

Multiverse analysis

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Enter author note here.

The authors made the following contributions. First Author: Conceptualization, Writing - Original Draft Preparation, Writing - Review & Editing; Ernst-August Doelle: Writing - Review & Editing, Supervision.

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### Abstract

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

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Multiverse analysis

## Results

### Model diagnostics

The model diagnostics for the main analysis, and for all models presented in this document are in Table 1

### Fixed Effect Model

In this document we show the results using another analytic technique. Namely treating study ID as a fixed effect. This is what we wrote in the protocol originally.

**The effects of physical activity volume on sleep.** We estimated the effects of physical activity on sleep (RQ1) using fixed-effects models. We estimated the effect of physical activity volume on sleep by age, and the results are presented in Table 2 and Figure 1.

**The effects of physical activity intensity on sleep.** We estimated how physical activity intensity affects sleep across different age groups. We present the results controlling for sex, SES, and BMI, in Table 2 and Figure 2.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 3 and Figure 3.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 3 and Figure 4.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 3 and Figure 5.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 3 and Figure 6.

### **Log Transforming PA Volume**

Based on preliminary modelling on a subset of the data, we chose to leave physical activity volume in its natural form to enhance interpretability. The log scale meant that the variable became unintepretable towards the edge of its range. Below, we present the results had we not made this decision. These results are all moderated by age, as this was our primary analysis. The associated figures are back-transformed to the scale range.

**The effects of physical activity volume on sleep.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by age, and the results are presented in Table 4 and Figure 7.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 5 and Figure 8.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 5 and Figure 9.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 5 and Figure 10.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by age. Results, controlling for sex, SES, and BMI are presented in Table 5 and Figure 11.

### Moderation

In the following section we present models for a range of moderators which were pre-defined in our protocol.

**BMI**

**The effects of physical activity volume on sleep by BMI.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by BMI, and the results are presented in Table 6 and Figure 12

**The effects of physical activity intensity on sleep by BMI.** We estimated how physical activity intensity affects sleep across BMI. We present the results in Table 6 and Figure 13.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by BMI. Results, controlling for sex, SES, and BMI are presented in Table 7 and Figure 14.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by BMI. Results, controlling for sex, SES, and BMI are presented in Table 7 and Figure 15.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by BMI. Results, controlling for sex, SES, and BMI are presented in Table 7 and Figure 16.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by BMI. Results are presented in Table 7 and Figure 17.

**SES**

**The effects of physical activity volume on sleep by SES.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by SES, and the results are presented in Table 8 and Figure 18

**The effects of physical activity intensity on sleep by SES.** We estimated how physical activity intensity affects sleep across SES. We present the results in Table 8 and Figure 19.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by SES. Results, controlling for sex, SES, and BMI are presented in Table 9 and Figure 20.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by SES. Results, controlling for sex, SES, and BMI are presented in Table 9 and Figure 21.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by SES. Results, controlling for sex, SES, and BMI are presented in Table 9 and Figure 22.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by SES. Results are presented in Table 9 and Figure 23.

**sex**

**The effects of physical activity volume on sleep by sex.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by sex, and the results are presented in Table 10 and Figure 24

**The effects of physical activity intensity on sleep by sex.** We estimated how physical activity intensity affects sleep across sex. We present the results in Table 10 and Figure 25.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by sex. Results, controlling for sex, SES, and BMI are presented in Table 11 and Figure 26.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by sex. Results, controlling for sex, SES, and BMI are presented in Table 11 and Figure 27.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by sex. Results, controlling for sex, SES, and BMI are presented in Table 11 and Figure 28.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by sex. Results are presented in Table 11 and Figure 29.

**weekday**

**The effects of physical activity volume on sleep by weekday.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by weekday, and the results are presented in Table 12 and Figure 30

**The effects of physical activity intensity on sleep by weekday.** We estimated how physical activity intensity affects sleep across weekday. We present the results in Table 12 and Figure 31.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by weekday. Results, controlling for sex, SES, and BMI are presented in Table 13 and Figure 32.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by weekday. Results, controlling for sex, SES, and BMI are presented in Table 13 and Figure 33.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by weekday. Results, controlling for sex, SES, and BMI are presented in Table 13 and Figure 34.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by weekday. Results are presented in Table 13 and Figure 35.

**season**

**The effects of physical activity volume on sleep by season.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by season, and the results are presented in Table 14 and Figure 36

**The effects of physical activity intensity on sleep by season.** We estimated how physical activity intensity affects sleep across season. We present the results in Table 14 and Figure 37.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by season. Results, controlling for sex, SES, and BMI are presented in Table 15 and Figure 38.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by season. Results, controlling for sex, SES, and BMI are presented in Table 15 and Figure 39.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by season. Results, controlling for sex, SES, and BMI are presented in Table 15 and Figure 40.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by season. Results are presented in Table 15 and Figure 41.

**region**

**The effects of physical activity volume on sleep by region.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by region, and the results are presented in Table 16 and Figure 42

**The effects of physical activity intensity on sleep by region.** We estimated how physical activity intensity affects sleep across region. We present the results in Table 16 and Figure 43.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by region. Results, controlling for sex, SES, and BMI are presented in Table 17 and Figure 44.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by region. Results, controlling for sex, SES, and BMI are presented in Table 17 and Figure 45.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by region. Results, controlling for sex, SES, and BMI are presented in Table 17 and Figure 46.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by region. Results are presented in Table 17 and Figure 47.

**daylight hours**

**The effects of physical activity volume on sleep by daylight hours.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by daylight hours, and the results are presented in Table 18 and Figure 48

**The effects of physical activity intensity on sleep by daylight hours.** We estimated how physical activity intensity affects sleep across daylight hours. We present the results in Table 18 and Figure 49.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by daylight hours. Results, controlling for sex, SES, and BMI are presented in Table 19 and Figure 50.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by daylight hours. Results, controlling for sex, SES, and BMI are presented in Table 19 and Figure 51.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by daylight hours. Results, controlling for sex, SES, and BMI are presented in Table 19 and Figure 52.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by daylight hours. Results are presented in Table 19 and Figure 53.

**wear location**

**The effects of physical activity volume on sleep by wear location.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by wear location, and the results are presented in Table 20 and Figure 54

**The effects of physical activity intensity on sleep by wear location.** We estimated how physical activity intensity affects sleep across wear location. We present the results in Table 20 and Figure 55.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by wear location. Results, controlling for sex, SES, and BMI are presented in Table 21 and Figure 56.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by wear location. Results, controlling for sex, SES, and BMI are presented in Table 21 and Figure 57.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by wear location. Results, controlling for sex, SES, and BMI are presented in Table 21 and Figure 58.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by wear location. Results are presented in Table 21 and Figure 59.

**most active hour**

**The effects of physical activity volume on sleep by most active hour.** We estimated the effects of physical activity on sleep (RQ1) using mixed-effects models. We estimated the effect of physical activity volume on sleep by most active hour, and the results are presented in Table 22 and Figure 60

**The effects of physical activity intensity on sleep by most active hour.** We estimated how physical activity intensity affects sleep across most active hour. We present the results in Table 22 and Figure 61.

**The effects of sleep duration on physical activity.** We estimated the effect of sleep duration on physical activity by most active hour. Results, controlling for sex, SES, and BMI are presented in Table 23 and Figure 62.

**The effects of sleep efficiency on physical activity.** We estimated the effect of sleep efficiency on physical activity by most active hour. Results, controlling for sex, SES, and BMI are presented in Table 23 and Figure 63.

**The effects of sleep onset on physical activity.** We estimated the effect of sleep onset on physical activity by most active hour. Results, controlling for sex, SES, and BMI are presented in Table 23 and Figure 64.

**The effects of sleep regularity on physical activity.** We estimated the effect of sleep regularity on physical activity by most active hour. Results are presented in Table 23 and Figure 65.

Table 1

*Model diagnostics*

| Model name                                     | Skewness | Kurtosis | Converged (%) |
|--|----------|----------|---------------|
| Models moderated by age                        |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.26     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.20     | 6.37     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.73    | 2.02     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.93     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.28     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.29     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.03     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.45     | 19.82    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.06     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.80    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.45     | 19.81    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.04     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.16    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.15     | 1.98     | 100.00%       |
| Models moderated by age fixeddef               |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.26     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.20     | 6.37     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.73    | 2.02     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.94     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.27     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.30     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.03     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.45     | 19.81    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.06     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.79    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.45     | 19.81    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.04     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.15    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.15     | 1.98     | 100.00%       |

Table 1 continued

| Model name                                     |       | Skewness | Kurtosis | Converged (%) |
|--|-------|----------|----------|---------------|
| Models moderated by age log                    |       |          |          |               |
| Scale sleep duration by log PA volume          | -0.09 | 1.95     | 100.00%  |               |
| Scale sleep efficiency by log PA volume        | -0.89 | 3.23     | 100.00%  |               |
| Scale sleep onset by log PA volume             | 0.20  | 6.36     | 100.00%  |               |
| Scale sleep regularity by log PA volume        | -0.73 | 2.02     | 100.00%  |               |
| Scale sleep duration by PA intensity           | -0.09 | 1.93     | 100.00%  |               |
| Scale sleep efficiency by PA intensity         | -0.89 | 3.28     | 100.00%  |               |
| Scale sleep onset by PA intensity              | 0.22  | 6.29     | 100.00%  |               |
| Scale sleep regularity by PA intensity         | -0.73 | 2.03     | 100.00%  |               |
| Log PA volume by sleep duration(lagged)        | -0.45 | 2.55     | 100.00%  |               |
| Scale PA intensity by sleep duration(lagged)   | 0.09  | 2.06     | 100.00%  |               |
| Log PA volume by sleep efficiency(lagged)      | -0.46 | 2.55     | 100.00%  |               |
| Scale PA intensity by sleep efficiency(lagged) | 0.09  | 2.05     | 100.00%  |               |
| Log PA volume by sleep onset(lagged)           | -0.45 | 2.55     | 100.00%  |               |
| Scale PA intensity by sleep onset(lagged)      | 0.09  | 2.04     | 100.00%  |               |
| Log PA volume by sleep regularity(lagged)      | -0.37 | 2.28     | 100.00%  |               |
| Scale PA intensity by sleep regularity(lagged) | 0.15  | 1.98     | 100.00%  |               |
| Models moderated by bmi                        |       |          |          |               |
| Scale sleep duration by PA volume              | -0.08 | 1.94     | 100.00%  |               |
| Scale sleep efficiency by PA volume            | -0.89 | 3.24     | 100.00%  |               |
| Scale sleep onset by PA volume                 | 0.21  | 6.37     | 100.00%  |               |
| Scale sleep regularity by PA volume            | -0.73 | 2.02     | 100.00%  |               |
| Scale sleep duration by PA intensity           | -0.09 | 1.93     | 100.00%  |               |
| Scale sleep efficiency by PA intensity         | -0.89 | 3.28     | 100.00%  |               |
| Scale sleep onset by PA intensity              | 0.22  | 6.32     | 100.00%  |               |
| Scale sleep regularity by PA intensity         | -0.73 | 2.03     | 100.00%  |               |
| Scale PA volume by sleep duration(lagged)      | 1.45  | 19.82    | 100.00%  |               |
| Scale PA intensity by sleep duration(lagged)   | 0.09  | 2.05     | 100.00%  |               |
| Scale PA volume by sleep efficiency(lagged)    | 1.45  | 19.81    | 100.00%  |               |
| Scale PA intensity by sleep efficiency(lagged) | 0.09  | 2.05     | 100.00%  |               |
| Scale PA volume by sleep onset(lagged)         | 1.45  | 19.82    | 100.00%  |               |
| Scale PA intensity by sleep onset(lagged)      | 0.09  | 2.05     | 100.00%  |               |
| Scale PA volume by sleep regularity(lagged)    | 1.50  | 20.11    | 100.00%  |               |
| Scale PA intensity by sleep regularity(lagged) | 0.14  | 1.98     | 100.00%  |               |
| Models moderated by ses                        |       |          |          |               |

Table 1 continued

| Model name                                     | Skewness | Kurtosis | Converged (%) |
|--|----------|----------|---------------|
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.24     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.21     | 6.39     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.73    | 2.01     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.93     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.28     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.29     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.02     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.45     | 19.80    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.77    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.45     | 19.79    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.10    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.14     | 1.99     | 100.00%       |
| Models moderated by weekday                    |          |          |               |
| Scale sleep duration by PA volume              | -0.11    | 1.93     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.88    | 3.24     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.17     | 6.62     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.75    | 2.13     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.11    | 1.91     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.88    | 3.26     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.20     | 6.39     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.76    | 2.15     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.52     | 20.56    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.12     | 2.10     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.52     | 20.44    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.12     | 2.14     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.53     | 20.60    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.13     | 2.12     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.55     | 20.63    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.16     | 2.05     | 100.00%       |
| Models moderated by season                     |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |

Table 1 continued

| Model name                                     | Skewness | Kurtosis | Converged (%) |
|--|----------|----------|---------------|
| Scale sleep efficiency by PA volume            | -0.89    | 3.26     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.21     | 6.38     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.72    | 2.00     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.94     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.29     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.30     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 1.99     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.46     | 19.87    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.83    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.46     | 19.85    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.11    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.14     | 1.96     | 100.00%       |
| Models moderated by region                     |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.88    | 3.24     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.20     | 6.35     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.73    | 2.00     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.08    | 1.92     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.28     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.31     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.03     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.46     | 19.92    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.44     | 19.72    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.06     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.46     | 19.93    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.04     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.05    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.14     | 2.00     | 100.00%       |
| Models moderated by daylight                   |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.26     | 100.00%       |

Table 1 continued

| Model name                                     | Skewness | Kurtosis | Converged (%) |
|--|----------|----------|---------------|
| Scale sleep onset by PA volume                 | 0.21     | 6.38     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.72    | 2.00     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.94     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.29     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.32     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.03     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.46     | 19.88    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.84    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.46     | 19.86    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.11    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.14     | 1.99     | 100.00%       |
| Models moderated by wear location              |          |          |               |
| Scale sleep duration by PA volume              | -0.09    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.24     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.20     | 6.38     | 100.00%       |
| Scale sleep regularity by PA volume            | -0.73    | 2.04     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.94     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.27     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.28     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.04     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.45     | 19.83    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.45     | 19.83    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.47     | 19.92    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.50     | 20.15    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.15     | 1.99     | 100.00%       |
| Models moderated by PA mostactivehr            |          |          |               |
| Scale sleep duration by PA volume              | -0.08    | 1.95     | 100.00%       |
| Scale sleep efficiency by PA volume            | -0.89    | 3.26     | 100.00%       |
| Scale sleep onset by PA volume                 | 0.21     | 6.40     | 100.00%       |

Table 1 continued

| Model name                                     | Skewness | Kurtosis | Converged (%) |
|--|----------|----------|---------------|
| Scale sleep regularity by PA volume            | -0.73    | 2.02     | 100.00%       |
| Scale sleep duration by PA intensity           | -0.09    | 1.93     | 100.00%       |
| Scale sleep efficiency by PA intensity         | -0.89    | 3.28     | 100.00%       |
| Scale sleep onset by PA intensity              | 0.22     | 6.31     | 100.00%       |
| Scale sleep regularity by PA intensity         | -0.73    | 2.03     | 100.00%       |
| Scale PA volume by sleep duration(lagged)      | 1.44     | 19.69    | 100.00%       |
| Scale PA intensity by sleep duration(lagged)   | 0.09     | 2.04     | 100.00%       |
| Scale PA volume by sleep efficiency(lagged)    | 1.44     | 19.72    | 100.00%       |
| Scale PA intensity by sleep efficiency(lagged) | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep onset(lagged)         | 1.45     | 19.70    | 100.00%       |
| Scale PA intensity by sleep onset(lagged)      | 0.09     | 2.05     | 100.00%       |
| Scale PA volume by sleep regularity(lagged)    | 1.48     | 19.97    | 100.00%       |
| Scale PA intensity by sleep regularity(lagged) | 0.13     | 1.97     | 100.00%       |

Table 2

*Physical activity predicting sleep controlling for SES, sex, BMI, and the fixed effects of study IDs.*

| Term                                 | Physical activity volume (z) |                |      |        | Physical activity intensity (z) |         |                |      |        |        |
|--------------------------------------|------------------------------|----------------|------|--------|---------------------------------|---------|----------------|------|--------|--------|
|                                      | $\beta$                      | [95% CI]       | SE   | t      | p                               | $\beta$ | [95% CI]       | SE   | t      | p      |
| <b>Sleep duration (z)</b>            |                              |                |      |        |                                 |         |                |      |        |        |
| (Intercept)                          | 0.80                         | [0.66, 0.94]   | 0.07 | 10.91  | < .001                          | 0.73    | [0.59, 0.88]   | 0.07 | 9.96   | < .001 |
| Physical activity                    | 0.12                         | [0.08, 0.16]   | 0.02 | 5.62   | < .001                          | 0.08    | [0.04, 0.13]   | 0.02 | 3.60   | < .001 |
| Age                                  | 0.00                         | [0.00, 0.00]   | 0.00 | -0.19  | .853                            | 0.00    | [-0.01, 0.00]  | 0.00 | -0.39  | .695   |
| Physical activity <sup>2</sup>       | -0.01                        | [-0.02, 0.00]  | 0.00 | -2.01  | .044                            | 0.00    | [-0.02, 0.03]  | 0.01 | 0.33   | .741   |
| Physical activity × age              | 0.00                         | [0.00, 0.00]   | 0.00 | -0.89  | .372                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.21  | .227   |
| Age × Physical activity <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | -0.09  | .930                            | 0.00    | [0.00, 0.00]   | 0.00 | -0.63  | .526   |
| <b>Sleep efficiency (z)</b>          |                              |                |      |        |                                 |         |                |      |        |        |
| (Intercept)                          | -0.39                        | [-0.54, -0.24] | 0.08 | -5.22  | < .001                          | -0.46   | [-0.60, -0.31] | 0.08 | -6.03  | < .001 |
| Physical activity                    | 0.14                         | [0.10, 0.18]   | 0.02 | 6.72   | < .001                          | 0.07    | [0.02, 0.11]   | 0.02 | 2.83   | .005   |
| Age                                  | 0.00                         | [-0.01, 0.00]  | 0.00 | -0.52  | .604                            | 0.00    | [-0.01, 0.00]  | 0.00 | -0.85  | .397   |
| Physical activity <sup>2</sup>       | -0.02                        | [-0.03, -0.01] | 0.00 | -4.90  | < .001                          | -0.02   | [-0.04, 0.01]  | 0.01 | -1.08  | .278   |
| Physical activity × age              | 0.00                         | [0.00, 0.00]   | 0.00 | -5.11  | < .001                          | 0.00    | [0.00, 0.00]   | 0.00 | -2.10  | .036   |
| Age × Physical activity <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 2.16   | .031                            | 0.00    | [0.00, 0.00]   | 0.00 | 1.49   | .137   |
| <b>Sleep onset (z)</b>               |                              |                |      |        |                                 |         |                |      |        |        |
| (Intercept)                          | -1.06                        | [-1.18, -0.95] | 0.06 | -17.96 | < .001                          | -1.02   | [-1.14, -0.91] | 0.06 | -17.41 | < .001 |
| Physical activity                    | -0.04                        | [-0.06, -0.01] | 0.02 | -2.34  | .020                            | -0.05   | [-0.08, -0.02] | 0.02 | -3.22  | .001   |
| Age                                  | 0.00                         | [0.01, 0.00]   | 0.00 | -1.45  | .156                            | 0.00    | [-0.01, 0.00]  | 0.00 | -1.61  | .108   |
| Physical activity <sup>2</sup>       | 0.00                         | [-0.01, 0.00]  | 0.00 | -0.72  | .469                            | -0.04   | [-0.06, -0.02] | 0.01 | -3.67  | < .001 |
| Physical activity × age              | 0.00                         | [0.00, 0.00]   | 0.00 | -5.32  | < .001                          | 0.00    | [0.00, 0.00]   | 0.00 | -0.26  | .793   |
| Age × Physical activity <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 2.21   | .027                            | 0.00    | [0.00, 0.00]   | 0.00 | 3.70   | < .001 |
| <b>Sleep regularity (z)</b>          |                              |                |      |        |                                 |         |                |      |        |        |

Table 2 continued

| Term                                 | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--------------------------------------|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|                                      | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| (Intercept)                          | 0.23 [0.09, 0.37]            | 0.07 | 3.25  | .001   | 0.15 [0.00, 0.29]               | 0.07 | 1.99  | .047   |
| Physical activity                    | 0.25 [0.21, 0.29]            | 0.02 | 12.15 | < .001 | 0.28 [0.24, 0.32]               | 0.02 | 12.61 | < .001 |
| Age                                  | 0.00 [0.00, 0.00]            | 0.00 | -0.05 | .957   | 0.00 [-0.01, 0.00]              | 0.00 | -1.64 | .102   |
| Physical activity <sup>2</sup>       | -0.03 [-0.04, -0.02]         | 0.00 | -6.53 | < .001 | -0.09 [-0.11, -0.06]            | 0.01 | -6.46 | < .001 |
| Physical activity × age              | 0.00 [0.00, 0.00]            | 0.00 | -1.68 | .093   | 0.00 [-0.01, 0.00]              | 0.00 | -9.36 | < .001 |
| Age × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | -1.57 | .145   | 0.00 [0.00, 0.00]               | 0.00 | 2.50  | .012   |

*Note.* Adjusted for SES, sex, BMI, and the fixed effects of study IDs. Outcomes variables are listed in the column headers.

