

Author comment in reply to responses and direct communications to analysis piece: Forty years of sports performance research and little insight gained

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In our analysis of forty years of sports performance research and little insight gained we state in the methods 'We did not review posters, supplements, theses, or unavailable articles.' We have corrected instances in the data supplement, supplied by GSK, where author or email communication has amended papers inclusion, required clarification of methods or the quality assessment.

Changes to the data supplement (accompanying this comment) are highlighted in bold which include:

- Removal of one paper from the supplement [point 26]
- Changed seven studies from high risk of bias to moderate risk of bias [points 1, 2, 3, 4, 5, 17, 27]
- Marked one paper as duplicate [point 16]
- work never published to supplement [point 28]

Of this list of 176 studies, with the removal of the one not relevant paper, the number of studies should now read as 175 and of the studies we were able to critically review 106 studies (101 clinical trials) dating from 1971 through to 2012, should read as 105 studies (100 clinical trials).

In terms of poorly designed research we stated: 'Most studies (76%) were low in quality because of a lack of allocation concealment and blinding, and often the findings contrasted with each other.' With the change of seven studies from low to moderate, and the removal of one moderate study, the proportion of low quality studies is 70%. However, in terms of our assessment we have been generous, particularly with regard to the lack of detail in the published papers. Readers should remain sceptical of work where methods such as randomized or blinded are reported without accompanying details. Where a lack of detailed reporting occurs the Cochrane risk of bias tool judges the risk of bias to be uncertain, particularly when information is inadequate. Therefore, no studies were judged to be of high quality.

The lack of allocation concealment remains a considerable issue: methods of randomization were not routinely reported across the 100 clinical studies. Proper randomisation relies upon adequate allocation concealment. Such a sequence keeps the investigator and the participants unaware of the intervention assignments: 'Inadequate allocation concealment leads to exaggerated estimates of treatment effect, on average, but with scope for bias in either direction.' [Lancet. 2002 Feb 16;359(9306):614-8.] Methods such as systematic rotation reported in points 8, 9, 10 and 11 are not deemed randomized.

In terms of blinding, methods of who were exactly blinded were not routinely reported: Schulz and Grimes state the importance of blinding and its detailed reporting in papers:

'Many investigators and readers naively consider a randomised trial as high quality simply because it is double blind, as if double-blinding is the sine qua non of a randomised controlled trial. Although double blinding (blinding investigators, participants, and outcome assessors) indicates a strong design, trials that are not double blinded should not automatically be deemed inferior. Rather than

solely relying on terminology like double blinding, researchers should explicitly state who was blinded, and how.' [Lancet. 2002 Feb 23;359(9307):696-700]

Given, many articles in the supplement report blinding without details readers should remain vigilant about the quality. Where papers only reported single blinded participants [point 12] this was judged as lack of adequate blinding.

The sequence for such studies is to report whether the investigator delivering the intervention are blinded to the allocation (including the method of randomization), whether the participants were blinded (where possible) and crucially whether the outcome assessors were blinded when performing the data analysis.

Where thesis, posters, supplements, reviews were included in the list of studies [points 18,19,20,21,24 and 25] we report in the paper and the supplement we did not review their quality.

Changes and responses to the data supplement and comments are outlined in Box 1. We continue to welcome dialogue over the supplement, the inclusion of papers and clarification of methods for these papers, particularly for those we were unable to review due to access or lack of publication.

Box 1 Points:

1. Galloway SDR, Maughan RJ. The effects of substrate and fluid provision on thermoregulatory and metabolic responses to prolonged exercise in a hot environment. J Sports Sci 2000;18:339-51.

Marked as cross over trial changed to randomized cross over trial – **changed the high risk of bias to moderate**

2. Venables MC, Shaw L, Jeukendrup AE, Roedig-Penman A, Finke M, Newcombe RG, et al. Erosive effect of a new sports drink on dental enamel during exercise. Med Sci Sports Exerc 2005;37:39-44.

Marked as cross over study changed to randomized cross over trial - **changed high risk of bias to moderate**

3. Gant N, Ali A, Foskett A. The influence of caffeine and carbohydrate coingestion on simulated soccer performance. Int J Sport Nutr Exerc Metab 2010;20:191-7.

Marked as cross over study changed to randomized cross over study – Marked as blinding not used - **changed high risk to moderate**

4. Rollo I, Williams C, Gant N, Nute M. The influence of carbohydrate mouth rinse on self-selected speed during a 30-min treadmill run. Int J Sport Nutr Exerc Metab 2008;18:585-600.

