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EVALUATION OF PHYSICAL ACTIVITY AND ENERGY REQUIREMENTS IN TROTTING HORSES USING GPS TECHNIQUE DURING OUTDOOR TRAINING

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EXERCISE REQUIREMENTS

- Additive approach (maintenance + exercise) used by most common systems (INRA and NRC)
- Exercise requirements -> length and intensity of effort
- Difficult measurement of intensity in outdoor (studies mostly carried out on treadmill)
- Estimates of energy expenditure during exercise mainly by oxygen consumption (Coenen, 2008; Ellis, 2008; Eaton, 1995) from heart rate or speed measured in standardized condition of slope and ground

GLOBAL POSITIONING SYSTEM - GPS

GPS allow estimates of:

- Position
- Distance
- Time
- Speed
- Slope of ground

(Outdoors activities)

Use of GPS as suitable method for the evaluation of both physical activity and energy requirements in trotting horse during outdoor training

EXPERIMENTAL SITE

“GINA BIASUZZI” STABLE
MIRANO (VENICE)-ITALY

MATERIALS AND METHODS

- 30 Standardbred horses:
  - 20 males
  - 10 females
- Three age classes:
  - 2 years
  - 3 years
  - ≥ 4 years
- 5 weeks of study

FEEDING

- Animals fed individually grass hay (2 times daily and a mixture of cereals (three times: early morning, noon and middle afternoon) containing 60% whole oats, 30% cracked barley, and 10% flaked corn
- The amount of feeding changed daily according to the programmed physical activity
- Residuals were weighed daily to obtain actual feed intake

BODY WEIGHT AND BCS RECORDS

At the beginning and at the end of the experiment

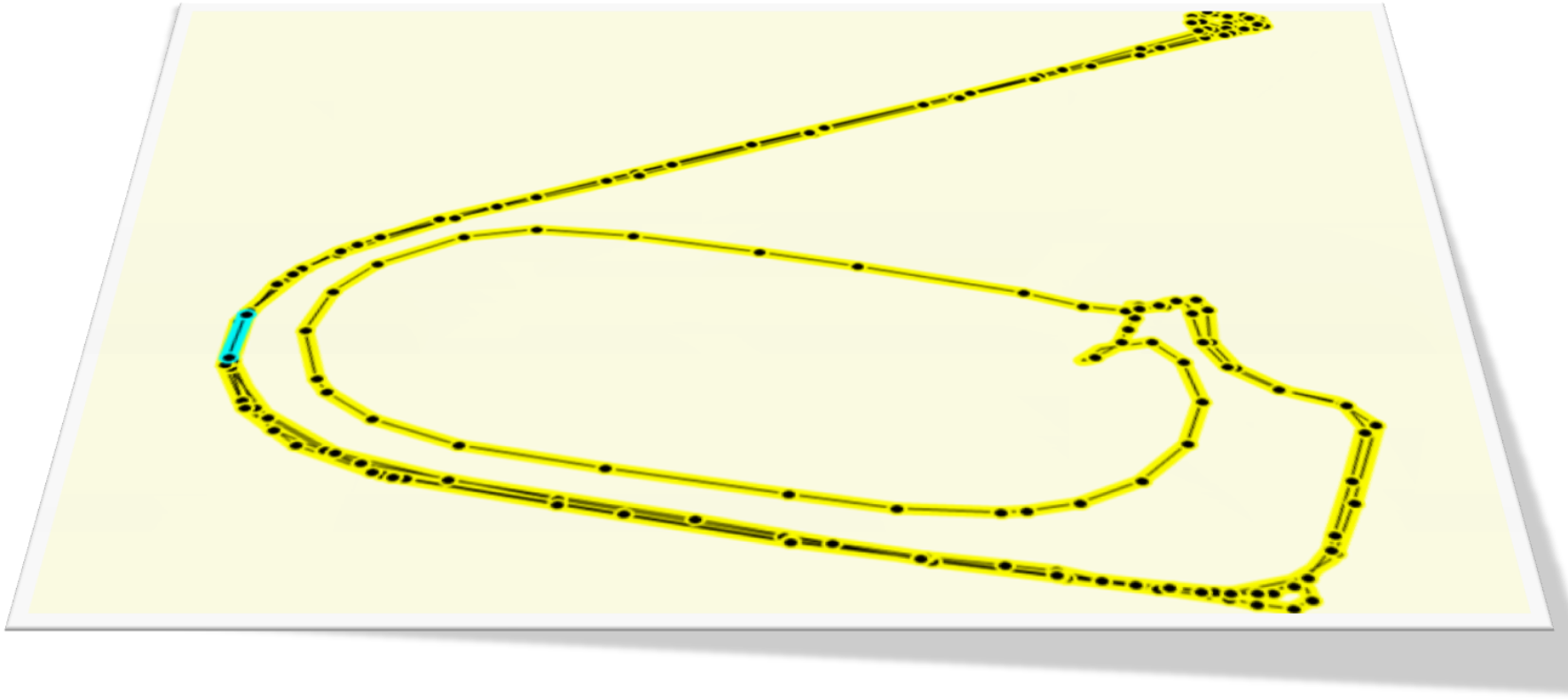
- BW: with a specific scale based on electronic system during footrest
- BCS: French system consisting of a 6 points scale (from 0 to 5; (Martin-Rosset, 1990) by a skilled operator