Table 3

Sleep predicting physical activity controlling for SES, sex, BMI, and the fixed effects of study IDs

| Term                                | Physical activity volume (z) |                |      | Physical activity intensity (z) |        |                  |                |      |              |
|-------------------------------------|------------------------------|----------------|------|---------------------------------|--------|------------------|----------------|------|--------------|
|                                     | $\beta$                      | [95% CI]       | SE   | t                               | p      | $\beta$ [95% CI] | SE             | t    | p            |
| <b>Sleep duration (z)</b>           |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                         | 0.33                         | [0.20, 0.47]   | 0.07 | 4.89                            | < .001 | 1.10             | [0.98, 1.22]   | 0.06 | 17.73 < .001 |
| Sleep duration                      | -0.01                        | [-0.03, 0.01]  | 0.01 | -1.14                           | .256   | -0.04            | [-0.06, -0.02] | 0.01 | -3.79 < .001 |
| Age                                 | -0.02                        | [-0.03, -0.01] | 0.00 | -5.58                           | .007   | -0.02            | [-0.03, -0.02] | 0.00 | -6.27 .007   |
| Sleep duration <sup>2</sup>         | -0.01                        | [-0.02, 0.00]  | 0.01 | -1.70                           | .098   | -0.01            | [-0.02, -0.01] | 0.00 | -2.97 .003   |
| Sleep duration × age                | 0.00                         | [0.00, 0.00]   | 0.00 | 0.50                            | .620   | 0.00             | [0.00, 0.00]   | 0.00 | 5.03 < .001  |
| Age × Sleep duration <sup>2</sup>   | 0.00                         | [0.00, 0.00]   | 0.00 | -0.53                           | .593   | 0.00             | [0.00, 0.00]   | 0.00 | 1.55 .122    |
| <b>Sleep efficiency (z)</b>         |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                         | 0.32                         | [0.19, 0.45]   | 0.07 | 4.68                            | < .001 | 1.08             | [0.96, 1.20]   | 0.06 | 17.28 < .001 |
| Sleep efficiency                    | -0.01                        | [-0.03, 0.02]  | 0.01 | -0.62                           | .534   | -0.03            | [-0.05, 0.00]  | 0.01 | -1.83 .072   |
| Age                                 | -0.02                        | [-0.03, -0.01] | 0.00 | -5.55                           | .007   | -0.02            | [-0.03, -0.02] | 0.00 | -6.21 .008   |
| Sleep efficiency <sup>2</sup>       | 0.00                         | [-0.01, 0.01]  | 0.00 | 0.20                            | .844   | 0.00             | [0.01, 0.00]   | 0.00 | -1.07 .286   |
| Sleep efficiency × age              | 0.00                         | [0.00, 0.00]   | 0.00 | 0.56                            | .577   | 0.00             | [0.00, 0.00]   | 0.00 | 0.58 .563    |
| Age × Sleep efficiency <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | -0.60                           | .549   | 0.00             | [0.00, 0.00]   | 0.00 | -1.07 .285   |
| <b>Sleep onset (z)</b>              |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                         | 0.33                         | [0.19, 0.46]   | 0.07 | 4.79                            | < .001 | 1.11             | [0.99, 1.23]   | 0.06 | 17.76 < .001 |
| Sleep onset                         | 0.01                         | [-0.02, 0.04]  | 0.01 | 0.82                            | .417   | 0.05             | [0.02, 0.08]   | 0.01 | 3.32 .002    |
| Age                                 | -0.02                        | [-0.03, -0.01] | 0.00 | -5.49                           | .008   | -0.02            | [-0.03, -0.02] | 0.00 | -6.12 .008   |
| Sleep onset <sup>2</sup>            | 0.00                         | [-0.02, 0.02]  | 0.01 | 0.03                            | .976   | 0.01             | [-0.01, 0.03]  | 0.01 | 1.20 .235    |
| Sleep onset × age                   | 0.00                         | [0.00, 0.00]   | 0.00 | -0.97                           | .332   | 0.00             | [0.00, 0.00]   | 0.00 | -1.90 .062   |
| Age × Sleep onset <sup>2</sup>      | 0.00                         | [0.00, 0.00]   | 0.00 | -0.48                           | .634   | 0.00             | [0.00, 0.00]   | 0.00 | -1.48 .140   |
| Sleep regularity (z)                |                              |                |      |                                 |        |                  |                |      |              |

Table 3 continued

| Term                                | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|-------------------------------------|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|                                     | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| (Intercept)                         | 0.33                         | [0.19, 0.46]   | 0.07 | 4.83  | < .001                          | 1.11    | [0.99, 1.24]   | 0.06 | 17.52 | < .001 |
| Sleep regularity                    | 0.13                         | [0.10, 0.15]   | 0.01 | 10.36 | < .001                          | 0.10    | [0.08, 0.12]   | 0.01 | 8.58  | < .001 |
| Age                                 | -0.02                        | [-0.03, -0.01] | 0.00 | -5.50 | .008                            | -0.02   | [-0.03, -0.02] | 0.00 | -6.24 | .008   |
| Sleep regularity <sup>2</sup>       | -0.01                        | [-0.02, 0.00]  | 0.01 | -1.77 | .077                            | -0.03   | [-0.04, -0.01] | 0.01 | -4.05 | < .001 |
| Sleep regularity × age              | 0.00                         | [0.00, 0.00]   | 0.00 | -3.79 | < .001                          | 0.00    | [0.00, 0.00]   | 0.00 | -4.50 | < .001 |
| Age × Sleep regularity <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 0.51  | .607                            | 0.00    | [0.00, 0.00]   | 0.00 | 3.09  | .002   |

*Note.* Adjusted for SES, sex, BMI, and the fixed effects of study IDs. Outcomes variables are listed in the row headers.

Table 4

*Physical activity predicting sleep controlling for SES, sex, and BMI.*

| Term                             | Physical activity volume (h) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|----------------------------------|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|                                  | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| <i>Sleep duration (z)</i>        |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                      | -0.56                        | [-1.35, 0.23]  | 0.40 | -1.38 | .168                            | 0.25    | [0.01, 0.50]   | 0.12 | 2.02  | .043   |
| Log pa volume                    | 0.24                         | [-0.19, 0.67]  | 0.22 | 1.08  | .280                            | 0.09    | [0.04, 0.13]   | 0.02 | 3.65  | < .001 |
| Age                              | 0.02                         | [0.00, 0.04]   | 0.01 | 1.72  | .086                            | 0.00    | [-0.01, 0.00]  | 0.00 | -1.16 | .247   |
| Log pa volume <sup>2</sup>       | -0.01                        | [-0.07, 0.06]  | 0.03 | -0.16 | .872                            | 0.00    | [-0.02, 0.03]  | 0.01 | 0.30  | .761   |
| Log pa volume × age              | -0.01                        | [-0.03, 0.00]  | 0.01 | -1.75 | .080                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.24 | .214   |
| Age × log pa volume <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 1.59  | .112                            | 0.00    | [0.00, 0.00]   | 0.00 | -0.58 | .563   |
| <i>Sleep efficiency (z)</i>      |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                      | -2.66                        | [-3.46, -1.86] | 0.41 | -6.51 | < .001                          | 0.27    | [0.01, 0.52]   | 0.13 | 2.04  | .042   |
| Log pa volume                    | 1.41                         | [0.97, 1.85]   | 0.22 | 6.28  | < .001                          | 0.06    | [0.02, 0.11]   | 0.02 | 2.75  | .006   |
| Age                              | 0.04                         | [0.02, 0.07]   | 0.01 | 3.46  | .001                            | 0.00    | [0.00, 0.00]   | 0.00 | 0.31  | .754   |
| Log pa volume <sup>2</sup>       | -0.17                        | [-0.23, -0.10] | 0.03 | -5.16 | < .001                          | -0.01   | [-0.04, 0.01]  | 0.01 | -0.94 | .346   |
| Log pa volume × age              | -0.02                        | [-0.03, -0.01] | 0.01 | -2.70 | .007                            | 0.00    | [0.00, 0.00]   | 0.00 | -2.03 | .043   |
| Age × log pa volume <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 2.04  | .042                            | 0.00    | [0.00, 0.00]   | 0.00 | 1.32  | .186   |
| <i>Sleep onset (z)</i>           |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                      | -1.04                        | [-1.67, -0.42] | 0.32 | -3.26 | .001                            | 0.03    | [-0.29, 0.34]  | 0.16 | 0.15  | .877   |
| Log pa volume                    | 0.69                         | [0.38, 0.99]   | 0.15 | 4.44  | < .001                          | -0.05   | [-0.09, -0.02] | 0.02 | -3.24 | .001   |
| Age                              | 0.02                         | [0.01, 0.04]   | 0.01 | 2.85  | .004                            | 0.00    | [-0.01, 0.00]  | 0.00 | -1.22 | .222   |
| Log pa volume <sup>2</sup>       | -0.11                        | [-0.15, -0.06] | 0.02 | -4.77 | < .001                          | -0.04   | [-0.06, -0.02] | 0.01 | -3.64 | < .001 |
| Log pa volume × age              | -0.01                        | [-0.02, 0.00]  | 0.00 | -2.44 | .015                            | 0.00    | [0.00, 0.00]   | 0.00 | -0.25 | .802   |
| Age × log pa volume <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 1.75  | .080                            | 0.00    | [0.00, 0.00]   | 0.00 | 3.65  | < .001 |
| <i>Sleep regularity (z)</i>      |                              |                |      |       |                                 |         |                |      |       |        |

| Term                             | Physical activity volume (ln) |      |       |        | Physical activity intensity (z) |      |       |        |
|----------------------------------|-------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|                                  | $\beta$ [95% CI]              | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| (Intercept)                      | -2.28 [-3.02, -1.53]          | 0.38 | -6.00 | < .001 | 0.62 [0.37, 0.86]               | 0.12 | 4.96  | < .001 |
| Log pa volume                    | 1.15 [0.74, 1.56]             | 0.21 | 5.54  | < .001 | 0.28 [0.23, 0.32]               | 0.02 | 12.62 | < .001 |
| Age                              | -0.03 [-0.05, 0.00]           | 0.01 | -2.01 | .057   | 0.00 [-0.01, 0.00]              | 0.00 | -0.81 | .416   |
| Log pa volume <sup>2</sup>       | -0.10 [-0.16, -0.05]          | 0.03 | -3.55 | < .001 | -0.08 [-0.11, -0.06]            | 0.01 | -6.34 | < .001 |
| Log pa volume × age              | 0.02 [0.00, 0.03]             | 0.01 | 2.32  | .030   | 0.00 [-0.01, 0.00]              | 0.00 | -9.30 | < .001 |
| Age × log pa volume <sup>2</sup> | 0.00 [0.00, 0.00]             | 0.00 | -2.46 | .023   | 0.00 [0.00, 0.00]               | 0.00 | 2.35  | .019   |

*Note.* Adjusted for SES, sex, and BMI. Outcomes variables are listed in the column headers.

*Sleep predicting physical activity controlling for SES, sex, and BMI*

| Term                                | Physical activity volume (ln) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|-------------------------------------|-------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|                                     | $\beta$                       | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| Sleep duration (z)                  |                               |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                         | 4.42                          | [4.24, 4.61]   | 0.09 | 46.65 | < .001                          | 1.48    | [1.25, 1.71]   | 0.12 | 12.64 | < .001 |
| Sleep duration                      | -0.02                         | [-0.03, 0.00]  | 0.01 | -2.80 | .006                            | -0.04   | [-0.06, -0.02] | 0.01 | -3.78 | < .001 |
| Age                                 | -0.01                         | [-0.02, -0.01] | 0.00 | -5.49 | .008                            | -0.02   | [-0.03, -0.02] | 0.00 | -8.87 | .001   |
| Sleep duration <sup>2</sup>         | -0.01                         | [-0.01, 0.00]  | 0.00 | -2.37 | .020                            | -0.01   | [-0.02, -0.01] | 0.00 | -2.99 | .003   |
| Sleep duration × age                | 0.00                          | [0.00, 0.00]   | 0.00 | 1.27  | .203                            | 0.00    | [0.00, 0.00]   | 0.00 | 5.03  | < .001 |
| Age × Sleep duration <sup>2</sup>   | 0.00                          | [0.00, 0.00]   | 0.00 | -1.06 | .288                            | 0.00    | [0.00, 0.00]   | 0.00 | 1.56  | .118   |
| Sleep efficiency (z)                |                               |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                         | 4.42                          | [4.23, 4.61]   | 0.10 | 46.29 | < .001                          | 1.47    | [1.24, 1.71]   | 0.12 | 12.47 | < .001 |
| Sleep efficiency                    | 0.00                          | [-0.01, 0.01]  | 0.01 | 0.20  | .843                            | -0.02   | [-0.05, 0.00]  | 0.01 | -1.77 | .082   |
| Age                                 | -0.01                         | [-0.02, -0.01] | 0.00 | -5.46 | .009                            | -0.02   | [-0.03, -0.02] | 0.00 | -8.69 | .001   |
| Sleep efficiency <sup>2</sup>       | 0.00                          | [0.00, 0.00]   | 0.00 | 0.49  | .621                            | 0.00    | [0.01, 0.00]   | 0.00 | -1.04 | .296   |
| Sleep efficiency × age              | 0.00                          | [0.00, 0.00]   | 0.00 | -0.18 | .858                            | 0.00    | [0.00, 0.00]   | 0.00 | 0.54  | .591   |
| Age × Sleep efficiency <sup>2</sup> | 0.00                          | [0.00, 0.00]   | 0.00 | -1.21 | .228                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.08 | .281   |
| Sleep onset (z)                     |                               |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                         | 4.42                          | [4.24, 4.61]   | 0.10 | 46.36 | < .001                          | 1.47    | [1.24, 1.70]   | 0.12 | 12.47 | < .001 |
| Sleep onset                         | 0.01                          | [0.00, 0.03]   | 0.01 | 1.93  | .061                            | 0.05    | [0.02, 0.08]   | 0.01 | 3.37  | .002   |
| Age                                 | -0.01                         | [-0.02, -0.01] | 0.00 | -5.44 | .009                            | -0.02   | [-0.03, -0.02] | 0.00 | -8.66 | .001   |
| Sleep onset <sup>2</sup>            | -0.01                         | [-0.02, 0.00]  | 0.01 | -1.42 | .162                            | 0.01    | [-0.01, 0.03]  | 0.01 | 1.17  | .245   |
| Sleep onset × age                   | 0.00                          | [0.00, 0.00]   | 0.00 | -2.02 | .045                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.93 | .059   |
| Age × Sleep onset <sup>2</sup>      | 0.00                          | [0.00, 0.00]   | 0.00 | 0.41  | .680                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.46 | .146   |
| Sleep regularity (z)                |                               |                |      |       |                                 |         |                |      |       |        |

Table 5 continued

| Term                                | Physical activity volume (ln) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|-------------------------------------|-------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|                                     | $\beta$                       | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| (Intercept)                         | 4.39                          | [4.21, 4.57]   | 0.09 | 47.38 | < .001                          | 1.46    | [1.23, 1.69]   | 0.12 | 12.64 | < .001 |
| Sleep regularity                    | 0.08                          | [0.07, 0.09]   | 0.01 | 14.43 | < .001                          | 0.10    | [0.08, 0.12]   | 0.01 | 8.61  | < .001 |
| Age                                 | -0.01                         | [-0.02, -0.01] | 0.00 | -5.46 | .009                            | -0.02   | [-0.03, -0.02] | 0.00 | -9.04 | .001   |
| Sleep regularity <sup>2</sup>       | -0.01                         | [-0.02, -0.01] | 0.00 | -4.06 | < .001                          | -0.03   | [-0.04, -0.01] | 0.01 | -3.99 | < .001 |
| Sleep regularity × age              | 0.00                          | [0.00, 0.00]   | 0.00 | -4.68 | < .001                          | 0.00    | [0.00, 0.00]   | 0.00 | -4.52 | < .001 |
| Age × Sleep regularity <sup>2</sup> | 0.00                          | [0.00, 0.00]   | 0.00 | 0.44  | .659                            | 0.00    | [0.00, 0.00]   | 0.00 | 3.06  | .002   |

*Note.* Adjusted for SES, sex, and BMI. Outcomes variables are listed in the row headers.

Table 6

*Physical activity predicting sleep controlling for SES, age, and sex.*

| Term                           | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--------------------------------|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|                                | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <i>Sleep duration (z)</i>      |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.23 [-0.03, 0.48]           | 0.13 | 1.74  | .081   | 0.25 [0.01, 0.50]               | 0.13 | 2.01  | .045   |
| Physical activity              | 0.15 [0.01, 0.30]            | 0.07 | 2.03  | .101   | 0.11 [0.02, 0.20]               | 0.05 | 2.30  | .039   |
| Physical activity <sup>2</sup> | -0.01 [-0.04, 0.02]          | 0.02 | -0.43 | .668   | 0.02 [-0.03, 0.06]              | 0.02 | 0.77  | .439   |
| Age                            | 0.00 [-0.01, 0.00]           | 0.00 | -0.90 | .367   | 0.00 [-0.01, 0.00]              | 0.00 | -1.20 | .231   |
| Physical activity × bmi        | 0.00 [-0.01, 0.00]           | 0.00 | -0.68 | .532   | 0.00 [-0.01, 0.00]              | 0.00 | -0.93 | .376   |
| <i>Sleep efficiency (z)</i>    |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.23 [-0.02, 0.48]           | 0.13 | 1.84  | .066   | 0.31 [0.03, 0.60]               | 0.15 | 2.14  | .036   |
| Physical activity              | 0.17 [0.08, 0.25]            | 0.04 | 3.76  | < .001 | 0.06 [-0.04, 0.17]              | 0.05 | 1.14  | .291   |
| Physical activity <sup>2</sup> | -0.01 [-0.05, 0.02]          | 0.02 | -0.68 | .511   | -0.03 [-0.13, 0.08]             | 0.05 | -0.52 | .639   |
| Age                            | 0.00 [0.00, 0.01]            | 0.00 | 1.14  | .256   | 0.00 [0.00, 0.01]               | 0.00 | 0.68  | .495   |
| Physical activity × bmi        | 0.00 [-0.01, 0.00]           | 0.00 | -2.19 | .031   | 0.00 [-0.01, 0.00]              | 0.00 | -0.82 | .430   |
| <i>Sleep onset (z)</i>         |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.05 [-0.29, 0.38]           | 0.17 | 0.27  | .789   | 0.05 [-0.27, 0.36]              | 0.16 | 0.29  | .773   |
| Physical activity              | -0.01 [-0.13, 0.10]          | 0.06 | -0.21 | .845   | -0.05 [-0.12, 0.02]             | 0.04 | -1.41 | .192   |
| Physical activity <sup>2</sup> | -0.01 [-0.03, 0.02]          | 0.01 | -0.55 | .587   | -0.05 [-0.08, -0.02]            | 0.02 | -3.14 | .002   |
| Age                            | 0.00 [-0.01, 0.00]           | 0.00 | -0.88 | .385   | 0.00 [0.00, 0.00]               | 0.00 | -0.67 | .504   |
| Physical activity × bmi        | 0.00 [-0.01, 0.00]           | 0.00 | -1.73 | .125   | 0.00 [0.00, 0.00]               | 0.00 | -0.47 | .643   |
| <i>Sleep regularity (z)</i>    |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.39 [0.08, 0.70]            | 0.16 | 2.48  | .042   | 0.64 [0.39, 0.89]               | 0.13 | 5.07  | < .001 |
| Physical activity              | 0.02 [-0.63, 0.68]           | 0.33 | 0.07  | .948   | 0.17 [0.02, 0.31]               | 0.08 | 2.18  | .112   |
| Physical activity <sup>2</sup> | 0.00 [-0.10, 0.11]           | 0.05 | 0.05  | .964   | -0.03 [-0.11, 0.06]             | 0.04 | -0.58 | .595   |

| Term                           | Physical activity volume (z) |      |      |      | Physical activity intensity (z) |      |       |      |
|--------------------------------|------------------------------|------|------|------|---------------------------------|------|-------|------|
|                                | $\beta$ [95% CI]             | SE   | t    | p    | $\beta$ [95% CI]                | SE   | t     | p    |
| Age                            | 0.00 [0.00, 0.01]            | 0.00 | 0.55 | .584 | 0.00 [0.00, 0.00]               | 0.00 | -0.10 | .922 |
| Physical activity $\times$ bmi | 0.01 [-0.02, 0.04]           | 0.02 | 0.67 | .570 | 0.00 [-0.01, 0.00]              | 0.00 | -1.11 | .316 |

*Note.* Adjusted for SES, age, and sex. Outcomes variables are listed in the column headers.

