Effects of interrupting daily sedentary behavior on children's glucose metabolism: A 6-day randomized controlled trial

Online Supplemental Material

eTable_1: Results from unadjusted mixed model for predicting change in primary outcome (insulin mIU/dL) over time (N=89)

eTable_2: Results from unadjusted and covariate-adjusted mixed models for three-way interaction for predicting change in primary outcome of insulin (mIU/dL) over time by experimental condition and weight status (N=89)

eTable_3: Results from six separate mixed models predicting change in analyte concentrations over time by experimental condition (N=93)

eTable_4: Results from five separate mixed models for three-way interaction for predicting change in secondary outcome analyte concentrations over time by experimental condition and weight status (Healthy weight vs overweight/obese 'OV/OB'; N=93)

eFigure_1: Demonstrative continuous data monitoring of a participant executing each of the conditions SIT (completely sedentary behavior for 3h) and SIT+WALK (sedentary behavior interrupted with 3 min of moderate exertion walking on a treadmill every 30 minutes over 3h)

eFigure_2: Oral glucose tolerance test results (free fatty acids, cortisol, triglycerides) by condition

eTable_1. Results from unadjusted mixed model for predicting change in primary outcome (insulin) over time (N=89)

	Insulin (mIU/dL)			
Variable	Estimate	SE	F value*	P value
Intercept	1.09	0.05	22.62	**<.001**
Fasting concentration	0.03	0.00	135.14	**<.001**
Time (ref=180 min)			135.14	**<.001**
Condition (ref=SIT)	-0.07	0.05	1.58	.210
Time*Condition			1.32	.247
0 min	-0.01	0.05	-0.27	.785
30 min	0.06	0.05	1.15	.250
60 min	0.05	0.05	1.01	.314
90 min	0.13	0.05	2.40	**.017**
120 min	0.03	0.05	0.61	.545
150 min	-0.01	0.05	-0.13	.897
180 min	0.07	0.05	1.24	.215

*t value for intercept (random effect)

Unit conversation factors: Insulin mIU/ml*6.9=pmol/L

eTable_2. Results from unadjusted and covariate-adjusted mixed models for three-way interaction for predicting change in primary outcome of **insulin (mIU/dL)** over time by experimental condition and weight status (N=89)

	Unadjusted model				**Adjusted model***			
Variable	Estimate	SE	F value[†]	P value	Estimate	SE	F value[†]	P value
Intercept	1.09	0.06	19.02	**<.001**	0.82	0.16	5.13	**<.001**
Fasting concentration	0.03	0.00	88.16	**<.001**	0.02	0.00	47.94	**<.001**
Time (ref=180 min)			255.78	**<.001**			255.78	**<.001**
Condition (ref=SIT)	-0.12	0.07	1.84	.176			2.78	.096
OV/OB (ref=no)	0.06	0.08	3.01	.084	0.04	0.09	0.75	.386
Time*Condition			1.29	.260			1.29	.260
OV/OB*Condition			0.10	.751			0.07	.787
OV/OB*Time			0.72	.632			0.72	.632
OV/OB*Condition*Time			0.61	.719			0.61	.719

[**]Additionally adjusted for arcsine square root transformed percent fat, Tanner pubertal stage (ref=1)
[†]*t* value for intercept (random effect)
OV/OB Overweight/Obese per CDC pediatric age-based definition
Unit conversation factors: Insulin mIU/ml*6.9=pmol/L

eTable_3. Results from six separate mixed models predicting change in analyte concentrations over time by experimental condition (N=93)

