounted horses was $117 \pm 7$ beats $min^{-1}$ and in the mounted horses $113 \pm 7$ beats $min^{-1}$ (Table 1); this difference was not significant. During the 15 min canter there was a small but significant difference between mean HR of the first 10 min with 1 vaulter performing compulsory exercises, (HR= $112 \pm 7$ beats $min^{-1}$) and mean HR during the last 5 min with 1 to 3 vaulters performing free-style exercises (HR= $117 \pm 7$ beats-$min^{-1}$) (Fig. 2).

The condition of the arena surface influenced mean HR during the 15 min canter period: mean HR during the not-mounted lungeing tests on the good firm surface being $117 \pm 7$ beats $min^{-1}$, whilst on the loose sand surface mean HR was $159 \pm 20$ beats $min^{-1}$ (Table 1, Fig. 3).

Lactate accumulation was not demonstrated in any of the tests on the good firm surface; LA varying between 0.5 and 1.3 mmol $l^{-1}$ (Fig. 4). The loose sand surfaces varied markedly at the three riding schools. There was a considerable range of HR (Table 1) and LA following cantering in the lungeing tests on the loose sand surface (0.8 to 4.1 mmol $l^{-1}$). In the samples collected 2 min after the 15 min canter, a small but significant difference in LA was found between not-mounted horses lunged on a good firm surface and not-mounted horses lunged on a loose sand surface ($0.8 \pm 0.2$ and $1.8 \pm 1.2$ mmol $l^{-1}$ respectively) (Fig. 4).

The PCV before and 30 min after the test did not differ significantly, though the values were significantly higher immediately after the canter (Fig. 5). No differences could be demonstrated between the PCV immediately after the canter in the mounted and not-mounted horses tested on the good firm surface. However, the PCV in samples taken 2 min after cantering was significantly higher in the horses tested on the loose sand surface than those tested on the good firm surface. There was no significant difference between the serum CPK and AST levels before and after any of the tests.

## DISCUSSION

### *Work-load during vaulting*

In this study the highest mean HR during a 15 min canter on a good firm surface was 125 beats $min^{-1}$ and the highest LA after a canter on a good firm surface was 1.0 mmol $l^{-1}$. In event horses during roads and tracks phases lasting at least 15 to 20 min, average HR is 120–130 beats $min^{-1}$. During cross country, HR will increase[2] to 190–200 beats $min^{-1}$ and, after the finish, LA is at least 8–12 mmol $l^{-1}$. Heart rate of an endurance horse exercising for several hours is 100–110 beats $min^{-1}$ during trot and 120–130 beats $min^{-1}$ during canter; LA re-

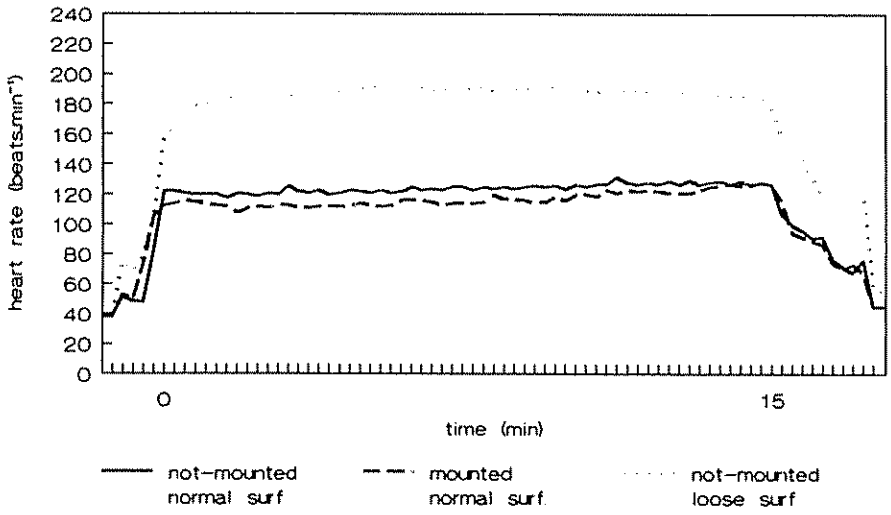


*Fig 3.* Heart rates during the 15 min canter of horse E in all three test situations.

mains below the point of blood LA accumulation.[4,6] The HR during racing is over 200 beats $min^{-1}$, while plasma LA exceeds 25 mmol $l^{-1}$. Therefore metabolic stress in vaulting horses is low compared with that determined in horses in other disciplines.

Rapid lactate accumulation commences above LA of 4 mmol $l^{-1}$.[8] In trained Dutch

Table 1. *Age, sex and mean heart rates (beats × $min^{-1}$) of eight Dutch Warmblood vaulting horses from four riding schools before, during and after a 15 min canter*

ND = not determined

| Horses | | | HR not-mounted good firm surface | | | HR mounted good firm surface | | | HR not-mounted loose sand surface | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | Age | Sex | Before | During | After | Before | During | After | Before | During | After |
| A | 13 | g | 30 | 115 | 52 | 32 | 107 | 48 | 33 | 156 | 72 |
| B | 13 | g | 32 | 123 | 42 | 30 | 111 | 42 | 25 | 167 | 56 |
| C | 20 | g | 27 | 125 | 50 | 29 | 122 | 56 | 29 | 140 | 51 |
| D | 6 | g | 44 | 122 | 48 | 37 | 119 | 48 | 33 | 135 | 50 |
| E | 22 | g | 38 | 124 | 45 | 38 | 117 | 44 | 37 | 188 | 52 |
| F | 11 | m | 38 | 110 | 46 | 41 | 107 | 47 | 40 | 168 | 53 |
| G | 6 | m | 30 | 105 | 41 | 29 | 104 | 41 | ND | ND | ND |
| H | 11 | g | 34 | 113 | 46 | 32 | 120 | 45 | ND | ND | ND |
| Mean | 13 | – | 34 | 117 | 46 | 34 | 113 | 46 | 33 | 159* | 56 |
| SD | 6 | – | 6 | 7 | 4 | 5 | 7 | 5 | 5 | 20 | 8 |

* Difference between this value and the HR during a mounted or not-mounted standardized lungeing test on a good firm surface was statistically significant ($p < 0.01$).

