

Cardiopulmonary exercise testing, body composition and metabolic status after allogeneic hematopoietic stem cell transplantation in childhood

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KEY MESSAGES

- ✓ An unfavorable metabolic profile after alloHSCT is associated with low physical fitness
- ✓ Emphasis on a healthy, active lifestyle remains important long after alloHSCT

INTRODUCTION

Well-known long-term complications of alloHSCT in childhood include endocrine system damage and secondary malignancies. In addition, survivors of childhood alloHSCT are at risk of cardiovascular (CV) and metabolic disturbances.

OBJECTIVES

Cross-sectional investigation of exercise performance by cardiopulmonary exercise testing (CPET) and metabolic parameters in boys and girls, who underwent alloHSCT for a hematological malignancy in childhood, in comparison to healthy peers.

METHODS

Cardiopulmonary exercise testing: Maximal oxygen consumption (VO₂peak), maximal load (PPeak), exercise duration (time), VE/VCO₂ slope, oxygen uptake efficiency slope (OUES) ventilatory anaerobic threshold (VAT)

DXA: Whole body fat and lean mass

Hormones: leptin/adiponectin ratio (L/A ratio), homeostatic model assessment for insulin resistance (HOMA-IR)

Participants

Inclusion criteria:

- Boys and girls of 15 to 25 years
- AlloHSCT: ≥2-year interval since alloHSCT

Cases:

- AlloHSCT: n=21 (10 males, 11 females)
- Controls: n=21 (11 males, 10 females)

Diagnosis and treatment:

- Age at alloHSCT: 9.2±4.91 years.
- Diagnosis:
 - Acute lymphoblastic leukemia: n=15
 - Acute & chronic myeloid leukemia: n=2 & n=2
 - Anaplastic large cell lymphoma and myelodysplastic syndrome: n=1 & n=1
- Myeloablative conditioning regimens:
 - Total body irradiation based (1200 cGy): n=14
 - Busulfan based: n=7
 - +Cyclophosphamide (≥ 120 mg/kg): n=10
- Acute GvHD (grade II to IV): n=8
- Chronic GvHD: n=1

