EFFECT OF THE RATIO BETWEEN CARRIED AND BODY WEIGHT ON FINISHING TIME IN THOROUGHBREDS

EFECTO DE LA RELACIÓN ENTRE PESO SOPORTADO Y EL TIEMPO DE CARRERA EN PSI

Lee, H.K.[1] and Park, K.D.[1]*

[1]Genomic Informatics Center. Hankyong National University. Anseong-si. Gyeonggi-do. 456-749. Korea
*doobalo@hknu.ac.kr

ADDITIONAL KEYWORDS

Handicap. KRA (Korea Racing Association).

PALABRAS CLAVE ADICIONALES

Handicap. KRA (Asociacion Coreana de Carreras).

SUMMARY

Since the racehorses with excellent performance have a heavy carried weight (CW) in the current system, their finishing time does not increase along with heavier CW. As the CW increases, the finishing time decreases. Moreover, the percentage of victories also gets higher as the CW increases. Therefore, the effect of ratio CW/BW as the ratio of carried weight to the body weight on finishing time was analyzed in order to suggest the problems of current CW system. The objective of this study is to examine the influence of CW/BW ratio on finishing time, using a total of 155 656 racing records belong to 8197 racehorses. Generally, the BW of racehorse is heavier, the potentiality as a good racehorse is higher. The fact that the ratio CW/BW is high means that most of racehorses have lighter BW. As the ratio CW/BW increases in the racing distance of 1000 m, the actual finishing time tends to increase in general. The finishing time that has run while bearing the ratio of 12.0-12.7%, has demonstrated a good racing record. When the ratio CW/BW is about 13.1% or more, it has begun to influence on the finishing time gradually. Also, the racehorse tends to have a growth potential in a long distance race when the BW is no less than 475-480 kg. Consequently, when setting a handicap, it is desirable to consider the just before raced BW of racehorse to a certain degree.

RESUMEN

Dado que los caballos de carrera con excelentes prestaciones transportan un *handicap* pesado (CW) en el sistema actual, su tiempo a la finalización no aumenta con *handicaps* (CW) aún mayores. Cuando el CW aumenta, el tiempo de carrera disminuye. Por otra parte, el porcentaje de victorias se hace mayor a medida que aumenta el CW. Por ello, el efecto de la relación CW/BW, como relación entre peso transportado y peso corporal, sobre el tiempo de la carrera fue analizado al objeto de detectar los problemas en el sistema actual de *handicap*. El objetivo de este estudio fue examinar la influencia de la relación CW/BW, sobre el tiempo de carrera, empleando un total de 155 656 registros pertenecientes a 8197 carreras. Generalmente si el peso corporal del caballo es más pesado, su potencial como buen caballo de carrera es mayor. El hecho de que la relación CW/BW sea alta, significa que el peso de los caballos es menor. Cuando la relación CW/BW aumenta en la distancia de 1000 m el tiempo de la carrera tiende a aumentar. Cuando la relación está entre 12,0-12,7%, se ha demostrado conseguir un buen tiempo de carrera. Cuando la relación CW/BW es de 13,1 o más, comienza a influir gradualmente sobre el tiempo de carrera. También el caballo tiende a tener un buen potencial de recuperación en una distancia larga cuando el BW no es inferior a 475-480 kg. Consecuentemente cuando se asigna un *handicap*, es deseable tener en cuenta el peso del caballo antes de la carrera.

INTRODUCTION

The Korea Racing Association (KRA) tries to be the Part-II horse racing operation

Recibido: 18-3-09. Aceptado: 22-7-09.

country in accordance with the promotion policy of horse industry and is about to build the advanced racehorse improvement system targeting to hold the International Invitational Race. Although the Korea horse racing industry has grown up at a surprising speed in quantity, the improvement in the racehorse quality has fallen behind. Despite of this fact, the signs that the studies on horse are to be made actively would be regarded as quite encouraging.

Handicap weight is an extra weight to carry, allotted to handicap a racehorse which has proved itself able to beat all the other entries if it was not allotted this handicap. This mechanism is to guarantee a fair competition. Usually, carried weight (CW) refers to the weight a racehorse is assigned to carry in a race. CW can be divided into the weight for age, special allowance and handicap weight. Basically, how much weight a racehorse carries in a race is partly determined by age and sex.

Since an excessive level of CW may force the racehorse owner to lose the chance of the victory, this can be a very sensitive issue. Although the handicap race is gradually decreasing, the overseas horse racing systems that are well developed as compared to that of Korea rely on the empirical theory rather than the scientific theory. Especially, the CW system may be the case. Accordingly, the objective of this study is to suggest the problems of current CW system and to look into the effect of CW to the body weight (BW) on finished time.