Table 7

*Sleep predicting physical activity controlling for SES, age, and sex*

| Term                          | Physical activity volume (z) |                |      | Physical activity intensity (z) |        |                  |                |      |              |
|-------------------------------|------------------------------|----------------|------|---------------------------------|--------|------------------|----------------|------|--------------|
|                               | $\beta$                      | [95% CI]       | SE   | t                               | p      | $\beta$ [95% CI] | SE             | t    | p            |
| <b>Sleep duration (z)</b>     |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                   | 1.69                         | [1.29, 2.10]   | 0.21 | 8.25                            | < .001 | 1.48             | [1.26, 1.69]   | 0.11 | 13.52 < .001 |
| Sleep duration                | -0.01                        | [-0.05, 0.04]  | 0.02 | -0.27                           | .785   | -0.03            | [-0.10, 0.04]  | 0.03 | -0.90 .409   |
| Sleep duration <sup>2</sup>   | -0.01                        | [-0.03, 0.02]  | 0.01 | -0.56                           | .584   | -0.01            | [-0.05, 0.02]  | 0.02 | -0.90 .410   |
| Age                           | -0.02                        | [-0.03, -0.02] | 0.00 | -6.01                           | .004   | -0.02            | [-0.03, -0.02] | 0.00 | -8.76 .001   |
| Sleep duration × bmi          | 0.00                         | [0.00, 0.00]   | 0.00 | -0.11                           | .912   | 0.00             | [0.00, 0.00]   | 0.00 | 1.10 .295    |
| <b>Sleep efficiency (z)</b>   |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                   | 1.69                         | [1.28, 2.10]   | 0.21 | 8.11                            | < .001 | 1.47             | [1.24, 1.70]   | 0.12 | 12.63 < .001 |
| Sleep efficiency              | 0.01                         | [-0.06, 0.07]  | 0.03 | 0.15                            | .883   | -0.01            | [-0.07, 0.05]  | 0.03 | -0.41 .693   |
| Sleep efficiency <sup>2</sup> | 0.00                         | [-0.02, 0.02]  | 0.01 | 0.34                            | .736   | 0.00             | [-0.02, 0.02]  | 0.01 | 0.02 .985    |
| Age                           | -0.02                        | [-0.03, -0.02] | 0.00 | -5.98                           | .005   | -0.02            | [-0.03, -0.02] | 0.00 | -8.85 .001   |
| Sleep efficiency × bmi        | 0.00                         | [0.00, 0.00]   | 0.00 | -0.28                           | .792   | 0.00             | [0.00, 0.00]   | 0.00 | -0.26 .800   |
| <b>Sleep onset (z)</b>        |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                   | 1.70                         | [1.30, 2.11]   | 0.21 | 8.23                            | < .001 | 1.45             | [1.20, 1.71]   | 0.13 | 11.03 < .001 |
| Sleep onset                   | 0.03                         | [-0.03, 0.09]  | 0.03 | 1.02                            | .311   | 0.04             | [-0.03, 0.11]  | 0.04 | 1.21 .258    |
| Sleep onset <sup>2</sup>      | -0.02                        | [-0.06, 0.02]  | 0.02 | -1.14                           | .275   | 0.01             | [-0.04, 0.06]  | 0.02 | 0.50 .638    |
| Age                           | -0.02                        | [-0.03, -0.02] | 0.00 | -5.87                           | .005   | -0.02            | [-0.03, -0.02] | 0.00 | -9.00 .001   |
| Sleep onset × bmi             | 0.00                         | [0.00, 0.00]   | 0.00 | -1.05                           | .301   | 0.00             | [0.00, 0.00]   | 0.00 | -0.61 .555   |
| <b>Sleep regularity (z)</b>   |                              |                |      |                                 |        |                  |                |      |              |
| (Intercept)                   | 1.66                         | [1.25, 2.06]   | 0.21 | 8.00                            | < .001 | 1.49             | [1.26, 1.71]   | 0.11 | 13.19 < .001 |
| Sleep regularity              | 0.13                         | [0.03, 0.23]   | 0.05 | 2.63                            | .067   | 0.11             | [0.05, 0.17]   | 0.03 | 3.59 .002    |
| Sleep regularity <sup>2</sup> | -0.03                        | [-0.06, 0.00]  | 0.02 | -1.72                           | .087   | -0.05            | [-0.09, -0.02] | 0.02 | -2.96 .005   |

| Term                          | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |      |
|-------------------------------|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|------|
|                               | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p    |
| Age                           | -0.02                        | [-0.03, -0.02] | 0.00 | -6.00 | .005                            | -0.02   | [-0.03, -0.02] | 0.00 | -9.01 | .001 |
| Sleep regularity $\times$ bmi | 0.00                         | [0.01, 0.00]   | 0.00 | -0.77 | .488                            | 0.00    | [0.00, 0.00]   | 0.00 | -1.75 | .086 |

*Note.* Adjusted for SES, age, and sex. Outcomes variables are listed in the row headers.

Table 8

*Physical activity predicting sleep controlling for age, sex, and BMI.*

| Term                           | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |        |
|--------------------------------|------------------------------|------|-------|---------------------------------|----------------------|------|-------|--------|
|                                | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p      |
| Sleep duration (z)             |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                    | 0.22 [-0.03, 0.48]           | 0.13 | 1.72  | .086                            | 0.27 [0.02, 0.51]    | 0.13 | 2.13  | .033   |
| Physical activity              | 0.10 [0.05, 0.15]            | 0.02 | 4.14  | < .001                          | 0.06 [0.02, 0.10]    | 0.02 | 3.19  | .001   |
| Physical activity <sup>2</sup> | -0.01 [-0.02, 0.00]          | 0.01 | -1.87 | .062                            | 0.00 [-0.02, 0.03]   | 0.01 | 0.14  | .893   |
| Age                            | 0.00 [-0.01, 0.00]           | 0.00 | -0.97 | .330                            | 0.00 [-0.01, 0.00]   | 0.00 | -1.24 | .216   |
| Physical activity × sesmedium  | 0.00 [-0.07, 0.06]           | 0.03 | -0.11 | .913                            | 0.01 [-0.04, 0.06]   | 0.02 | 0.40  | .690   |
| Physical activity × sesshigh   | 0.02 [-0.04, 0.08]           | 0.03 | 0.53  | .593                            | 0.01 [-0.04, 0.05]   | 0.02 | 0.27  | .789   |
| Sleep efficiency (z)           |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                    | 0.22 [-0.02, 0.47]           | 0.12 | 1.78  | .076                            | 0.27 [0.01, 0.52]    | 0.13 | 2.07  | .038   |
| Physical activity              | 0.04 [-0.01, 0.09]           | 0.03 | 1.65  | .101                            | 0.00 [-0.03, 0.04]   | 0.02 | 0.10  | .919   |
| Physical activity <sup>2</sup> | -0.01 [-0.02, 0.00]          | 0.01 | -1.62 | .108                            | 0.01 [-0.01, 0.03]   | 0.01 | 1.13  | .258   |
| Age                            | 0.00 [0.00, 0.01]            | 0.00 | 1.07  | .287                            | 0.00 [0.00, 0.01]    | 0.00 | 0.56  | .576   |
| Physical activity × sesmedium  | 0.01 [-0.06, 0.07]           | 0.03 | 0.20  | .839                            | 0.00 [-0.05, 0.04]   | 0.02 | -0.10 | .921   |
| Physical activity × sesshigh   | 0.06 [-0.01, 0.12]           | 0.03 | 1.67  | .100                            | 0.04 [-0.01, 0.08]   | 0.02 | 1.63  | .103   |
| Sleep onset (z)                |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                    | 0.03 [-0.30, 0.36]           | 0.17 | 0.16  | .877                            | 0.00 [-0.32, 0.32]   | 0.16 | 0.01  | .994   |
| Physical activity              | -0.11 [-0.15, -0.08]         | 0.02 | -6.11 | < .001                          | -0.08 [-0.10, -0.05] | 0.01 | -5.66 | < .001 |
| Physical activity <sup>2</sup> | 0.01 [0.00, 0.02]            | 0.00 | 1.81  | .070                            | -0.01 [-0.02, 0.01]  | 0.01 | -0.79 | .435   |
| Age                            | 0.00 [0.00, 0.00]            | 0.00 | -0.90 | .368                            | 0.00 [0.00, 0.00]    | 0.00 | -0.68 | .496   |
| Physical activity × sesmedium  | 0.01 [-0.04, 0.06]           | 0.02 | 0.43  | .665                            | -0.02 [-0.06, 0.01]  | 0.02 | -1.22 | .223   |
| Physical activity × sesshigh   | 0.04 [-0.01, 0.08]           | 0.02 | 1.57  | .121                            | 0.02 [-0.02, 0.05]   | 0.02 | 1.07  | .286   |
| Sleep regularity (z)           |                              |      |       |                                 |                      |      |       |        |

| Term                           | Physical activity volume (z) |      |       | Physical activity intensity (z) |                     |      |       |        |
|--------------------------------|------------------------------|------|-------|---------------------------------|---------------------|------|-------|--------|
|                                | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]    | SE   | t     | p      |
| (Intercept)                    | 0.48 [0.27, 0.69]            | 0.11 | 4.43  | < .001                          | 0.64 [0.40, 0.88]   | 0.12 | 5.25  | < .001 |
| Physical activity              | 0.19 [0.13, 0.24]            | 0.03 | 6.77  | < .001                          | 0.07 [0.04, 0.11]   | 0.02 | 3.93  | < .001 |
| Physical activity <sup>2</sup> | -0.02 [-0.03, -0.01]         | 0.01 | -3.33 | .001                            | -0.01 [-0.03, 0.01] | 0.01 | -0.80 | .428   |
| Age                            | 0.00 [0.00, 0.01]            | 0.00 | 0.59  | .562                            | 0.00 [0.00, 0.00]   | 0.00 | -0.19 | .848   |
| Physical activity × sesmedium  | 0.06 [-0.02, 0.13]           | 0.04 | 1.43  | .185                            | 0.02 [-0.03, 0.06]  | 0.02 | 0.69  | .488   |
| Physical activity × seshigh    | 0.04 [-0.03, 0.11]           | 0.03 | 1.14  | .272                            | 0.05 [0.00, 0.10]   | 0.02 | 2.14  | .038   |

Note. Adjusted for age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 9

*Sleep predicting physical activity controlling for age, sex, and BMI*

| Term                          | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |        |
|-------------------------------|------------------------------|------|-------|---------------------------------|----------------------|------|-------|--------|
|                               | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p      |
| Sleep duration (z)            |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.70 [1.29, 2.11]            | 0.21 | 8.18  | < .001                          | 1.48 [1.25, 1.71]    | 0.12 | 12.68 | < .001 |
| Sleep duration                | 0.00 [-0.02, 0.02]           | 0.01 | -0.20 | .843                            | 0.01 [-0.01, 0.04]   | 0.01 | 1.21  | .226   |
| Sleep duration <sup>2</sup>   | -0.01 [-0.02, 0.00]          | 0.01 | -2.32 | .021                            | -0.01 [-0.02, 0.00]  | 0.01 | -1.57 | .116   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.94 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.80 | .001   |
| Sleep duration × sesmedium    | 0.01 [-0.02, 0.04]           | 0.02 | 0.60  | .547                            | -0.01 [-0.04, 0.02]  | 0.02 | -0.59 | .558   |
| Sleep duration × seshigh      | -0.02 [-0.05, 0.01]          | 0.02 | -1.60 | .109                            | -0.02 [-0.06, 0.01]  | 0.02 | -1.55 | .123   |
| Sleep efficiency (z)          |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.69 [1.28, 2.10]            | 0.21 | 8.11  | < .001                          | 1.48 [1.25, 1.71]    | 0.12 | 12.59 | < .001 |
| Sleep efficiency              | 0.02 [-0.01, 0.05]           | 0.01 | 1.34  | .186                            | -0.01 [-0.04, 0.01]  | 0.01 | -0.94 | .352   |
| Sleep efficiency <sup>2</sup> | 0.00 [0.00, 0.01]            | 0.00 | 0.96  | .339                            | 0.00 [-0.01, 0.00]   | 0.00 | -0.97 | .344   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.99 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.83 | .001   |
| Sleep efficiency × sesmedium  | -0.01 [-0.05, 0.02]          | 0.02 | -0.71 | .483                            | 0.00 [-0.03, 0.04]   | 0.02 | 0.02  | .984   |
| Sleep efficiency × seshigh    | -0.05 [-0.08, -0.01]         | 0.02 | -2.27 | .030                            | -0.01 [-0.05, 0.02]  | 0.02 | -0.74 | .459   |
| Sleep onset (z)               |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.69 [1.28, 2.10]            | 0.21 | 8.07  | < .001                          | 1.48 [1.25, 1.71]    | 0.12 | 12.59 | < .001 |
| Sleep onset                   | -0.01 [-0.03, 0.02]          | 0.01 | -0.41 | .686                            | 0.02 [0.00, 0.05]    | 0.01 | 1.70  | .089   |
| Sleep onset <sup>2</sup>      | -0.01 [-0.03, 0.01]          | 0.01 | -1.09 | .282                            | -0.01 [-0.02, 0.01]  | 0.01 | -0.84 | .401   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.98 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.92 | .001   |
| Sleep onset × sesmedium       | -0.02 [-0.06, 0.02]          | 0.02 | -0.85 | .405                            | -0.01 [-0.05, 0.03]  | 0.02 | -0.45 | .652   |
| Sleep onset × seshigh         | 0.03 [-0.01, 0.07]           | 0.02 | 1.61  | .111                            | 0.00 [-0.03, 0.04]   | 0.02 | 0.08  | .937   |
| Sleep regularity (z)          |                              |      |       |                                 |                      |      |       |        |

Table 9 continued

| Term                          | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|-------------------------------|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|                               | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| (Intercept)                   | 1.63 [1.23, 2.04]            | 0.20 | 7.99  | < .001 | 1.44 [1.22, 1.67]               | 0.11 | 12.57 | < .001 |
| Sleep regularity              | 0.10 [0.07, 0.13]            | 0.01 | 6.75  | < .001 | 0.06 [0.03, 0.09]               | 0.01 | 4.00  | < .001 |
| Sleep regularity <sup>2</sup> | -0.01 [-0.02, 0.01]          | 0.01 | -0.77 | .444   | -0.01 [-0.03, 0.01]             | 0.01 | -0.98 | .328   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.98 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -9.06 | .001   |
| Sleep regularity × sesmedium  | 0.00 [-0.04, 0.03]           | 0.02 | -0.22 | .823   | -0.01 [-0.05, 0.02]             | 0.02 | -0.66 | .508   |
| Sleep regularity × seshigh    | 0.00 [-0.04, 0.04]           | 0.02 | -0.04 | .966   | 0.02 [-0.02, 0.06]              | 0.02 | 0.98  | .327   |

Note. Adjusted for age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 10

*Physical activity predicting sleep controlling for SES, age, and BMI.*

| Term                           | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--------------------------------|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|                                | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Sleep duration (z)             |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.21 [-0.04, 0.47]           | 0.13 | 1.63  | .104   | 0.26 [0.02, 0.50]               | 0.12 | 2.09  | .037   |
| Physical activity              | 0.12 [0.08, 0.16]            | 0.02 | 5.74  | < .001 | 0.07 [0.04, 0.10]               | 0.02 | 4.31  | < .001 |
| Physical activity <sup>2</sup> | -0.01 [-0.02, 0.00]          | 0.01 | -1.12 | .262   | 0.01 [-0.01, 0.03]              | 0.01 | 1.24  | .213   |
| Age                            | 0.00 [-0.01, 0.00]           | 0.00 | -0.93 | .354   | 0.00 [-0.01, 0.00]              | 0.00 | -1.24 | .215   |
| Physical activity × sexmale    | -0.02 [-0.07, 0.03]          | 0.03 | -0.82 | .415   | 0.00 [-0.03, 0.04]              | 0.02 | 0.15  | .883   |
| Sleep efficiency (z)           |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.21 [-0.03, 0.45]           | 0.12 | 1.72  | .085   | 0.26 [0.00, 0.51]               | 0.13 | 1.98  | .048   |
| Physical activity              | 0.09 [0.06, 0.13]            | 0.02 | 4.72  | < .001 | 0.02 [-0.01, 0.05]              | 0.02 | 1.09  | .274   |
| Physical activity <sup>2</sup> | -0.02 [-0.03, -0.01]         | 0.01 | -3.01 | .003   | 0.02 [0.00, 0.04]               | 0.01 | 2.10  | .036   |
| Age                            | 0.00 [0.00, 0.01]            | 0.00 | 1.17  | .241   | 0.00 [0.00, 0.01]               | 0.00 | 0.61  | .545   |
| Physical activity × sexmale    | -0.05 [-0.10, 0.00]          | 0.03 | -2.02 | .044   | 0.00 [-0.04, 0.04]              | 0.02 | -0.03 | .972   |
| Sleep onset (z)                |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.02 [-0.31, 0.35]           | 0.17 | 0.14  | .888   | 0.00 [-0.32, 0.31]              | 0.16 | -0.03 | .976   |
| Physical activity              | -0.11 [-0.14, -0.08]         | 0.01 | -7.90 | < .001 | -0.08 [-0.10, -0.06]            | 0.01 | -7.06 | < .001 |
| Physical activity <sup>2</sup> | 0.01 [0.00, 0.02]            | 0.00 | 1.75  | .081   | -0.01 [-0.02, 0.01]             | 0.01 | -1.09 | .275   |
| Age                            | 0.00 [0.00, 0.00]            | 0.00 | -0.84 | .404   | 0.00 [0.00, 0.00]               | 0.00 | -0.68 | .499   |
| Physical activity × sexmale    | 0.03 [0.00, 0.07]            | 0.02 | 1.74  | .081   | 0.00 [-0.03, 0.03]              | 0.01 | 0.00  | .998   |
| Sleep regularity (z)           |                              |      |       |        |                                 |      |       |        |
| (Intercept)                    | 0.49 [0.28, 0.70]            | 0.11 | 4.56  | < .001 | 0.64 [0.40, 0.87]               | 0.12 | 5.26  | < .001 |
| Physical activity              | 0.23 [0.19, 0.26]            | 0.02 | 12.09 | < .001 | 0.09 [0.06, 0.12]               | 0.02 | 5.72  | < .001 |
| Physical activity <sup>2</sup> | -0.04 [-0.05, -0.03]         | 0.01 | -7.22 | < .001 | -0.01 [-0.03, 0.00]             | 0.01 | -1.55 | .122   |

| Term                               | Physical activity volume (z) |      |       |      | Physical activity intensity (z) |      |       |      |
|------------------------------------|------------------------------|------|-------|------|---------------------------------|------|-------|------|
|                                    | $\beta$ [95% CI]             | SE   | t     | p    | $\beta$ [95% CI]                | SE   | t     | p    |
| Age                                | 0.00 [0.00, 0.01]            | 0.00 | 0.60  | .554 | 0.00 [0.00, 0.00]               | 0.00 | -0.10 | .919 |
| Physical activity $\times$ sexmale | 0.00 [-0.05, 0.05]           | 0.02 | -0.05 | .957 | 0.02 [-0.02, 0.05]              | 0.02 | 0.88  | .378 |

Note. Adjusted for SES, age, and BMI. Outcomes variables are listed in the column headers.

