



Investigating Associations between Energy Availability and Appetite Related Biomarkers (Ghrelin, Leptin, PYY and GLP-1) in Student Athletes

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Introduction

Background:

- Some athletes fail to adequately fuel to meet both exercise and physiological demands, leading to low energy availability (LEA), which can disrupt endocrine function ¹⁻³.
- However, associations with appetite-related hormones are unclear.

Aim and Objectives:

- To investigate associations between EA and appetite-related biomarkers (ghrelin, leptin, PYY and GLP-1) in highly trained student athletes in Ireland.

Methodology

- Fifty-nine student athletes (n=33 males, n=26 females; age 21.2 ± 1.8 years) participated.

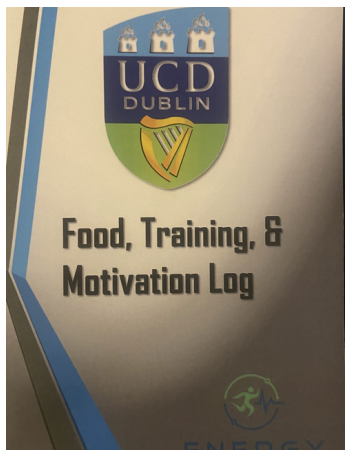
Table 1: Study Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Males and Females aged 18-40 years:	
- Enrolled full-time in third level education. - Train for and participate in a named sport at third level. - Train a minimum of x2/week (>45 minutes per session). - Competed at a minimum of national level. - Competed in the last 6 months and in the next 6 months. - Have no health comorbidities.	- Pregnant women. - People with severe claustrophobia. - People with diabetes mellitus/other conditions that prevent fasting. - People on medications that influence metabolic rate. - People with current symptoms of COVID-19. - People who smoke regularly (>10 cigarettes/day).

Participants visited the lab on two occasions (one week inbetween):

Days 1-7:

Energy intake and expenditure were estimated:



Weighed food diary



Actiheart device



VO2 Max and lactate test



Bodpod



Blood sample

Day 7:

Body composition measured, food diaries and actiheart returned:

$$EA \text{ (kcal} \cdot \text{kg}^{-1} \text{ Fat Free Mass (FFM)} \cdot \text{day}^{-1}) = \frac{[\text{Energy Intake (kcal)} - \text{Activity Energy Expenditure (kcal)}]}{\text{FFM (kg)/day}^3}$$

Results

Participant Demographic Characteristics

- Sports included: n=29 rowing, n=8 cycling, n=16 athletics, n=6 other
- Level of competition: n=28 national, n=28 international n=both

Table 2: Participant Characteristics (n=59).

	Males (n=33)	Females (n=26)	Total (n=59)
Age (y)	21.3 ± 1.4	21.2 ± 2.2	21.2 ± 1.8
% Fat Mass	10.73 ± 4.16	21.92 ± 7.72	15.66 ± 8.16

Values are expressed as mean ± SD.

Results

Appetite Related Hormones in LEA vs Moderate/Optimal EA

- EA status (low vs moderate/optimal) did not significantly affect fasting levels of hormones (p>0.05 for all, Table 3).

Table 3: Appetite-Related Hormone Concentrations Across EA Groups.

	LEA (n=36)	Mod/Opt EA (n=23)	P-Value (p < 0.05)
Ghrelin* (pg/ml)	156.0 [96.9]	130.4 [94.9]	0.47
Leptin* (pg/ml)	278.3 [652.3]	240.5 [698.7]	0.72
PYY* (pg/ml)	55.90 [23.15]	57.93 [18.20]	0.88
GLP-1* (pM)	8.35 [3.19]	8.48 [3.68]	0.72

Variables were compared using Mann-Whitney U tests in SPSS. *Values are expressed as median and [IQR].

Correlations Between Appetite Related Hormones, Body Weight and Composition and EA Categories

- Weight significantly predicted ghrelin concentrations ($\beta = -.392$, $p = .002$, $n = 59$), with higher body weight associated with lower ghrelin concentrations.
- Percentage fat mass was a significant predictor of leptin ($\beta = .716$, $p < .001$, $n = 59$).

