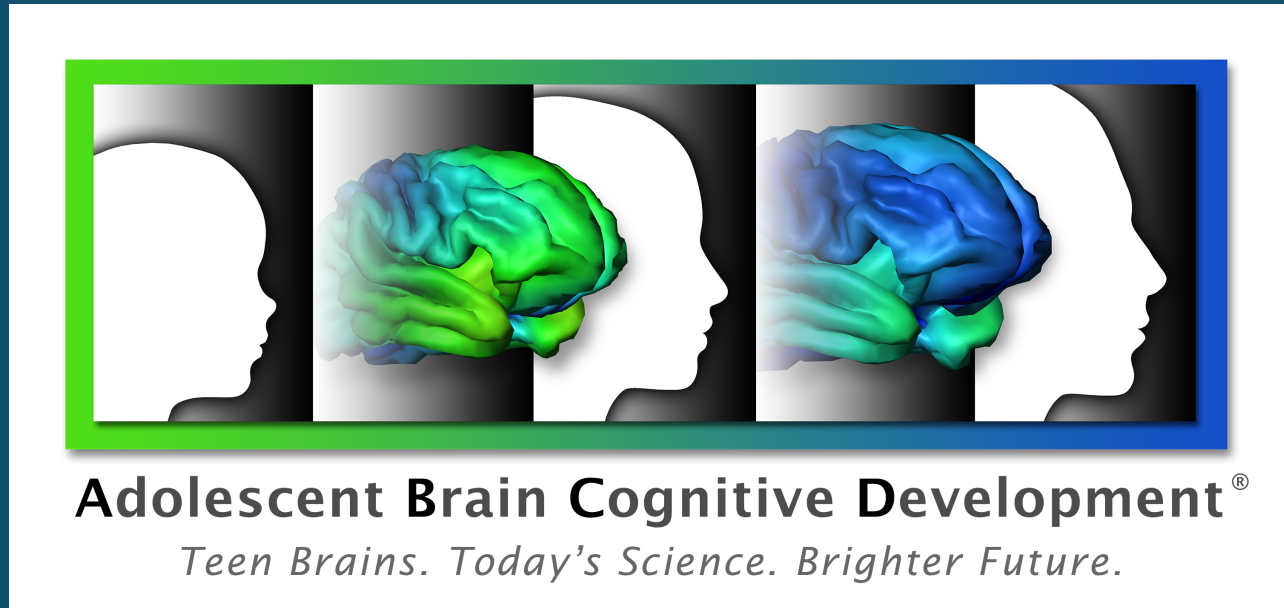


# Using daily wearable cardio fitness and sleep data to predict obesity in early adolescence

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## Motivation

Between 2017 and 2020, the percentage of obese U.S. 12- to 19-year-olds was 22.2%<sup>1</sup>.

Early adolescence is a particularly high-risk time for the development of obesity<sup>2</sup> and the related cardiovascular health issues<sup>3</sup>.

Each 1-h decrease in sleep duration increases the odds of obesity by 80% in adolescents.

Minorities are at increased risk<sup>1</sup>.

*This study aims to use objective, continuous measures of sleep and physical activity data combined with socio-demographic information in a large sample of early adolescents to predict adolescent obesity.*

## Method

### Participants:

- The study analyzed data from 3,028 (Year 2, Mean<sub>age</sub> = 11.94 years, SD= 0.65, 49.5% female) participants in the Adolescent Brain Cognitive Development (ABCD) Study® who wore Fitbit Charge 2 devices for three weeks.