PHYSICAL ACTIVITY OF HORSES

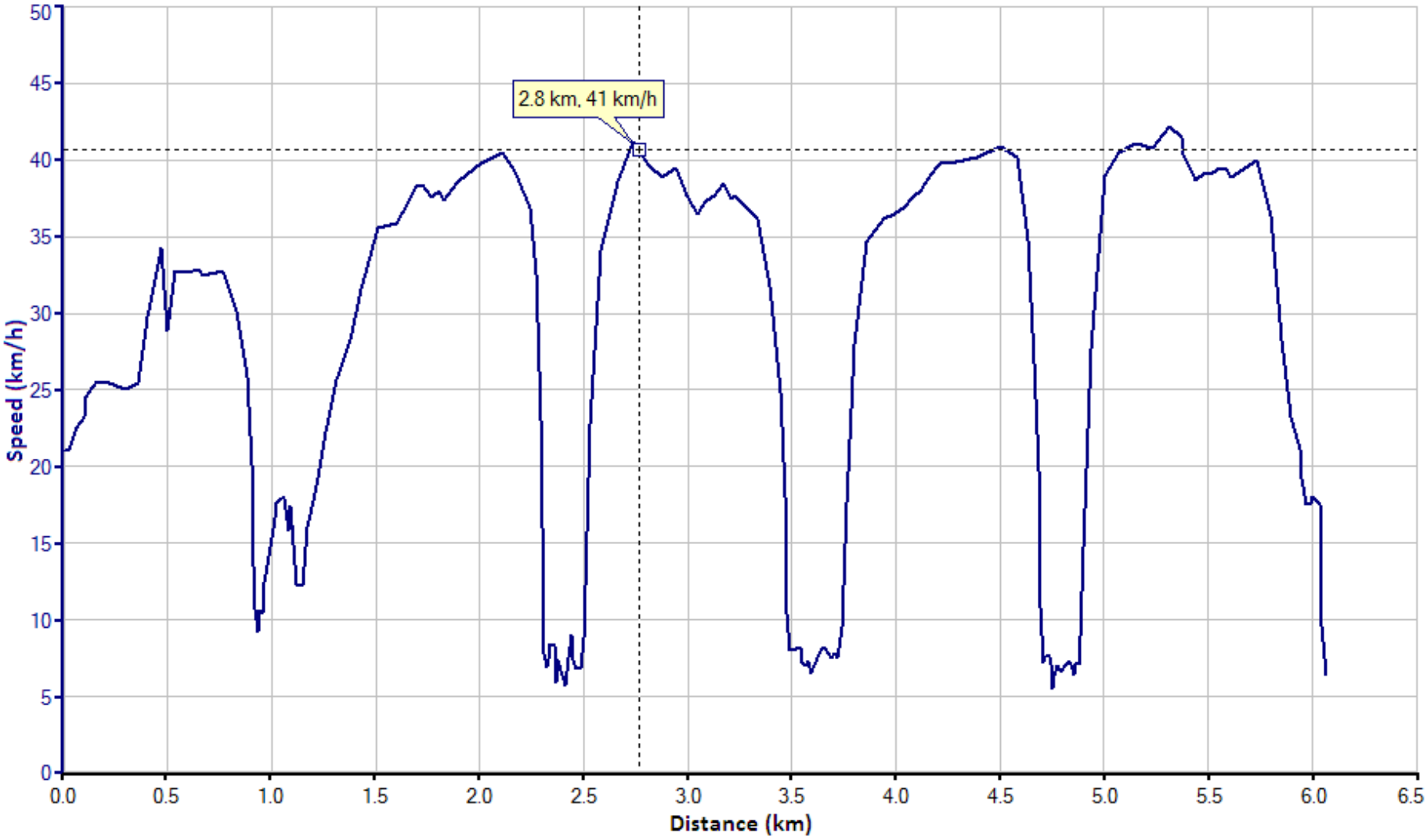
- Interval training
  - Slow run (“Treno”)
  - fast run (“Prova”) twice a week
- Two different race tracks
  - Oval (1000 m)
  - Straight (800 m)
  - Slow run (“Treno”)
- 7 GPS: 1 trainer
  6 handlers

