Objectively measured physical activity and sedentary behaviour in obese adolescents, and their relationship with fatness and metabolic outcomes

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Background

- The obesity epidemic in children and young people is a leading public health priority in the UK,[1] with 20% of 11-15 year olds in England being obese.[2]
- Insufficient physical activity (PA) and excessive sedentary behaviour (SB) are linked with increased fatness and risk for chronic diseases such as diabetes. [3]
- Adolescence is a critical stage for the development of body composition profiles and chronic disease risk, [4] and also a period when individuals become increasingly inactive. [3]
- In the UK, little is known on the objectively measured PA and SB levels of obese adolescents (already at higher risk for chronic diseases due to their increased adiposity), or their relationship with fatness and cardio-metabolic indicators.
- **The aims of this study were to :**
  1) **describe the PA and SB levels of obese adolescents;**
  2) **investigate the association of SB and moderate-to-vigorous PA (MVPA) with adolescent's fatness and cardio-metabolic indicators.**

help
Healthy Eating and Lifestyle Programme

Methods

- HELP is a randomized controlled trial of a complex lifestyle intervention for obese adolescents (BMI≥95th centile of UK 1990 reference;[5] age: 12-19 years) recruited from the community (London, UK), involving motivational interviewing and other psychological elements. Baseline measures were used in this study.
- Total, low- (LDL) and high-density lipoprotein cholesterol (HDL), triglycerides, insulin and glucose were obtained from fasting blood samples. Height, weight, waist circumference, and fat mass (4-limb bio-impedance) were measured by trained staff. Body mass index (BMI) was calculated (kg/m^2) and z-scores derived using the UK 1990 reference[5], and fat mas index (FMI) was derived.[6]
- ActiGraph accelerometers (15-sec epochs) assessed PA/SB. Time in SB, light and MVPA was derived with Evenson et al's[7] cut-points, and participants were included for analyses if providing ≥3 valid days (≥10hours wear-time).
- Normality of data was checked with the Shapiro-Wilk test, and sex differences were assessed with Chi-square or t-tests/Mann-Whitney U tests.
- Univariable (adjusted for wear-time) and multivariable linear regression models were used to investigate the association of MVPA and SB with fatness and cardio-metabolic indicators. Wear-time was excluded from multivariable analyses due to colinearity issues (VIF >6.0; correlations with MVPA/SB >0.6).

Results

- Of the 174 adolescents assessed at baseline, 102 provided complete data for accelerometry, fatness and metabolic indicators, and were included for analysis.
- Included participants were not significantly different from those excluded, except for insulin (median: 11.1 vs. 15.7 mmol/L respectively) and glucose levels (mean: 4.4 vs. 4.6 mmol/L respectively; both p<0.01).
- Participants had a mean age of 15.2 years (±2.1), with the majority being girls (65%) and of white British (37%) or black Caribbean (35%) ethnicity. Table 1 describes the fatness and metabolic profiles of the included sample.

Table 1 – Participants' fatness and metabolic characteristics.

BMI z-score	**BMI centile**	**Waist circumf.** (cm)	**Fat free mass** (kg)
2.9 (SD: 0.5)	99.8 (IQR: 99.3 - 99.9)	100.5 (SD: 11.5)	51.3 (SD: 10.3)
Fat mass (kg)	**Fat mass index** (kg/m2)	**Glucose** (mmol/L)	**Insulin** (mmol/L)
38.7 (SD: 10.9)	14.2 (SD: 4.0)	4.4 (SD: 0.4)	11.1 (IQR: 5.5 - 17.3)
Triglyceride (mmol/L)	**Total cholesterol** (mmol/L)	**HDL cholesterol** (mmol/L)	**LDL cholesterol** (mmol/L)
1.0 (IQR: 0.7 - 1.3)	4.3 (SD: 0.9)	1.1 (IQR: 1.0 - 1.3)	2.7 (SD: 0.8)

Note: Data represents Mean (Standard deviation (SD)), or Median (Inter-quartile range (IQR))

- Participants spent most of their day in SB (median: 73.2%; IQR: 69.1%, 76.3%), and only a small amount of time in MVPA (median: 4.1%; IQR: 3.0%, 5.4%).
- Boys did more daily MVPA than girls (p=0.004), and were more likely to meet national PA guidelines (24.3% vs. 9.2%; p=0.04).

