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Why is the 3500 kcal per pound weight loss rule wrong?

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We welcome the recent article by Thomas *et al.*[1] criticizing the commonly used 3500 kcal per pound weight loss rule. This echoes our research showing that the 3500-kcal rule leads to overestimation of weight loss in individuals and populations.[2,3] Despite our agreement with the spirit of the article, we believe it has the potential to generate confusion about exactly why the 3500-kcal rule is wrong.

The most serious error of the 3500-kcal rule is its failure to account for dynamic changes in energy balance that occur during an intervention. Unfortunately, we feel that this error is obscured by the equation of Thomas *et al.*[1] meant to represent the predictions of the 3500-kcal rule: $W(t) = W_0 + \Delta EB \times t/3500$, where the change in energy balance, ΔEB, was defined as the difference between the rates of energy intake and expenditure. What the authors failed to stress was that they calculated ΔEB as the initial difference between the energy intake and expenditure rates and assumed it to be a static quantity. In reality, ΔEB is dynamic and, if accurately estimated over time, then the above equation provides a reasonable estimate of weight change.

Mathematical models attempt to correct this deficiency by estimating the dynamic changes in ΔEB.[4] Thomas *et al.*[1] correctly demonstrated that the typical assumption of a static ΔEB leads to exaggerated weight loss predictions with no plateau. However, the static ΔEB assumption was not explicitly stated and the reader may be led to the erroneous conclusion that the deficiency of the 3500-kcal rule is the numerical value '3500'.

Conservation of energy requires that the cumulative energy deficit (that is, the integral of ΔEB) equals the energy lost from the body. The 3500-kcal rule was motivated by calculating that a pound of adipose tissue stores approximately 3500 kcal.[5] A more accurate accounting of body composition changes demonstrated that this value is appropriate for modest weight changes in overweight and obese people, but is an overestimate in others.[6] However, using a 'corrected' numerical value for the energy content of lost tissue does not repair the 3500-kcal rule without also accounting for the ΔEB dynamics.

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

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