Table 11

*Sleep predicting physical activity controlling for SES, age, and BMI*

| Term                          | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |        |
|-------------------------------|------------------------------|------|-------|---------------------------------|----------------------|------|-------|--------|
|                               | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p      |
| Sleep duration (z)            |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.70 [1.29, 2.11]            | 0.21 | 8.16  | < .001                          | 1.48 [1.25, 1.70]    | 0.12 | 12.66 | < .001 |
| Sleep duration                | -0.02 [-0.04, -0.01]         | 0.01 | -2.59 | .010                            | 0.01 [-0.01, 0.02]   | 0.01 | 0.72  | .473   |
| Sleep duration <sup>2</sup>   | -0.01 [-0.02, 0.00]          | 0.00 | -2.82 | .005                            | -0.01 [-0.02, 0.00]  | 0.00 | -1.65 | .100   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.98 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.84 | .001   |
| Sleep duration × sexmale      | 0.03 [0.01, 0.06]            | 0.01 | 2.44  | .015                            | -0.01 [-0.04, 0.02]  | 0.01 | -0.78 | .438   |
| Sleep efficiency (z)          |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.69 [1.28, 2.10]            | 0.21 | 8.09  | < .001                          | 1.48 [1.24, 1.71]    | 0.12 | 12.50 | < .001 |
| Sleep efficiency              | 0.01 [-0.01, 0.03]           | 0.01 | 0.89  | .374                            | -0.01 [-0.03, 0.01]  | 0.01 | -0.64 | .525   |
| Sleep efficiency <sup>2</sup> | 0.00 [0.00, 0.01]            | 0.00 | 0.65  | .518                            | 0.00 [-0.01, 0.00]   | 0.00 | -0.91 | .361   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.95 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.80 | .001   |
| Sleep efficiency × sexmale    | -0.02 [-0.05, 0.01]          | 0.01 | -1.45 | .149                            | -0.02 [-0.05, 0.00]  | 0.01 | -1.64 | .101   |
| Sleep onset (z)               |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.70 [1.29, 2.11]            | 0.21 | 8.15  | < .001                          | 1.48 [1.25, 1.71]    | 0.12 | 12.62 | < .001 |
| Sleep onset                   | 0.02 [0.00, 0.05]            | 0.01 | 2.22  | .027                            | 0.02 [0.00, 0.04]    | 0.01 | 2.10  | .036   |
| Sleep onset <sup>2</sup>      | -0.01 [-0.02, 0.00]          | 0.01 | -1.62 | .105                            | 0.00 [-0.02, 0.01]   | 0.01 | -0.50 | .617   |
| Age                           | -0.02 [-0.03, -0.02]         | 0.00 | -5.96 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -8.90 | .001   |
| Sleep onset × sexmale         | -0.05 [-0.08, -0.02]         | 0.01 | -3.42 | .001                            | 0.00 [-0.03, 0.03]   | 0.01 | -0.11 | .915   |
| Sleep regularity (z)          |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                   | 1.64 [1.24, 2.04]            | 0.21 | 8.00  | < .001                          | 1.45 [1.22, 1.67]    | 0.12 | 12.55 | < .001 |
| Sleep regularity              | 0.08 [0.06, 0.11]            | 0.01 | 7.70  | < .001                          | 0.06 [0.04, 0.08]    | 0.01 | 6.31  | < .001 |
| Sleep regularity <sup>2</sup> | -0.01 [-0.03, 0.00]          | 0.01 | -2.29 | .022                            | -0.02 [-0.03, -0.01] | 0.01 | -3.08 | .002   |

Table 11 continued

| Term                              | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |      |
|-----------------------------------|------------------------------|------|-------|---------------------------------|----------------------|------|-------|------|
|                                   | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p    |
| Age                               | -0.02 [-0.03, -0.01]         | 0.00 | -5.96 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -9.02 | .001 |
| Sleep regularity $\times$ sexmale | 0.02 [-0.01, 0.05]           | 0.01 | 1.56  | .119                            | -0.01 [-0.04, 0.02]  | 0.01 | -0.65 | .515 |

*Note.* Adjusted for SES, age, and BMI. Outcomes variables are listed in the row headers.

Table 12

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

TITLE

| Term   | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |        |
|--|------------------------------|------|-------|---------------------------------|----------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p      |
| <b>Sleep duration (z)</b>                        |                              |      |       |                                 |                      |      |       |        |
| (Intercept)                                      | 0.24 [-0.02, 0.50]           | 0.13 | 1.80  | .072                            | 0.29 [0.04, 0.54]    | 0.13 | 2.31  | .021   |
| Physical activity                                | 0.10 [0.05, 0.16]            | 0.03 | 3.74  | < .001                          | 0.12 [0.08, 0.15]    | 0.02 | 6.10  | < .001 |
| Weekdaymonday                                    | -0.05 [-0.10, 0.00]          | 0.03 | -1.86 | .063                            | -0.06 [-0.12, 0.00]  | 0.03 | -2.00 | .046   |
| Weekdaysaturday                                  | 0.06 [0.01, 0.11]            | 0.02 | 2.50  | .012                            | 0.08 [0.02, 0.14]    | 0.03 | 2.76  | .006   |
| Weekdaysunday                                    | 0.02 [-0.03, 0.07]           | 0.03 | 0.61  | .540                            | -0.01 [-0.07, 0.05]  | 0.03 | -0.33 | .743   |
| Weekdaythursday                                  | -0.05 [-0.10, 0.00]          | 0.03 | -1.94 | .052                            | -0.06 [-0.12, 0.00]  | 0.03 | -1.90 | .057   |
| Weekdaytuesday                                   | -0.07 [-0.12, -0.02]         | 0.03 | -2.90 | .004                            | -0.08 [-0.14, -0.02] | 0.03 | -2.61 | .009   |
| Weekdaywednesday                                 | -0.10 [-0.15, -0.05]         | 0.03 | -3.89 | < .001                          | -0.11 [-0.17, -0.05] | 0.03 | -3.71 | < .001 |
| Physical activity <sup>2</sup>                   | -0.01 [-0.03, 0.00]          | 0.01 | -1.69 | .091                            | -0.01 [-0.03, 0.02]  | 0.01 | -0.39 | .699   |
| Age  | 0.00 [-0.01, 0.00]           | 0.00 | -0.88 | .379                            | 0.00 [-0.01, 0.00]   | 0.00 | -1.15 | .251   |
| Physical activity × weekdaymonday                | -0.02 [-0.08, 0.05]          | 0.03 | -0.45 | .652                            | -0.05 [-0.10, -0.01] | 0.02 | -2.25 | .024   |
| Physical activity × weekdaysaturday              | 0.02 [-0.05, 0.08]           | 0.03 | 0.47  | .640                            | -0.09 [-0.14, -0.05] | 0.02 | -3.92 | < .001 |
| Physical activity × weekdaysunday                | 0.05 [-0.02, 0.12]           | 0.03 | 1.44  | .151                            | -0.07 [-0.12, -0.03] | 0.02 | -3.03 | .002   |
| Physical activity × weekdaythursday              | -0.04 [-0.11, 0.03]          | 0.04 | -1.09 | .277                            | -0.03 [-0.07, 0.02]  | 0.02 | -1.20 | .232   |
| Physical activity × weekdaytuesday               | 0.00 [-0.07, 0.07]           | 0.04 | 0.06  | .952                            | -0.03 [-0.07, 0.02]  | 0.02 | -1.19 | .235   |
| Physical activity × weekdaywednesday             | -0.02 [-0.10, 0.05]          | 0.04 | -0.66 | .509                            | -0.05 [-0.10, -0.01] | 0.02 | -2.22 | .026   |
| Weekdaymonday × Physical activity <sup>2</sup>   | 0.01 [-0.01, 0.03]           | 0.01 | 0.88  | .379                            | 0.01 [-0.02, 0.05]   | 0.02 | 0.72  | .471   |
| Weekdaysaturday × Physical activity <sup>2</sup> | 0.00 [-0.02, 0.02]           | 0.01 | 0.40  | .690                            | -0.02 [-0.06, 0.02]  | 0.02 | -0.98 | .325   |
| Weekdaysunday × Physical activity <sup>2</sup>   | -0.01 [-0.03, 0.01]          | 0.01 | -0.91 | .362                            | 0.01 [-0.03, 0.04]   | 0.02 | 0.32  | .750   |
| Weekdaythursday × Physical activity <sup>2</sup> | 0.02 [0.00, 0.05]            | 0.01 | 1.96  | .050                            | 0.03 [-0.01, 0.06]   | 0.02 | 1.41  | .159   |
| Weekdaytuesday × Physical activity <sup>2</sup>  | 0.01 [-0.01, 0.03]           | 0.01 | 0.76  | .445                            | 0.01 [-0.02, 0.05]   | 0.02 | 0.64  | .525   |

Table 12 continued

## TITLE

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Weekdaywednesday $\times$ Physical activity <sup>2</sup> | 0.01 [-0.01, 0.03]           | 0.01 | 0.97  | .332   | 0.02 [-0.02, 0.06]              | 0.02 | 1.15  | .249   |
| Sleep efficiency (z)                                     |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.27 [0.02, 0.52]            | 0.13 | 2.14  | .032   | 0.33 [0.08, 0.59]               | 0.13 | 2.55  | .011   |
| Physical activity  | 0.05 [-0.01, 0.10]           | 0.03 | 1.65  | .100   | 0.02 [-0.02, 0.06]              | 0.02 | 1.12  | .264   |
| Weekdaymonday  | -0.03 [-0.08, 0.02]          | 0.02 | -1.16 | .246   | -0.05 [-0.11, 0.01]             | 0.03 | -1.63 | .102   |
| Weekdaysaturday  | -0.09 [-0.14, -0.05]         | 0.02 | -3.87 | < .001 | -0.11 [-0.16, -0.05]            | 0.03 | -3.63 | < .001 |
| Weekdaysunday  | -0.11 [-0.16, -0.06]         | 0.03 | -4.19 | < .001 | -0.15 [-0.20, -0.09]            | 0.03 | -5.01 | < .001 |
| Weekdaythursday  | 0.00 [-0.05, 0.05]           | 0.03 | 0.04  | .970   | 0.00 [-0.06, 0.06]              | 0.03 | -0.11 | .914   |
| Weekdaytuesday   | -0.04 [-0.08, 0.01]          | 0.03 | -1.40 | .163   | -0.04 [-0.10, 0.02]             | 0.03 | -1.30 | .192   |
| Weekdaywednesday   | -0.04 [-0.09, 0.01]          | 0.03 | -1.54 | .125   | -0.04 [-0.10, 0.02]             | 0.03 | -1.26 | .207   |
| Physical activity <sup>2</sup>                           | -0.01 [-0.03, 0.01]          | 0.01 | -1.16 | .246   | 0.00 [-0.03, 0.03]              | 0.01 | 0.08  | .939   |
| Age  | 0.00 [0.00, 0.01]            | 0.00 | 1.06  | .288   | 0.00 [0.00, 0.00]               | 0.00 | 0.51  | .613   |
| Physical activity $\times$ weekdaymonday                 | 0.00 [-0.07, 0.07]           | 0.03 | 0.04  | .969   | -0.02 [-0.06, 0.03]             | 0.02 | -0.85 | .397   |
| Physical activity $\times$ weekdaysaturday               | 0.04 [-0.02, 0.11]           | 0.03 | 1.25  | .212   | -0.04 [-0.09, 0.00]             | 0.02 | -1.80 | .072   |
| Physical activity $\times$ weekdaysunday                 | 0.03 [-0.03, 0.10]           | 0.03 | 0.93  | .350   | -0.03 [-0.07, 0.02]             | 0.02 | -1.13 | .259   |
| Physical activity $\times$ weekdaythursday               | 0.01 [-0.06, 0.08]           | 0.04 | 0.21  | .835   | 0.00 [-0.04, 0.05]              | 0.02 | 0.07  | .946   |
| Physical activity $\times$ weekdaytuesday                | 0.01 [-0.06, 0.07]           | 0.03 | 0.19  | .853   | 0.01 [-0.04, 0.05]              | 0.02 | 0.29  | .768   |
| Physical activity $\times$ weekdaywednesday              | -0.01 [-0.08, 0.06]          | 0.04 | -0.39 | .699   | -0.01 [-0.06, 0.03]             | 0.02 | -0.63 | .528   |
| Weekdaymonday $\times$ Physical activity <sup>2</sup>    | 0.00 [-0.02, 0.02]           | 0.01 | -0.19 | .852   | 0.01 [-0.02, 0.05]              | 0.02 | 0.63  | .527   |
| Weekdaysaturday $\times$ Physical activity <sup>2</sup>  | 0.00 [-0.02, 0.02]           | 0.01 | -0.07 | .941   | 0.01 [-0.03, 0.05]              | 0.02 | 0.52  | .600   |
| Weekdaysunday $\times$ Physical activity <sup>2</sup>    | -0.01 [-0.03, 0.01]          | 0.01 | -0.64 | .520   | 0.03 [-0.01, 0.06]              | 0.02 | 1.40  | .160   |
| Weekdaythursday $\times$ Physical activity <sup>2</sup>  | -0.01 [-0.03, 0.02]          | 0.01 | -0.64 | .520   | 0.00 [-0.04, 0.03]              | 0.02 | -0.25 | .801   |
| Weekdaytuesday $\times$ Physical activity <sup>2</sup>   | 0.00 [-0.02, 0.02]           | 0.01 | 0.29  | .772   | 0.00 [-0.03, 0.04]              | 0.02 | 0.27  | .790   |

Table 12 continued

TITLE

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Weekdaywednesday $\times$ Physical activity <sup>2</sup> | 0.01 [-0.02, 0.03]           | 0.01 | 0.55  | .583   | 0.00 [-0.03, 0.04]              | 0.02 | 0.21  | .830   |
| Sleep onset (z)  |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.01 [-0.31, 0.34]           | 0.17 | 0.08  | .933   | -0.02 [-0.34, 0.30]             | 0.16 | -0.12 | .902   |
| Physical activity  | -0.08 [-0.12, -0.04]         | 0.02 | -4.04 | < .001 | -0.05 [-0.07, -0.02]            | 0.01 | -3.55 | < .001 |
| Weekdaymonday  | -0.07 [-0.10, -0.03]         | 0.02 | -3.78 | < .001 | -0.06 [-0.10, -0.02]            | 0.02 | -2.73 | .006   |
| Weekdaysaturday  | 0.10 [0.07, 0.13]            | 0.02 | 5.89  | < .001 | 0.08 [0.04, 0.12]               | 0.02 | 3.80  | < .001 |
| Weekdaysunday  | 0.07 [0.04, 0.11]            | 0.02 | 4.02  | < .001 | 0.06 [0.02, 0.10]               | 0.02 | 3.15  | .002   |
| Weekdaythursday  | -0.05 [-0.08, -0.01]         | 0.02 | -2.67 | .008   | -0.04 [-0.08, 0.00]             | 0.02 | -1.82 | .069   |
| Weekdaytuesday   | -0.04 [-0.08, -0.01]         | 0.02 | -2.53 | .011   | -0.04 [-0.08, 0.00]             | 0.02 | -1.83 | .067   |
| Weekdaywednesday   | -0.03 [-0.06, 0.01]          | 0.02 | -1.66 | .096   | -0.01 [-0.05, 0.03]             | 0.02 | -0.38 | .706   |
| Physical activity <sup>2</sup>                           | 0.01 [0.00, 0.02]            | 0.01 | 1.45  | .147   | 0.00 [-0.02, 0.02]              | 0.01 | -0.27 | .790   |
| Age  | 0.00 [0.00, 0.00]            | 0.00 | -0.72 | .469   | 0.00 [0.00, 0.00]               | 0.00 | -0.58 | .561   |
| Physical activity $\times$ weekdaymonday                 | -0.04 [-0.09, 0.00]          | 0.02 | -1.89 | .059   | -0.03 [-0.06, 0.00]             | 0.02 | -1.84 | .066   |
| Physical activity $\times$ weekdaysaturday               | 0.08 [0.03, 0.13]            | 0.02 | 3.42  | .001   | 0.01 [-0.03, 0.04]              | 0.02 | 0.36  | .718   |
| Physical activity $\times$ weekdaysunday                 | 0.01 [-0.04, 0.05]           | 0.02 | 0.25  | .804   | -0.07 [-0.10, -0.04]            | 0.02 | -4.29 | < .001 |
| Physical activity $\times$ weekdaythursday               | -0.05 [-0.10, 0.00]          | 0.03 | -1.80 | .072   | -0.03 [-0.06, 0.00]             | 0.02 | -1.92 | .055   |
| Physical activity $\times$ weekdaytuesday                | -0.06 [-0.11, -0.01]         | 0.02 | -2.38 | .017   | -0.02 [-0.05, 0.01]             | 0.02 | -1.05 | .292   |
| Physical activity $\times$ weekendwednesday              | -0.05 [-0.10, 0.00]          | 0.03 | -1.96 | .050   | 0.00 [-0.04, 0.03]              | 0.02 | -0.30 | .762   |
| Weekdaymonday $\times$ Physical activity <sup>2</sup>    | 0.00 [-0.01, 0.02]           | 0.01 | 0.27  | .786   | 0.00 [-0.02, 0.03]              | 0.01 | 0.14  | .887   |
| Weekdaysaturday $\times$ Physical activity <sup>2</sup>  | -0.02 [-0.03, 0.00]          | 0.01 | -2.27 | .023   | 0.01 [-0.02, 0.04]              | 0.01 | 0.77  | .443   |
| Weekdaysunday $\times$ Physical activity <sup>2</sup>    | 0.00 [-0.02, 0.01]           | 0.01 | -0.62 | .536   | -0.01 [-0.03, 0.02]             | 0.01 | -0.40 | .692   |
| Weekdaythursday $\times$ Physical activity <sup>2</sup>  | 0.00 [-0.02, 0.02]           | 0.01 | -0.11 | .910   | -0.01 [-0.03, 0.02]             | 0.01 | -0.57 | .567   |
| Weekdaytuesday $\times$ Physical activity <sup>2</sup>   | 0.00 [-0.01, 0.02]           | 0.01 | 0.68  | .498   | 0.00 [-0.02, 0.03]              | 0.01 | 0.13  | .899   |

Table 12 continued

## TITLE

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Weekdaywednesday $\times$ Physical activity <sup>2</sup> | 0.01 [-0.01, 0.02]           | 0.01 | 0.70  | .486   | -0.01 [-0.04, 0.01]             | 0.01 | -1.08 | .282   |
| Sleep regularity (z)                                     |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.49 [0.27, 0.71]            | 0.11 | 4.45  | < .001 | 0.65 [0.41, 0.90]               | 0.12 | 5.28  | < .001 |
| Physical activity  | 0.18 [0.12, 0.23]            | 0.03 | 6.73  | < .001 | 0.02 [-0.02, 0.05]              | 0.02 | 1.03  | .305   |
| Weekdaymonday  | 0.01 [-0.03, 0.06]           | 0.02 | 0.60  | .549   | 0.02 [-0.03, 0.07]              | 0.03 | 0.73  | .468   |
| Weekdaysaturday  | -0.12 [-0.16, -0.08]         | 0.02 | -5.48 | < .001 | -0.13 [-0.18, -0.08]            | 0.03 | -4.90 | < .001 |
| Weekdaysunday  | -0.17 [-0.22, -0.12]         | 0.03 | -6.81 | < .001 | -0.20 [-0.25, -0.14]            | 0.03 | -7.15 | < .001 |
| Weekdaythursday  | 0.18 [0.13, 0.22]            | 0.02 | 7.44  | < .001 | 0.20 [0.15, 0.26]               | 0.03 | 6.93  | < .001 |
| Weekdaytuesday   | 0.20 [0.15, 0.24]            | 0.02 | 8.13  | < .001 | 0.19 [0.14, 0.25]               | 0.03 | 6.98  | < .001 |
| Weekdaywednesday   | 0.21 [0.16, 0.26]            | 0.03 | 8.02  | < .001 | 0.22 [0.16, 0.28]               | 0.03 | 7.28  | < .001 |
| Physical activity <sup>2</sup>                           | -0.02 [-0.04, -0.01]         | 0.01 | -3.31 | .001   | 0.00 [-0.03, 0.02]              | 0.01 | -0.34 | .734   |
| Age  | 0.00 [0.00, 0.00]            | 0.00 | 0.34  | .736   | 0.00 [-0.01, 0.00]              | 0.00 | -0.46 | .651   |
| Physical activity $\times$ weekdaymonday                 | 0.06 [0.00, 0.12]            | 0.03 | 1.88  | .062   | 0.10 [0.05, 0.14]               | 0.02 | 4.10  | < .001 |
| Physical activity $\times$ weekdaysaturday               | 0.01 [-0.05, 0.07]           | 0.03 | 0.18  | .856   | -0.04 [-0.08, 0.00]             | 0.02 | -1.88 | .660   |
| Physical activity $\times$ weekdaysunday                 | 0.04 [-0.02, 0.11]           | 0.03 | 1.36  | .175   | -0.01 [-0.05, 0.04]             | 0.02 | -0.27 | .789   |
| Physical activity $\times$ weekdaythursday               | 0.01 [-0.05, 0.08]           | 0.03 | 0.33  | .744   | 0.08 [0.04, 0.12]               | 0.02 | 3.79  | < .001 |
| Physical activity $\times$ weekdaytuesday                | 0.01 [-0.06, 0.07]           | 0.03 | 0.18  | .858   | 0.13 [0.08, 0.17]               | 0.02 | 5.80  | < .001 |
| Physical activity $\times$ weekdaywednesday              | 0.03 [-0.04, 0.10]           | 0.03 | 0.86  | .390   | 0.10 [0.06, 0.15]               | 0.02 | 4.95  | < .001 |
| Weekdaymonday $\times$ Physical activity <sup>2</sup>    | -0.01 [-0.03, 0.01]          | 0.01 | -1.32 | .190   | -0.04 [-0.08, -0.01]            | 0.02 | -2.65 | .008   |
| Weekdaysaturday $\times$ Physical activity <sup>2</sup>  | 0.00 [-0.02, 0.02]           | 0.01 | 0.09  | .927   | 0.00 [-0.04, 0.03]              | 0.02 | -0.22 | .823   |
| Weekdaysunday $\times$ Physical activity <sup>2</sup>    | -0.01 [-0.03, 0.01]          | 0.01 | -0.90 | .368   | -0.01 [-0.05, 0.02]             | 0.02 | -0.86 | .389   |
| Weekdaythursday $\times$ Physical activity <sup>2</sup>  | 0.00 [-0.03, 0.02]           | 0.01 | -0.42 | .674   | -0.04 [-0.07, 0.00]             | 0.02 | -2.17 | .031   |
| Weekdaytuesday $\times$ Physical activity <sup>2</sup>   | 0.00 [-0.02, 0.02]           | 0.01 | 0.32  | .748   | -0.01 [-0.04, 0.03]             | 0.02 | -0.32 | .746   |

