# Commentary; Snap-N-Send: A Valid and Reliable Method for Assessing the Energy Intake of Elite Adolescent Athletes

Nessan Costello[1,2], Jim McKenna[1], Kevin Deighton[1], Ben Jones[1,3,4]

Institute for Sport, Physical Activity and Leisure, Leeds Beckett University, Leeds, West Yorkshire, United Kingdom

1 Leeds Beckett University, Institute for Sport, Physical Activity and Leisure, Carnegie Faculty, Leeds, United Kingdom.
2 Leeds Rhinos RLFC, Leeds, United Kingdom
3 Yorkshire Carnegie
4 The Rugby Football League

Corresponding Author
Nessan Costello
Room G03, Macaulay Hall,
Institute for Sport, Physical Activity and Leisure,
Centre for Sports Performance,
Headingley Campus, Leeds Beckett University
W. Yorkshire, LS6 3QS
Phone: (0044) 7837367874
Email: N.Costello@leedsbeckett.ac.uk

Author Information
Jim McKenna; Phone: (0044) 1138127483
Email: J.McKenna@leedsbeckett.ac.uk
Kevin Deighton; Phone: (0044) 1138123582
Email: K.Deighton@leedsbeckett.ac.uk
Ben Jones; Phone: (0044) 1138124009
Email: B.Jones@leedsbeckett.ac.uk

**Word Count:** 989

Costello, N., Deighton, K., Dyson, J., Mckenna, J. & Jones, B. 2017. Snap-N-Send: A valid and reliable method for assessing the energy intake of elite adolescent athletes. *Eur J Sport Sci,* 17**,** pp. 1044-1055.

Diet is an ever-changing, poorly characterised and multifaceted phenomenon. Consequently, traditional dietary assessment methods demonstrate considerable random intra- and inter-individual day-to-day variation and systematic over- or under-reporting bias (errors of reliability and validity; Beaton et al. 1997; Freedman et al. 2015) across populations (Pérez-Rodrigo et al. 2015). Expressed practically, true assessments of energy intake are misrepresented by hundreds of calories per day (Archer et al. 2016), erroneously informing medical conclusions (Schoenfeld & Ioannidis 2013), media claims (Archer, Pavela & Lavie 2015) and national dietary guidelines (Chowdhury et al. 2014). Ultimately, the enormous potential of nutrition research to drive national health, patient welfare and public service (Dhurandhar et al. 2015), urgently necessitates, and ethically obligates, the valid assessment of diet within all dietetic output.

Technological advances have enabled development of a new generation of electronic dietary intake assessments (e-DIA; Rollo et al. 2016). E-DIA support previously unachievable assessment ideologies, such as ecological momentary assessment (EMA; Hand & Perzynski 2016), allowing for the rapid collection, management and storage of dietary information as it occurs in the habitual environment of participants (Gemming et al. 2015). Nonetheless, many objective e-DIA remain limited by their poor accessibility (i.e. expense) and inability to translate into actual dietary or energy intakes (Rollo et al. 2016). Such methods require further development (Rollo et al. 2016) and robust validation (Kirkpatrick et al. 2016) before their measurement sensitivity can be confirmed. Alternatively, self-reported e-DIA are highly accessible, providing enhanced validity over traditional approaches (Kirkpatrick & Collins 2016). Nevertheless, such methods are still subject to the considerable measurement error that confounds traditional self-report dietary assessment; evidently, a new and improved approach is required.

In light of these limitations, we propose a novel behavioural approach within the valid assessment of diet. This approach recasts self-report dietary assessment as both potentially valid and reliable (Dhurandhar et al. 2015), allowing for possibly unique distinction between methodological and behavioural (Maurer et al. 2006) measurement error. Methodological measurement error is inherent within the innate design of a dietary assessment tool. For example, the finite food items listed by a food frequency questionnaire (FFQ), the recall bias within memory-based assessment methods (M-BMs; Archer, Pavela & Lavie 2015), or ‘estimation’ involved within an estimated food diary

