Training induced cardio-respiratory fitness and body composition changes in adults with type 1 diabetes versus healthy controls.

Scoubeau C[1,3], Klass M[2,3] Faoro V[1]

[1]Cardio-Pulmonary Exercise Laboratory, FSM, ULB; [2]Laboratory of Applied Biology, FSM, ULB, [3]Research unit in Biometry and exercise nutrition, FSM, ULB

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Introduction

It is well established that exercise plays a key role in the management of diabetes and helps to reduce comorbidities (1). Lower cardio-respiratory fitness in adults with type 1 diabetes (T1D) have previously been described when compared to healthy subjects (2). However, it is not clear if training induced changes are similar between T1D and healthy subjects.

Aim of the study

The aim of the study is to assess if the same training protocol induces similar improvements in adults with T1D and healthy control.

Methods

Ten adults with T1D (7 female; 43 ± 13 years old) and ten healthy matched volunteers (7 female; 43 ± 13 years old) took part in a 12-weeks, 3 times weekly, self-managed exercise program performed in an easily accessible gym. Cardiopulmonary exercise testing (CPET) and body composition assessment with dual-energy x-ray absorptiometry were repeated before and after the intervention. Characteristics at baseline are presented in table 1.

The training program (fig.1) consisted of a combination of high intensity interval training (HIIT) on a stationary bike and strength training. HIIT was composed of 8 bouts of 2 minutes pedaling at 90% of maximal heart rate interspaced with 2 minutes of active rest. The strength part was composed of 4 exercises focusing on the main muscle groups, with 3 sets of 10 repetitions per exercise. After a first supervised training session, participants pursued the program in a self-managed manner. The training sessions and heart rate were recorded using a physical activity tracker.
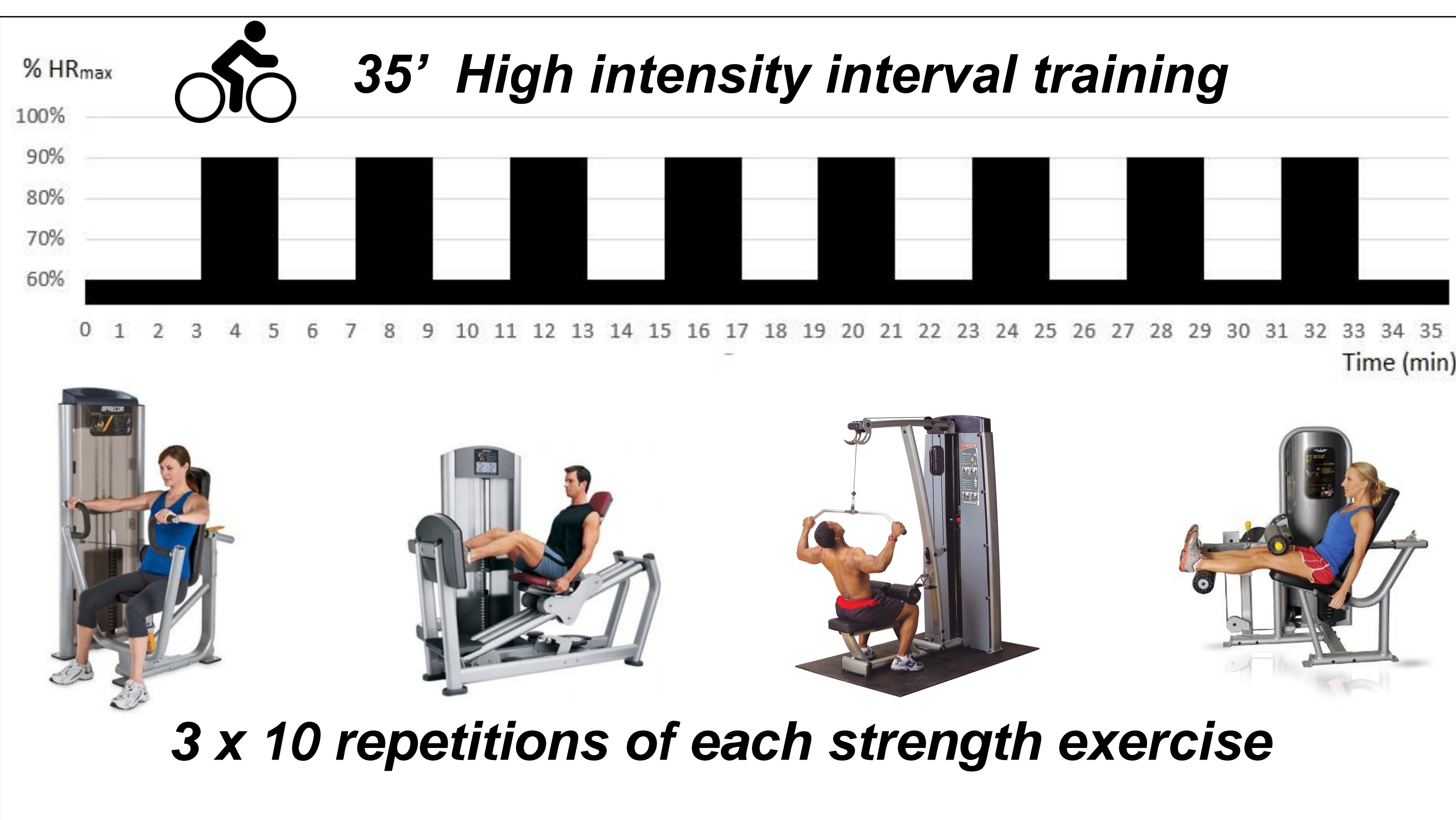

