Published in final edited form as:

Scand J Med Sci Sports. 2019 August ; 29(8): 1263–1264. doi:10.1111/sms.13458.

Accelerometry Does Not Measure Energy Expenditure

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Dear Editors,

In the manuscript by Fazzi et al. entitled 'Activity behaviors in lean and morbidly obese pregnant women',¹ physical activity assessed by questionnaire and accelerometry was reported to be lower in pregnant women with morbid obesity compared to pregnant women of normal weight. Total daily energy expenditure however, was higher in women with morbid obesity. Thus, the authors conclude, "energy expenditure might not be the key factor to obesity".

The authors base their conclusion on the false assumption that accelerometry can provide an accurate and "objective measurement of energy expenditure". Accelerometry as correctly described, assesses the magnitude and duration of movement and gravitational forces of activity to yield outcome variables such as activity counts and activity duration. These variables are then imputed into proprietary equations that predict, but do not measure, energy expenditure from body weight, height, and age of an individual. Similarly, the reported resting energy expenditure data was predicted, and not measured, using the same individual parameters.² Using this predicted data, the authors then calculated the proportion of energy expended in various intensities of activity.

We agree with the rationale to undertake this type of analysis because it is valuable to inform the design of future intervention studies (e.g., reduce sedentary behavior or stimulate moderate to vigorous physical activity) for pregnant women. However, the published analysis and conclusions would be strengthened if they were based solely on accelerometry data (time spent in different intensities), and not extrapolated to energy expenditure. Using the accelerometry data alone, total activity counts were lower in women with obesity, whereas sedentary time was not different between the two groups of pregnant women. These data indicate that pregnant women with obesity engage in less moderate-to-vigorous physical activity. Extrapolating these data to energy expenditure either only confirms these

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results (less energy expended in vigorous-intensity activity) or overstates them (more energy expended in light-intensity activity).

Despite the lower total activity counts, compared to women with normal weight, women with obesity were reported to have higher energy expenditure.¹ The authors suggest that larger observed energy expenditure in women with obesity is due to differences in energy efficiency related to “the work of breathing and moving”, which cannot be inferred without objectively assessing energy expenditure. Although we agree that energy expenditure at rest or during activity is likely larger in women with obesity as compared to lean women, we argue that this observation is due to their increased body mass, and not to decreased energy or mechanical efficiency. With respect to resting metabolic rate, we have recently shown with objective measures that energy expenditure increases proportional to body weight (Figure 1A) and is, therefore, larger in women with increased obesity (Figure 1B).³ Importantly, we and others have shown that there are no physiological differences in energy expenditure between women of different body sizes, when differences in body size are taken into account (Figure 1C–D).^{3,4} With regard to energy efficiency during activity, the studies referenced indeed show higher energy expenditure in obese women for a given intensity of activity (VO_2 per watt), but an adjustment for the difference in body weight was not appropriately undertaken.⁵ Energy efficiency (metabolic or mechanical) in non-pregnant women, does not seem to be different between individuals with and without obesity, when body mass is accounted for.^{6,7} In pregnant women, we have yet unpublished data showing that energy requirements and external work performed increase during pregnancy, and that these were in relation to gestational weight gain, but they were not different between lean and overweight women.⁸ Collectively, these studies strongly argue against the hypothesis of reduced energy or mechanical efficiency in women with obesity at rest or while active.

Lastly, we would like to mention that the estimates for energy expenditure in the manuscript by Fazzi et al., are not “the best equation to estimate resting energy expenditure” for pregnant women. Well-known modifiers of energy expenditure including gestational age (8 kcal/d/week)^{4,9} and race (5–9% lower in African-American vs white women)^{10,11} are not accounted for in the Mifflin-St Jeor-equation for resting energy expenditure,² and likely neither by the Actical algorithm, although this is not described. We acknowledge that no equation has been published that accounts for both these variables but we and others have published more appropriate equations for pregnant women, accounting for gestational age or race.^{9,10}

In conclusion, accelerometers are useful and objective tools to characterize sedentary behavior and physical activity in pregnant women and provide data that measurements of energy expenditure, e.g., doubly-labeled water or metabolic chambers, cannot. The finding by Fazzi et al., that physical activity represented by counts is lower in morbidly obese women should therefore be interpreted as supportive of behavioral interventions attempting to attenuate gestational weight gain. Since this study did not directly measure energy expenditure, the conclusion that energy expenditure need not be the target of lifestyle interventions cannot be supported by the collected data and is contrary to the conclusion that should be drawn based on activity objectively measured by accelerometry.

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Figure 1.

Data are presented as individual data (A, C, and D) and as mean $\pm$ SEM (B). Obesity classes are defined by BMI at enrollment (<15 weeks gestation): 1: 30–34.9, 2: 35–39.9, 3: 40 kg/m². Methods (respiratory chamber and doubly-labelled water) are described in Most et al., Obesity (Silver Spring). 2018;26(6).