GPS RECORDINGS

TRACK & TRACES BY GPS

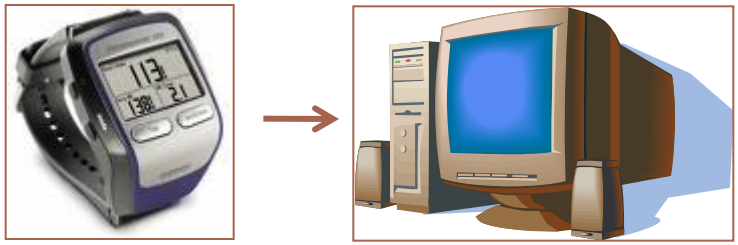


EXAMPLE OF A SINGLE RUN RECORDED



GPS DATA DOWNLOAD

Garmin Training Center®



- 687 total records (runs)
- 30 horses
- 5 weeks

Horse	Date	Total time (s)	Total Distance (m)	Mean speed (km/h)	Max speed (km/h)
Armbro	23/02/2009	1480	7182	17.47	27.0

ESTIMATES OF ENERGY EXPENDITURE FROM EXERCISE

Estimation of VO_2 by equation proposed by Coenen (2008):

$$\Sigma VO_2 = (-0.438 + 5.47\,x + 1.12\,x^2 + 0.065\,x^3 + 2.03\,z) * BW$$

where:

ΣVO_2 = ml/min

x = speed (m/sec);

z = slope (0 in this study);

BW = Body Weight (kg)

1 ml of O_2 is equivalent to 20.1 J (Kleiber, 1961)

Horse	Date	Total time (s)	Total Distance (m)	Mean speed (km/h)	Max speed (km/h)	→	Energy Expenditure (MJ)	Energy Expenditure (MCal)
Armbro	23/02/2009	1480	7182	17.47	27.0		16.9	4.03

ESTIMATES OF ENERGY REQUIREMENTS

Requirements of DE (NRC, 2007)

for the maintenance:

$DEm = 0.0363 * BW$

Total (maintenance + very intensive exercise):

$DEt = (0.0363 * BW) * 1.9$

STATISTIC ANALYSIS

Hierarchical linear model for repeated measurements using PROC MIXED of SAS (SAS, 2004)

$$y_{ijklm} = \mu + A_i + S_j + AS_{ij} + H_{k:ij} + D_{ijkl} + e_{ijklm}$$

Where:

y_{ijklm} = single observation

μ = overall mean

A_i = fixed effect of age class (i=1: 2 years; i=2: 3 years; i=3: ≥ 4 years)

S_j = fixed effect of sex (j=1, male; j=2, female)

