Oral carbohydrate demand during endurance exercise is depending on pre-exercise blood glucose concentration in people with type 1 diabetes: a randomized cross-over trial

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Introduction

- Beneficial effects of exercise are well described in individuals with type 1 diabetes (T1D) [1,2]
- Yet, it is unclear what the required amount of orally administered carbohydrates is to maintain euglycemia during endurance exercise in individuals with T1D [3]

Aim

- To investigate the impact of moderate-intensity exercise and pre-exercise blood glucose concentrations (BG) on the demand of orally administered carbohydrates (CHO) to maintain euglycemia (71 - 180 mg/dL) during endurance exercise sessions performed over 5 consecutive days on either a regular (100%) or reduced dose (75%) of insulin Degludec (IDeg) in people with T1D

Methods

- Four female and five male participants were included in this study

	Individuals with T1D
BMI (kg/m^2)	25.5 ± 3.9
Age (years)	32.1 ± 9
HbA_{1c} (%(mmol/mol))	7.2 (55) ± 0.7 (7)
Diabetes Duration (years)	19 ± 11

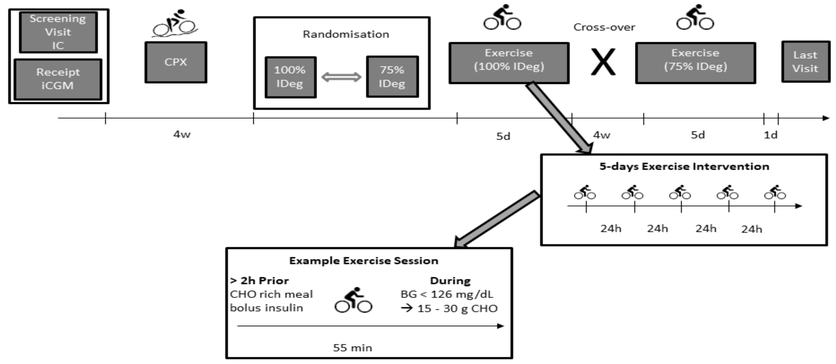

Fig. 1: *Study flow chart: iCGM = intermittently-viewed continuous glucose monitoring system, CPX = peak cardio-pulmonary exercise test, IDeg = insulin Degludec, CHO = carbohydrates, BG = blood glucose.*

- Participants were randomized to cycle for 55 minutes at moderate intensity [4] (63 ± 7% VO_{2max}) for 5 consecutive days on either 100% or 75% of their regular IDeg dose
- Exercise accumulating effect was analysed via one-way-ANOVA for repeated measures (day x administered CHO)
- Influence of pre-exercise BG was analysed by one-way ANOVA or Kruskal-Wallis stratified for BG quartiles and Spearman correlation
- The effect of IDeg dose (100% vs. 75%) on given CHO was calculated via Wilcoxon or student's t-test ($p < 0.05$)

Results

Tab. 1: *Pre-exercise blood glucose quartiles based on median, 25th and 75th percentile with concomitant carbohydrate consumption*

n=90 exercise sessions in 9 people		75% IDeg	100% IDeg	p-value
Pre-exercise BG (mg/dL)		177 ± 14	173 ± 10	0.66
Post-exercise BG (mg/dL)		105 [91 – 136]	120 [101 – 129]	0.57
Daily CHO during exercise per participant (g)		36 [9 – 62]	36 [9 – 66]	0.78
Quartiles				
		Min	**25**	**75**	**Max**	**p-value**
75% IDeg	BG (mmol/L)	6.7 ± 0.7 †	8.4 ± 0.6	10.5 ± 0.5	13.9 ± 2.6 †	0.03
	BG (mg/dL)	120 ± 13	150 ± 11	189 ± 9	250 ± 46	
	CHO (g)	54 [18 – 73]	44 [33 – 72]	36 [18 – 54]	0 [0 – 18]	
100% IDeg	BG (mmol/L)	7.3 ± 0.8 *	8.7 ± 0.3	10.2 ± 0.5 *	12.4 ± 1.7	0.03
	BG (mg/dL)	131 ± 15	156 ± 6	184 ± 10	223 ± 30	
	CHO (g)	62 ± 36	40 ± 30	22 ± 25	30 ± 35	

Conclusion

Our study elucidated the importance of orally administered CHO to maintain euglycemia during endurance exercise when pre-exercise bolus insulin was not reduced. The amount of orally administered CHO is linked to the pre-exercise blood glucose concentration and is not significantly different in comparison between a regular and 25% reduced basal insulin dose and no exercise accumulating effect was found. No clinically relevant hypoglycemia (<3.0 mmol/L; 54 mg/dL) occurred in 90 exercise sessions when CHO were administered at a blood glucose concentration of 7 mmol/L (126 mg/dL).

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