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Letter to the Editor

Energy balance in youth: an 'inter-dynamic' concept?

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Obesity prevention and treatment rest upon the use of energy balance (EB) equations to predict and orientate changes in body weight. Although the use of an appropriate EB equation is crucial for efficient interventions, the equation has evolved over time from static to more dynamic and complete conceptions(1). Today, in the clinical setting, EB is commonly considered as the difference between the total energy in (total energy intake; TEI) and the total energy out (total energy expenditure (TEE) corresponding to the physical activity-related EE + BMR + thermic effect of food (TEF)), which *per se* presents EI and EE as two distinct parameters (EB = TEI − TEE). Although it is now clear that energy intake (EI) and energy expenditure (EE) interact, the first theory proposed by Mayer assuming that EI was regulated with such flexibility that any exercise-induced EE was directly compensated for by a rise in EI(2) should systematically favour an almost neutral EB, which is clearly not the case in the population. Physical activity-induced EE refers not only to exercise-induced EE but also to the EE generated by all the daily activities (DA) such as sedentary behaviours (watching television, reading, video games, etc.), imposed sedentary activities (sitting time, bed rest, etc.) and sleep time. All these activities have been shown to affect EI in lean and obese youth(3), and interestingly the induced EE is not coupled to the subsequent EI(4). This may lead to reconsideration of the nature of the EI variable in the EB equation, which might then evolve as

$$\text{EB} = ((\text{EI (as food intake patterns and cues)} + \text{EI adaptations to DA (DA} - \text{EI}\Delta)) - \text{TEE}).$$

Although fat-free mass and BMR have been shown to influence EI in adults(5), no evidence supports this relationship in youth so far.

Therefore, DA affect EI and it has been shown that they may also induce adaptations of spontaneous physical activity and EE. Physical exercise (especially of high intensity) has been effectively shown to lead to a compensatory decrease of youth's spontaneous physical activity to preserve EB(6–8). These EE adaptations to exercise join up with the 'activitystat theory' first proposed by Rowland(9). Such a compensatory trend is also a determinant of the nature of TEE and thus of daily EB. TEE might then be subdivided as

$$\text{TEE} = (\text{BMR} + \text{TEF} + (\text{DAEE} + \text{EE adaptations to DA (DA} - \text{EE}\Delta))).$$

According to the dynamic interactions between DA and dietary intake, the daily EB equation no longer seems to consider TEI and TEE as independent parameters but as an interactive complex such that

$$\text{EB} = ((\text{EI (as food intake patterns and cues)} + \text{DA} - \text{EI}\Delta) - (\text{BMR} + \text{TEF} + (\text{DAEE} + \text{DA} - \text{EE}\Delta))).$$

Although this remains difficult to quantify, it has to be noticed that some dietary patterns (certain types of food or snacks for instance) can also affect the subsequent EI (in the function of their palatability or energy density for instance) or EE (such as TEF). It is also important to notice that such compensatory (alimentary and energetic) mechanisms are difficult to assess, which makes their consideration difficult when using such theoretical equations.

It has to be underlined here that the non-homeostatic dimension of appetite and EI control remains highly individual, variable and difficult to quantify as part of the equation. Our aim is to point out the inter-dynamic nature of this balance and the necessity to consider it. Using a static conception of EB where TEE and TEI are independently considered might limit the efficiency of interventions and explain why some interventions (dietary, exercise or both) do not provide the expected weight loss.

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