AS_{ij} = Interaction between A_i and S_j

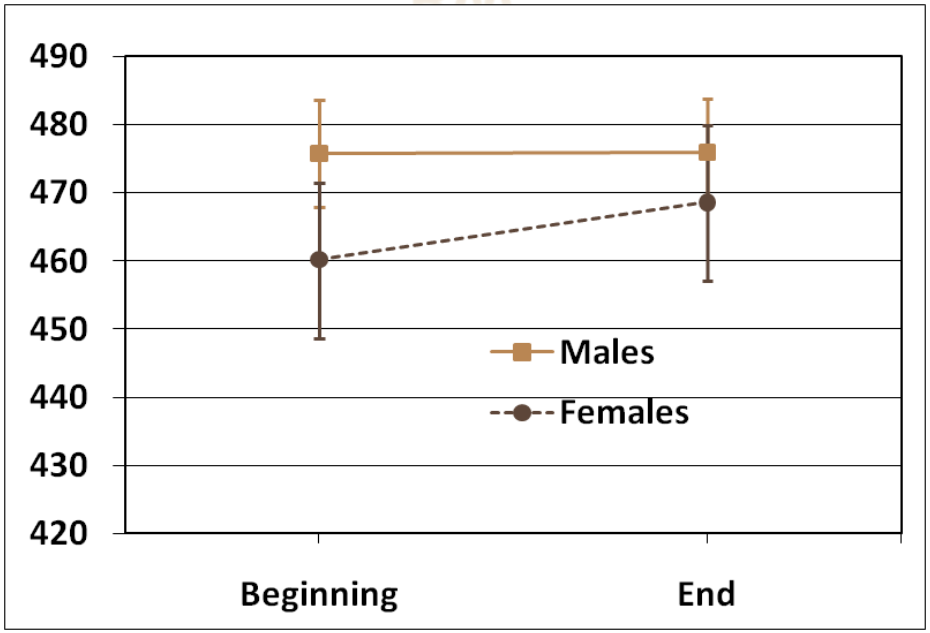
$H_{k:ij}$ = random effect of horse within AS_{ij} $\sim N(0, \sigma^2_h)$

D_{ijkl} = fixed effect of day

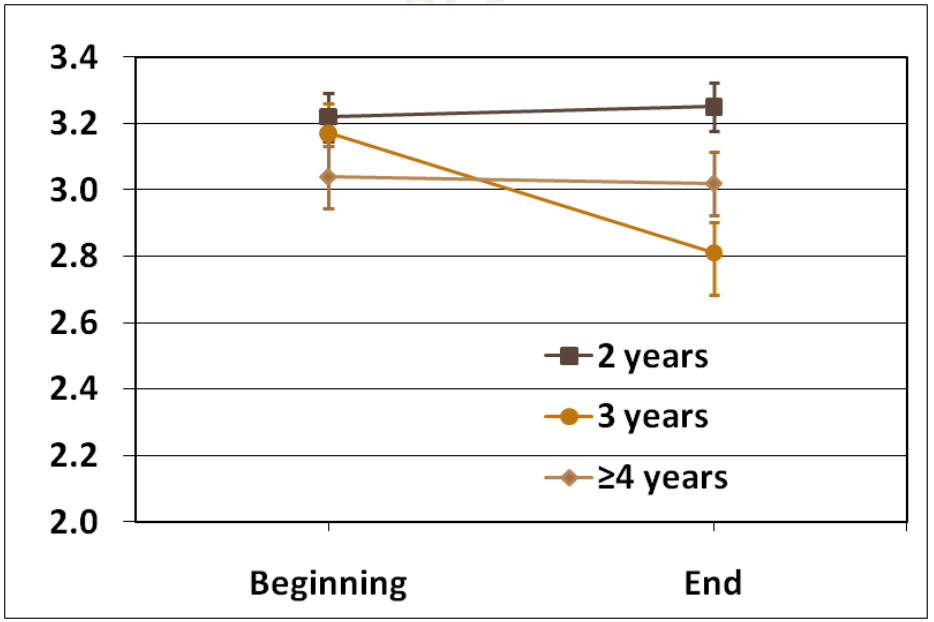
e_{ijklm} = random residual error term $\sim N(0, \sigma^2_e)$