35' High intensity interval training

3 x 10 repetitions of each strength exercise

Figure 1. Training protocol

References
1, Codella, R., et al (2017). Acta Diabetologica, 54(7), 615 630.
2, Eckstein et al, *Diabetes Care*, 44(1):240-247 2021

Table 1. Participants' characteristics at baseline *(mean ± standard deviation)*

	T1D (n=10)	Healthy (n=10)
Age (years)	43 ±13	43 ±13
Height (cm)	169 ± 7	170 ±8
Weight (kg)	76,2±13,5	71,0 ±14,9
HbA1c (%)	8,1±2,3	5,2 ±0,3

(T1D: adults with type 1 diabetes; HbA1c: Glycated hemoglobin)

Results

Results from the ANOVA analysis are presented in table 2. A significant effect of time ($p<0.01$) was observed for lean mass, VO_2peak, Wmax, O_2 pulse and ventilatory threshold. A significant effect for group indicate that adults with T1D had significantly higher $EqCO_2$ at ventilatory threshold. No Time x Group interaction were found for any of the parameters.

Table 2. Mixed model ANOVA for body composition and cardio-respiratory fitness *(mean ± standard deviation)*

	T1D (n=10)		Healthy (n=10)		Time	Group	Time x Group
	Pre	Post	Pre	Post			
BMI (kg/m²)	26.9±5.0	27.5±6.0	24.4±2.8	24.4±2.8	0,30	0,16	0,26
Fat mass (kg)	26.5±10.5	26.3±10.5	24.2±6.0	23.1±6.5	0,12	0,48	0,29
Lean mass (kg)	47.3±7.1	48,0±7.4	44.3±11.2	44.9±10.9	**0,03**	0,48	0,83
HRmax (bpm)	166±13	165±13	177±17	175±14	0,71	0,11	0,98
VO$_2$peak (L/min)	2.06±0.71	2.23±0.60	2.14±0.67	2.32±0.68	**<0,001**	0,78	0,97
VO$_2$max (mL/min/kg)	27.2±8.3	29.7±8.1	30.1±6.8	32.7±7.1	**<0,01**	0,39	0,95
Wmax (W)	159±56	178±54	183±58	198±57	**<0,001**	0,39	0,60
O$_2$ pulse (ml/beat)	12.9±3.2	14.0±2.9	12.4±4.2	13.4±4.3	**<0,01**	0,71	0,90
VT1 (L/min)	1.17±0.37	1.39±0.42	1.26±0.43	1.61±0.53	**<0,001**	0,43	0,18
VT1 (%VO$_2$max)	59±11	62±10	59±10	69±5	**<0,01**	0,37	0,17
EqCO$_2$ @ VT1	32.9±6.3	32.3±5.2	27.9±2.8	28.4±3.3	0,95	**0,04**	0,26

(BMI: Body mass index; VT1: first ventilatory threshold; HRmax: maximal heart rate; Wmax: Maximal output; EqCO2: ventilatory equivalent for CO_2)

Conclusion

In a context of controlled T1D glycemia, a 12 weeks of self-managed combined training (aerobic and resistance) intervention is effective in improving cardio-respiratory fitness and lean mass. Similar training-induced improvements were observed in adults with T1D and healthy controls, suggesting minimal influence of T1D in body composition and cardio-respiratory fitness training responses

Acknowledgements