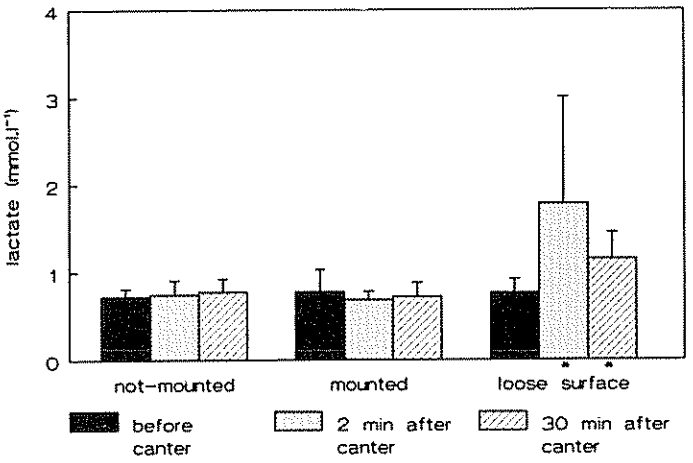


*Fig. 4.* Mean blood lactate concentration ± SD (mmol $l^{-1}$) of Dutch Warmblood vaulting horses before exercise, 2 and 30 min after a 15 min canter. * Statistically significant difference between LA in the not-mounted horses tested on the loose sand surface and LA in the mounted or not-mounted horses tested on the good firm surface at 2 and 30 min after cantering (one way AOV, $p<0.05$).

Warmblood horses the average HR at which LA accumulation commences has been demonstrated to be 174 beats $min^{-1}$.[9] So, in view of the mean HRs during the 15 min canter in the standardized lungeing tests, no lactate accumulation could be expected.

Evidence suggests the increased PCV immediately after cantering is the result of splenic contraction and not the result of hemoconcentration due to dehydration. No significant differences in CPK and AST activities were demonstrated before and after exercise. These findings also indicate that the work-load imposed on vaulting horses is low.

*Influence of weight and surface on work-load*

Mean HR during the lungeing tests on the good firm surface were slightly higher in the not-mounted horses than in the mounted horses. This might be just a chance effect, but considering the individual values in Table 1 it might also have been due to a psychogenic component. Exercise HR is not only the result of exercise but is also influenced by anxiety and excitation; the effect of this psychogenic component of the HR response to exercise increases as the relative work-load decreases.[8] Horses experienced in vaulting were not readily excitable; however, they

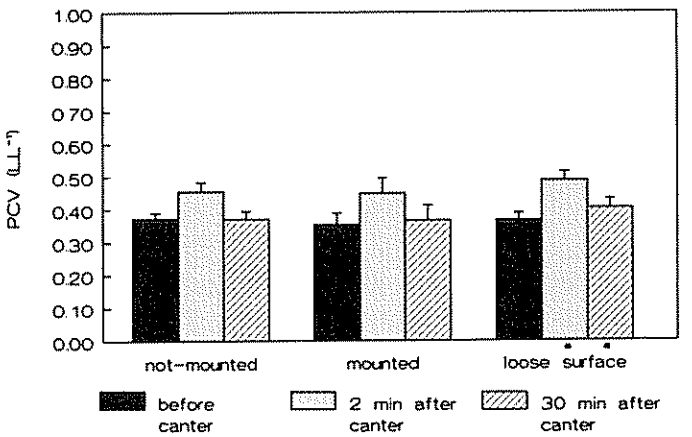


*Fig. 5* Mean packed cell volume ± SD ($l\,l^{-1}$) in Dutch Warmblood vaulting horses before exercise, 2 and 30 min after a 15 min canter. * Statistically significant difference between the PCV in the not-mounted horses on the loose sand surface and the PCV in the not-mounted horses on the good firm surface at 2 and 30 min after cantering (one way AOV, $p<0.05$).

seemed a little uneasy when no vaulters were present, which may explain the slightly higher HR in the not-mounted horses on the good firm surface.

The increased HR as seen during the last 5 min of the mounted standardized lungeing test is probably the result of both the greater weight of 2 or 3 vaulters and the progressing cantering time. In the not-mounted lungeing tests this increase was smaller. A small increase in HR (159 vs 165 beats $min^{-1}$) as a result of weight has been demonstrated in Standardbred trotters subjected to a horizontal treadmill exercise test with and without a load of approximately 10% bodyweight in the position of a riding saddle.[11]

The conclusion is that the work-load imposed on horses, which are regularly trained and used in vaulting competitions, remains below the threshold of LA accumulation, while no signs of dehydration or muscle damage are demonstrated. Consequently, the work-load performed by vaulting horses during competition is low in comparison with horses in other equestrian disciplines. However, the arena surface is an influence on work-load. A loose surface causes a greater increase in the work-load of a vaulting horse than the weight of 1, 2 or 3 vaulters.

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