Citation for published version:

Thompson, D, Peacock, OJ & Betts, J 2014, 'Substitution and compensation erode the energy deficit from exercise interventions', *Medicine and Science in Sports and Exercise*, vol. 46, no. 2, pp. 423.
<https://doi.org/10.1249/MSS.0000000000000164>

DOI:

[10.1249/MSS.0000000000000164](https://doi.org/10.1249/MSS.0000000000000164)

Publication date:

2014

Document Version

Peer reviewed version

[Link to publication](#)

This is a non-final version of an article published in final form in: Thompson, D, Peacock, OJ & Betts, J 2014, 'Substitution and compensation erode the energy deficit from exercise interventions' *Medicine and Science in Sports and Exercise*, vol 46, no. 2, pp. 423., and available online via:
<http://dx.doi.org/10.1249/MSS.0000000000000164>

University of Bath

Alternative formats

If you require this document in an alternative format, please contact:
openaccess@bath.ac.uk

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Substitution and compensation erode the energy deficit from exercise interventions

Dear Editor-in-Chief:

In their recent review, Melanson *et al* neatly illustrate how compensatory changes in diet or physical activity may explain why the weight loss achieved through an exercise program is less-than-predicted and highly variable between people (3). We would like to highlight a further consideration which could be just as important.

Physical activity energy expenditure can vary enormously from a sedentary PAL (Total Energy Expenditure/Basal Metabolic Rate) of <1.39 through to a highly active PAL of >2.00 (1). It is noteworthy that even a person with a very low PAL (e.g., 1.30) will expend several hundred kilocalories a day through physical activity. Therefore, when an exercise or physical activity intervention is prescribed for weight loss, we should bear in mind that the baseline is not zero and the prescription will be superimposed against the background of existing (variable) physical activity. Thus, an exercise prescription will rarely replace absolute rest. Indeed, it is quite conceivable that in some circumstances the prescribed exercise (e.g., walking) simply replaces non-prescribed (existing) physical activity of a similar intensity for a negligible or non-existent energy deficit.

We have briefly referred to this concept as 'substitution' (4) although it has been very poorly characterised in the literature. The substitution of non-prescribed physical activity with prescribed physical activity has the capacity to substantially erode the potential energy deficit from an exercise or physical activity intervention. Such substitution may help explain why prescribed exercise interventions do not always lead to an increase in overall daily energy expenditure (2, 6).

Many of the studies discussed in the review by Melanson *et al* simply subtracted measures of 'prescribed' exercise energy expenditure from measures of total physical activity energy

expenditure in order to derive non-prescribed physical activity (3). This approach does not take into account the loss of the physical activity which existed before the 'new' prescribed exercise was introduced. This may erroneously give the impression of behavioural compensation when, instead, the apparent reduction in non-prescribed physical activity is actually the product of substitution. Of course, variability in habitual physical activity, the duration and intensity of the intervention as well as the precise timing of newly prescribed exercise (relative to habitual physical activity) will all affect the degree of substitution. Our own 6-month exercise training study shows strong evidence for dietary compensation (i.e., an increase in energy intake) but no evidence for a compensatory reduction in non-prescribed physical activity (5).

Thus, we share Melanson and colleagues' views that behavioural compensation is a critically important consideration that helps explain why weight loss is less-than-predicted with exercise and also variable between people. We also share their excitement about the potential development of strategies to help susceptible individuals. This letter is intended to highlight that we also need to recognise the role of substitution if we hope to understand the true impact of behavioural compensation.

Dylan Thompson, Oliver J Peacock & James A Betts

Department for Health

University of Bath

Bath, BA2 7AY

UK

References

- 1) Brooks GA, Butte NF, Rand WM, Flatt JP, and Caballero B. Chronicle of the institute of medicine physical activity recommendation: How a physical activity recommendation came to be among dietary recommendations. *American Journal of Clinical Nutrition*. 2004;79(5):921-30.
- 2) Goran MI, and Poehlman ET. Endurance training does not enhance total energy-expenditure in healthy elderly persons. *American Journal of Physiology*. 1992;263(5):E950-E7.
- 3) Melanson EL, Keadle SK, Donnelly JE, Braun B, and King NA. Resistance to exercise-induced weight loss: Compensatory behavioral adaptations. *Medicine & Science in Sports & Exercise*. 2013;45(8):1600-9 10.249/MSS.0b013e31828ba942.
- 4) Thompson D, Karpe F, Lafontan M, and Frayn KN. Physical activity and exercise in the regulation of human adipose tissue physiology. *Physiological Reviews*. 2012;92:157-91.
- 5) Turner JE, Markovitch D, Betts JA, and Thompson D. Nonprescribed physical activity energy expenditure is maintained with structured exercise and implicates a compensatory increase in energy intake. *Am J Clin Nutr*. 2010;92(5):1009-16.
- 6) van der Heijden G-J, Sauer PJ, and Sunehag AL. Twelve weeks of moderate aerobic exercise without dietary intervention or weight loss does not affect 24-h energy expenditure in lean and obese adolescents. *Am J Clin Nutr*. 2010;91(3):589-96.