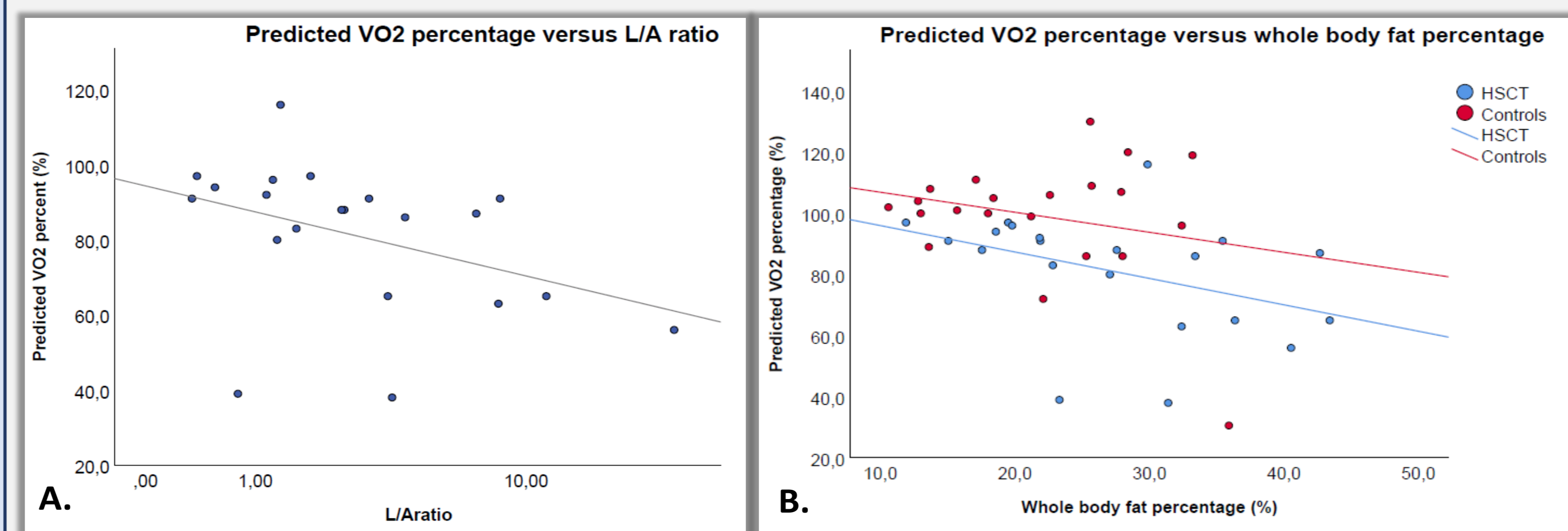
RESULTS

Characteristics	Patients		Controls	
	Males	Females	Males	Females
Age at evaluation (y)	19 ± 3	20 ± 3	20 ± 3	20 ± 3
Interval (y)	9.3 ± 5.06	12.5 ± 3.56	NA	NA
Height (cm)	170.2 ± 6.72	164.9 ± 4.67	171.9 ± 5.05	165.8 ± 5.3
BMI (kg/m ²)	20.0 ± 2.37	22.3 ± 3.72	21.3 ± 2.71	22.3 ± 3.10
BSA (m ²)	1.61 ± 0.14	1.64 ± 0.15	1.68 ± 0.13	1.66 ± 0.13

BSA: body surface area; BMI: body mass index

Metabolic parameters	HSCT	Controls	p-value
L/A ratio	4.24 ± 5.91	1.55 ± 1.22	p=0.043
HOMA-IR	2.63 ± 1.69	1.78 ± 0.46	p=0.037
Whole body fat mass(kg)	16.36 ± 7.29	14.21 ± 5.50	p<0.006
Whole body total mass(kg)	59.60 ± 9.17	63.03 ± 9.41	NS
Whole body lean mass (kg)	41.27 ± 9.43	46.66 ± 6.43	p=0.016

L/A ratio and whole body fat percentage were negatively correlated with predicted VO₂ percentage
No correlation was seen with HOMA-IR



Figures: A. Predicted VO₂ percentage versus L/A ratio. B. Predicted VO₂ percentage versus whole body fat percentage.

Exercise test results	HSCT	Controls	p-value
Heartrate rest (bpm)	98.6 ± 13.9	89.6 ± 13.9	0.045
VO ₂ rest/kg (ml/kg/min)	6.4 ± 1.9	6.3 ± 1.9	NS
VO₂max/kg (ml/kg/min)	32.7 ± 9	38.8 ± 6	0.032
VO ₂ max% (%)	81.1 ± 19.7	99.1 ± 20.2	0.006
Heartrate max (bpm)	183.6 ± 9.8	187.8 ± 19.6	NS
Time (min)	9.0 ± 2.5	13.1 ± 2.8	<0.001
Load (Watt)	125.3 ± 44.7	195.9 ± 57.2	<0.001
Load% (%)	82.5 ± 47.3	112.6 ± 34.6	0.024
VE/VCO ₂ slope	26.9 ± 4.6	24.6 ± 2.5	NS
OUES	1939 ± 503	2489 ± 509	0.001
RER	1.14 ± 0.05	1.21 ± 0.07	0.009
VE (l/min)	61.1 ± 17.6	87.1 ± 23.1	0.002
VAT (%)	66.9 ± 17.4	50.2 ± 9.2	0.001

HR: hearth rate; bpm beats per minute; VO₂max: maximal oxygen consumption at peak exercise; VAT: ventilatory anaerobic treshold; RER: respiratory exchange ratio; VE: minute ventilation; VE/VCO₂: minute ventilation divided by CO₂ production; OUES: Oxygen Uptake Efficiency slope

CONCLUSIONS

Adolescents and young adults after HSCT have lower maximal exercise performance and a less favorable metabolic profile in comparison with healthy controls. Leptin/adiponectin ratio and whole body fat percentage are negatively correlated with physical fitness, stressing the importance of healthy lifestyle promotion and physical rehabilitation in this patient population.