BODY WEIGHT & BCS

BW



BCS

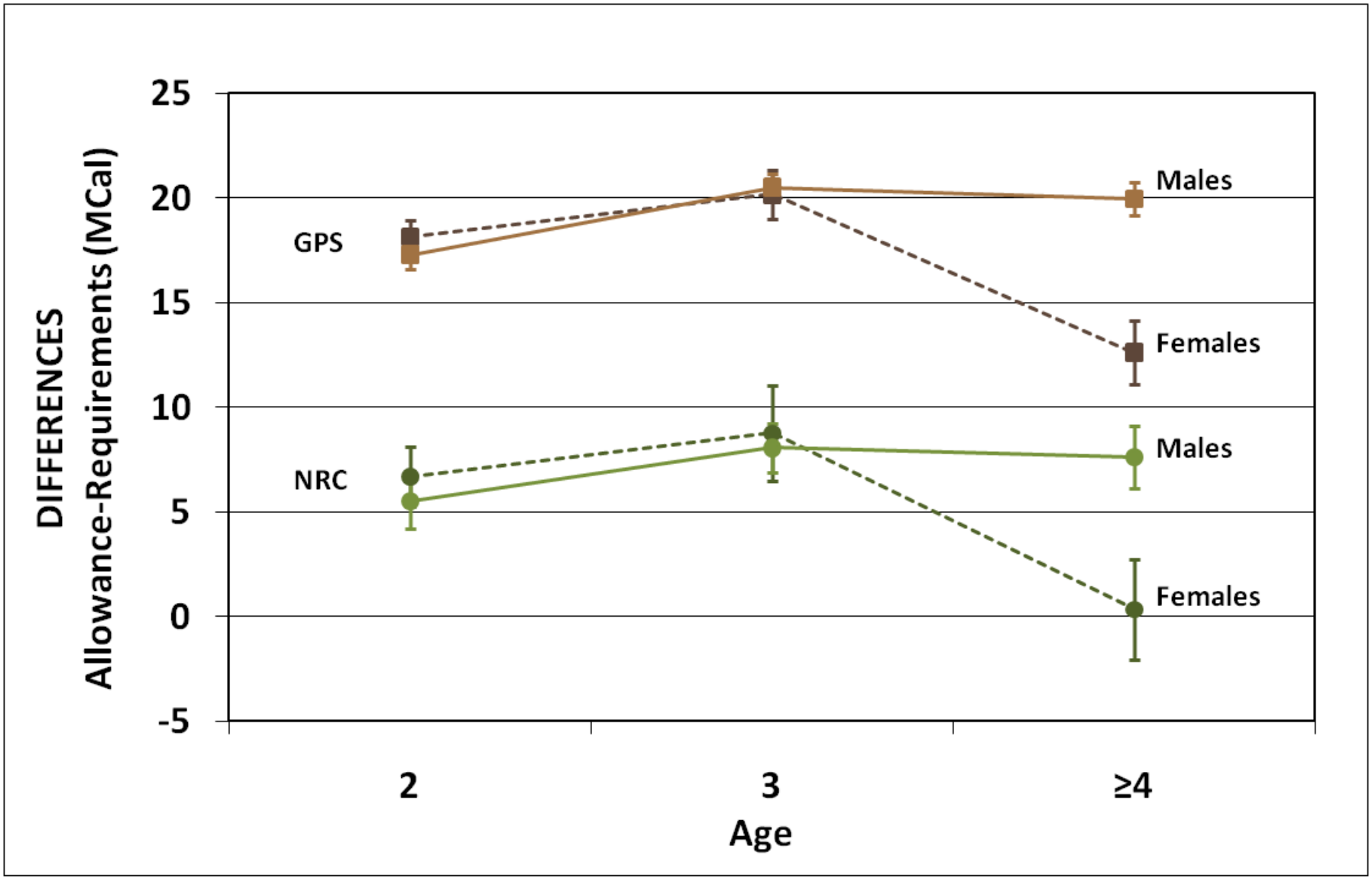


ANOVA ON PHYSICAL ACTIVITY

Training variable	Age (A)	Sex (S)	A x S	Days	RSE
Total Time (s)	n.s.	n.s.	n.s.	n.s.	2968
Total Distance (m)	n.s.	n.s.	n.s.	n.s.	4497
Mean speed (km/h)	n.s.	n.s.	n.s.	n.s.	9.01
Max speed (km/h)	n.s.	n.s.	n.s.	n.s.	8.63

Training variable	Mean
Total Time (s)	1680
Total Distance (m)	7800
Mean speed (km/h)	18.0
Max speed (km/h)	31.0

ENERGY ALLOWANCES VS. REQUIREMENTS



CONCLUSION

- GPS is a simple and not too expensive tool to evaluate actual physical activity in standardbred horses
- It allows a great amount of information and a possible greater personalization of activity
- At present, not useful tool to estimate energy requirements due to exercise
- Need of specific equations aimed to estimate energy expenditure and optimize diets on the basis of actual individual exercise