Table 12 continued

| Term   | Physical activity volume (z) |               |      |       | Physical activity intensity (z) |         |               |      |       |      |
|--|------------------------------|---------------|------|-------|---------------------------------|---------|---------------|------|-------|------|
|  | $\beta$                      | [95% CI]      | SE   | t     | p                               | $\beta$ | [95% CI]      | SE   | t     | p    |
| Weekdaywednesday $\times$ Physical activity <sup>2</sup> | -0.01                        | [-0.03, 0.01] | 0.01 | -1.04 | .299                            | -0.04   | [-0.07, 0.00] | 0.02 | -2.02 | .045 |

*Note.* Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 13

Sleep predicting physical activity controlling for SES, age, sex, and BMI

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Sleep duration (z)                            |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                   | 1.78 [1.37, 2.19]            | 0.21 | 8.51  | < .001 | 1.52 [1.29, 1.75]               | 0.12 | 12.98 | < .001 |
| Sleep duration                                | 0.05 [0.02, 0.08]            | 0.01 | 3.51  | < .001 | 0.07 [0.04, 0.10]               | 0.02 | 4.65  | < .001 |
| Weekdaymonday                                 | -0.16 [-0.19, -0.12]         | 0.02 | -8.10 | < .001 | -0.06 [-0.10, -0.02]            | 0.02 | -2.98 | .003   |
| Weekdaysaturday                               | -0.08 [-0.12, -0.05]         | 0.02 | -4.36 | < .001 | -0.07 [-0.11, -0.03]            | 0.02 | -3.62 | < .001 |
| Weekdaysunday                                 | -0.17 [-0.21, -0.13]         | 0.02 | -8.74 | < .001 | -0.17 [-0.21, -0.13]            | 0.02 | -8.72 | < .001 |
| Weekdaythursday                               | -0.03 [-0.07, 0.01]          | 0.02 | -1.66 | .099   | 0.03 [-0.01, 0.07]              | 0.02 | 1.37  | .173   |
| Weekdaytuesday                                | -0.05 [-0.09, -0.01]         | 0.02 | -2.72 | .007   | -0.02 [-0.06, 0.02]             | 0.02 | -0.91 | .362   |
| Weekdaywednesday                              | -0.06 [-0.10, -0.02]         | 0.02 | -3.09 | .002   | 0.01 [-0.03, 0.05]              | 0.02 | 0.60  | .550   |
| Sleep duration <sup>2</sup>                   | 0.00 [-0.02, 0.01]           | 0.01 | -0.17 | .866   | 0.02 [0.00, 0.03]               | 0.01 | 2.04  | .042   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.94 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.81 | .001   |
| Sleep duration × weekdaymonday                | -0.04 [-0.08, 0.00]          | 0.02 | -2.04 | .041   | -0.09 [-0.13, -0.05]            | 0.02 | -4.69 | < .001 |
| Sleep duration × weekdaysaturday              | -0.09 [-0.12, -0.05]         | 0.02 | -4.30 | < .001 | -0.11 [-0.15, -0.07]            | 0.02 | -5.38 | < .001 |
| Sleep duration × weekdaysunday                | -0.09 [-0.13, -0.05]         | 0.02 | -4.53 | < .001 | -0.11 [-0.15, -0.07]            | 0.02 | -5.39 | < .001 |
| Sleep duration × weekdaythursday              | -0.08 [-0.12, -0.03]         | 0.02 | -3.52 | < .001 | -0.02 [-0.06, 0.02]             | 0.02 | -0.98 | .330   |
| Sleep duration × weekdaytuesday               | -0.04 [-0.08, 0.00]          | 0.02 | -1.84 | .065   | -0.04 [-0.08, 0.00]             | 0.02 | -1.83 | .067   |
| Sleep duration × weekdaywednesday             | -0.04 [-0.08, 0.00]          | 0.02 | -1.74 | .082   | -0.02 [-0.07, 0.02]             | 0.02 | -1.18 | .237   |
| Weekdaymonday × Sleep duration <sup>2</sup>   | -0.01 [-0.03, 0.01]          | 0.01 | -0.53 | .595   | -0.03 [-0.05, -0.01]            | 0.01 | -2.86 | .005   |
| Weekdaysaturday × Sleep duration <sup>2</sup> | -0.02 [-0.04, 0.00]          | 0.01 | -1.65 | .100   | -0.04 [-0.06, -0.02]            | 0.01 | -3.46 | .001   |
| Weekdaysunday × Sleep duration <sup>2</sup>   | -0.01 [-0.04, 0.01]          | 0.01 | -1.18 | .240   | -0.03 [-0.05, -0.01]            | 0.01 | -2.59 | .013   |
| Weekdaythursday × Sleep duration <sup>2</sup> | -0.01 [-0.04, 0.02]          | 0.01 | -0.86 | .400   | -0.01 [-0.03, 0.02]             | 0.01 | -0.72 | .477   |
| Weekdaytuesday × Sleep duration <sup>2</sup>  | 0.00 [-0.03, 0.02]           | 0.01 | -0.37 | .714   | -0.02 [-0.04, 0.00]             | 0.01 | -1.68 | .092   |

Table 13 continued

## TITLE

| Term  | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |        |        |
|---|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|--------|--------|
|   | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t      | p      |
| Weekdaywednesday × Sleep duration <sup>2</sup>  | 0.00                         | [−0.02, 0.02]  | 0.01 | −0.23 | .815                            | −0.02   | [−0.04, 0.00]  | 0.01 | −1.93  | .053   |
| Sleep efficiency (z)                            |                              |                |      |       |                                 |         |                |      |        |        |
| (Intercept)                                     | 1.77                         | [1.36, 2.18]   | 0.21 | 8.47  | < .001                          | 1.53    | [1.29, 1.76]   | 0.12 | 12.94  | < .001 |
| Sleep efficiency                                | 0.01                         | [−0.02, 0.04]  | 0.02 | 0.66  | .511                            | −0.03   | [−0.06, 0.01]  | 0.02 | −1.61  | .114   |
| Weekdaymonday                                   | −0.16                        | [−0.19, −0.12] | 0.02 | −8.78 | < .001                          | −0.07   | [−0.10, −0.03] | 0.02 | −3.76  | < .001 |
| Weekdaysaturday                                 | −0.09                        | [−0.12, −0.05] | 0.02 | −5.07 | < .001                          | −0.09   | [−0.12, −0.05] | 0.02 | −5.04  | < .001 |
| Weekdaysunday                                   | −0.17                        | [−0.21, −0.14] | 0.02 | −9.70 | < .001                          | −0.18   | [−0.21, −0.14] | 0.02 | −10.07 | < .001 |
| Weekdaythursday                                 | −0.04                        | [−0.07, 0.00]  | 0.02 | −2.21 | .027                            | 0.02    | [−0.01, 0.06]  | 0.02 | 1.23   | .219   |
| Weekdaytuesday                                  | −0.05                        | [−0.08, −0.01] | 0.02 | −2.74 | .006                            | −0.03   | [−0.06, 0.01]  | 0.02 | −1.63  | .103   |
| Weekdaywednesday                                | −0.06                        | [−0.10, −0.03] | 0.02 | −3.46 | .001                            | 0.00    | [−0.04, 0.04]  | 0.02 | 0.02   | .984   |
| Sleep efficiency <sup>2</sup>                   | 0.00                         | [−0.01, 0.01]  | 0.01 | 0.55  | .583                            | 0.00    | [−0.01, 0.01]  | 0.01 | 0.08   | .934   |
| Age   | −0.02                        | [−0.03, −0.02] | 0.00 | −5.97 | .005                            | −0.02   | [−0.03, −0.02] | 0.00 | −8.77  | .001   |
| Sleep efficiency × weekdaymonday                | −0.01                        | [−0.05, 0.04]  | 0.02 | −0.38 | .705                            | 0.03    | [−0.02, 0.08]  | 0.03 | 1.29   | .205   |
| Sleep efficiency × weekdaysaturday              | −0.04                        | [−0.09, 0.00]  | 0.02 | −2.04 | .042                            | 0.01    | [−0.04, 0.05]  | 0.02 | 0.28   | .776   |
| Sleep efficiency × weekdaysunday                | 0.02                         | [−0.02, 0.07]  | 0.02 | 1.06  | .291                            | 0.06    | [0.02, 0.11]   | 0.02 | 2.84   | .005   |
| Sleep efficiency × weekdaythursday              | −0.02                        | [−0.06, 0.02]  | 0.02 | −0.86 | .391                            | −0.01   | [−0.05, 0.04]  | 0.02 | −0.22  | .823   |
| Sleep efficiency × weekdaytuesday               | −0.02                        | [−0.07, 0.02]  | 0.02 | −1.07 | .283                            | −0.02   | [−0.06, 0.03]  | 0.02 | −0.77  | .443   |
| Sleep efficiency × weekdaywednesday             | −0.02                        | [−0.06, 0.02]  | 0.02 | −0.86 | .391                            | −0.01   | [−0.06, 0.04]  | 0.02 | −0.36  | .724   |
| Weekdaymonday × Sleep efficiency <sup>2</sup>   | 0.00                         | [−0.02, 0.01]  | 0.01 | −0.18 | .857                            | −0.01   | [−0.02, 0.01]  | 0.01 | −0.94  | .349   |
| Weekdaysaturday × Sleep efficiency <sup>2</sup> | −0.01                        | [−0.02, 0.01]  | 0.01 | −1.03 | .303                            | 0.00    | [−0.02, 0.01]  | 0.01 | −0.43  | .670   |
| Weekdaysunday × Sleep efficiency <sup>2</sup>   | 0.00                         | [−0.02, 0.01]  | 0.01 | −0.24 | .809                            | 0.00    | [−0.02, 0.01]  | 0.01 | −0.50  | .619   |
| Weekdaythursday × Sleep efficiency <sup>2</sup> | 0.00                         | [−0.01, 0.01]  | 0.01 | 0.05  | .963                            | −0.01   | [−0.02, 0.00]  | 0.01 | −1.27  | .205   |
| Weekdaytuesday × Sleep efficiency <sup>2</sup>  | −0.01                        | [−0.02, 0.01]  | 0.01 | −1.14 | .252                            | 0.00    | [−0.02, 0.01]  | 0.01 | −0.70  | .482   |

Table 13 continued

## TITLE

| Term   | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|--|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|  | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| Weekdaywednesday × Sleep efficiency <sup>2</sup> | 0.00                         | [−0.01, 0.01]  | 0.01 | −0.03 | .979                            | −0.01   | [−0.02, 0.00]  | 0.01 | −1.37 | .171   |
| Sleep onset (z)                                  |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                                      | 1.78                         | [1.37, 2.19]   | 0.21 | 8.49  | < .001                          | 1.52    | [1.29, 1.75]   | 0.12 | 13.00 | < .001 |
| Sleep onset                                      | −0.03                        | [−0.06, 0.00]  | 0.02 | −1.95 | .052                            | −0.03   | [−0.06, 0.00]  | 0.02 | −1.78 | .075   |
| Weekdaymonday                                    | −0.18                        | [−0.22, −0.14] | 0.02 | −8.57 | < .001                          | −0.06   | [−0.10, −0.02] | 0.02 | −2.71 | .007   |
| Weekdaysaturday                                  | −0.10                        | [−0.14, −0.06] | 0.02 | −4.83 | < .001                          | −0.08   | [−0.12, −0.04] | 0.02 | −4.05 | < .001 |
| Weekdaysunday                                    | −0.18                        | [−0.22, −0.14] | 0.02 | −8.75 | < .001                          | −0.19   | [−0.23, −0.15] | 0.02 | −8.95 | < .001 |
| Weekdaythursday                                  | −0.04                        | [−0.08, 0.00]  | 0.02 | −1.73 | .083                            | 0.03    | [−0.01, 0.07]  | 0.02 | 1.55  | .122   |
| Weekdaytuesday                                   | −0.05                        | [−0.09, −0.01] | 0.02 | −2.56 | .011                            | −0.02   | [−0.06, 0.02]  | 0.02 | −0.96 | .337   |
| Weekdaywednesday                                 | −0.08                        | [−0.12, −0.04] | 0.02 | −3.61 | < .001                          | 0.00    | [−0.04, 0.05]  | 0.02 | 0.22  | .827   |
| Sleep onset <sup>2</sup>                         | −0.01                        | [−0.04, 0.01]  | 0.01 | −1.17 | .242                            | 0.01    | [−0.01, 0.03]  | 0.01 | 0.95  | .340   |
| Age  | −0.02                        | [−0.03, −0.02] | 0.00 | −5.96 | .005                            | −0.02   | [−0.03, −0.02] | 0.00 | −8.92 | .001   |
| Sleep onset × weekdaymonday                      | 0.02                         | [−0.02, 0.05]  | 0.02 | 0.96  | .338                            | 0.09    | [0.06, 0.13]   | 0.02 | 5.08  | < .001 |
| Sleep onset × weekdaysaturday                    | 0.05                         | [0.02, 0.09]   | 0.02 | 2.87  | .004                            | 0.09    | [0.05, 0.13]   | 0.02 | 4.85  | < .001 |
| Sleep onset × weekdaysunday                      | 0.09                         | [0.06, 0.13]   | 0.02 | 5.02  | < .001                          | 0.14    | [0.10, 0.18]   | 0.02 | 7.46  | < .001 |
| Sleep onset × weekdaythursday                    | 0.05                         | [0.01, 0.09]   | 0.02 | 2.35  | .019                            | 0.00    | [−0.04, 0.04]  | 0.02 | −0.12 | .908   |
| Sleep onset × weekdaytuesday                     | 0.02                         | [−0.02, 0.06]  | 0.02 | 1.03  | .302                            | 0.01    | [−0.02, 0.05]  | 0.02 | 0.74  | .460   |
| Sleep onset × weekdaywednesday                   | 0.00                         | [−0.03, 0.04]  | 0.02 | 0.25  | .803                            | 0.01    | [−0.03, 0.05]  | 0.02 | 0.41  | .682   |
| Weekdaymonday × Sleep onset <sup>2</sup>         | 0.03                         | [0.00, 0.06]   | 0.01 | 1.90  | .058                            | −0.03   | [−0.06, 0.00]  | 0.01 | −2.22 | .027   |
| Weekdaysaturday × Sleep onset <sup>2</sup>       | 0.01                         | [−0.02, 0.04]  | 0.02 | 0.52  | .606                            | −0.02   | [−0.05, 0.01]  | 0.02 | −1.36 | .172   |
| Weekdaysunday × Sleep onset <sup>2</sup>         | 0.00                         | [−0.03, 0.03]  | 0.02 | −0.08 | .940                            | −0.02   | [−0.05, 0.01]  | 0.01 | −1.62 | .105   |
| Weekdaythursday × Sleep onset <sup>2</sup>       | 0.00                         | [−0.03, 0.03]  | 0.02 | −0.12 | .908                            | −0.02   | [−0.05, 0.01]  | 0.02 | −1.21 | .227   |
| Weekdaytuesday × Sleep onset <sup>2</sup>        | 0.00                         | [−0.03, 0.03]  | 0.02 | 0.07  | .943                            | −0.02   | [−0.05, 0.01]  | 0.02 | −1.05 | .292   |

Table 13 continued

## TITLE

| Term  | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|---|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|   | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| Weekdaywednesday × Sleep onset <sup>2</sup>     | 0.02                         | [-0.01, 0.05]  | 0.02 | 1.33  | .184                            | -0.01   | [-0.05, 0.02]  | 0.02 | -0.96 | .339   |
| Sleep regularity (z)                            |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                                     | 1.69                         | [1.29, 2.10]   | 0.21 | 8.26  | < .001                          | 1.50    | [1.27, 1.72]   | 0.12 | 12.89 | < .001 |
| Sleep regularity                                | 0.12                         | [0.09, 0.15]   | 0.02 | 6.96  | < .001                          | 0.04    | [0.01, 0.07]   | 0.02 | 2.50  | .013   |
| Weekdaymonday                                   | -0.12                        | [-0.16, -0.08] | 0.02 | -6.06 | < .001                          | -0.06   | [-0.10, -0.02] | 0.02 | -2.98 | .003   |
| Weekdaysaturday                                 | -0.04                        | [-0.08, 0.00]  | 0.02 | -1.97 | .049                            | -0.05   | [-0.09, -0.01] | 0.02 | -2.57 | .010   |
| Weekdaysunday                                   | -0.13                        | [-0.16, -0.09] | 0.02 | -6.40 | < .001                          | -0.16   | [-0.20, -0.12] | 0.02 | -8.14 | < .001 |
| Weekdaythursday                                 | 0.00                         | [-0.04, 0.04]  | 0.02 | -0.22 | .822                            | 0.03    | [-0.01, 0.07]  | 0.02 | 1.24  | .215   |
| Weekdaytuesday                                  | -0.03                        | [-0.07, 0.01]  | 0.02 | -1.48 | .138                            | -0.03   | [-0.07, 0.01]  | 0.02 | -1.31 | .190   |
| Weekdaywednesday                                | -0.04                        | [-0.08, 0.00]  | 0.02 | -1.98 | .048                            | -0.01   | [-0.05, 0.04]  | 0.02 | -0.28 | .780   |
| Sleep regularity <sup>2</sup>                   | 0.01                         | [-0.01, 0.04]  | 0.01 | 1.24  | .216                            | 0.00    | [-0.02, 0.02]  | 0.01 | -0.09 | .929   |
| Age   | -0.02                        | [-0.03, -0.01] | 0.00 | -5.96 | .005                            | -0.02   | [-0.03, -0.02] | 0.00 | -8.98 | .001   |
| Sleep regularity × weekdaymonday                | -0.03                        | [-0.09, 0.03]  | 0.03 | -1.05 | .308                            | 0.00    | [-0.05, 0.05]  | 0.02 | 0.00  | .998   |
| Sleep regularity × weekdaysaturday              | -0.05                        | [-0.10, -0.01] | 0.02 | -2.41 | .016                            | 0.01    | [-0.03, 0.05]  | 0.02 | 0.36  | .720   |
| Sleep regularity × weekdaysunday                | 0.00                         | [-0.05, 0.05]  | 0.02 | 0.02  | .983                            | 0.03    | [-0.02, 0.08]  | 0.02 | 1.23  | .221   |
| Sleep regularity × weekdaythursday              | -0.05                        | [-0.10, -0.01] | 0.02 | -2.31 | .022                            | 0.00    | [-0.04, 0.04]  | 0.02 | -0.08 | .939   |
| Sleep regularity × weekdaytuesday               | -0.05                        | [-0.09, -0.01] | 0.02 | -2.27 | .023                            | 0.00    | [-0.04, 0.05]  | 0.02 | 0.09  | .932   |
| Sleep regularity × weekendwednesday             | -0.05                        | [-0.09, -0.01] | 0.02 | -2.23 | .026                            | 0.01    | [-0.04, 0.05]  | 0.02 | 0.23  | .815   |
| Weekdaymonday × Sleep regularity <sup>2</sup>   | -0.01                        | [-0.04, 0.02]  | 0.02 | -0.68 | .499                            | -0.01   | [-0.03, 0.02]  | 0.01 | -0.40 | .690   |
| Weekdaysaturday × Sleep regularity <sup>2</sup> | -0.06                        | [-0.09, -0.03] | 0.02 | -3.62 | < .001                          | -0.05   | [-0.08, -0.02] | 0.02 | -3.18 | .001   |
| Weekdaysunday × Sleep regularity <sup>2</sup>   | -0.03                        | [-0.06, 0.00]  | 0.02 | -1.76 | .079                            | -0.02   | [-0.05, 0.02]  | 0.02 | -1.03 | .306   |
| Weekdaythursday × Sleep regularity <sup>2</sup> | -0.04                        | [-0.07, -0.01] | 0.02 | -2.57 | .010                            | -0.01   | [-0.05, 0.02]  | 0.02 | -0.86 | .388   |
| Weekdaytuesday × Sleep regularity <sup>2</sup>  | -0.02                        | [-0.05, 0.01]  | 0.02 | -1.06 | .291                            | 0.00    | [-0.03, 0.03]  | 0.02 | -0.16 | .872   |