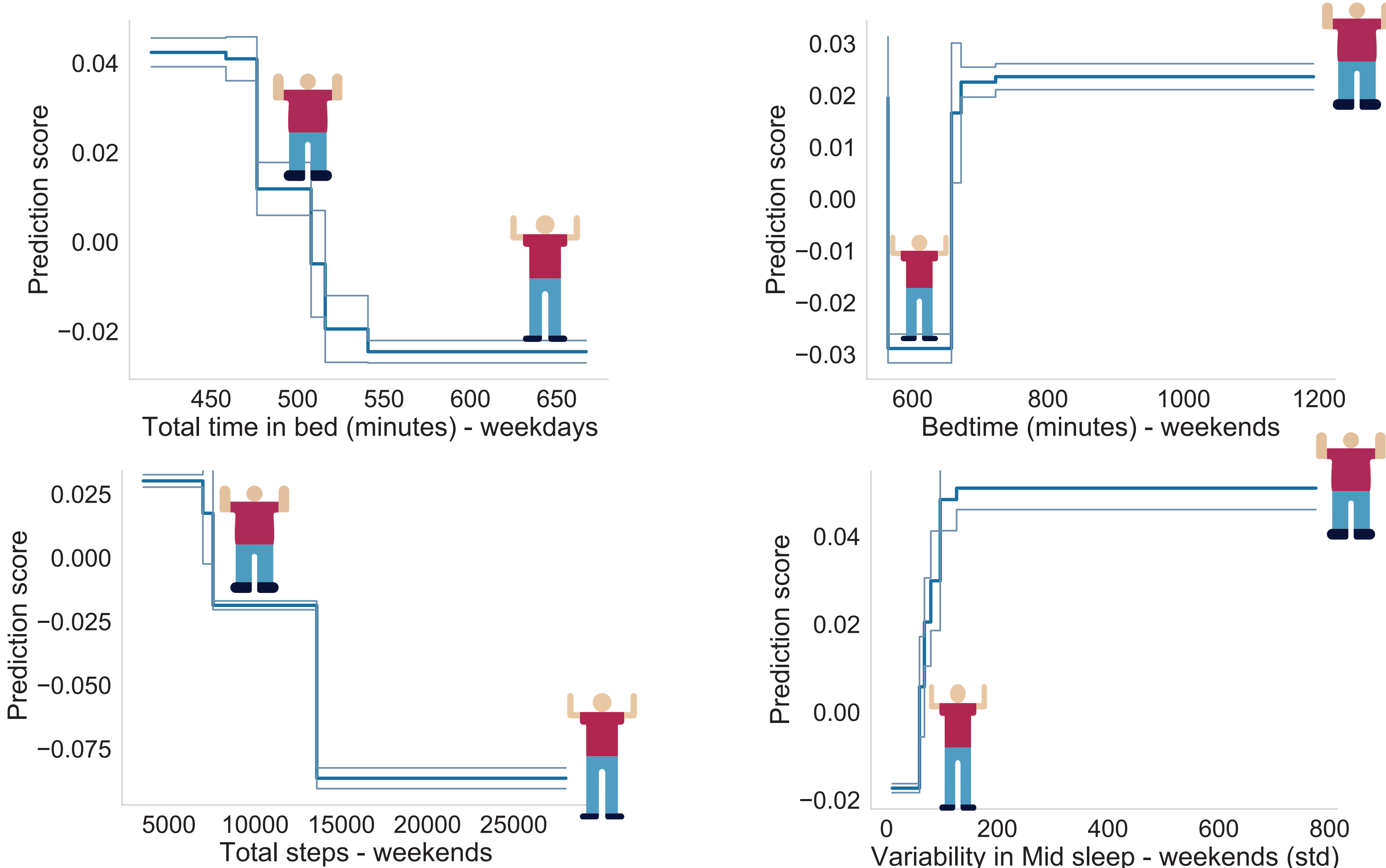