Marked as lack of blinding changed to blinding - **changed high risk of bias to moderate**

5. Betts JA, Toone RJ, Stokes KA, Thompson D. Systemic indices of skeletal muscle damage and recovery of muscle function after exercise: effect of combined carbohydrate–protein ingestion. Appl Physiol Nutr Metab 2009;34:773-84

Marked as Lack of blinding - direct author communication study was blinded – **changed high risk to moderate**

6. Bilzon JL, Allsopp AJ, Williams C. Eur J Appl Physiol. Short-term recovery from prolonged constant pace running in a warm environment: the effectiveness of a carbohydrate-electrolyte solution 2000 Jul;82(4):305-12.

Paper methods state:

Procedures

The CES and sweetened placebo (P) treatments were administered in a double-blind, cross-over design. In the CES trial subjects

Remain as marked as non-randomized as no mention of randomized or allocation methods remains high risk

7. Bishop NC, Gleeson M, Nicholas CW, Ali A. Influence of carbohydrate supplementation on plasma cytokine and neutrophil degranulation responses to high intensity intermittent exercise. Int J Sport Nutr Exerc Metab. 2002 Jun;12(2):145-56.

Marked as randomized paper and as unavailable in document - no change

8. Bowtell JL, Leese GP, Smith K, Watt PW, Nevill A, Rooyackers O, Wagenmakers AJ, Rennie MJ. Modulation of whole body protein metabolism, during and after exercise, by variation of dietary protein. J Appl Physiol. 1998 Nov;85(5):1744-52.

Paper methods states

Four subjects (3 men and 1 woman) participated in the two trials, separated by at least 4 wk; diets were allocated by systematic rotation. A further group of eight subjects (7 men and 1 woman) participated in one trial only, being allocated by systematic rotation to one of the protocols ($n = 4$ in each group). The subjects' characteristics are given in Table 1. An

Remain as marked as non-randomized as insufficient details to be judged as randomized – no change

9. Bowtell JL, Gelly K, Jackman ML, Patel A, Simeoni M, Rennie MJ. Effect of oral glutamine on whole body carbohydrate storage during recovery from exhaustive exercise. J Appl Physiol. 1999 Jun;86(6):1770-7.

Paper methods states

Seven male subjects [weight: 76.2 ± 3.4 kg, height: 1.78 ± 0.03 m, body fat: $16.0 \pm 3.6\%$, and maximal $\dot{V}O_{2\max}$: 38.9 ± 3.2 ml·kg⁻¹·min⁻¹] participated in three trials, in each of which they received one of three different drinks by systematic rotation: 18.5% (wt/vol) glucose polymer

Remain as marked as non-randomized as insufficient details to be judged as randomized - no change

10. Bowtell JL, Leese GP, Smith K, Watt PW, Nevill A, Rooyackers O, Wagenmakers AJ, Rennie MJ. Effect of oral glucose on leucine turnover in human subjects at rest and during exercise at two levels of dietary protein. *J Physiol*. 2000 May 15;525 Pt 1:271-81.

Paper methods states

Four subjects (3 male and 1 female) participated in all four trials, separated by at least 4 weeks; diets were allocated by systematic rotation. A further group of 16 subjects (14 male and 2 female) participated in one trial only, being allocated by systematic rotation to one of the protocols ($n = 4$ in each group). This second

Remain as marked as non-randomized as insufficient details to be judged as randomized - no change

11. Bowtell JL, Gelly K, Jackman ML, Patel A, Simeoni M, Rennie MJ. Effect of different carbohydrate drinks on whole body carbohydrate storage after exhaustive exercise. *J Appl Physiol*. 2000 May;88(5):1529-36.

Paper methods states

Seven men [mass 77.0 ± 1.6 kg, height 1.76 ± 0.03 m, body fat $14.6 \pm 3.1\%$, and maximal oxygen uptake ($\dot{V}O_{2\max}$) 42.3 ± 1.5 ml \cdot kg⁻¹ \cdot min⁻¹] participated in three trials, receiving one of three different carbohydrate drinks by systematic rotation:

Remain as marked as non-randomized as insufficient details to be judged as randomized - no change

12. Breen L, Philp A, Witard OC, Jackman SR, Selby A, Smith K, Baar K, Tipton KD. The influence of carbohydrate-protein co-ingestion following endurance exercise on myofibrillar and mitochondrial protein synthesis. *J Physiol*. 2011 Aug 15;589(Pt 16):4011-25. Epub 2011 Jul 11.