	Insulin(mIU/mL)[*,†]				**C-Peptide**(ng/mL)[§]				**Glucose**(mg/dL) **(N=92)**			
Variable	Estimate	SE	F value[‡]	p value	Estimate	SE	F value[‡]	p value	Estimate	SE	F value[‡]	p value
Intercept	0.73	0.12	5.91	<.001	0.18	0.06	2.76	.007	1.88	0.07	26.28	<.001
Fasting concentration	0.02	0.00	51.58	<.001	0.14	0.02	83.42	<.001	0.00	0.00	2.48	.116
Time (ref=180 min)			259.35	<.001			395.70	<.001			129.92	<.001
Condition (ref=SIT)	-0.08	0.05	2.87	.091	-0.02	0.03	1.61	.206	-0.01	0.02	0.27	.603
Time*Condition			1.32	.247			0.90	.496			1.28	.263
0 min	-0.00	0.05	-0.06	.953	0.00	0.03	0.02	.984	-0.00	0.02	-0.04	.964
30 min	0.07	0.05	1.41	.159	0.04	0.03	1.30	.194	0.01	0.02	0.83	.405
60 min	0.07	0.05	1.26	.207	0.03	0.03	1.15	.252	0.01	0.02	0.46	.684
90 min	0.14	0.05	2.70	.007	0.06	0.03	2.04	.042	0.03	0.02	1.60	.111
120 min	0.04	0.05	0.85	.397	0.03	0.03	0.90	.367	0.00	0.02	0.01	.995
150 min	0.00	0.05	0.09	.930	-0.01	0.03	-0.22	.825	-0.02	0.02	-1.48	.139
180 min	0.08	0.05	1.51	.133	0.00	0.02	0.62	.538	0.01	0.02	0.85	.398
	Free Fatty Acids(mmol/L)[§]				**Triglycerides**(mg/dL)[*]				**Cortisol**(ug/dL)[‖]			
Variable	Estimate	SE	F value[ǂ]	p value	Estimate	SE	F value[‡]	p value	Estimate	SE	F value[‡]	p value
Intercept	-1.57	0.09	-17.34	<.001	1.06	0.05	20.66	<.001	1.08	0.14	7.55	<.001
Fasting concentration	0.27	0.06	23.67	<.001	0.01	0.00	529.87	<.001	0.01	0.00	27.19	<.001
Time (ref=0 min)			566.14	<.001			133.73	<.001			25.49	<.001
Condition (ref=SIT)	-0.01	0.04	0.03	.856	0.02	0.02	1.78	.183	-0.02	0.03	0.16	.689
Time*Condition			1.45	.194			0.41	.873			0.25	.961
0 min	0.01	0.04	0.16	.874	-0.01	0.02	-0.37	.711	-0.02	0.03	-0.59	.554
30 min	0.07	0.04	1.88	.061	-0.02	0.02	-1.40	.300	-0.01	0.03	-0.35	.729
60 min	-0.01	0.04	-0.27	.784	-0.03	0.02	-1.40	.162	-0.02	0.03	-0.57	.567
90 min	-0.03	0.04	-1.08	.280	-0.02	0.02	-1.29	.197	0.00	0.03	0.05	.957
120 min	-0.04	0.04	0.72	.470	-0.02	0.02	-1.29	.196	0.01	0.03	0.17	.864
150 min	0.03	0.04	0.72	.470	-0.02	0.02	-1.30	.195	-0.02	0.03	-0.65	.517
180 min	0.01	0.04	0.23	.821	-0.02	0.02	-1.30	.194	0.02	0.03	0.57	.567

[*]Additionally adjusted for arcsine square root transformed percent fat, Tanner pubertal stage (ref=1)

[†] N=89 due to missing data

[ǂ] *t* value for intercept and time*condition interactions (random effects)

[§]Additionally adjusted for arcsine square root transformed percent fat

‖Additionally adjusted for age (yr) and OGTT start time
Unit conversation factors: Insulin mIU/ml*6.9=pmol/L; C-peptide ng/ml*0.33=nmol/L; Glucose mg/dL*0.055=mmol/L; FFA mg/dL*.035=mmol/L; Triglycerides mg/dL*.011=mmol/L; Cortisol ug/dL*27.6=nmol/L