MATERIALS AND METHODS

DATA COLLECTION

The data used in this study are finishing time records collected from thoroughbred racehorses that raced at Gwacheon racecourse from January, 1994 to December, 2006 provided by KRA. Records distributed outside the 3.5 standard deviations, from the mean of each distance, were all eliminated from the data for the reasons of possible injuries of the racehorse during the race, or unavoidable mistake made by the jockey. The data actually for analysis contained 155 656 finished time records of 8197 racehorses and pedigree of each horse was extended as far as possible to create a file with a total of 15 770 animals. Finishing time means racing time from start position to finish line and BW was measured before each race. Fixed effects included in the analytical model were racing distance, sex, age of year and contemporary group. Sex of racehorses was classified into stallion, gelding and mare, and number of age and

Table I. *Frequencies and means of variables for analysis of data by racing distance.* (Frecuencias y medias de las variables para el análisis de datos según distancia de la carrera).

Racing distance	No. of records	No. of horses	Time seconds	Age years	Carried weight (kg)	Body weight (kg)	CW/BW (%)[2]
1000m	37951	6919	65.01	3.3	53.8	443.3	12.19
1200m	34810	7001	78.84	3.8	54.3	445.9	12.23
1400m	15871	6071	91.95	4.4	54.4	447.8	12.20
1700m	17497	4281	115.95	4.7	54.2	450.1	12.08
1800m	10008	3551	122.64	5.1	54.3	453.4	12.01
1900m	9861	2289	129.45	5.5	54.1	455.7	11.89
2000m	155656	1709	135.94	5.9	53.9	460.0	11.74
Overall	29658	8197[1]	-	4.3	54.2	448.6	12.12

[1]Total number of racehorses used across all distance, not the column sum; [2]Carried weight/body weight.

contemporary group were 6, 14 and 119, respectively.

A statistical summary of the data for finished time is shown in **table I**. The number of race records and racehorses decreases as the distance of race increases, which is explained to be due to the reason of high selection of better racehorses for a longer distance. Racehorses do not have their best distance to race, and when the racehorse becomes a winner in a shorter distance, he/she enters into the race of a longer distance in Korea Racing System, which is why racing distance have to include in the statistical model. Also, the age of racehorse tends to increase **(table I)**.

STATISTICAL METHODS

The analytical model used is as follows:

$$y_{ijklmno} = \mu + d_i + s_j + m_k + c_l + h_m + a_n + p_n + e_{ijklmno}$$

where:
$y_{ijklmno}$= finished time,
μ= overall mean,
d_i= fixed effect of the i^{th} racing distance (i= 1000 m, 1200 m, …, 2000 m),
s_j= fixed effect of the j^{th} sex (j= gelding, stallion, mare),
m_k= fixed effect of the k^{th} age (k= 2, 3, …, 7 years more than),
c_l= fixed effect of the l^{th} contemporary group (l= 1, 2, …, 14, 119),
h_m= fixed effect of the m^{th} ratio CW/BW (m= less than 10.0%, 10.1%, …, 14.4% more than),
a_n= additive genetic effect of the n^{th} animal (n= 1, 2, …, 15, 770),
p_n= permanent environmental effect of the n^{th} animal (n= 1, 2, …, 8, 197),
$e_{ijklmno}$= random residual effect,

and when
$Var(a) = A\sigma^2_a$,
$Var(p) = I\sigma^2_p$,
$Var(e) = I\sigma^2_e$,

variance ratios used in animal model were as follows:

$t_1 = \sigma^2_e/\sigma^2_a = (1-r)/h^2$,
$t_2 = \sigma^2_e/\sigma^2_p = (1-r)/(r-h^2)$.

where:
A= numerator relationship matrix,
I= identity matrix,
h^2= heritability,
r= repeatability.

The heritability and repeatability used in this study were assumed 0.298 and 0.395, respectively (Park and Lee, 1999). The solution of mixed model equation was solved using the PEST program (Groeneveld *et al.*, 1990).

RESULTS AND DISCUSSION

According to Tolley *et al.* (1983) and Buttram *et al.* (1988a), although the prize money and the order of finish are important selection traits in racehorses, they are not normally distributed; so, they argued that the records of racehorse without winning prize money, must be eliminated from the data. Also neither the prize money nor the order of finish can be used to examine effect of ratio CW/BW because they do not properly account for the environmental differences affecting the racing performance.

Contemporary group means that the racehorses ran together at the same track in the same race on the same date (Buttram *et al.*, 1988b), and average size of the contemporary group was approximately 11 heads. The effect of different racing methods by year was account for by the year of race, the season effect on race was accounted for by the month of race, the condition of race track was accounted for by the date of race, and the individual race can account for the sampling variation of racehorse classes and the presence of the winning racehorses in a group (Buttram *et al.*, 1988b; Park and Lee, 1999).

