THE ACCURACY OF BASAL ENERGY EXPENDITURE ESTIMATION BASED ON HEAT FLUX AND MACHINE LEARNING AS BODY COMPOSITION CHANGES

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INTRODUCTION

The basal energy expenditure (BEE) provides more than half our total daily energy consumption. However, most sports enthusiasts monitor BEE estimates using portable trackers and monitors based on background information (age, gender, height, weight) and the user's heart rate.

A novel heat flux sensor solution measures amount of heat released from the skin surface [1] combined with a machine learning algorithm.

PURPOSE

This study compared the accuracies of these two different BEE estimations -methods with indirect calorimetry of respiratory gases before and after preparing (23 weeks) and recovering (23 weeks) phases of physique athletes for fitness and body building competitions.

METHODS

A total of 58 physique athletes participated to this study

- 27 athletes competed during the study.
- 31 athletes were controls and engaged in fitness-related strength training with no competition goal and no body fat reduction during the study period (Fig 1).

BEE measurements were taken simultaneously to measure respiratory gases, heart rate and heat flux, and body composition was analysed at the same visit.

BEE was calculated using Weir's equation [2] as the gold standard and a trained algorithm with heat flux.

RESULTS

		Fat% after 23 weeks	*p*-value
Women	(competitors)	14.1 ± 7.4%	<0.05
	(controls)	25.3 ± 6.8%	
Men	(competitors)	5.6 ± 2.1%	<0.001
	(controls)	18.1 ± 7.2%	

BEE estimates by the heat flux method (1656 ± 410 kcal/d) were not statistically different from indirect calorimetry (1657 ± 305 kcal/d), in contrast to background information estimations (1718 ± 270 kcal/d, p<0.001).

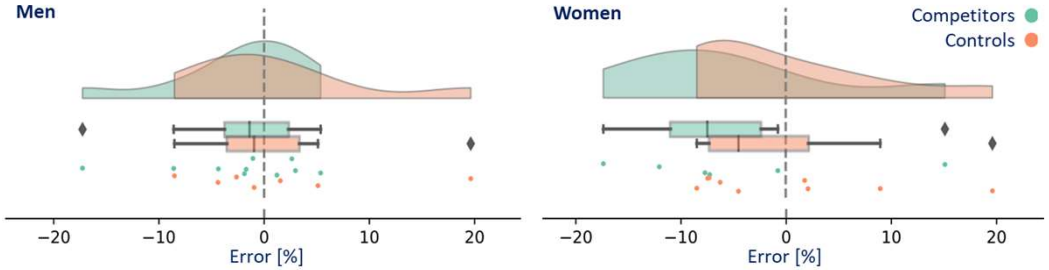
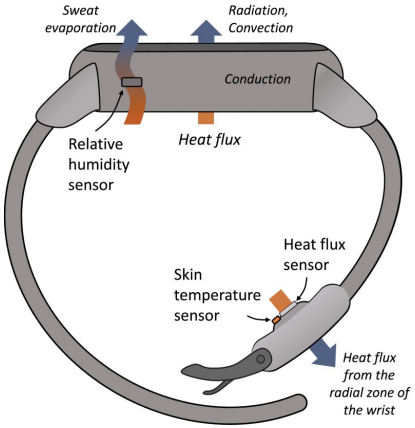


Fig 2. Error in estimating resting energy expenditure using the heat flux method (after 23 weeks)

Fig 1. Basal energy expenditure and body composition (DXA) measurements

EE values from the heat flux method and indirect calorimetry were positively correlated (r=0.346, p<0.001), whereas resting heart rate and indirect calorimetry values were not correlated.

The configuration combining background information and heat flux gave the lowest mean error (6.73%) for BEE. The accuracy of heat flux estimates did not differ between the competition and control groups. However, there was a statistical difference between genders (p < 0.05), with higher errors in estimates for females (Fig 2).



CONCLUSIONS

The heat flux method using machine learning appears to be promising tool for more accurate estimation of resting energy expenditure. Overall, the average error, ~7%, is much lower than errors of consumer devices documented in previous studies [3]. Further studies should also focus on testing heat flux and machine learning in different populations as their body composition changes.

1. Levikari et al. (2021) 2. Weir (1949) 3. Shcherbina et al. (2017)