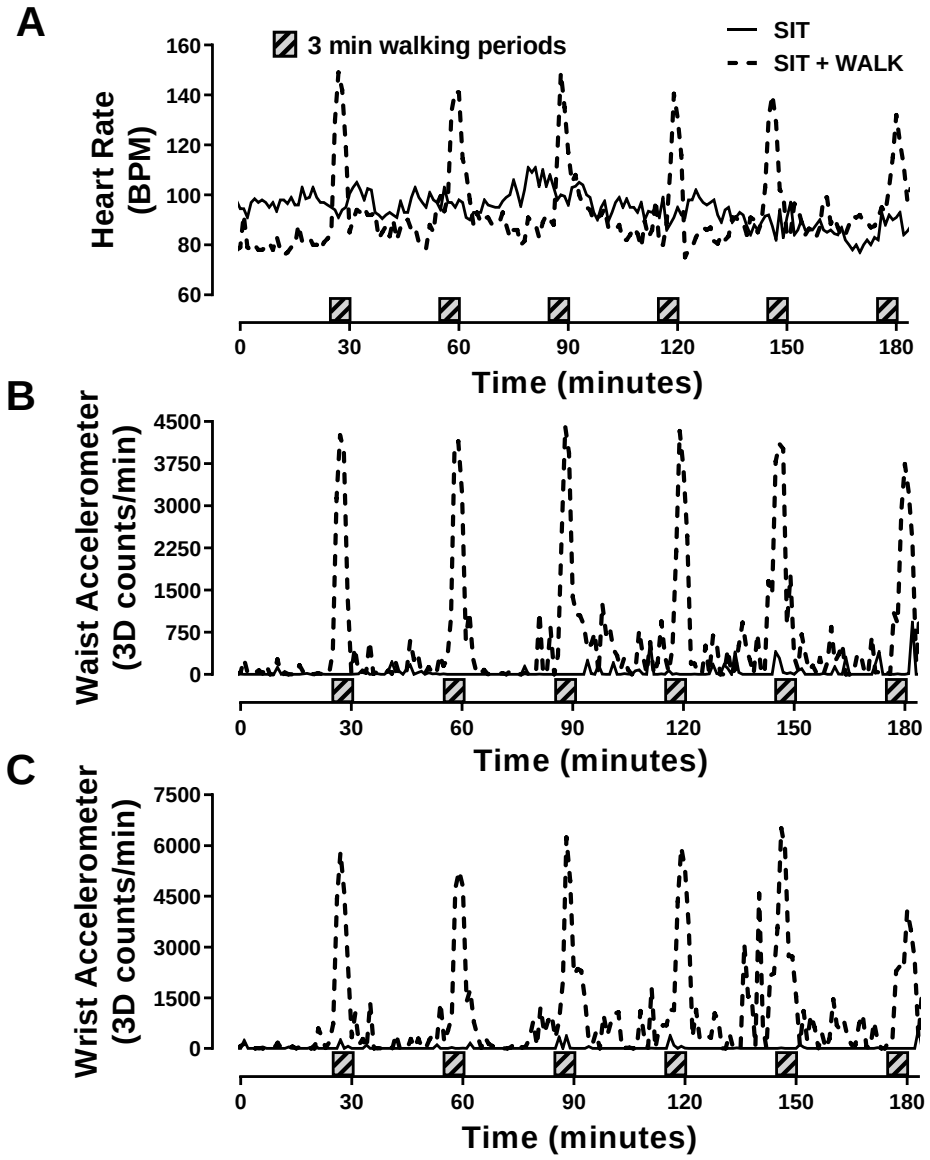
eTable_4. Results from five separate mixed models for three-way interaction for predicting change in secondary outcome analyte concentrations over time by experimental condition and weight status (Healthy weight vs overweight/obese 'OV/OB'; N=93)