The carried weight (CW) is defined as the jockey weight, saddles, saddle cloth and other necessary tack except for whip, safety helmet, blinkers, number cloth bridle and reins. The mode of CW was 55 kg (22.8% of the whole data) and, the average CW was 54.2 kg. There was no considerable

Table II. *Frequencies and percentages of winning by carried weight and sex.* (Frecuencias y porcentajes de victorias según peso transportado y sexo).

Carried weight (kg)	No. of records (%)	Winning frequency (%) to the start		
		Male	Female	Overall
48	842 (0.5)	5 (1.7)	9 (1.6)	14 (1.7)
49	1480 (1.0)	6 (1.2)	31 (3.1)	37 (2.5)
50	4879 (3.1)	52 (3.1)	147 (4.6)	199 (4.1)
51	9498 (6.1)	144 (5.3)	334 (4.9)	478 (5.0)
52	13484 (8.7)	281 (6.4)	496 (5.5)	777 (5.8)
53	20913 (13.4)	717 (8.2)	1026 (8.4)	1743 (8.3)
54	29949 (19.2)	903 (8.6)	1712 (8.8)	2615 (8.7)
55	36271 (23.3)	1724 (10.5)	1799 (9.1)	3523 (9.7)
56	20443 (13.1)	1507 (10.8)	660 (10.3)	2167 (10.6)
57	13472 (8.7)	1399 (11.5)	201 (15.5)	1600 (11.9)
58	2796 (1.8)	469 (19.3)	65 (17.7)	534 (19.1)
59	1037 (0.7)	203 (21.2)	24 (30.0)	227 (21.9)
> 60	592 (0.4)	211 (38.7)	18 (38.3)	229 (38.7)

difference by the racing distance, and the result has appeared to be about 1 kg less than the average CW (55.2 kg) of Brazilian racehorse (Buxadera and Mota, 2008). Considering that the average BW of racehorses is 449 kg, they have run the races while bearing 12.1% of their BW on average. Generally, the finished time records that have carried 58 kg or more as to be defined as carrying a handicap were 2.84% of the whole data and the finished time records with an excessive level of CW (60 kg or

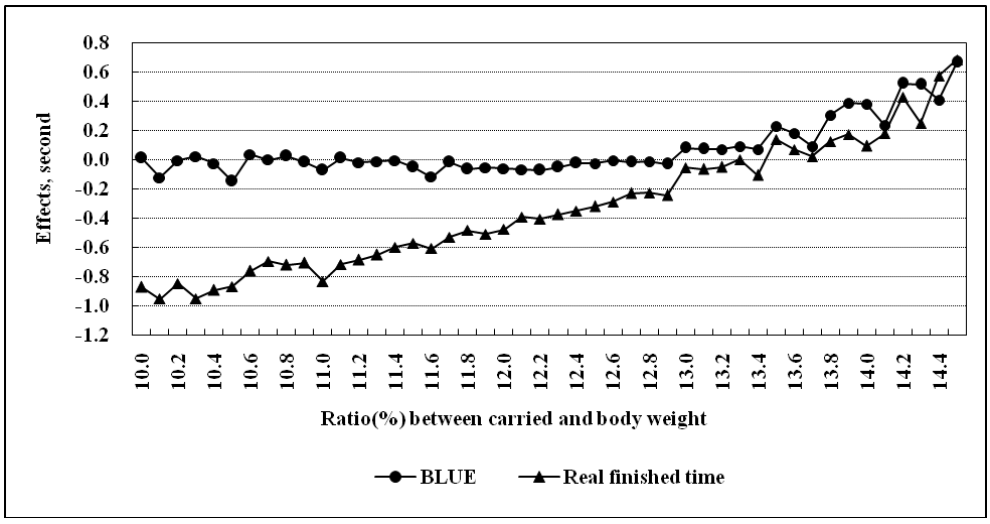

Figure 1. *Effects of the ratio between carried and body for finishing time at the 1000m.* (Efectos de la relación entre peso transportado y peso corporal, para el tiempo de terminación en 1000 m).

