

# Using Survey, Time-Diary and Accelerometer Data to Estimate Adolescent Moderate-to-Vigorous Physical Activity Levels Using Structural Equation Modelling

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## Introduction

Physical activity constitutes a major aspect of maintaining a healthy lifestyle in adolescents, however adolescents worldwide aged 11-17 appear to be rather inactive, with four-fifths failing to meet recommended physical activity levels (Guthold et al., 2020). Understanding which factors are associated with physical activity in adolescents would help targeting and designing interventions to support the achievement of guidelines in this age group, however some of these associations may differ depending on how physical activity has been measured (Dollman et al., 2009).

## Methods

The novelty of this work comes because we have combined three distinct measures of physical activity from the same population of adolescents to create a robust latent variable. We are using the Millennium Cohort Study (MCS), a UK-representative, longitudinal, multi-disciplinary study. At age 14, the MCS collected survey (SURV), time diary (TUD) and accelerometer (ACC) data, where the last two were collected on the same days (a weekday and a weekend day), allowing for direct comparison (UCL, 2023). Structural equation modelling (SEM) was used to examine the associations between these three distinct measures of moderate-to-vigorous physical activity (MVPA) combined to create a latent variable, and factors known to be associated: gender, ethnicity, parental MVPA, BMI, self-confidence, time spent on watching TV and social networking on weekdays, and (highest) parental education and family structure as control variables.

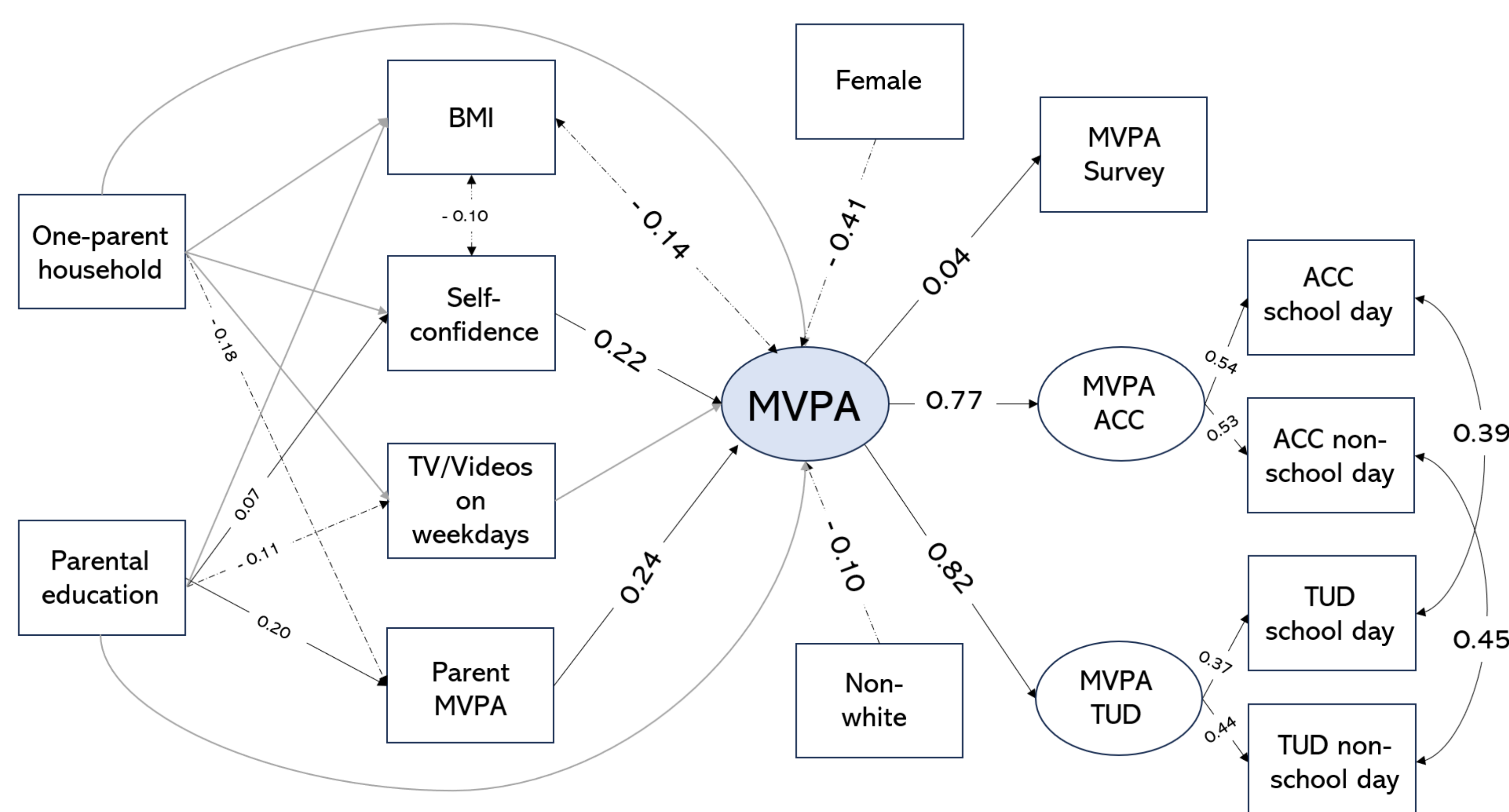
### Survey questionnaires (SURV) | Time diaries (TUD) | Accelerometers (ACC)