	C-peptide (ng/mL)*				**Glucose (mg/dL) (N=92)**			
Variable	Estimate	SE	F value†	P value	Estimate	SE	F value†	P value
Intercept	0.19	0.09	2.15	**.034**	1.90	0.07	26.13	**<.001**
Fasting concentration	0.14	0.02	83.18	**<.001**	0.00	0.00	1.16	.248
Time (ref=180 min)			388.41	**<.001**			126.71	**<.001**
Condition (ref=SIT)	-0.05	0.04	1.30	.255	-0.03	0.02	0.13	.715
OV/OB (ref=no)	-0.01	0.05	0.00	.946	0.02	0.02	1.61	.205
Time*Condition			0.86	.524			1.30	.258
OV/OB*Condition			1.21	.273			2.38	.124
OV/OB*Time			1.14	.340			1.24	.282
OV/OB*Condition*Time			0.44	.851			0.35	.911
	Free Fatty Acids (mmol/L)*				**Triglycerides** (mg/dL) ‡			
Variable	Estimate	SE	F value†	P value	Estimate	SE	F value†	P value
Intercept	-1.62	0.12	-13.21	**<.001**	1.06	0.07	14.72	**<.001**
Fasting concentration	0.29	0.06	26.90	**<.001**	0.01	0.00	506.22	**<.001**
Time (ref=180 min)			567.92	**<.001**			145.12	**<.001**
Condition (ref=SIT)	0.11	0.05	0.16	.692	0.03	0.02	1.79	.181
OV/OB (ref=no)	0.08	0.07	0.01	.927	0.07	0.04	0.28	.594
Time*Condition			1.50	.178			0.46	.841
OV/OB*Condition			4.69	**.031**			0.11	.744
OV/OB*Time			1.34	.237			16.22	**<.001**
OV/OB*Condition*Time			2.07	**.055**			0.36	.902
	Cortisol (ug/dL)§ **(N=92)**							
Variable	Estimate	SE	F value†	P value				
Intercept	1.05	0.14	7.33	**<.001**				
Fasting concentration	0.01	0.00	31.90	**<.001**				
Time (ref=180 min)			25.66	**<.001**				
Condition (ref=SIT)	-0.00	0.04	0.28	.600				
OV/OB (ref=no)	-0.02	0.05	5.18	.023				
Time*Condition			0.26	.954				
OV/OB*Condition			0.63	.429				
OV/OB*Time			1.78	.101				
OV/OB*Condition*Time			0.69	.656				