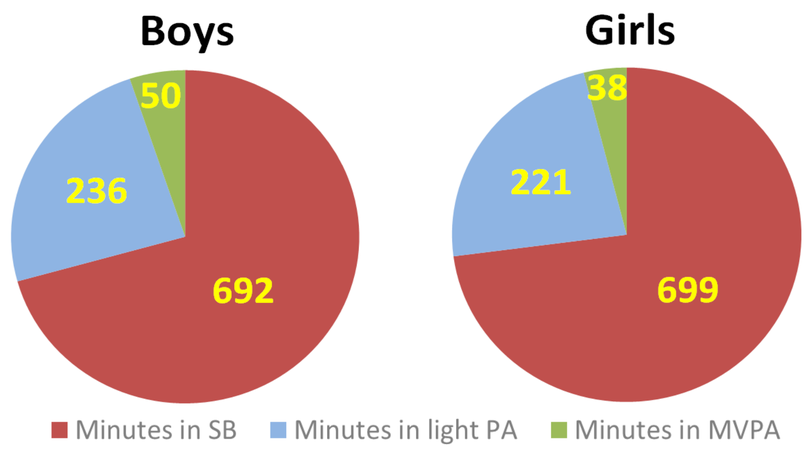

Fig. 1 – Daily time in sedentary behaviour, light and moderate-to-vigorous physical activity (by sex)

- Univariable models: **MVPA** associated with **FMI** (B= -0.05), **FM** (B= -0.11), and **FFM** (B= 0.14; all p<0.05); and **SB** associated with **insulin** (B= -0.02; p=0.02).
- In multivariable models including MVPA and SB (adjusted for age and sex), **only MVPA remained significantly associated with FMI and FFM** (see table 2):

Table 2 – Multivariable regression analysis results (significant coefficients are in bold).

	MVPA		**Sedentary behaviour**	
BMI z-score	0.000	(95% CI: -0.006 to 0.006)	0.000	(95% CI: -0.001 to 0.001)
BMI centile	0.001	(95% CI: -0.006 to 0.007)	0.000	(95% CI: -0.002 to 0.001)
Waist circumference	0.008	(95% CI: -0.120 to 0.137)	-0.019	(95% CI: -0.044 to 0.006)
Fat free mass	**0.131**	**(95% CI: 0.035 to 0.226)**	0.012	(96% CI: -0.006 to 0.030)
Fat mass	-0.104	(95% CI: -0.221 to 0.014)	-0.019	(95% CI: -0.041 to 0.004)
Fat mass index	**-0.044**	**(95% CI: -0.087 to -0.002)**	-0.007	(95% CI: -0.015 to 0.002)
Glucose	0.002	(95% CI: -0.002 to 0.007)	0.000	(95% CI: -0.001 to 0.001)
Insulin	0.034	(95% CI: -0.092 to 0.160)	-0.022	(95% CI: -0.046 to 0.002)
Triglycerides	-0.002	(95% CI: -0.010 to 0.005)	0.000	(95% CI: -0.002 to 0.001)
Total cholesterol	0.002	(95% CI: -0.008 to 0.013)	0.000	(95% CI: -0.002 to 0.002)
LDL cholesterol	0.003	(95% CI: -0.006 to 0.013)	0.000	(95% CI: -0.002 to 0.002)
HDL cholesterol	0.000	(95% CI: -0.003 to 0.004)	0.000	(95% CI: -0.001 to 0.000)

Conclusions

- **Most adolescents did not meet current PA guidelines, and spent most of their day in SB.**
- **Although causality cannot be inferred, results highlight the importance of promoting MVPA to improve the body composition profiles of obese adolescents.**

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