Survey question: On how many days in the last week did you do a total of at least an hour of moderate to vigorous physical activity?  
Every day | 5-6 days | 3-4 days | 1-2 days | Not at all

Time diaries were collected over a 24-hour period over a 10-day period, using an app, web or paper. The app employed a question-based approach, where the web and paper diaries a grid measurement approach recorded in 10-min. slots. 44 age-appropriate activity categories were used to describe their daily time-use. The following were used to construct the MVPA time-use variable: Cycling / Individual ball games and training (e.g., tennis, badminton) / Jogging, running, walking, hiking / Team ball games and training (e.g. football, hockey) / Swimming and other water sport / Other exercise and sports, dancing, keeping fit, skiing, gymnastics / Travel by physically active means (walk, bike etc.)

Accelerometers are objective tools used to measure movement in real time, which are reliable and accurate and generate data on duration and intensity of activities. The MCS used the GENEActiv Original which is triaxial, allowing movement to be recorded in three dimensions, offering higher data accuracy/quality. They are robust and waterproof. The variable used calculated the time spent in bouts (short periods of intense activity), where the participant spent more than 80% of 10 minutes in MVPA (Heywood, 2018): Mins in mod/vig: 5sec epoch, 80% bout criteria 100 ENMO 1min

## Results



### Notes:

Significant coefficients at 0.05 level are represented by black arrows (continuous line for positive coefficients, and dotted for negative), where are non-significant coefficients at 0.05 level by grey arrows.

Use of Maximum Likelihood (ML). Standardised coefficients are reported. Robustness checks: RMSA < 0.08 and CFI > 0.9, indicating acceptable goodness of fit.

Source: The UK Millennium Cohort Study Wave 6, N= 1837. Adjusted for complex survey design and non-response. Only cohort members who completed the survey and had good quality TUD (Reporting at least one episode of sleep and eating/drinking, more than 5 episode changes and no more than 90 minutes of missing data and ACC were included in the analyses.

Independent variables: Ethnicity (White/Other), Sex (Male/Female), Parental MVPA (7 categories: Every day or almost every day to Less often or never, BMI (continuous), Self-confidence (Strongly disagree, Disagree, Agree, Strongly agree), TV/Video watching on weekdays (none to 7 or more hours), Family structure (Two-parent household/Lone-parent household), Parental education (highest if two available, None/NVQ1 /NVQ2 /NVQ3 /NVQ4 /NVQ5).

## Conclusion

All indicators made a substantial contribution to defining the MVPA latent variable, with most direct effects being significant. **Combining different measures of MVPA may help improve the identification of the factors associated with adolescent MVPA levels, and this can ultimately be used to plan more effectively physical activity interventions and promote MVPA in adolescents and children.**

## References

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