promoting physical activity need to be clear and consistent and only change when there is unequivocal evidence to do so. Although the evidence concerning activity and weight gain is weak, it is not so weak that the current public health guidance should be altered. However, where a change is required is in the expectations of those responsible for public health who should be realistic that changes in population level physical activity on their own, even if they are achieved, are unlikely to result in a substantial reduction in the prevalence of obesity even though small changes could have benefits for other health endpoints.

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References

Commentary: Physical activity does influence obesity risk when it actually occurs in sufficient amount

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We appreciate the opportunity to comment on the recently accepted article entitled ‘Physical activity does not influence obesity risk: time to clarify the public health message’.1 However we disagree with the
conclusions of Luke et al., and those of some others who suggest that physical activity is not helpful in weight control, and believe that four factors account for this difference in conclusions. Specifically, we believe that there are four pairs of concepts in which, within each pair, seemingly similar but distinct concepts are conflated, leading to erroneous conclusions. Specifically:

(i) Participation in a physical activity programme is conflated with performance of physical activity.
(ii) Being assigned to a physical activity intervention is conflated with performance of physical activity.
(iii) Body weight is conflated with body composition.
(iv) Expend energy in activity is conflated with creating a net energy deficit in total energy balance.

Differences between participation and performance of physical activity: the importance of differentiating between physical activity and exercise training

When assessing the effectiveness of physical activity on weight loss, it is important to consider participation of physical activity vs actual performance of exercise. We believe it is important to point out the differences between physical activity and exercise training. We do not see these as mutually exclusive categories, as exercise is a subset of physical activity, but it is important to mention subtle differences between them. Both terms refer to voluntary movements produced by skeletal muscle contraction that result in calorie expenditure above a basal level; however, physical activity consists of non-structured activities such as gardening, walking the dog and raking leaves, whereas exercise is a form of physical activity that is specifically planned, structured and repeated over time such as weight training, running or spin class. This may seem like a minute point, but it is critical when assessing the efficacy of ‘physical activity’ vs ‘exercise training’ on weight loss. We believe that simply participating in a physical activity programme may not provide a sufficient stimulus that leads to weight loss, but rather it is important to engage in a training programme that is consistent and provides a sufficient dose (intensity and/or duration) that can lead to weight loss. However, we do recognize that the optimal dose has yet to be identified and there are many factors that must be considered when assessing the efficacy of physical activity/exercise and weight loss. For example, participation in exercise training does not always result in increased free-living activity-related energy expenditure (AEE). It has been shown that older adults may compensate for increased exercise training by lowering their non-training energy expenditure (NEAT). On the other hand, we have recently shown that exercise training less frequently stimulates more NEAT and results in large increases in AEE as well as weight and fat mass loss as compared with a more frequent training protocol. These findings are crucial, as it has become increasingly important to identify specific dose responses to exercise training for improving health outcomes. Identifying the optimal dose of exercise for calorie expenditure, while leaving sufficient energy for ‘free-living activities’, is an important issue as we prescribe exercise for weight loss.

Assignment vs performance: impact of exercise dose and intensity

Supervised exercise training is effective for inducing weight loss, although the amount of weight loss varies between individuals. When assessing weight loss from exercise it is important to separate differences between individuals being assigned to an exercise condition from those actually exercising. Hence, exercise may be very efficacious under a supervised exercise training programme, but only modestly effective when individuals are assigned without supervision. Indeed, this has been shown in obese adults among whom a 65% greater decrease in weight was observed in individuals who received weekly supervised training as compared with controls who received oral advice regarding exercise training. In addition to exercise supervision, it is also important to look at the quantity and quality of exercise being prescribed. The Studies of a Targeted Risk Reduction Intervention through Defined Exercise (STRRIDE) elegantly demonstrated that there was a clear dose-response relationship between the amount of weekly supervised exercise training and the amount of weight change in overweight individuals, independent of calorie intake. This is the most recent study to report these findings and these results have been corroborated by several earlier studies that also showed that a greater amount of exercise resulted in greater weight loss; thus it appears that the modest effects of exercise training on weight loss are likely due to the incorporation of modest exercise training interventions. Therefore, the title of the commentary by Luke and Cooper may confuse readers. It would be more apt to help readers understand the point that the majority of society does not engage in a sufficient amount of physical activity that will increase energy expenditure and thus will not have a significant impact on long-term energy balance. Indeed, this point is made by the authors themselves.