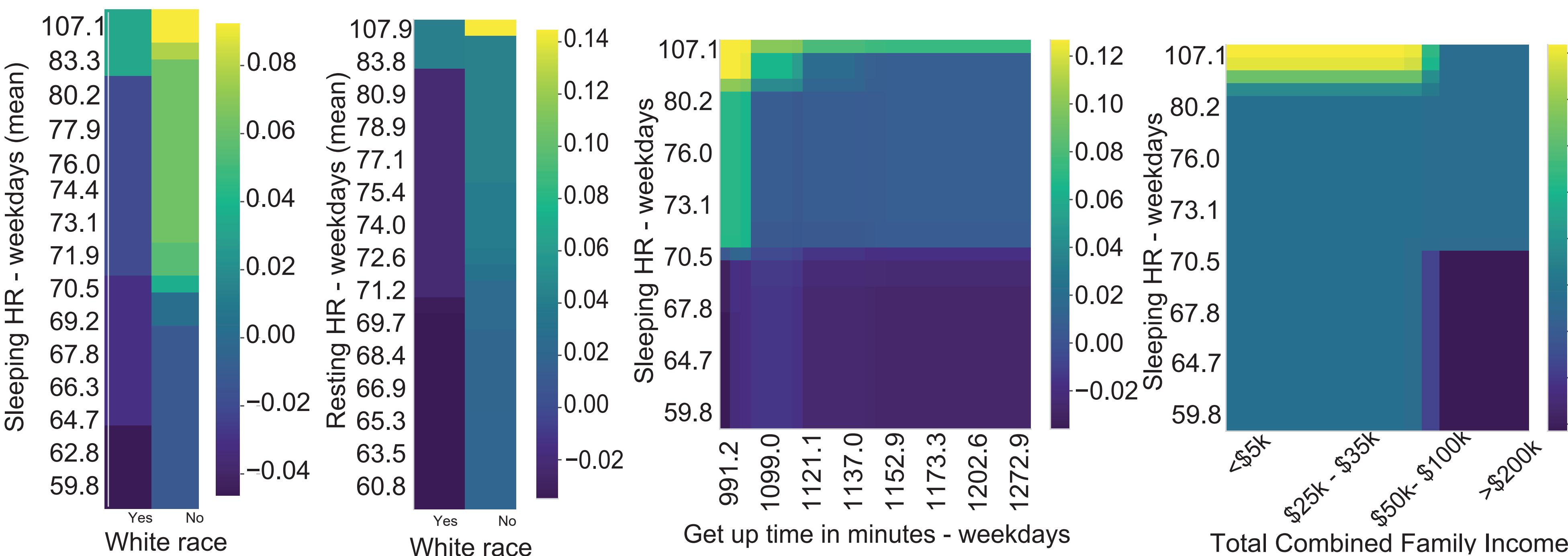