Table 13 continued

| Term  | Physical activity volume (z) |          |       |      | Physical activity intensity (z) |         |          |       |      |
|---|------------------------------|----------|-------|------|---------------------------------|---------|----------|-------|------|
|   | $\beta$                      | [95% CI] | SE    | t    | p                               | $\beta$ | [95% CI] | SE    | t    |
| Weekdaywednesday $\times$ Sleep regularity <sup>2</sup> | -0.03 [-0.06, 0.01]          | 0.02     | -1.47 | .144 | -0.01 [-0.04, 0.03]             | 0.02    | 0.02     | -0.32 | .750 |

*Note.* Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 14

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |      |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p    |
| <b>Sleep duration (z)</b>                     |                              |      |       |        |                                 |      |       |      |
| (Intercept)                                   | 0.25 [-0.01, 0.50]           | 0.13 | 1.87  | .061   | 0.29 [0.04, 0.53]               | 0.13 | 2.28  | .023 |
| Physical activity                             | 0.11 [0.07, 0.16]            | 0.02 | 4.74  | < .001 | 0.06 [0.02, 0.09]               | 0.02 | 3.18  | .001 |
| Seasonspring                                  | -0.10 [-0.17, -0.03]         | 0.04 | -2.75 | .006   | -0.07 [-0.14, 0.01]             | 0.04 | -1.80 | .072 |
| Seasonsummer                                  | -0.15 [-0.23, -0.08]         | 0.04 | -3.89 | < .001 | -0.13 [-0.21, -0.05]            | 0.04 | -3.11 | .002 |
| Seasonwinter                                  | 0.03 [-0.03, 0.10]           | 0.03 | 1.01  | .311   | 0.04 [-0.04, 0.11]              | 0.04 | 0.97  | .330 |
| Physical activity <sup>2</sup>                | -0.01 [-0.02, 0.00]          | 0.00 | -1.37 | .170   | 0.01 [-0.01, 0.04]              | 0.01 | 1.08  | .278 |
| Age   | 0.00 [-0.01, 0.00]           | 0.00 | -0.64 | .522   | 0.00 [-0.01, 0.00]              | 0.00 | -0.98 | .327 |
| Physical activity × seasonspring              | -0.04 [-0.10, 0.03]          | 0.03 | -1.08 | .280   | 0.00 [-0.05, 0.05]              | 0.02 | 0.05  | .957 |
| Physical activity × seasonsummer              | 0.02 [-0.06, 0.10]           | 0.04 | 0.38  | .702   | -0.02 [-0.07, 0.04]             | 0.03 | -0.53 | .598 |
| Physical activity × seasonwinter              | 0.02 [-0.05, 0.08]           | 0.03 | 0.56  | .576   | 0.03 [-0.02, 0.07]              | 0.03 | 1.02  | .307 |
| Seasonspring × Physical activity <sup>2</sup> | 0.01 [-0.01, 0.03]           | 0.01 | 0.81  | .415   | -0.01 [-0.05, 0.02]             | 0.02 | -0.86 | .388 |
| Seasonsummer × Physical activity <sup>2</sup> | -0.01 [-0.04, 0.01]          | 0.01 | -0.91 | .363   | -0.02 [-0.06, 0.02]             | 0.02 | -1.15 | .249 |
| Seasonwinter × Physical activity <sup>2</sup> | -0.01 [-0.03, 0.00]          | 0.01 | -1.57 | .117   | -0.01 [-0.05, 0.02]             | 0.02 | -0.69 | .491 |
| <b>Sleep efficiency (z)</b>                   |                              |      |       |        |                                 |      |       |      |
| (Intercept)                                   | 0.22 [-0.03, 0.46]           | 0.13 | 1.74  | .083   | 0.28 [0.02, 0.54]               | 0.13 | 2.15  | .032 |
| Physical activity                             | 0.07 [0.02, 0.11]            | 0.02 | 2.82  | .005   | 0.01 [-0.03, 0.04]              | 0.02 | 0.36  | .718 |
| Seasonspring                                  | -0.05 [-0.12, 0.02]          | 0.04 | -1.37 | .172   | -0.07 [-0.15, 0.00]             | 0.04 | -1.87 | .062 |
| Seasonsummer                                  | -0.03 [-0.11, 0.05]          | 0.04 | -0.82 | .414   | -0.05 [-0.13, 0.04]             | 0.04 | -1.07 | .285 |
| Seasonwinter                                  | 0.03 [-0.04, 0.09]           | 0.03 | 0.73  | .464   | 0.01 [-0.06, 0.08]              | 0.04 | 0.28  | .776 |
| Physical activity <sup>2</sup>                | -0.01 [-0.02, 0.00]          | 0.00 | -2.20 | .028   | 0.00 [-0.02, 0.02]              | 0.01 | 0.02  | .986 |
| Age   | 0.00 [0.00, 0.01]            | 0.00 | 1.30  | .194   | 0.00 [0.00, 0.01]               | 0.00 | 0.75  | .453 |

Table 14 continued

TITLE

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Physical activity $\times$ seasonspring              | -0.03 [-0.10, 0.03]          | 0.03 | -0.99 | .323   | 0.01 [-0.04, 0.06]              | 0.02 | 0.45  | .654   |
| Physical activity $\times$ seasonsummer              | 0.05 [-0.03, 0.13]           | 0.04 | 1.26  | .207   | 0.03 [-0.03, 0.09]              | 0.03 | 0.96  | .339   |
| Physical activity $\times$ seasonwinter              | 0.01 [-0.05, 0.08]           | 0.03 | 0.44  | .661   | 0.01 [-0.04, 0.06]              | 0.03 | 0.33  | .738   |
| Seasonspring $\times$ Physical activity <sup>2</sup> | 0.01 [-0.01, 0.03]           | 0.01 | 0.73  | .463   | 0.03 [0.00, 0.06]               | 0.02 | 1.84  | .066   |
| Seasonsummer $\times$ Physical activity <sup>2</sup> | -0.02 [-0.05, 0.00]          | 0.01 | -1.68 | .094   | 0.01 [-0.03, 0.04]              | 0.02 | 0.25  | .804   |
| Seasonwinter $\times$ Physical activity <sup>2</sup> | 0.00 [-0.02, 0.01]           | 0.01 | -0.65 | .514   | 0.01 [-0.02, 0.04]              | 0.02 | 0.54  | .591   |
| Sleep onset (z)                                      |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.00 [-0.33, 0.33]           | 0.17 | 0.01  | .991   | -0.02 [-0.34, 0.29]             | 0.16 | -0.15 | .882   |
| Physical activity                                    | -0.09 [-0.12, -0.05]         | 0.02 | -5.22 | < .001 | -0.08 [-0.11, -0.06]            | 0.01 | -6.28 | < .001 |
| Seasonspring   | 0.03 [-0.02, 0.08]           | 0.03 | 1.24  | .214   | 0.03 [-0.03, 0.08]              | 0.03 | 1.01  | .313   |
| Seasonsummer   | 0.04 [-0.01, 0.10]           | 0.03 | 1.53  | .126   | 0.04 [-0.02, 0.10]              | 0.03 | 1.21  | .225   |
| Seasonwinter   | 0.03 [-0.02, 0.08]           | 0.03 | 1.18  | .240   | 0.04 [-0.02, 0.09]              | 0.03 | 1.40  | .162   |
| Physical activity <sup>2</sup>                       | 0.00 [0.00, 0.01]            | 0.00 | 1.48  | .139   | 0.00 [-0.02, 0.01]              | 0.01 | -0.27 | .790   |
| Age  | 0.00 [0.00, 0.00]            | 0.00 | -0.89 | .372   | 0.00 [0.00, 0.00]               | 0.00 | -0.73 | .465   |
| Physical activity $\times$ seasonspring              | -0.02 [-0.07, 0.03]          | 0.02 | -0.88 | .381   | 0.01 [-0.03, 0.04]              | 0.02 | 0.32  | .747   |
| Physical activity $\times$ seasonsummer              | 0.00 [-0.06, 0.06]           | 0.03 | -0.04 | .966   | 0.04 [0.00, 0.08]               | 0.02 | 1.99  | .047   |
| Physical activity $\times$ seasonwinter              | -0.02 [-0.06, 0.03]          | 0.02 | -0.73 | .465   | 0.00 [-0.04, 0.03]              | 0.02 | -0.15 | .880   |
| Seasonspring $\times$ Physical activity <sup>2</sup> | 0.00 [-0.01, 0.02]           | 0.01 | 0.65  | .516   | 0.00 [-0.02, 0.02]              | 0.01 | -0.09 | .925   |
| Seasonsummer $\times$ Physical activity <sup>2</sup> | 0.01 [-0.01, 0.02]           | 0.01 | 0.67  | .500   | 0.01 [-0.02, 0.03]              | 0.01 | 0.46  | .647   |
| Seasonwinter $\times$ Physical activity <sup>2</sup> | 0.00 [-0.01, 0.01]           | 0.01 | 0.56  | .577   | -0.01 [-0.03, 0.01]             | 0.01 | -0.74 | .462   |
| Sleep regularity (z)                                 |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.49 [0.27, 0.70]            | 0.11 | 4.47  | < .001 | 0.65 [0.41, 0.88]               | 0.12 | 5.35  | < .001 |
| Physical activity                                    | 0.21 [0.17, 0.25]            | 0.02 | 9.27  | < .001 | 0.10 [0.06, 0.13]               | 0.02 | 5.29  | < .001 |

Table 14 continued

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |      |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p    |
| Seasonspring                                  | -0.05 [-0.12, 0.02]          | 0.04 | -1.53 | .126   | -0.09 [-0.16, -0.01]            | 0.04 | -2.27 | .023 |
| Seasonsummer                                  | 0.02 [-0.06, 0.09]           | 0.04 | 0.47  | .635   | -0.01 [-0.09, 0.07]             | 0.04 | -0.15 | .883 |
| Seasonwinter                                  | 0.00 [-0.06, 0.07]           | 0.03 | 0.06  | .948   | -0.05 [-0.12, 0.03]             | 0.04 | -1.24 | .214 |
| Physical activity <sup>2</sup>                | -0.03 [-0.04, -0.02]         | 0.00 | -5.79 | < .001 | -0.04 [-0.06, -0.01]            | 0.01 | -3.09 | .002 |
| Age   | 0.00 [0.00, 0.01]            | 0.00 | 0.84  | .412   | 0.00 [0.00, 0.00]               | 0.00 | 0.13  | .900 |
| Physical activity × seasonspring              | 0.05 [-0.01, 0.12]           | 0.03 | 1.56  | .120   | -0.03 [-0.08, 0.02]             | 0.02 | -1.32 | .187 |
| Physical activity × seasonsummer              | -0.03 [-0.11, 0.05]          | 0.04 | -0.77 | .441   | 0.01 [-0.05, 0.07]              | 0.03 | 0.33  | .744 |
| Physical activity × seasonwinter              | 0.04 [-0.02, 0.11]           | 0.03 | 1.38  | .169   | 0.05 [0.00, 0.10]               | 0.02 | 2.02  | .044 |
| Seasonspring × Physical activity <sup>2</sup> | -0.03 [-0.05, -0.01]         | 0.01 | -3.33 | .001   | 0.01 [-0.02, 0.04]              | 0.02 | 0.73  | .465 |
| Seasonsummer × Physical activity <sup>2</sup> | 0.00 [-0.03, 0.03]           | 0.01 | 0.01  | .989   | 0.04 [0.00, 0.08]               | 0.02 | 2.07  | .039 |
| Seasonwinter × Physical activity <sup>2</sup> | 0.00 [-0.02, 0.01]           | 0.01 | -0.67 | .506   | 0.04 [0.01, 0.07]               | 0.02 | 2.48  | .013 |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 15

*Sleep predicting physical activity controlling for SES, age, sex, and BMI*

| Term                                       | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Sleep duration (z)                         |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                | 1.68 [1.27, 2.09]            | 0.21 | 8.04  | < .001 | 1.49 [1.26, 1.73]               | 0.12 | 12.50 | < .001 |
| Sleep duration                             | 0.00 [-0.02, 0.03]           | 0.01 | 0.20  | .840   | 0.02 [-0.01, 0.04]              | 0.01 | 1.35  | .177   |
| Seasonspring                               | 0.00 [-0.06, 0.07]           | 0.03 | 0.15  | .883   | -0.07 [-0.13, -0.02]            | 0.03 | -2.58 | .010   |
| Seasonsummer                               | 0.03 [-0.04, 0.10]           | 0.03 | 0.89  | .374   | -0.05 [-0.11, 0.01]             | 0.03 | -1.58 | .115   |
| Seasonwinter                               | 0.03 [-0.03, 0.09]           | 0.03 | 0.86  | .388   | 0.00 [-0.05, 0.05]              | 0.03 | 0.04  | .970   |
| Sleep duration <sup>2</sup>                | -0.01 [-0.02, 0.01]          | 0.01 | -0.96 | .340   | 0.00 [-0.01, 0.01]              | 0.01 | 0.13  | .895   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -5.99 | .004   | -0.02 [-0.03, -0.02]            | 0.00 | -8.79 | .001   |
| Sleep duration × seasonspring              | -0.03 [-0.06, 0.00]          | 0.02 | -1.72 | .087   | -0.03 [-0.06, 0.00]             | 0.02 | -1.90 | .058   |
| Sleep duration × seasonsummer              | -0.04 [-0.08, 0.00]          | 0.02 | -2.00 | .046   | -0.03 [-0.07, 0.01]             | 0.02 | -1.27 | .204   |
| Sleep duration × seasonwinter              | 0.02 [-0.02, 0.05]           | 0.02 | 0.91  | .360   | -0.01 [-0.04, 0.03]             | 0.02 | -0.46 | .648   |
| Seasonspring × Sleep duration <sup>2</sup> | 0.00 [-0.02, 0.01]           | 0.01 | -0.38 | .702   | -0.01 [-0.03, 0.01]             | 0.01 | -1.34 | .181   |
| Seasonsummer × Sleep duration <sup>2</sup> | -0.02 [-0.04, 0.00]          | 0.01 | -1.91 | .056   | -0.02 [-0.04, 0.00]             | 0.01 | -2.17 | .030   |
| Seasonwinter × Sleep duration <sup>2</sup> | -0.01 [-0.03, 0.00]          | 0.01 | -1.38 | .169   | -0.02 [-0.03, 0.00]             | 0.01 | -1.73 | .087   |
| Sleep efficiency (z)                       |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                | 1.68 [1.27, 2.09]            | 0.21 | 8.02  | < .001 | 1.50 [1.27, 1.74]               | 0.12 | 12.59 | < .001 |
| Sleep efficiency                           | 0.00 [-0.03, 0.03]           | 0.01 | -0.08 | .935   | -0.01 [-0.04, 0.02]             | 0.01 | -0.81 | .418   |
| Seasonspring                               | 0.01 [-0.05, 0.07]           | 0.03 | 0.30  | .763   | -0.08 [-0.13, -0.02]            | 0.03 | -2.86 | .004   |
| Seasonsummer                               | 0.03 [-0.04, 0.09]           | 0.03 | 0.85  | .394   | -0.06 [-0.12, 0.00]             | 0.03 | -2.02 | .043   |
| Seasonwinter                               | 0.02 [-0.04, 0.08]           | 0.03 | 0.62  | .535   | -0.01 [-0.07, 0.04]             | 0.03 | -0.57 | .568   |
| Sleep efficiency <sup>2</sup>              | 0.00 [0.00, 0.01]            | 0.00 | 0.57  | .566   | 0.00 [-0.01, 0.00]              | 0.00 | -0.65 | .515   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -6.01 | .004   | -0.02 [-0.03, -0.02]            | 0.00 | -8.80 | .001   |

Table 15 continued

| Term  | Physical activity volume (z) |                |      |       |        | Physical activity intensity (z) |                |      |       |        |
|---|------------------------------|----------------|------|-------|--------|---------------------------------|----------------|------|-------|--------|
|   | $\beta$                      | [95% CI]       | SE   | t     | p      | $\beta$                         | [95% CI]       | SE   | t     | p      |
| Sleep efficiency $\times$ seasonspring              | 0.00                         | [0.04, 0.03]   | 0.02 | -0.12 | .905   | -0.02                           | [-0.06, 0.01]  | 0.02 | -1.19 | .235   |
| Sleep efficiency $\times$ seasonsummer              | 0.01                         | [-0.04, 0.05]  | 0.02 | 0.23  | .817   | 0.01                            | [-0.03, 0.05]  | 0.02 | 0.36  | .718   |
| Sleep efficiency $\times$ seasonwinter              | 0.00                         | [-0.04, 0.04]  | 0.02 | -0.13 | .897   | -0.01                           | [-0.04, 0.03]  | 0.02 | -0.42 | .672   |
| Seasonspring $\times$ Sleep efficiency <sup>2</sup> | 0.00                         | [-0.01, 0.01]  | 0.01 | -0.20 | .842   | 0.00                            | [-0.01, 0.01]  | 0.01 | -0.83 | .406   |
| Seasonsummer $\times$ Sleep efficiency <sup>2</sup> | -0.01                        | [-0.02, 0.01]  | 0.01 | -0.89 | .373   | -0.01                           | [-0.02, 0.01]  | 0.01 | -1.08 | .282   |
| Seasonwinter $\times$ Sleep efficiency <sup>2</sup> | 0.00                         | [-0.02, 0.01]  | 0.01 | -0.56 | .577   | 0.00                            | [-0.01, 0.01]  | 0.01 | 0.10  | .919   |
| Sleep onset (z)                                     |                              |                |      |       |        |                                 |                |      |       |        |
| (Intercept)   | 1.68                         | [1.27, 2.09]   | 0.21 | 8.02  | < .001 | 1.51                            | [1.27, 1.74]   | 0.12 | 12.71 | < .001 |
| Sleep onset   | 0.00                         | [-0.02, 0.03]  | 0.01 | 0.13  | .895   | 0.02                            | [-0.01, 0.04]  | 0.01 | 1.20  | .230   |
| Seasonspring  | 0.01                         | [-0.05, 0.07]  | 0.03 | 0.29  | .769   | -0.09                           | [-0.14, -0.03] | 0.03 | -3.00 | .003   |
| Seasonsummer  | 0.04                         | [-0.03, 0.11]  | 0.03 | 1.17  | .243   | -0.08                           | [-0.14, -0.02] | 0.03 | -2.46 | .014   |
| Seasonwinter  | 0.03                         | [-0.04, 0.09]  | 0.03 | 0.81  | .419   | -0.02                           | [-0.07, 0.04]  | 0.03 | -0.58 | .564   |
| Sleep onset <sup>2</sup>                            | 0.00                         | [-0.01, 0.02]  | 0.01 | 0.27  | .785   | -0.01                           | [-0.03, 0.00]  | 0.01 | -1.43 | .152   |
| Age   | -0.02                        | [-0.03, -0.02] | 0.00 | -5.99 | .005   | -0.02                           | [-0.03, -0.02] | 0.00 | -8.84 | .001   |
| Sleep onset $\times$ seasonspring                   | 0.00                         | [-0.04, 0.04]  | 0.02 | 0.21  | .838   | 0.01                            | [-0.03, 0.05]  | 0.02 | 0.44  | .658   |
| Sleep onset $\times$ seasonsummer                   | 0.01                         | [-0.03, 0.06]  | 0.02 | 0.62  | .535   | 0.02                            | [-0.02, 0.06]  | 0.02 | 0.87  | .386   |
| Sleep onset $\times$ seasonwinter                   | -0.02                        | [-0.06, 0.02]  | 0.02 | -1.01 | .313   | 0.00                            | [-0.04, 0.03]  | 0.02 | -0.10 | .920   |
| Seasonspring $\times$ Sleep onset <sup>2</sup>      | 0.00                         | [-0.03, 0.02]  | 0.01 | -0.26 | .798   | 0.01                            | [-0.02, 0.03]  | 0.01 | 0.72  | .472   |
| Seasonsummer $\times$ Sleep onset <sup>2</sup>      | -0.03                        | [-0.05, 0.00]  | 0.01 | -2.15 | .032   | 0.01                            | [-0.02, 0.03]  | 0.01 | 0.44  | .663   |
| Seasonwinter $\times$ Sleep onset <sup>2</sup>      | -0.01                        | [-0.04, 0.01]  | 0.01 | -0.95 | .340   | 0.01                            | [-0.02, 0.03]  | 0.01 | 0.42  | .673   |
| Sleep regularity (z)                                |                              |                |      |       |        |                                 |                |      |       |        |
| (Intercept)   | 1.63                         | [1.23, 2.03]   | 0.21 | 7.92  | < .001 | 1.47                            | [1.24, 1.70]   | 0.12 | 12.57 | < .001 |
| Sleep regularity                                    | 0.09                         | [0.06, 0.12]   | 0.01 | 6.47  | < .001 | 0.05                            | [0.03, 0.08]   | 0.01 | 3.88  | < .001 |