Body weight vs body composition

Another factor that needs to be considered is the role that physical activity and exercise training have on body composition. Exercise training has been shown to optimize fat losses during energy restriction weight loss programmes. Perhaps even more important, exercise training has been shown to cause preferential loss of visceral fat during weight loss as well as preventing regain of visceral fat during long-term follow-up following weight loss. Given these findings, and the fact that the accumulation of visceral fat is the phenotype of obesity that presents the
greatest health risk, simply looking at weight loss as the primary outcome does not provide a clear picture of the effects of exercise training on body weight. The distribution of fat mass and fat-free mass should be considered when interpreting the effects of exercise on weight loss.

**Energy expenditure and compensation**

Although exercise training and high levels of physical activity are often reported to have modest effects on weight loss, doubly labelled water studies suggest that high levels of physical activity and exercise training have a much larger impact on energy balance and prevention of weight gain. With that in mind, we agree that weight loss cannot occur if compensation occurs for the calories expended during exercise. However, given the fact that supervised exercise has been shown to successfully reduce weight, we do not believe that complete compensation is typically responsible for the lack of weight loss following exercise training among overweight or obese persons. We believe that additional factors such as personal and environmental differences and cognitive sets need to be considered when evaluating compensatory calorie intake following exercise.

Personal differences, such as genotype, current physical state and demographic and psychological characteristics, can all have a role in calorie intake and exercise. For example, there are specific differences in compensatory responses between non-obese compared with obese individuals. It has been shown that lean individuals often respond to exercise by increasing calorie intake, whereas this is less likely to be observed in obese individuals. Furthermore, gender differences should also be considered as it has previously been shown that women may partially compensate by increasing energy intake following exercise, whereas men did not show any tendency to alter energy intake after exercise.

The environment can also influence subsequent energy intake following exercise. Specifically, environmental temperature may play a significant role in the magnitude of calorie compensation following acute exercise. Several studies have shown significantly greater energy intake following exercise in cold or neutral conditions compared with warmer conditions. Therefore, it is possible that exercise in a warm environment (e.g. outdoors as opposed to air-conditioned gym) may be preferable for achieving short-term negative energy balance. Future studies are needed to confirm the effects of environmental temperature on long-term energy intake as opposed to single acute meal ingestion to determine whether subsequent meals are able to compensate for the observed acute compensation following exercise.

Lastly, cognitive sets have also been linked to physical activity and subsequent food consumption. Werle et al. showed that manipulating the way physical activity is perceived can alter subsequent food intake. Specifically, they had individuals participate in physical activity by having them perform a scenic walk and telling them that they were engaging in exercise or by creating a fun scenario focusing on music that was not perceived as exercise. When physical activity was perceived as exercise, individuals tended to increase their food consumption as compared with when exercise was presented as a fun activity. Additionally, they also demonstrated that simply reading about physical activity led to an increase in snacking and overall food consumption. Similar results were obtained by simply having women converse about exercise while exercising vs converse about entertainment while exercising. Therefore, it is possible that perception of physical activity can affect calorie compensation, which suggests a need to create innovative and creative ways when prescribing exercise for weight loss. Individual differences in pleasure and perceived exertion should be included when evaluating effectiveness of physical activity and weight loss.

**Conclusions and recommendations**

In summary, we believe that there are sufficient data to show that exercise is beneficial for weight loss if the exercise programme is adhered to. However, we do not disagree with the contention that exercise recommendations may be difficult to complete for individuals who are already overweight or obese. We also feel there is a need for larger supervised exercise training studies with more sophisticated techniques (such as doubly labelled water) to assess energy expenditure. Additionally, it is important to assess changes in fat mass and lean mass when determining the effects of exercise on body weight. Simply using weight or body mass index (BMI) as a determining factor does not provide a clear picture of the potential benefits of exercise for obtaining a healthy body composition. Lastly, the environment, personal differences and cognitive differences need to be considered when determining whether or not an exercise or physical activity intervention is compensated for by alterations in other components of energy balance and is ultimately effective for improving body composition.

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**References**


We appreciate the thoughtful perspectives1–5 on our article6 and can readily acknowledge that we learned something. Given the format of this exchange we will take the opportunity to break from academic fashion and make our remarks more informal, and hopefully thereby less veiled in rhetoric. As an opener, we re-state the logic behind our paper: if a public health intervention doesn’t work, we shouldn’t recommend it, and instead we should concentrate on the real source of the problem.