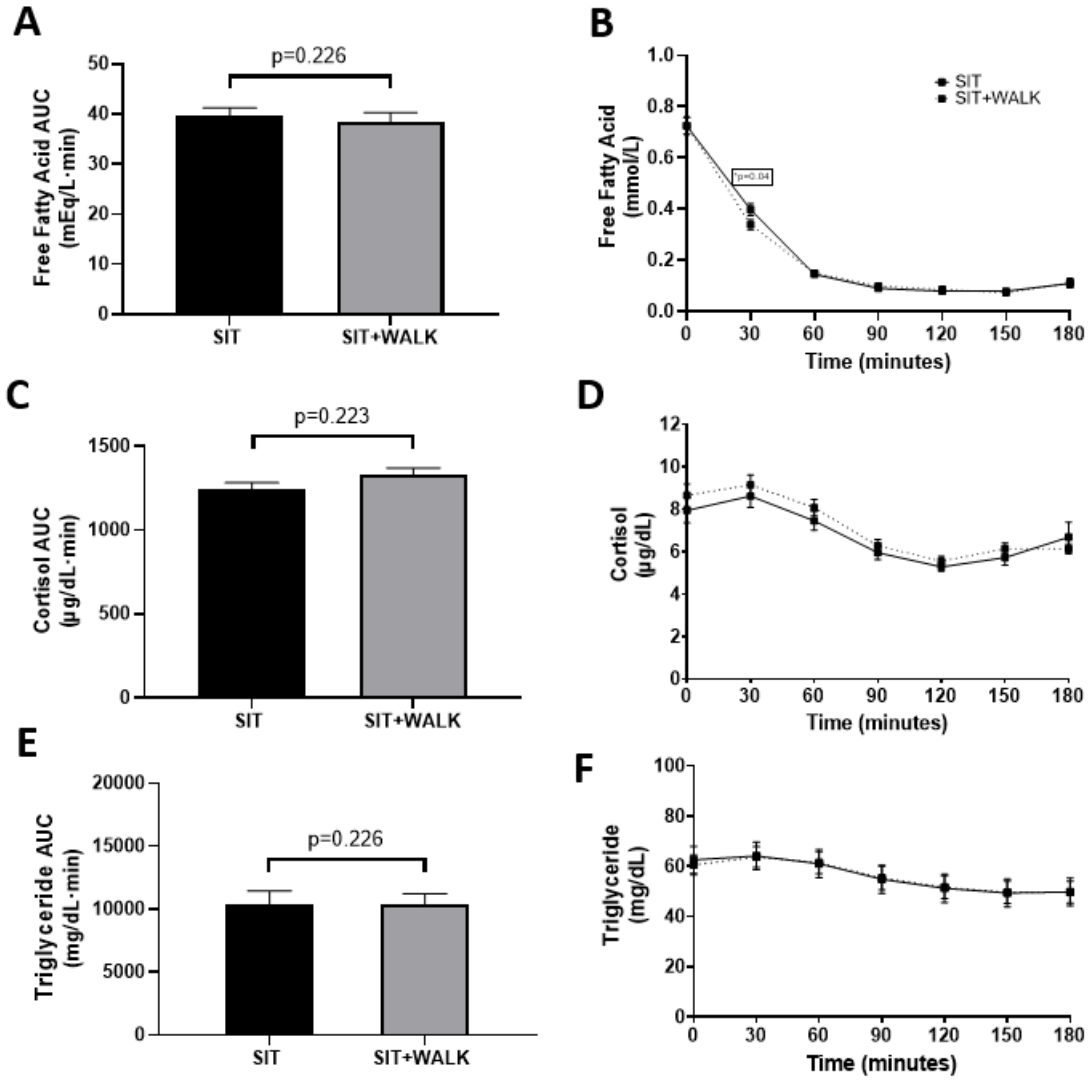
*Additionally adjusted for arcsine square root transformed percent fat
†*t* value for intercept (random effect)
‡Additionally adjusted for arcsine square root transformed percent fat, Tanner pubertal stage (ref=1)
§Additionally adjusted for age (yr) and OGTT start time
OV/OB Overweight/Obese per CDC pediatric age-based definition

Unit conversation factors: C-peptide ng/ml*0.33=nmol/L; Glucose mg/dL*0.055=mmol/L; FFA mg/dL*.035=mmol/L; Triglycerides mg/dL*.011=mmol/L; Cortisol ug/dL*27.6=nmol/L

eFirgure_1. Demonstrative continuous data monitoring of individual participants executing the conditions SIT (completely sedentary behavior for 3h) and SIT+WALK (sedentary behavior interrupted with 3 min of moderate intensity walking on a treadmill every 30 minutes over 3h).



eFigure_2. Oral glucose tolerance test results (free fatty acids, cortisol, triglycerides) by condition.



The effect of sitting interrupted with 3 min of moderate-intensity walking every half hour (SIT + WALK; grey bar/dotted line) vs. uninterrupted sitting (SIT; black bar/solid line) on hormones and analytes: (A), 3h serum FFA AUC (B) FFA linear trend, (C), 3h serum cortisol AUC (D), cortisol linear trend, (E), 3h serum triglycerides AUC and (F) triglyceride linear trend. Unadjusted mean SE are shown in A, C, E.

AUC p-values are results of ANOVA comparing log-transformed analytes adjusted for: fat mass (% percentage arcsine sqrt transformed), pubertal stage (pre, early, or late), and basal analyte log transformed.

Linear trend p-values all >0.05 for time*condition effect in mixed models adjusted for fat mass (% percentage arcsine sqrt transformed), pubertal stage (pre, early, or late), and basal analyte log transformed.