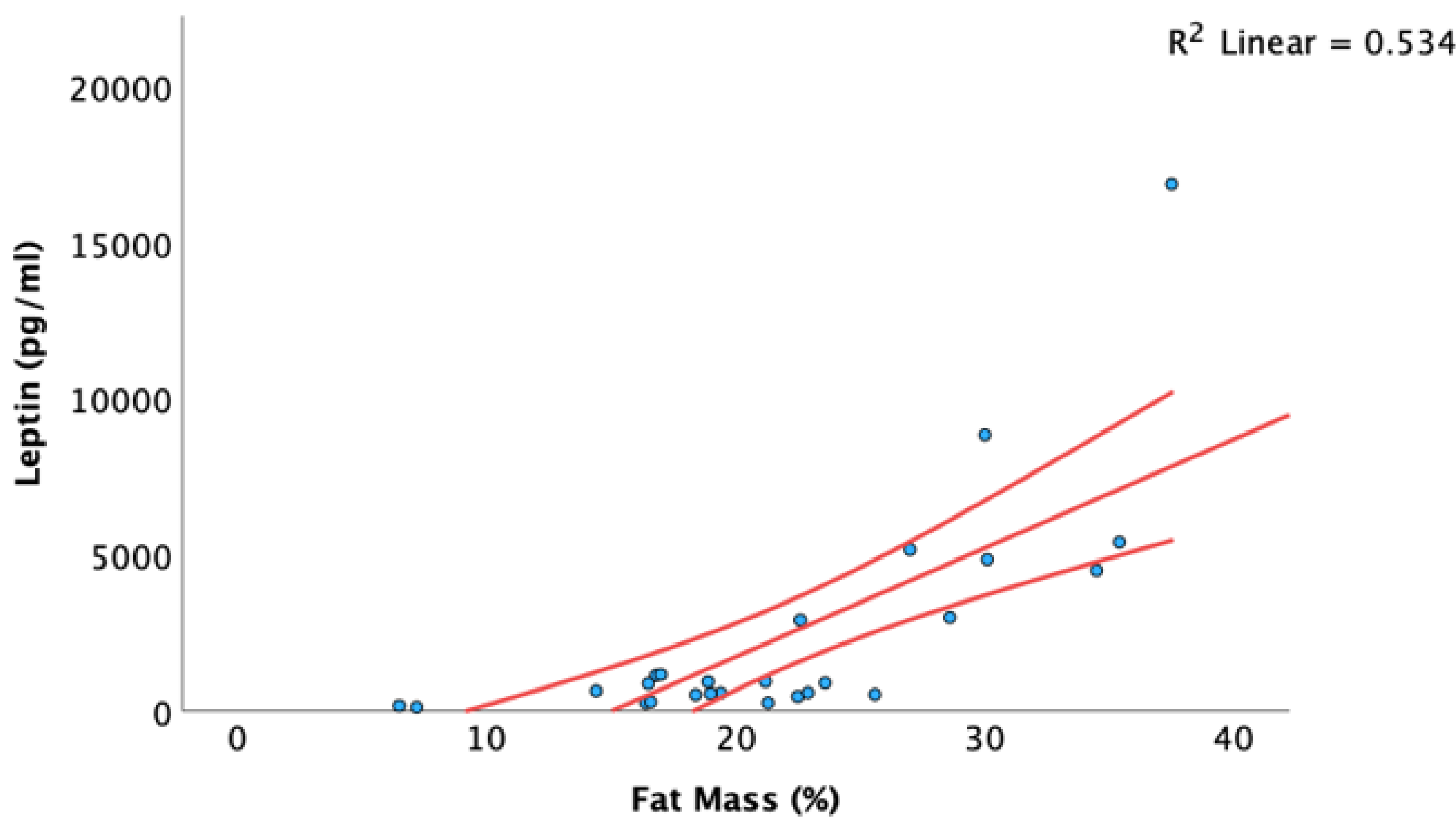


Figure 1: Relationship Between Percentage Fat Mass (%FM) and Leptin Concentration in Female Participants (n=26, p=.055).

Emerging Trends in Female Cohort

In the Moderate/Optimal EA Group:

- BMI was significantly lower ($p = 0.01$).
- Higher leptin concentrations ($\beta = .280$, $p = .055$).
- Lower PYY concentrations ($\beta = -.354$, $p = .084$).

Male Cohort

- Using a LEA threshold of 20 kcal·kg⁻¹ FFM·day⁻¹, there was no association between LEA and appetite hormones.

Conclusion

- EA was not associated with fasting appetite-related hormones.
- Body composition was associated with fasting ghrelin and leptin concentrations.
- Appetite-related hormones do not appear to respond to LEA by stimulating appetite and increasing EI, highlighting the need for careful dietary planning to meet nutritional goals in athletes.

References

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- Taguchi M, Manore MM. Reexamining the calculations of exercise energy expenditure in the energy availability equation of free-living athletes. *Front Sports Act Living*. 2022;4:885631.