BOOK OF ABSTRACTS **Open Access**

Pre-exercise optimisation of the alkalosis response to sodium bicarbonate ingestion: have we been missing its peak ergogenic effect?

Sparks, SA.[1]✉, Deb, S.K. [2], Gough, L.A.[3] & McNaughton, L.R.[1]

Purpose:
Several studies underlined the impact of pacing strategy on cycling time-trial performance. It has been reported that under steady environmental conditions, maintaining a constant power output (PO) is the most efficient strategy to improve performance (Wells et al. 2013). The Exposure Variation Analysis (EVA) method has recently been proposed to evaluate these pacing strategies, quantifying for an optimal constant pacing strategy the times spent at an accurate PO (APO), at an inappropriate PO (IPO), and the short-time regulations of inappropriate PO (REG) (Ouvrard et al. 2017). It has been demonstrated that increasing time spent at APO and decreasing time spent at IPO allows cyclists to develop higher mean PO and improve performance (Ouvrard et al. 2018. Under review). However, as these indexes are influenced by time-trials course, they were never used to monitor pacing strategies and performance for several time-trials performed by the same cyclists yet. The aim of this study was to analyse the relationships between changes of performance, mean PO and EVA pacing parameters in two professional cyclists during seven official competitive time-trials.

Methods:
PO were collected for two professional cyclists (mean VO_2max 79.0 ± 8.5 mL.min^{-1}.kg^{-1}) during the seven-same time-trials (performed between April 2013 and June 2017 and ranged from 18.7 to 51.6 km). PO fluctuations were analysed from EVA to quantify times spent at APO (PO between 90 and 110 % of mean time-trial PO), IPO (PO lower than 90 % or higher than 110 % of mean PO for more than 10 s) and REG (PO lower than 90 % or higher than 110 % of mean PO for less than 10 s). Relationships between Δ_{meanPO} (differences between subject 1 and subject 2 mean PO for each time-trial) and $\Delta_{meanPO\%}$ (differences between subject 1 and subject 2 mean PO, each expressed as a percentage of the subject's record PO on the time trial duration) and Δ_{APO} (differences between subject 1 and subject 2 times spent at APO), Δ_{IPO} (differences between subject 1 and subject 2 times spent at IPO), and Δ_{REG} (differences between subject 1 and subject 2 REG) were assessed thanks to Pearson correlation coefficients.

Results & Discussion:
Δ_{meanPO} ranged from -24 to +39 W for similar physical potentials (20-min record PO 432 vs 428 W). A trend to a negative relationship was identified between Δ_{meanPO} and Δ_{IPO} ($r = -0.70$, $p = 0.08$). Stronger and significant relationships were identified between $\Delta_{meanPO\%}$ and Δ_{IPO} ($r = -0.94$, $p = 0.002$) and Δ_{APO} ($r = 0.86$, $p = 0.01$, Figure 1). The main finding of this study is that, when comparing two cyclists during several time-trials, changes of EVA pacing parameters were related to changes of cyclists' ability to develop high mean PO. The more the cyclists were able to decrease their time spent at IPO and increase their time spent at APO, the more they had a maximal use of their physical capacity during the time-trial, allowing them to develop higher mean PO expressed as a percentage of their record PO. These results are in accordance with Wells et al. (2013), who demonstrated that maintaining a constant PO, and thus increasing time spent at APO, is optimal for time-trial performance under steady environmental conditions. Conversely, increasing PO variations, and consequently time spent at IPO or REG, reflect poor adherence to constant speed, increasing biomechanical losses or fatigue.

Conclusion:

EVA seems to be a valuable method to monitor pacing and performance changes for two cyclists during several time-trials. Values of times spent at IPO and APO can be compared between cyclists to determine if their pacing strategy were optimal to achieve the best performance possible.

References:

1. Carr, A.J., Slater, G.J., Gore, C.J., Dawson, B., and Burke, L.M. (2012). Reliability and effect of sodium bicarbonate: buffering and 2000-m rowing performance. International Journal of Sports Physiology and Performance, 7(2):152-60.
2. Deb, S.K., Gough, L.A., Sparks, S.A., and McNaughton, L.R. (2018). Sodium bicarbonate supplementation improves severe-intensity intermittent exercise under moderate acute hypoxic conditions. *European Journal of Applied Physiology*. 118(3):607-615. DOI: 10.1007/s00421-018-3801-7.
3. Gough, L., Deb, S., Sparks, S.A., and McNaughton, L.R. (2017a). The Reproducibility of Blood Acid Base Responses in Male Collegiate Athletes Following Individualised Doses of Sodium Bicarbonate: A Randomised Controlled Crossover Study. *Sports Medicine (In Press)*. DOI: 10.1007/s40279-017-0699-x.
4. Gough, L., Deb., S.K., Sparks, S.A., and McNaughton, L.R. (2017b). The reproducibility of 4 km time trial (TT) performance following individualised sodium bicarbonate supplementation: a randomised controlled trial in trained cyclists. *Sports Medicine Open* 3(1):34. DOI: 10.1186/s40798-017-0101-4.
5. McNaughton, L.R. Gough, L., Deb, S., Bentley, D., and Sparks, S.A. (2016). Recent developments in the use of sodium bicarbonate as an ergogenic aid. *Current Sports Medicine Reports*, 15(4):233-44. DOI: 10.1249/JSR.0000000000000283.
6. Miller, P., Robinson, A., Sparks, S.A., Bridge, C.A., Bentley, D., and McNaughton, L.R. (2016). The effects of novel ingestion of sodium bicarbonate on repeated sprint ability. *Journal of Strength and Conditioning Research.* 30(2) 561-568. DOI: 10.1519/JSC.0000000000001126.
7. Sparks, S.A., Williams, E.L., Bentley, D., Bridge, C.A., and McNaughton, L.R. (2017). Sodium bicarbonate ingestion and individual variability in time to peak pH. *Research in Sports Medicine*, 25(1): 58-66. DOI: 10.1080/15438627.2016.1258645.

Key words: Ergogenic aid, performance, nutritional intervention, supplement.

✉**Contact email:** andy.sparks@edgehill.ac.uk (A Sparks)

[1] Sport Nutrition and Performance Research Group, Department of Sport and Physical Activity, Edge Hill University, Ormskirk, UK

[2] School of Life Sciences, University of Westminster, London, UK

[3] School of Health Sciences, Birmingham City University, Birmingham, UK