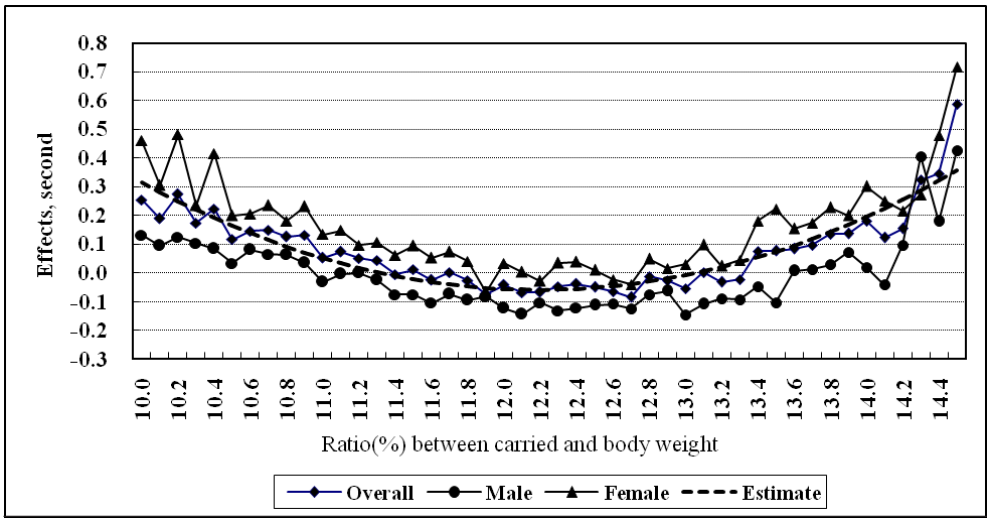

Figure 2. *Effects of ratio between carried and body weights and finishing time from all dataset.* (Relación entre peso transportado y peso corporal, y tiempo de terminación en el conjunto de datos).

more) were found 0.33% of the whole data. The racehorses that have carried the CW of 60 kg or more were mostly the racehorses that have proven their racing ability in the perspective of the prize money.

As shown in the **table II**, percentages of winning have not decreased even though the CW has increased. In some cases, the percentage of victories has increased and this result was found to be identical to the report of Bugislaus *et al.* (2004). Buttram *et al*. (1988a) has reported that the finished time may be influenced when the CW becomes 56.2 kg, and the average CW was approximately 55 kg in Quarter Horse. However, considering the Quarter Horse race that the racing distance is 320 m, the result was different from that of thoroughbred flat race.

The fact that runs a race while carrying a heavy CW proves that the racing ability is relatively excellent. Hence as the CW is heavier, the relative percentage of victories gets higher since the racehorse excellent in the racing ability carries a heavier weight. Therefore, it may not be reasonable to consider the CW is fixed effect.

Since the Korea racing system sets the CW only be the sex and age of racehorse regardless of the BW, it is apparent that the racehorse of less BW may have a disadvantage in the CW. As shown in the **figure 1**, the real finished time has increased as the ratio CW/BW of racehorse increases at the racing distance of 1000 m. When having used the BLUEs (Best Linear Unbiased Estimates) of the ratio CW/BW, the finished time was affected gradually when the ratio of CW to the BW gets to about 12.9%.

Figure 2 shows when the ratio CW/BW influences on the finished time. The finished time in general were quite good when running the races while carrying the CW of about 12.0-12.7% as compared to the BW of racehorse. When the ratio CW/BW reaches at about 13.0%, the CW has gradually influenced on the finished time. Considering the Korea racing system, the racehorse may have a growth potential only if the BW of

Table III. *Weighted means of breeding values for finishing time by body weight (BW) group.* (Medias ponderadas de valores genéticos para tiempo de terminación según peso corporal, BW).

BW (kg)	Mean breeding value			BW (kg)	Mean breeding value		
	Overall	Male	Female		Overall	Male	Female
360	0.631	0.735	0.611	0.005	0.024	0.056	-0.011
370	0.516	0.451	0.535	470	-0.004	0.029	-0.043
380	0.446	0.448	0.445	480	-0.019	0.002	-0.049
390	0.345	0.364	0.338	490	-0.024	-0.015	-0.037
400	0.316	0.369	0.292	500	-0.027	-0.025	-0.030
410	0.249	0.304	0.222	510	-0.027	-0.043	0.004
420	0.189	0.246	0.157	520	-0.054	-0.078	0.004
430	0.123	0.179	0.086	530	-0.088	-0.121	0.016
440	0.087	0.136	0.048	540	-0.217	-0.213	-0.231
450	0.047	0.094	0.005	550	-0.253	-0.248	-0.272

racehorse is at least 470-480 kg **(table III)**. Therefore, it is desirable to consider the just before raced BW of racehorse in a certain degree when setting a handicap.

CONCLUSION

Generally, the carried weight (CW) is granted under an assumption that 1 kg of weight allowance as equivalent to an average difference of 2 lengths (5 m). And it has been speculated that marginal CW is about 13% of body weight (BW) of racehorse.

However, according to the result of this study, the estimate was quite different from the fact and the finished time was gradually influenced as the ratio CW/BW reaches at about 13%.

Accordingly, the racehorse with lighter BW relatively holds a disadvantage in the CW. Hence in the future, it is necessary to establish a system of granting CW while considering the BW of racehorse.

ACKNOWLEDGEMENT

This work was supported by a grant from the Next-Generation BioGreen 21 Program (No.PJ0081062011), Rural Development Administration, Republic of Korea.

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