Unexpected Postprandial Energy Expenditure and Fuel Oxidation Responses to Meals with Different Macronutrient Compositions

Dear Editor:

Xiong et al. (1) addressed the question of whether postprandial profiles in energy expenditure (EE), substrate oxidation, and plasma metabolites vary following isocaloric meals of differing macronutrient distribution consumed by men classified as normal weight (NW) or overweight/obese (OW). They also tested the effect of exercise performed 90 min after the meals. Their conclusion that many of the variables measured with indirect calorimetry did not differ among meal types or between NW and OW men contradicts several prior studies, which is surprisingly overlooked in the discussion. Several of the cited references report different patterns of postprandial EE and substrate oxidation than what Xiong et al. found, but this is not acknowledged. There are 5 specific concerns.

1. On the resting day trials, EE values following all 3 meals (high carbohydrate, high fat, high protein) followed a similar 16–19% increase beginning immediately after meal consumption and persisting at the same magnitude each hour for 3 h. According to the protocol, EE was measured immediately before and after the 20-min meal consumption period. How the postprandial EE at "time 0" increased so quickly, when digestion and absorption had presumably just begun, is hard to explain. Perhaps the participants were stressed due to blood collection or other testing performed? Additionally, postprandial EE typically rises over the first hour and then begins to return toward baseline over the next 2–3 h when participants remain quietly resting (2–7), but it is unclear why Xiong et al. (1) observed a rapid, prolonged step change in EE.
2. Patterns for postprandial substrate oxidation did not differ between meals, which disagrees with prior studies. High-carbohydrate meals typically promote a transient (1–3 h) increase in carbohydrate oxidation rate (with corresponding reduction in fat oxidation), whereas after a high-fat meal, carbohydrate oxidation typically declines and fat oxidation remains stable or increases over 2–4 h (2, 3, 5–9). Xiong et al. (1) report that after all 3 meal types, the respiratory exchange ratio (RER) declined for both NW and OW participants, falling progressively lower over time. At the 3-h measurement on the resting trials, the mean value for RER for the OW group was 0.70–0.72, which is unusually low under the conditions described. A decline in RER would be expected following the high-fat meal, but for the high-carbohydrate meal, the reported results are opposite of what is expected. The larger increase in serum insulin at 2 h after the high-carbohydrate meal compared with the high-fat meal is consistent with prior studies, but an increase in insulin has been shown to suppress lipolysis and fat utilization (10) rather than promote the increase in fat oxidation as reported by Xiong et al. (1).
3. The EE values do not follow patterns expected for people of different body sizes and are not internally consistent. In the absence of endocrine or inflammatory conditions, absolute EE in adults is positively correlated with body size, particularly lean mass (7). However, on all 3 resting trials, the NW and OW groups are reported to have the same absolute EE values (kJ/h) even though they differ by ∼20 kg in body mass and ∼8 kg in fat-free mass. In contrast, on each of the 3 exercise trials, absolute resting EE is ∼20% higher for the OW group compared with the NW group. It is very difficult to reconcile how the groups could be so consistent across the resting or the exercise trials but different between those trial types, especially given the order of trials.
4. The reported values for carbohydrate and fat oxidation (g/h, Tables 2 and 3) appear incorrect. For example, there is a 12–13% difference between the NW and OW groups for baseline rates of substrate oxidation on the resting day high-carbohydrate trial, yet the groups have the same RER and their EE values differ only by 1 kJ/h. These calculations are not congruent. Likewise, using the equations cited in the article, the reported EE and RER values can be used to determine the required rates of VO_2 (oxygen consumption) and VCO_2 (carbon dioxide production) and the corresponding rates of fat and carbohydrate oxidation. For the NW group on the resting high-carbohydrate trial, the baseline EE and RER are reported as 313 kJ/h and 0.84, respectively. The estimated VO_2 and VCO_2 to achieve those values would be 0.258 and 0.217 L/min, respectively. The corresponding rates of fat and carbohydrate oxidation would therefore be 4.14 and 9.62 g/h, which are much different from what is reported in Table 2. This pattern of mismatched results persists throughout Tables 2 and 3. In Table 3, there are clear rounding errors because the EE values at rest and exercise do not agree with the corresponding delta values, and converting the substrate oxidation delta values to energy equivalents yields results that do not match the reported delta EE values.
5. A minor but common occurrence is misstating the findings of cited studies. For example, in the second paragraph of the discussion, Xiong et al. (1) cite 2 studies (their references 17 and 28) as being in agreement with their findings. However, both of the cited studies showed differences in substrate oxidation between meal types, and the study described as testing British people was performed on women in the United States.

The unexpected patterns of EE and fuel oxidation reported by Xiong et al. (1) could be due to technical challenges

over the study period, such changes in room temperature, a change in inspired gas concentrations due to poor ventilation, measurement error due to drift in the gas analyzer readings, or lack of proper instrument calibration and quality control. The lack of internal agreement with the data presented suggests errors in calculations, missing data, and/or typographical errors. In any case, these data require careful review. It would be helpful for readers if the authors could provide a clear explanation for why their results are so different from prior studies and confirm that the data are presented correctly.

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