Methods state

thought to regulate MPS were also investigated. In a single-blind, cross-over study, 10 trained cyclists (age 29 ± 6 years, $\dot{V}O_{2\max}$ 66.5 ± 5.1 ml kg⁻¹ min⁻¹) completed two trials in a randomized order. Subjects cycled for 90 min at $77 \pm 1\%$ $\dot{V}O_{2\max}$ before ingesting a CHO (25 g of carbohydrate)

Stays marked as lack of blinding due to lack of reported blinding of outcome assessors – no change

13. Casey A, Mann R, Banister K, Fox J, Morris PG, Macdonald IA, Greenhaff PL. Effect of carbohydrate ingestion on glycogen resynthesis in human liver and skeletal muscle, measured by (13)C MRS. *Am J Physiol Endocrinol Metab*. 2000 Jan;278(1):E65-75.

Methods states

ingestion was followed by a 4-h recovery period. A crossover design was adopted, with subjects receiving all three treatments on separate occasions, in a double-blind fashion. These trials were separated by a minimum of 2 wk.

Remain as marked as non-randomized as insufficient details of the methods, no reported mention of randomization or of the methods of allocation to be judged as randomized or concealed allocation – no change

14. Hulston CJ, Jeukendrup AE. Substrate metabolism and exercise performance with caffeine and carbohydrate intake. *Med Sci Sports Exerc.* 2008 Dec;40(12):2096-104.

Marked in supplement as randomized with blinding and at moderate risk. No mention of power calculation in methods.

Statistical analysis. All data are expressed as means \pm SEM unless otherwise stated. One-way ANOVA was performed to study differences in TT performance between trials. Two-way (trial \times time) ANOVA for repeated measures was performed to study differences in substrate metabolism, tracer enrichment, plasma glucose kinetics, and plasma metabolite concentrations. Significant effects were followed up by *post hoc* comparisons (Tukey HSD). Data analysis was performed using SPSS for Windows version 13.0 software (SPSS Inc., Chicago, IL) or by hand. Significance was accepted at $P < 0.05$.

No change to supplement

15. Rollo I, Cole M, Miller R, Williams C. Influence of mouth rinsing a carbohydrate solution on 1-h running performance. *Med Sci Sports Exerc.* 2010 Apr;42(4):798-804.

2010 study marked as randomized and blinded in data supplement

Methods state

tion was matched in formulation to the CHO-E solution except that it contained no CHO. Both the exercise and resting studies used double-blind random crossover design.

No mention of power calculation in the paper

16. 2009 Rollo study in supplement is a duplicate of 2010 study – **marked as duplicate**

17. Rollo I, Williams C, Nevill M. Influence of ingesting versus mouth rinsing a carbohydrate solution during a 1-h run. *Med Sci Sports Exerc.* 2011 Mar;43(3):468-75.

Marked as non-blinded methods state

performance. The study used a double-blind random crossover design for the ingestion trials. Runners were asked to refrain from heavy exercise and to consume a standardized diet 48 h before each trial, i.e., they recorded their food intake in the 48 h before the first trial and replicated it before the subsequent trials. There were no significant differences in the aver-

Supplement changed quality from high to moderate

No mention of power calculation in the paper

18. Betts, Stevenson, Williams, Sheppard, Grey & Griffin 2005 - quality not assessed – no change

19. Betts, Duffy, Gunner & Williams 2005 – quality not assessed – no change

20. Betts, James 2005, PhD thesis - quality not assessed – no change

21. Betts, Williams, Boobis & Tsintzas 2008: supplement and duplicate - quality not assessed – no change

22. Betts and Toone 2008 , marked as abstract only, judged to be moderate quality - no change

23. Betts, Toone, Stokes & Thompson. marked as abstract only, judged to be moderate quality - no change

24. Betts, Stokes, Toone & Williams 2009 – quality not assessed as marked in document unable to find =- no change

25. Betts and Williams 2010 – quality not assessed as marked as a review in supplement – no change

26. Foskett A, Ali A, Gant N. Caffeine enhances cognitive function and skill performance during simulated soccer activity. *Int J Sport Nutr Exerc Metab.* 2009 Aug;19(4):410-23.

Direct author communication:

‘This study had absolutely nothing to do with sports drinks and was not funded by industry. No solutions or beverages were ingested. The study was concerned with caffeine and soccer skill. Participants ingested anhydrous caffeine powder or a placebo powder an hour before exercise and drank tap-water to replace fluid loss during exercise. This work was funded internally by the academic institution.’

Judged to be moderate quality - **paper removed from supplement**

27 Gant N, Ali A, Foskett A. The influence of caffeine and carbohydrate coingestion on simulated soccer performance. *Int J Sport Nutr Exerc Metab.* 2010 Jun;20(3):191-7.

Paper marked as published in supplement as unobtainable, direct author communication confirmed as randomized – **quality changed from high to moderate**

28. 2006, Gant, Williams & Backhouse.

This entry refers to an unpublished abstract, the work was never published and does not appear within proceedings or any publication associated with an ISBN.

Paper marked as supplement and not reviewed, **added work never published to supplement**