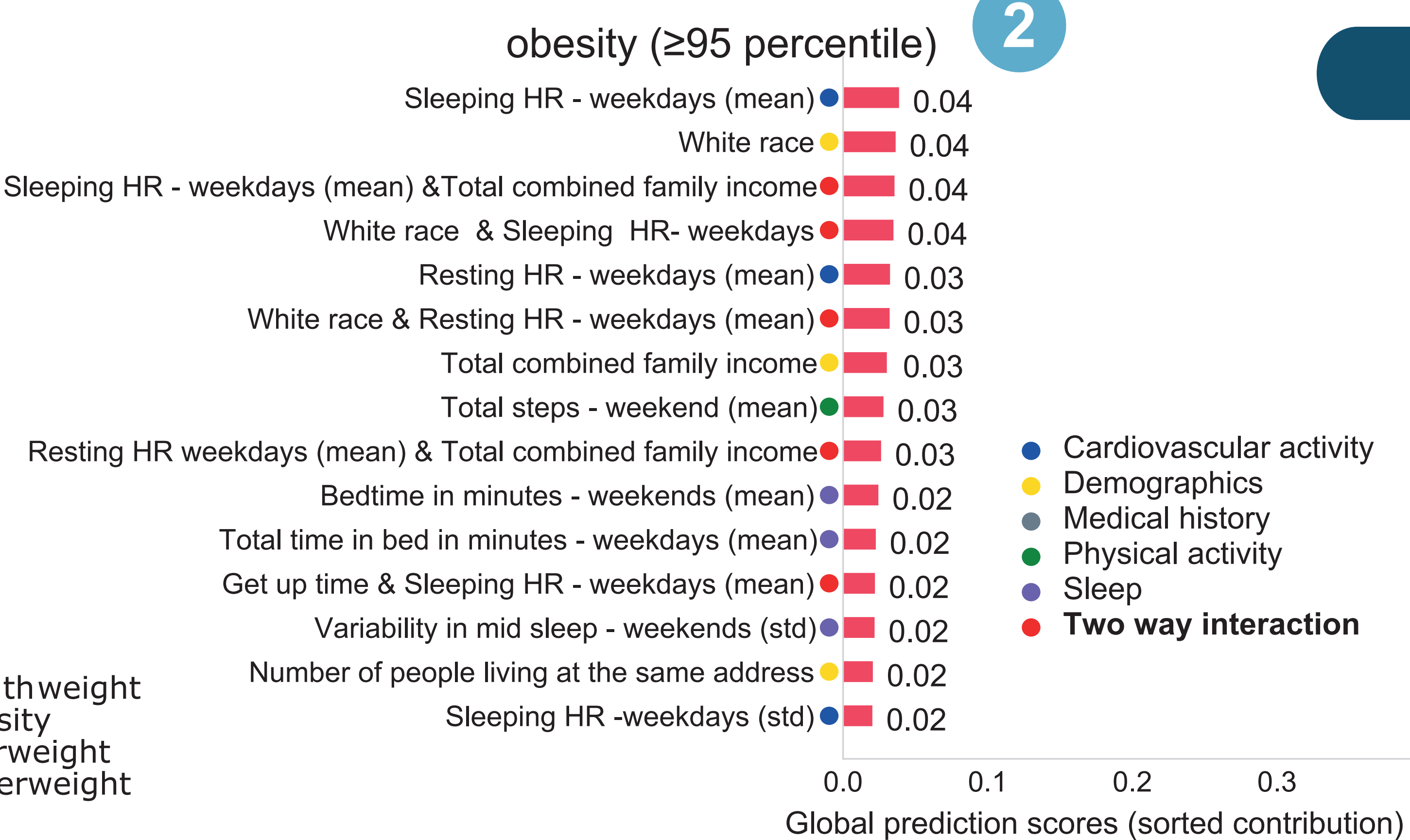
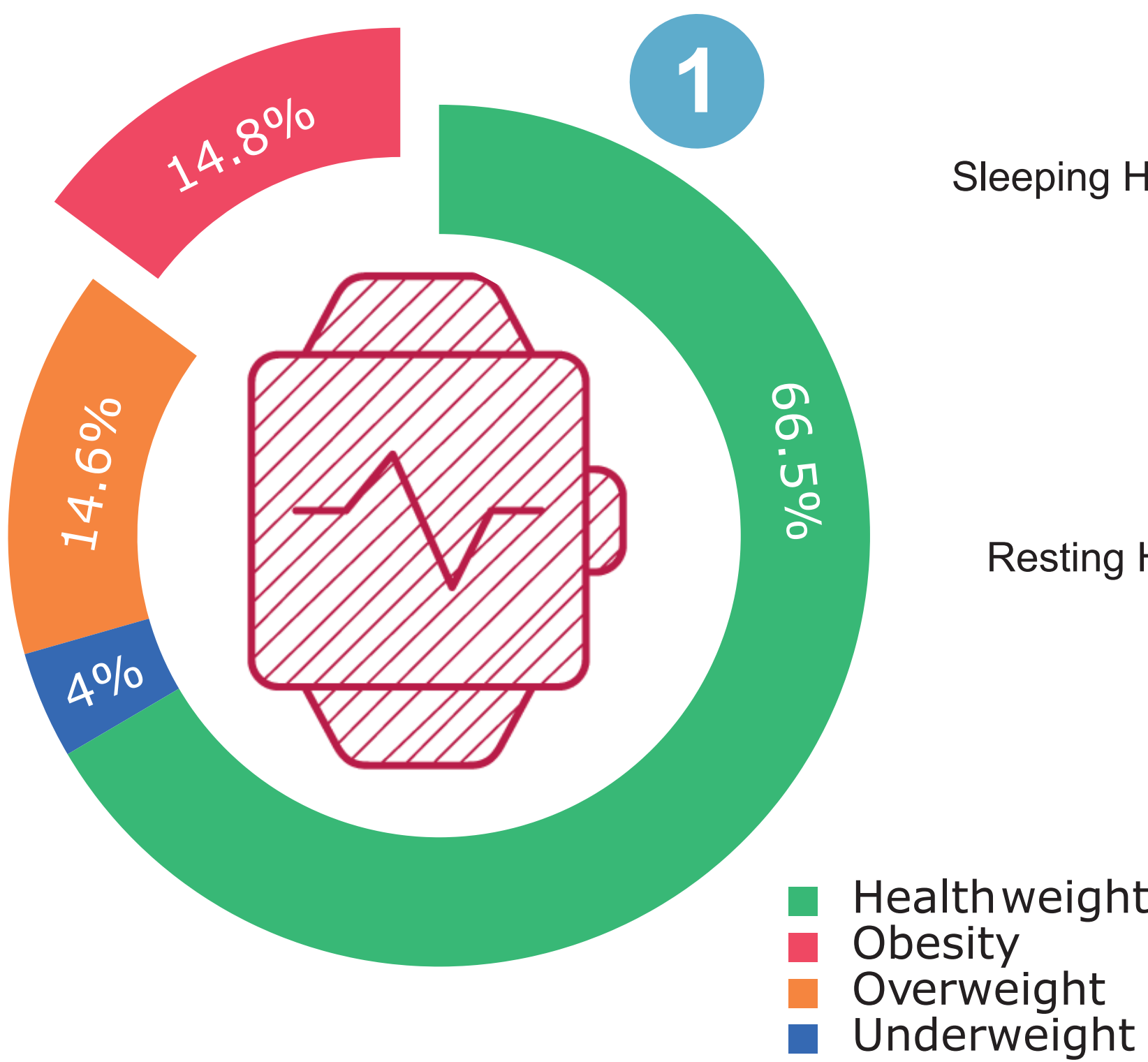
### Measures and Data analysis