(Thompson, 2008). Such dietary assessment tools cannot be absent of methodological measurement error even when completed correctly by a behaviourally adhered participant. Alternatively, behavioural measurement error emerges from poor participant 'capability' and/or 'motivation' (Patterson et al., 2013) to complete any dietary assessment in exact accordance with the method design, for the entire recording period. For example, poor literacy skills might affect the 'capability' of an individual to comprehend the questions within a FFQ, whereas, poor 'motivation' might result in the completion of a weighed food diary via estimation, rather than actually weighing dietary consumption as designed (Thompson, 2008). It is now clear that methodological measurement error is the sole focus of current dietary assessment critique (Archer et al. 2016), research (Rollo et al. 2016) and design innovation (Thompson et al. 2010). However, whereas methodological error can be attenuated by appropriate dietary assessment tool selection (Thompson et al. 2015); behavioural error requires unique, and oft over-looked, addressment.

Leading behaviour change science, as summarised by the Behaviour Change Wheel (BCW; Michie, Atkins and West, 2014), can be used to define population-specific behavioural barriers to the accurate recording of diet; attenuating, if not entirely eradicating, behavioural measurement error. The Capability, Opportunity, Motivation – Behaviour model (COM-B) outlines how to effectively change the desired behaviour, through nine intervention functions and seven categories of policy. The systematic, theoretical and applied nature of the BCW, summarised into eight easy-to-understand implementation steps, makes it an outstanding and pragmatic choice to help achieve valid dietary assessment. In this regard, we have recently validated a behavioural approach within a challenging population of elite adolescent athletes. Forty-seven behaviour change techniques (BCTs) were identified and delivered across six intervention domains and five categories of policy to over-determine correct and habitual adherence to real-time protocols (EMA) utilising an innovative method ('Snap-N-Send'; Costello et al., 2017). Findings strongly evidence the importance of deploying comprehensive behaviour change science alongside innovative technology to secure improved adherence to real-time protocols and more valid self-reported dietary assessment.

Subsequently, a behavioural approach can be used to prevent complex biases, often accepted as innate (Maurer et al. 2006) shortcomings within self-report dietary research. By ensuring, rather than assuming, that participants are both behaviourally 'capable' and 'motivated' to record what they consume, social desirability and reactivity bias can be attenuated, if not completely prevented. Furthermore, a behavioural approach which confirms high participant adherence to real-time

assessment protocols (EMA) can also attenuate, if not theoretically prevent, the extensive memory-based bias (Schwarz, 2004) apparent within epidemiological research (Archer, Pavela & Lavie 2015). Additionally, increased participant 'capability' and/or 'motivation' most likely explains why many innovative e-DIA now report improved validity and reliability (Rollo et al. 2016; Costello et al., 2017) over traditional, often laborious self-report methods (Thompson, 2008). Ultimately, further successful attenuation of measurement error within dietary assessment hinges upon effective deployment of primary behaviour change science into the design and delivery of innovative or existing dietary intake assessment.

To conclude, diet is the product of dynamic behavioural and environmental exposure, which presents unique challenges for methodological design and valid assessment. Left unattended, this dynamism produces substantial methodological and behavioural measurement error, which undermines confidence in assessment outcomes. Although there have been improvements in the execution of dietary assessments (Rollo et al. 2016), these have been insufficient to offset calls to abandon self-report assessment altogether (Archer et al. 2016). New eclectic models of behaviour change (e.g. COM-B) are now available to guide the design of bespoke instruments that address behaviours that impede accurate dietary reporting. This new scientific domain represents an original and effective approach to reduce and even prevent dietary assessment measurement error. Using this approach effectively, signals a paradigm shift in expectations for instrument design and implementation within the valid assessment of diet.

# References


Archer, E., et al., 2016. The Validity of US Nutritional Surveillance: USDA's Loss-Adjusted Food Availability Data Series 1971-2010. *Current Problems in Cardiology*, 41(11–12), pp.268–292.

Archer, E., Pavela, G. & Lavie, C.J., 2015. A Discussion of the Refutation of Memory-Based Dietary Assessment Methods (M-BMs): The Rhetorical Defense of Pseudoscientific and Inadmissible Evidence. *Mayo Clinic Proceedings*, 90(12), pp.1736–1739.