Table 15 continued

| Term  | Physical activity volume (z) |      |       |      | Physical activity intensity (z) |      |       |      |
|---|------------------------------|------|-------|------|---------------------------------|------|-------|------|
|   | $\beta$ [95% CI]             | SE   | t     | p    | $\beta$ [95% CI]                | SE   | t     | p    |
| Seasonspring  | 0.00 [-0.06, 0.06]           | 0.03 | 0.02  | .980 | -0.09 [-0.15, -0.04]            | 0.03 | -3.32 | .001 |
| Seasonsummer  | 0.01 [-0.05, 0.08]           | 0.03 | 0.42  | .676 | -0.07 [-0.13, -0.01]            | 0.03 | -2.33 | .020 |
| Seasonwinter  | 0.01 [-0.05, 0.07]           | 0.03 | 0.45  | .649 | -0.01 [-0.06, 0.04]             | 0.03 | -0.32 | .745 |
| Sleep regularity <sup>2</sup>                       | -0.02 [-0.04, -0.01]         | 0.01 | -2.93 | .003 | -0.03 [-0.04, -0.01]            | 0.01 | -3.05 | .002 |
| Age   | -0.02 [-0.03, -0.01]         | 0.00 | -5.95 | .005 | -0.02 [-0.03, -0.02]            | 0.00 | -8.93 | .001 |
| Sleep regularity $\times$ seasonspring              | 0.01 [-0.03, 0.05]           | 0.02 | 0.32  | .752 | -0.01 [-0.04, 0.03]             | 0.02 | -0.27 | .789 |
| Sleep regularity $\times$ seasonsummer              | -0.03 [-0.08, 0.01]          | 0.02 | -1.42 | .160 | -0.02 [-0.07, 0.02]             | 0.02 | -0.93 | .356 |
| Sleep regularity $\times$ seasonwinter              | 0.03 [-0.01, 0.07]           | 0.02 | 1.55  | .122 | 0.04 [0.00, 0.08]               | 0.02 | 1.99  | .053 |
| Seasonspring $\times$ Sleep regularity <sup>2</sup> | 0.03 [0.00, 0.05]            | 0.01 | 2.17  | .030 | 0.03 [0.01, 0.05]               | 0.01 | 2.40  | .017 |
| Seasonsummer $\times$ Sleep regularity <sup>2</sup> | 0.01 [-0.02, 0.04]           | 0.01 | 0.84  | .403 | 0.01 [-0.02, 0.04]              | 0.01 | 0.56  | .572 |
| Seasonwinter $\times$ Sleep regularity <sup>2</sup> | 0.01 [-0.01, 0.04]           | 0.01 | 1.20  | .230 | 0.00 [-0.02, 0.03]              | 0.01 | 0.38  | .701 |

*Note.* Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 16

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Sleep duration (z)                                   |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.46 [0.16, 0.76]            | 0.15 | 2.98  | .003   | 0.52 [0.22, 0.82]               | 0.15 | 3.43  | .001   |
| Physical activity                                    | -0.01 [-0.07, 0.06]          | 0.03 | -0.17 | .863   | -0.01 [-0.11, 0.09]             | 0.05 | -0.20 | .839   |
| Regioneurope   | -0.25 [-0.45, -0.05]         | 0.10 | -2.47 | .014   | -0.28 [-0.48, -0.08]            | 0.10 | -2.74 | .006   |
| Regionafrica   | -0.16 [-0.38, 0.06]          | 0.11 | -1.41 | .158   | -0.26 [-0.48, -0.03]            | 0.11 | -2.24 | .025   |
| Regionasia   | -0.36 [-0.62, -0.10]         | 0.13 | -2.75 | .006   | -0.42 [-0.66, -0.18]            | 0.12 | -3.46 | .001   |
| Regionnorth america                                  | -0.18 [-0.41, 0.04]          | 0.11 | -1.61 | .106   | -0.18 [-0.40, 0.05]             | 0.12 | -1.53 | .126   |
| Regionsouth america                                  | -0.43 [-0.63, -0.22]         | 0.10 | -4.11 | < .001 | -0.48 [-0.69, -0.27]            | 0.11 | -4.53 | < .001 |
| Physical activity <sup>2</sup>                       | 0.01 [0.00, 0.02]            | 0.01 | 1.91  | .056   | 0.04 [0.00, 0.09]               | 0.02 | 1.89  | .059   |
| Age  | 0.00 [-0.01, 0.00]           | 0.00 | -1.10 | .273   | 0.00 [-0.01, 0.00]              | 0.00 | -1.30 | .194   |
| Physical activity × regioneurope                     | 0.12 [0.04, 0.19]            | 0.04 | 3.01  | .003   | 0.08 [-0.03, 0.18]              | 0.05 | 1.41  | .159   |
| Physical activity × regionafrica                     | 0.13 [-0.01, 0.28]           | 0.07 | 1.78  | .076   | 0.17 [0.00, 0.34]               | 0.09 | 1.96  | .050   |
| Physical activity × regionasia                       | 0.17 [-0.01, 0.35]           | 0.09 | 1.85  | .065   | 0.14 [-0.03, 0.31]              | 0.09 | 1.56  | .118   |
| Physical activity × regionnorth america              | 0.08 [-0.06, 0.23]           | 0.08 | 1.10  | .271   | -0.02 [-0.17, 0.13]             | 0.08 | -0.29 | .770   |
| Physical activity × regionsouth america              | 0.17 [0.07, 0.27]            | 0.05 | 3.38  | .001   | 0.08 [-0.04, 0.20]              | 0.06 | 1.25  | .211   |
| Regioneurope × Physical activity <sup>2</sup>        | -0.03 [-0.04, -0.01]         | 0.01 | -3.13 | .002   | -0.04 [-0.09, 0.01]             | 0.02 | -1.72 | .086   |
| Regionafrica × Physical activity <sup>2</sup>        | -0.11 [-0.25, 0.03]          | 0.07 | -1.57 | .118   | -0.07 [-0.18, 0.03]             | 0.05 | -1.44 | .151   |
| Regionasia × Physical activity <sup>2</sup>          | -0.04 [-0.18, 0.09]          | 0.07 | -0.61 | .541   | -0.11 [-0.24, 0.03]             | 0.07 | -1.58 | .115   |
| Regionnorth america × Physical activity <sup>2</sup> | -0.03 [-0.07, 0.02]          | 0.02 | -1.20 | .231   | -0.02 [-0.12, 0.07]             | 0.05 | -0.49 | .627   |
| Regionsouth america × Physical activity <sup>2</sup> | -0.05 [-0.08, -0.03]         | 0.01 | -3.69 | < .001 | -0.07 [-0.14, 0.01]             | 0.04 | -1.78 | .075   |
| Sleep efficiency (z)                                 |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.39 [0.10, 0.68]            | 0.15 | 2.66  | .008   | 0.48 [0.18, 0.77]               | 0.15 | 3.16  | .002   |

Table 16 continued

TITLE

| Term   | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |        |
|--|------------------------------|------|-------|---------------------------------|----------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p      |
| Physical activity                                    | -0.05 [-0.12, 0.02]          | 0.03 | -1.51 | .130                            | -0.07 [-0.17, 0.03]  | 0.05 | -1.32 | .186   |
| Regioneurope   | -0.20 [-0.39, 0.00]          | 0.10 | -1.96 | .050                            | -0.24 [-0.44, -0.04] | 0.10 | -2.30 | .021   |
| Regionafrica   | -0.03 [-0.25, 0.19]          | 0.11 | -0.26 | .795                            | -0.19 [-0.42, 0.04]  | 0.12 | -1.61 | .108   |
| Regionasia   | -0.21 [-0.47, 0.05]          | 0.13 | -1.61 | .106                            | -0.37 [-0.61, -0.12] | 0.12 | -2.96 | .003   |
| Regionnorth america                                  | 0.01 [-0.21, 0.24]           | 0.11 | 0.13  | .900                            | -0.11 [-0.34, 0.12]  | 0.12 | -0.91 | .361   |
| Regionsouth america                                  | -0.20 [-0.40, 0.01]          | 0.10 | -1.88 | .060                            | -0.38 [-0.59, -0.17] | 0.11 | -3.50 | < .001 |
| Physical activity <sup>2</sup>                       | 0.01 [0.00, 0.02]            | 0.01 | 1.44  | .149                            | 0.03 [-0.02, 0.07]   | 0.02 | 1.11  | .266   |
| Age  | 0.00 [0.00, 0.01]            | 0.00 | 0.67  | .501                            | 0.00 [0.00, 0.00]    | 0.00 | 0.33  | .740   |
| Physical activity × regioneurope                     | 0.08 [0.00, 0.15]            | 0.04 | 1.99  | .046                            | 0.07 [-0.04, 0.17]   | 0.05 | 1.29  | .196   |
| Physical activity × regionafrica                     | 0.18 [0.04, 0.33]            | 0.07 | 2.48  | .013                            | 0.16 [0.00, 0.33]    | 0.08 | 1.94  | .053   |
| Physical activity × regionasia                       | 0.15 [-0.03, 0.33]           | 0.09 | 1.61  | .108                            | 0.15 [-0.02, 0.32]   | 0.09 | 1.78  | .075   |
| Physical activity × regionnorth america              | 0.22 [0.08, 0.37]            | 0.07 | 2.99  | .003                            | 0.04 [-0.11, 0.19]   | 0.08 | 0.52  | .603   |
| Physical activity × regionsouth america              | 0.33 [0.23, 0.43]            | 0.05 | 6.65  | < .001                          | 0.18 [0.05, 0.30]    | 0.06 | 2.80  | .005   |
| Regioneurope × Physical activity <sup>2</sup>        | -0.02 [-0.04, 0.00]          | 0.01 | -2.40 | .016                            | -0.02 [-0.06, 0.03]  | 0.02 | -0.63 | .529   |
| Regionafrica × Physical activity <sup>2</sup>        | -0.09 [-0.23, 0.04]          | 0.07 | -1.34 | .180                            | -0.01 [-0.11, 0.09]  | 0.05 | -0.25 | .806   |
| Regionasia × Physical activity <sup>2</sup>          | -0.11 [-0.24, 0.03]          | 0.07 | -1.56 | .118                            | -0.02 [-0.16, 0.11]  | 0.07 | -0.34 | .733   |
| Regionnorth america × Physical activity <sup>2</sup> | -0.02 [-0.06, 0.02]          | 0.02 | -0.89 | .372                            | 0.03 [-0.06, 0.12]   | 0.05 | 0.57  | .566   |
| Regionsouth america × Physical activity <sup>2</sup> | -0.06 [-0.09, -0.03]         | 0.01 | -3.98 | < .001                          | -0.05 [-0.12, 0.02]  | 0.04 | -1.41 | .159   |
| Sleep onset (z)                                      |                              |      |       |                                 |                      |      |       |        |
| (Intercept)  | -0.08 [-0.43, 0.28]          | 0.18 | -0.42 | .671                            | -0.08 [-0.42, 0.26]  | 0.17 | -0.44 | .663   |
| Physical activity                                    | -0.09 [-0.14, -0.04]         | 0.02 | -3.73 | < .001                          | -0.08 [-0.15, 0.00]  | 0.04 | -2.05 | .041   |
| Regioneurope   | 0.13 [-0.03, 0.29]           | 0.08 | 1.56  | .118                            | 0.12 [-0.04, 0.28]   | 0.08 | 1.45  | .148   |
| Regionafrica   | 0.05 [-0.12, 0.23]           | 0.09 | 0.61  | .540                            | -0.04 [-0.22, 0.13]  | 0.09 | -0.46 | .646   |

Table 16 continued

TITLE

| Term   | Physical activity volume (z) |      |       | Physical activity intensity (z) |                     |      |       |        |
|--|------------------------------|------|-------|---------------------------------|---------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]    | SE   | t     | p      |
| Regionasia   | 0.14 [-0.06, 0.33]           | 0.10 | 1.37  | .172                            | 0.10 [-0.09, 0.28]  | 0.10 | 1.02  | .310   |
| Regionnorth america                                  | 0.14 [-0.03, 0.32]           | 0.09 | 1.58  | .114                            | 0.06 [-0.12, 0.24]  | 0.09 | 0.69  | .490   |
| Regionsouth america                                  | 0.19 [0.03, 0.35]            | 0.08 | 2.28  | .023                            | 0.13 [-0.04, 0.29]  | 0.08 | 1.50  | .133   |
| Physical activity <sup>2</sup>                       | 0.00 [0.00, 0.01]            | 0.00 | 1.12  | .263                            | -0.03 [-0.06, 0.00] | 0.02 | -2.02 | .043   |
| Age  | 0.00 [-0.01, 0.00]           | 0.00 | -1.05 | .292                            | 0.00 [0.00, 0.00]   | 0.00 | -0.88 | .377   |
| Physical activity × regioneurope                     | -0.03 [-0.09, 0.02]          | 0.03 | -1.22 | .223                            | 0.00 [-0.08, 0.07]  | 0.04 | -0.03 | .977   |
| Physical activity × regionafrica                     | 0.06 [-0.04, 0.17]           | 0.05 | 1.22  | .223                            | 0.06 [-0.06, 0.18]  | 0.06 | 0.96  | .339   |
| Physical activity × regionasia                       | -0.01 [-0.14, 0.12]          | 0.07 | -0.14 | .885                            | -0.03 [-0.15, 0.09] | 0.06 | -0.49 | .623   |
| Physical activity × regionnorth america              | 0.11 [0.00, 0.22]            | 0.05 | 2.01  | .045                            | 0.08 [-0.02, 0.19]  | 0.05 | 1.53  | .126   |
| Physical activity × regionsouth america              | 0.06 [-0.01, 0.13]           | 0.04 | 1.70  | .090                            | 0.03 [-0.06, 0.12]  | 0.04 | 0.65  | .515   |
| Regioneurope × Physical activity <sup>2</sup>        | 0.01 [0.00, 0.02]            | 0.01 | 1.71  | .087                            | 0.03 [0.00, 0.07]   | 0.02 | 1.99  | .047   |
| Regionafrica × Physical activity <sup>2</sup>        | -0.03 [-0.12, 0.07]          | 0.05 | -0.52 | .605                            | 0.04 [-0.03, 0.11]  | 0.04 | 1.04  | .298   |
| Regionasia × Physical activity <sup>2</sup>          | -0.02 [-0.11, 0.08]          | 0.05 | -0.32 | .752                            | 0.07 [-0.03, 0.16]  | 0.05 | 1.38  | .169   |
| Regionnorth america × Physical activity <sup>2</sup> | 0.01 [-0.02, 0.04]           | 0.02 | 0.93  | .350                            | 0.00 [-0.07, 0.06]  | 0.03 | -0.07 | .946   |
| Regionsouth america × Physical activity <sup>2</sup> | -0.01 [-0.03, 0.01]          | 0.01 | -0.65 | .515                            | 0.01 [-0.04, 0.06]  | 0.03 | 0.44  | .657   |
| Sleep regularity (z)                                 |                              |      |       |                                 |                     |      |       |        |
| (Intercept)  | 0.35 [0.09, 0.62]            | 0.14 | 2.61  | .009                            | 0.53 [0.25, 0.82]   | 0.15 | 3.65  | < .001 |
| Physical activity                                    | 0.22 [0.16, 0.29]            | 0.03 | 6.82  | < .001                          | 0.19 [0.09, 0.29]   | 0.05 | 3.77  | < .001 |
| Regioneurope   | 0.21 [0.03, 0.40]            | 0.09 | 2.25  | .024                            | 0.16 [-0.03, 0.36]  | 0.10 | 1.62  | .104   |
| Regionafrica   | 0.47 [0.26, 0.68]            | 0.11 | 4.39  | < .001                          | 0.28 [0.06, 0.51]   | 0.11 | 2.51  | .012   |
| Regionasia   | 0.31 [0.07, 0.56]            | 0.12 | 2.51  | .012                            | 0.28 [0.04, 0.52]   | 0.12 | 2.30  | .021   |
| Regionnorth america                                  | 0.22 [0.01, 0.44]            | 0.11 | 2.02  | .044                            | 0.09 [-0.13, 0.31]  | 0.11 | 0.78  | .436   |
| Regionsouth america                                  | 0.01 [-0.18, 0.20]           | 0.10 | 0.12  | .905                            | -0.06 [-0.26, 0.15] | 0.10 | -0.55 | .582   |

Table 16 continued

TITLE

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| Term   | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |       |      |
|--|------------------------------|------|-------|---------------------------------|----------------------|------|-------|------|
|  | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t     | p    |
| Physical activity <sup>2</sup>                       | -0.02 [-0.04, -0.01]         | 0.01 | -4.83 | < .001                          | -0.07 [-0.11, -0.02] | 0.02 | -3.02 | .003 |
| Age  | 0.00 [0.00, 0.00]            | 0.00 | .36   | .724                            | 0.00 [-0.01, 0.00]   | 0.00 | -0.44 | .663 |
| Physical activity × regioneurope                     | 0.01 [-0.06, 0.08]           | 0.04 | 0.26  | .794                            | -0.12 [-0.22, -0.02] | 0.05 | -2.32 | .021 |
| Physical activity × regionafrica                     | -0.15 [-0.29, -0.02]         | 0.07 | -2.23 | .026                            | 0.21 [0.05, 0.37]    | 0.08 | 2.56  | .011 |
| Physical activity × regionasia                       | -0.15 [-0.32, 0.02]          | 0.09 | -1.77 | .077                            | -0.06 [-0.23, 0.12]  | 0.09 | -0.62 | .538 |
| Physical activity × regionnorth america              | 0.12 [-0.02, 0.27]           | 0.07 | 1.63  | .108                            | 0.09 [-0.06, 0.23]   | 0.07 | 1.18  | .238 |
| Physical activity × regionsouth america              | 0.03 [-0.07, 0.12]           | 0.05 | 0.59  | .558                            | -0.01 [-0.13, 0.11]  | 0.06 | -0.13 | .897 |
| Regioneurope × Physical activity <sup>2</sup>        | -0.02 [-0.04, 0.00]          | 0.01 | -2.55 | .013                            | 0.06 [0.01, 0.10]    | 0.02 | 2.57  | .010 |
| Regionafrica × Physical activity <sup>2</sup>        | -0.38 [-0.50, -0.25]         | 0.06 | -5.84 | < .001                          | -0.13 [-0.22, -0.03] | 0.05 | -2.64 | .008 |
| Regionasia × Physical activity <sup>2</sup>          | 0.02 [-0.11, 0.14]           | 0.06 | 0.23  | .815                            | 0.15 [0.01, 0.29]    | 0.07 | 2.04  | .049 |
| Regionnorth america × Physical activity <sup>2</sup> | -0.05 [-0.09, -0.01]         | 0.02 | -2.46 | .015                            | -0.07 [-0.15, 0.02]  | 0.04 | -1.56 | .120 |
| Regionsouth america × Physical activity <sup>2</sup> | -0.04 [-0.06, -0.01]         | 0.01 | -2.79 | .005                            | -0.01 [-0.08, 0.06]  | 0.04 | -0.20 | .844 |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 17