- Explainable Boosting Machines (EBMs) were used to identify the most important measures for predicting obesity, including Fitbit sleep measures (duration, timing, efficiency, and regularity), cardiovascular fitness measures, and sociodemographic characteristics.
- Models were evaluated using area under the curve (AUC) and accuracy (ACC) metrics.



Fitness measures:  
• Resting heart rate - Fitbit photoplethysmography  
• Step counts - Fitbit actigraphy

### Obesity in the Fitbit sub sample

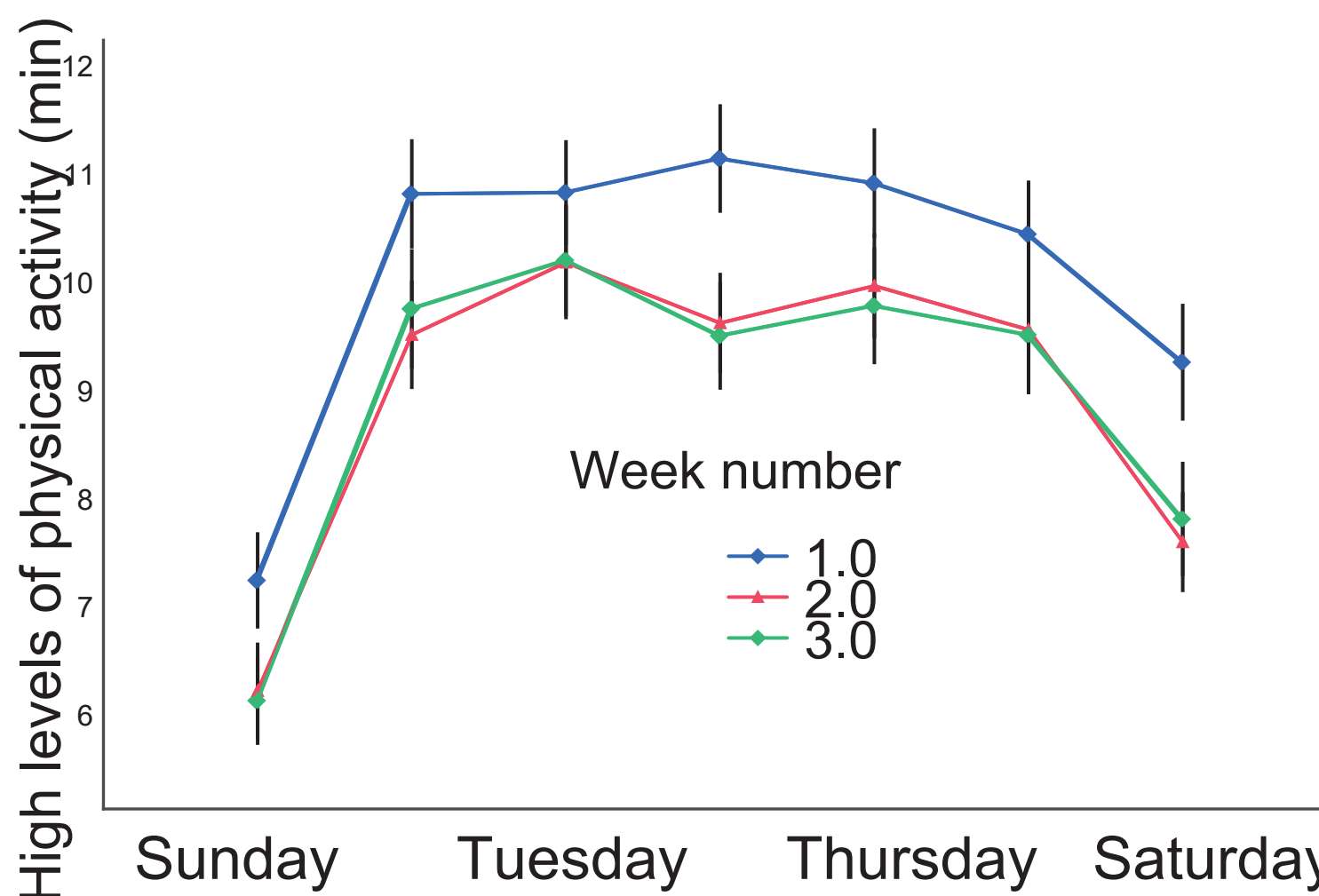


## Results

At the second-year visit, 15% percent of the adolescents were classified as having high BMI(Fig.1).

Our models performed well (2x5 cross validation Mean AUC = 0.71, best AUC = 0.74), with ~83% accuracy.

Shorter time in bed, later bedtime, more variable sleep patterns, low step counts, and higher resting and overnight heart rates with higher day-to-day variability were identified as important predictors of obesity (Fig.2). Sociodemographic factors, such as race and family income were also significant predictors.



## Conclusions

The study highlights the importance of adequate sleep and physical activity, as well as socioeconomic disparities, for obesity risk. Results also show the **clinical applicability** of wearable measures for continuous monitoring of sleep, physical activity, and heart rate in adolescents. Identifying measurable predictors of obesity risk can inform interventions and treatment strategies aimed at reducing obesity rates in adolescents.

## References

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