Archer, E., Pavela, G. & Lavie, C.J., 2015. The Inadmissibility of What We Eat in America and NHANES Dietary Data in Nutrition and Obesity Research and the Scientific Formulation of National Dietary Guidelines. *Mayo Clinic proceedings*, 90(7), pp.911–26.

Beaton, G.H., Burema, J. & Ritenbaugh, C., 1997. Errors in the interpretation of dietary assessments. *The American journal of clinical nutrition*, 65(4), p.1100S–1107S.

Costello, N., Deighton, K., Dyson J., McKenna J., Jones, B., 2017. Snap-n-Send: A valid and reliable method for assessing the energy intake of elite adolescent athletes. E*uropean Journal of Sport Science*, 17**,** pp.1044-1055.

Chowdhury, R. et al., 2014. Association of Dietary, Circulating, and Supplement Fatty Acids With Coronary Risk. *Annals of Internal Medicine*, 160(6), pp.398–406.

Dhurandhar, N.V., et al., 2015. Energy balance measurement: when something is not better than nothing. *International Journal of Obesity*, 39(7), pp.1109–1113.

Freedman, L.S. et al., 2015. Pooled Results From 5 Validation Studies of Dietary Self-Report Instruments Using Recovery Biomarkers for Potassium and Sodium Intake. *American Journal of Epidemiology*, 181(7), pp.473–487.

Gemming, L., Utter, J. & Ni Mhurchu, C., 2015. Image-Assisted Dietary Assessment: A Systematic Review of the Evidence. *Journal of the Academy of Nutrition and Dietetics*, 115(1), pp.64–77.

Hand, R.K. & Perzynski, A.T., 2016. Ecologic Momentary Assessment: Perspectives on Applications and Opportunities in Research and Practice Regarding Nutrition Behaviors. *Journal of Nutrition Education and Behavior*, 48(8), p.568–577.e1.

Kirkpatrick, S. & Collins, C., 2016. Assessment of Nutrient Intakes: Introduction to the Special Issue. *Nutrients*, 8(4), p.184.

Kirkpatrick, S.I. et al., 2016. Evaluation Of Dietary Assessment Tools: Does "Validated" Mean What We Think It Means? *The FASEB Journal*, 30(1 Supplement), p.43.8-43.8.

Maurer, J. et al., 2006. The Psychosocial and Behavioral Characteristics Related to Energy Misreporting. *Nutrition Reviews*, 64(2), pp.53–66.

Patterson, K., Grenny, J., Maxfield, D., McMillan, R., & Switzler, A. (2007). Influencer: The Power to Change Anything, First edition (Hardcover): McGraw-Hill Education.

Pérez-Rodrigo, C. et al., 2015. Dietary assessment in children and adolescents: issues and recommendations. *Nutr Hosp.Nutr Hosp*, 3131(3), pp.76–8376.

Rollo, M.E. et al., 2016. What Are They Really Eating? A Review on New Approaches to Dietary Intake Assessment and Validation. *Current Nutrition Reports*, 5(4), pp.307–314.

Schoenfeld, J.D. & Ioannidis, J.P., 2013. Is everything we eat associated with cancer? A systematic cookbook review. *American Journal of Clinical Nutrition*, 97(1), pp.127–134.

Schwarz, N., 2004. Retrospective and Concurrent Self-Reports: The Rationale for Real-Time Data Capture.

Michie, S., Atkins, L. & West, R. (2014). The Behaviour Change Wheel - A Guide to Designing

Interventions (2nd ed.). Great Britain Silverback Publishing.

Thompson, A.F.S., 2008. *Dietary assessment methodology*, Available at: http://appliedresearch.cancer.gov/diet/adi/thompson_subar_dietary_assessment_methodology.pdf.

Thompson, F.E. et al., 2010. Need for technological innovation in dietary assessment. *Journal of the American Dietetic Association*, 110(1), pp.48–51.

Thompson, F.E. et al., 2015. The National Cancer Institute's Dietary Assessment Primer: A Resource for Diet Research. *Journal of the Academy of Nutrition and Dietetics*, 115(12), pp.1986–95.