*Sleep predicting physical activity controlling for SES, age, sex, and BMI*

TITLE

| Term  | Physical activity volume (z) |      |       | Physical activity intensity (z) |                      |      |        |        |
|---|------------------------------|------|-------|---------------------------------|----------------------|------|--------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p                               | $\beta$ [95% CI]     | SE   | t      | p      |
| Sleep duration (z)                                |                              |      |       |                                 |                      |      |        |        |
| (Intercept)                                       | 1.98 [1.56, 2.40]            | 0.22 | 9.20  | < .001                          | 1.72 [1.51, 1.93]    | 0.11 | 16.19  | < .001 |
| Sleep duration                                    | 0.00 [-0.04, 0.04]           | 0.02 | 0.22  | .827                            | -0.03 [-0.07, 0.01]  | 0.02 | -1.37  | .179   |
| Regioneurope                                      | -0.33 [-0.53, -0.13]         | 0.10 | -3.30 | .001                            | -0.27 [-0.42, -0.12] | 0.08 | -3.46  | .001   |
| Regionafrica                                      | -0.29 [-0.50, -0.07]         | 0.11 | -2.65 | .008                            | -0.23 [-0.40, -0.06] | 0.09 | -2.63  | .009   |
| Regionasia  | -0.54 [-0.77, -0.31]         | 0.12 | -4.69 | < .001                          | -0.58 [-0.77, -0.40] | 0.09 | -6.27  | < .001 |
| Regionnorth america                               | -0.48 [-0.69, -0.26]         | 0.11 | -4.34 | < .001                          | -0.33 [-0.50, -0.16] | 0.09 | -3.77  | < .001 |
| Regionsouth america                               | -0.38 [-0.58, -0.18]         | 0.10 | -3.73 | < .001                          | -0.45 [-0.60, -0.29] | 0.08 | -5.56  | < .001 |
| Sleep duration <sup>2</sup>                       | -0.01 [-0.03, 0.01]          | 0.01 | -1.14 | .256                            | -0.02 [-0.04, 0.00]  | 0.01 | -1.70  | .095   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.97 | .005                            | -0.02 [-0.03, -0.02] | 0.00 | -10.19 | < .001 |
| Sleep duration × regioneurope                     | -0.01 [-0.05, 0.04]          | 0.02 | -0.30 | .764                            | 0.06 [0.01, 0.11]    | 0.02 | 2.56   | .014   |
| Sleep duration × regionafrica                     | -0.02 [-0.09, 0.04]          | 0.03 | -0.71 | .476                            | -0.02 [-0.09, 0.05]  | 0.04 | -0.57  | .573   |
| Sleep duration × regionasia                       | -0.02 [-0.11, 0.07]          | 0.05 | -0.34 | .734                            | 0.07 [-0.02, 0.16]   | 0.05 | 1.44   | .150   |
| Sleep duration × regionnorth america              | 0.02 [-0.05, 0.09]           | 0.04 | 0.53  | .598                            | -0.03 [-0.09, 0.04]  | 0.03 | -0.74  | .458   |
| Sleep duration × regionsouth america              | -0.05 [-0.11, 0.00]          | 0.03 | -1.96 | .051                            | -0.03 [-0.09, 0.03]  | 0.03 | -0.97  | .340   |
| Regioneurope × Sleep duration <sup>2</sup>        | 0.00 [-0.03, 0.02]           | 0.01 | -0.39 | .695                            | 0.01 [-0.01, 0.03]   | 0.01 | 1.07   | .291   |
| Regionafrica × Sleep duration <sup>2</sup>        | 0.00 [-0.04, 0.03]           | 0.02 | -0.15 | .883                            | 0.00 [-0.04, 0.03]   | 0.02 | -0.29  | .774   |
| Regionasia × Sleep duration <sup>2</sup>          | -0.01 [-0.04, 0.03]          | 0.02 | -0.26 | .793                            | 0.02 [-0.02, 0.06]   | 0.02 | 1.02   | .307   |
| Regionnorth america × Sleep duration <sup>2</sup> | 0.01 [-0.02, 0.05]           | 0.02 | 0.81  | .417                            | 0.02 [-0.01, 0.05]   | 0.02 | 1.14   | .254   |
| Regionsouth america × Sleep duration <sup>2</sup> | 0.01 [-0.02, 0.03]           | 0.01 | 0.46  | .648                            | 0.00 [-0.03, 0.02]   | 0.01 | -0.32  | .750   |
| Sleep efficiency (z)                              |                              |      |       |                                 |                      |      |        |        |
| (Intercept)                                       | 1.94 [1.52, 2.37]            | 0.22 | 8.93  | < .001                          | 1.69 [1.49, 1.90]    | 0.11 | 16.10  | < .001 |

Table 17 continued

TITLE

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |        |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|--------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t      | p      |
| Sleep efficiency                                    | -0.06 [-0.11, -0.01]         | 0.03 | -2.41 | .018   | -0.09 [-0.14, -0.04]            | 0.03 | -3.49  | .001   |
| Regioneurope  | -0.30 [-0.49, -0.10]         | 0.10 | -2.97 | .003   | -0.21 [-0.36, -0.05]            | 0.08 | -2.67  | .008   |
| Regionafrica  | -0.26 [-0.47, -0.05]         | 0.11 | -2.42 | .015   | -0.23 [-0.39, -0.06]            | 0.09 | -2.62  | .009   |
| Regionasia  | -0.48 [-0.70, -0.25]         | 0.12 | -4.13 | < .001 | -0.46 [-0.65, -0.28]            | 0.09 | -4.87  | < .001 |
| Regionnorth america                                 | -0.41 [-0.62, -0.20]         | 0.11 | -3.78 | < .001 | -0.32 [-0.48, -0.15]            | 0.09 | -3.68  | < .001 |
| Regionsouth america                                 | -0.35 [-0.55, -0.15]         | 0.10 | -3.47 | .001   | -0.44 [-0.59, -0.28]            | 0.08 | -5.43  | < .001 |
| Sleep efficiency <sup>2</sup>                       | 0.01 [-0.01, 0.02]           | 0.01 | 0.87  | .383   | -0.01 [-0.03, 0.00]             | 0.01 | -1.40  | .163   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -6.00 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -10.62 | < .001 |
| Sleep efficiency × regioneurope                     | 0.06 [0.01, 0.12]            | 0.03 | 2.34  | .023   | 0.08 [0.03, 0.13]               | 0.03 | 3.03   | .003   |
| Sleep efficiency × regionafrica                     | 0.06 [-0.03, 0.15]           | 0.05 | 1.40  | .166   | 0.06 [-0.04, 0.15]              | 0.05 | 1.20   | .239   |
| Sleep efficiency × regionasia                       | 0.11 [0.01, 0.22]            | 0.06 | 2.06  | .039   | 0.19 [0.09, 0.30]               | 0.05 | 3.52   | < .001 |
| Sleep efficiency × regionnorth america              | 0.10 [0.02, 0.19]            | 0.05 | 2.30  | .022   | 0.05 [-0.04, 0.13]              | 0.04 | 1.10   | .271   |
| Sleep efficiency × regionsouth america              | 0.06 [0.00, 0.12]            | 0.03 | 1.83  | .068   | 0.06 [-0.01, 0.12]              | 0.03 | 1.74   | .082   |
| Regioneurope × Sleep efficiency <sup>2</sup>        | -0.01 [-0.03, 0.01]          | 0.01 | -0.99 | .323   | 0.00 [-0.01, 0.02]              | 0.01 | 0.25   | .803   |
| Regionafrica × Sleep efficiency <sup>2</sup>        | -0.01 [-0.03, 0.01]          | 0.01 | -0.72 | .474   | 0.01 [-0.02, 0.03]              | 0.01 | 0.57   | .568   |
| Regionasia × Sleep efficiency <sup>2</sup>          | 0.00 [-0.03, 0.02]           | 0.01 | -0.22 | .828   | 0.02 [0.00, 0.05]               | 0.01 | 1.95   | .052   |
| Regionnorth america × Sleep efficiency <sup>2</sup> | 0.00 [-0.02, 0.03]           | 0.01 | 0.29  | .772   | 0.01 [-0.01, 0.03]              | 0.01 | 0.90   | .370   |
| Regionsouth america × Sleep efficiency <sup>2</sup> | -0.01 [-0.02, 0.01]          | 0.01 | -0.70 | .481   | 0.00 [-0.01, 0.02]              | 0.01 | 0.49   | .624   |
| Sleep onset (z)                                     |                              |      |       |        |                                 |      |        |        |
| (Intercept)   | 1.98 [1.55, 2.40]            | 0.22 | 9.15  | < .001 | 1.73 [1.53, 1.94]               | 0.10 | 16.59  | < .001 |
| Sleep onset   | -0.05 [-0.11, 0.01]          | 0.03 | -1.70 | .103   | 0.01 [-0.04, 0.06]              | 0.03 | 0.28   | .780   |
| Regioneurope  | -0.35 [-0.55, -0.15]         | 0.10 | -3.43 | .001   | -0.28 [-0.43, -0.12]            | 0.08 | -3.44  | .001   |
| Regionafrica  | -0.22 [-0.45, 0.00]          | 0.11 | -1.93 | .054   | -0.26 [-0.45, -0.07]            | 0.10 | -2.74  | .007   |

Table 17 continued

TITLE

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |        |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|--------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t      | p      |
| Regionasia                                     | -0.53 [-0.77, -0.29]         | 0.12 | -4.38 | < .001 | -0.56 [-0.75, -0.37]            | 0.10 | -5.69  | < .001 |
| Regionnorth america                            | -0.45 [-0.67, -0.22]         | 0.11 | -3.93 | < .001 | -0.36 [-0.54, -0.17]            | 0.09 | -3.83  | < .001 |
| Regionsouth america                            | -0.34 [-0.55, -0.14]         | 0.11 | -3.26 | .001   | -0.46 [-0.62, -0.29]            | 0.08 | -5.40  | < .001 |
| Sleep onset <sup>2</sup>                       | -0.03 [-0.07, 0.00]          | 0.02 | -1.94 | .056   | -0.04 [-0.07, -0.01]            | 0.02 | -2.37  | .018   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -6.00 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -10.43 | < .001 |
| Sleep onset × regioneurope                     | 0.03 [-0.03, 0.09]           | 0.03 | 0.94  | .355   | 0.00 [-0.06, 0.05]              | 0.03 | -0.15  | .879   |
| Sleep onset × regionafrica                     | 0.04 [-0.09, 0.18]           | 0.07 | 0.64  | .522   | 0.09 [-0.07, 0.25]              | 0.08 | 1.13   | .274   |
| Sleep onset × regionasia                       | 0.12 [-0.06, 0.30]           | 0.09 | 1.29  | .208   | 0.02 [-0.19, 0.22]              | 0.11 | 0.16   | .877   |
| Sleep onset × regionnorth america              | 0.09 [-0.01, 0.18]           | 0.05 | 1.80  | .075   | 0.08 [-0.02, 0.17]              | 0.05 | 1.61   | .108   |
| Sleep onset × regionsouth america              | 0.10 [0.03, 0.17]            | 0.04 | 2.89  | .006   | 0.05 [-0.02, 0.11]              | 0.03 | 1.43   | .154   |
| Regioneurope × Sleep onset <sup>2</sup>        | 0.04 [0.00, 0.07]            | 0.02 | 1.94  | .055   | 0.04 [0.00, 0.07]               | 0.02 | 2.17   | .030   |
| Regionafrica × Sleep onset <sup>2</sup>        | -0.05 [-0.19, 0.09]          | 0.07 | -0.68 | .502   | 0.09 [-0.07, 0.25]              | 0.08 | 1.10   | .291   |
| Regionasia × Sleep onset <sup>2</sup>          | 0.06 [-0.11, 0.23]           | 0.09 | 0.73  | .468   | 0.02 [-0.18, 0.22]              | 0.10 | 0.20   | .843   |
| Regionnorth america × Sleep onset <sup>2</sup> | 0.05 [-0.03, 0.14]           | 0.04 | 1.31  | .193   | 0.09 [0.01, 0.17]               | 0.04 | 2.16   | .034   |
| Regionsouth america × Sleep onset <sup>2</sup> | 0.03 [-0.01, 0.07]           | 0.02 | 1.44  | .150   | 0.04 [0.00, 0.09]               | 0.02 | 1.98   | .048   |
| Sleep regularity (z)                           |                              |      |       |        |                                 |      |        |        |
| (Intercept)                                    | 1.96 [1.55, 2.37]            | 0.21 | 9.38  | < .001 | 1.73 [1.53, 1.93]               | 0.10 | 16.99  | < .001 |
| Sleep regularity                               | 0.13 [0.07, 0.18]            | 0.03 | 4.42  | .006   | 0.03 [-0.01, 0.06]              | 0.02 | 1.40   | .163   |
| Regioneurope                                   | -0.38 [-0.58, -0.19]         | 0.10 | -3.85 | < .001 | -0.30 [-0.45, -0.15]            | 0.08 | -3.87  | < .001 |
| Regionafrica                                   | -0.33 [-0.54, -0.13]         | 0.11 | -3.16 | .002   | -0.29 [-0.46, -0.12]            | 0.09 | -3.41  | .001   |
| Regionasia                                     | -0.62 [-0.84, -0.40]         | 0.11 | -5.53 | < .001 | -0.62 [-0.80, -0.44]            | 0.09 | -6.68  | < .001 |
| Regionnorth america                            | -0.50 [-0.71, -0.29]         | 0.11 | -4.63 | < .001 | -0.32 [-0.49, -0.15]            | 0.09 | -3.70  | < .001 |
| Regionsouth america                            | -0.42 [-0.62, -0.22]         | 0.10 | -4.13 | < .001 | -0.47 [-0.63, -0.31]            | 0.08 | -5.86  | < .001 |

Table 17 continued

| Term  | Physical activity volume (z) |      |       |      | Physical activity intensity (z) |      |        |        |
|---|------------------------------|------|-------|------|---------------------------------|------|--------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p    | $\beta$ [95% CI]                | SE   | t      | p      |
| Sleep regularity <sup>2</sup>                       | -0.03 [-0.05, -0.01]         | 0.01 | -2.86 | .004 | -0.06 [-0.09, -0.04]            | 0.01 | -5.89  | < .001 |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.99 | .005 | -0.02 [-0.03, -0.02]            | 0.00 | -10.86 | < .001 |
| Sleep regularity × regioneurope                     | -0.03 [-0.09, 0.03]          | 0.03 | -1.07 | .327 | 0.03 [-0.02, 0.07]              | 0.02 | 1.15   | .253   |
| Sleep regularity × regionafrica                     | -0.06 [-0.14, 0.02]          | 0.04 | -1.56 | .129 | 0.07 [0.00, 0.14]               | 0.04 | 1.89   | .059   |
| Sleep regularity × regionasia                       | -0.08 [-0.18, 0.02]          | 0.05 | -1.55 | .131 | 0.17 [0.08, 0.26]               | 0.05 | 3.54   | < .001 |
| Sleep regularity × regionnorth america              | -0.05 [-0.15, 0.05]          | 0.05 | -1.02 | .320 | 0.05 [-0.03, 0.13]              | 0.04 | 1.20   | .229   |
| Sleep regularity × regionsouth america              | -0.01 [-0.07, 0.05]          | 0.03 | -0.33 | .745 | 0.06 [0.01, 0.12]               | 0.03 | 2.30   | .024   |
| Regioneurope × Sleep regularity <sup>2</sup>        | 0.02 [0.00, 0.05]            | 0.01 | 1.60  | .110 | 0.07 [0.05, 0.10]               | 0.01 | 5.53   | < .001 |
| Regionafrica × Sleep regularity <sup>2</sup>        | -0.01 [-0.05, 0.03]          | 0.02 | -0.49 | .627 | 0.06 [0.01, 0.10]               | 0.02 | 2.58   | .010   |
| Regionasia × Sleep regularity <sup>2</sup>          | 0.03 [-0.02, 0.08]           | 0.03 | 1.18  | .238 | 0.10 [0.04, 0.15]               | 0.03 | 3.55   | < .001 |
| Regionnorth america × Sleep regularity <sup>2</sup> | 0.02 [-0.03, 0.06]           | 0.02 | 0.81  | .420 | 0.01 [-0.03, 0.06]              | 0.02 | 0.59   | .555   |
| Regionsouth america × Sleep regularity <sup>2</sup> | 0.04 [0.01, 0.06]            | 0.01 | 2.39  | .017 | 0.06 [0.03, 0.09]               | 0.02 | 3.60   | < .001 |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 18

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <b>Sleep duration (z)</b>                       |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 0.56 [0.27, 0.84]            | 0.15 | 3.80  | < .001 | 0.57 [0.29, 0.85]               | 0.14 | 3.96  | < .001 |
| Physical activity                               | 0.13 [-0.02, 0.27]           | 0.07 | 1.72  | .085   | 0.13 [0.03, 0.24]               | 0.05 | 2.45  | .014   |
| Daylight hours                                  | -0.03 [-0.04, -0.02]         | 0.01 | -4.97 | < .001 | -0.03 [-0.04, -0.01]            | 0.01 | -4.07 | < .001 |
| Physical activity <sup>2</sup>                  | 0.02 [-0.03, 0.06]           | 0.02 | 0.71  | .479   | 0.05 [-0.02, 0.12]              | 0.04 | 1.49  | .137   |
| Age   | 0.00 [0.00, 0.00]            | 0.00 | -0.47 | .639   | 0.00 [-0.01, 0.00]              | 0.00 | -0.86 | .392   |
| Physical activity × daylight hours              | 0.00 [-0.01, 0.01]           | 0.01 | -0.23 | .818   | -0.01 [-0.01, 0.00]             | 0.00 | -1.26 | .208   |
| Daylight hours × Physical activity <sup>2</sup> | 0.00 [-0.01, 0.00]           | 0.00 | -1.15 | .251   | 0.00 [-0.01, 0.00]              | 0.00 | -1.43 | .153   |
| <b>Sleep efficiency (z)</b>                     |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 0.39 [0.11, 0.67]            | 0.14 | 2.76  | .006   | 0.42 [0.12, 0.71]               | 0.15 | 2.76  | .006   |
| Physical activity                               | 0.15 [0.01, 0.30]            | 0.07 | 2.07  | .038   | 0.00 [-0.11, 0.10]              | 0.05 | -0.05 | .960   |
| Daylight hours                                  | -0.02 [-0.03, 0.00]          | 0.01 | -2.58 | .010   | -0.01 [-0.03, 0.00]             | 0.01 | -1.99 | .047   |
| Physical activity <sup>2</sup>                  | -0.02 [-0.06, 0.02]          | 0.02 | -0.87 | .383   | 0.01 [-0.06, 0.08]              | 0.04 | 0.18  | .855   |
| Age   | 0.00 [0.00, 0.01]            | 0.00 | 1.39  | .164   | 0.00 [0.00, 0.01]               | 0.00 | 0.78  | .437   |
| Physical activity × daylight hours              | -0.01 [-0.02, 0.00]          | 0.01 | -1.17 | .240   | 0.00 [-0.01, 0.01]              | 0.00 | 0.35  | .724   |
| Daylight hours × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | 0.33  | .741   | 0.00 [-0.01, 0.01]              | 0.00 | 0.15  | .877   |
| <b>Sleep onset (z)</b>                          |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 0.00 [-0.34, 0.35]           | 0.18 | 0.01  | .995   | 0.00 [-0.34, 0.33]              | 0.17 | -0.02 | .981   |
| Physical activity                               | -0.10 [-0.21, 0.00]          | 0.05 | -1.93 | .053   | -0.14 [-0.22, -0.07]            | 0.04 | -3.72 | < .001 |
| Daylight hours                                  | 0.00 [-0.01, 0.01]           | 0.00 | 0.49  | .627   | 0.00 [-0.01, 0.01]              | 0.00 | 0.07  | .945   |
| Physical activity <sup>2</sup>                  | -0.02 [-0.05, 0.02]          | 0.02 | -1.00 | .319   | -0.04 [-0.09, 0.01]             | 0.03 | -1.48 | .139   |
| Age   | 0.00 [0.00, 0.00]            | 0.00 | -0.96 | .336   | 0.00 [0.00, 0.00]               | 0.00 | -0.77 | .443   |

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Physical activity $\times$ daylight hours              | 0.00 [-0.01, 0.01]           | 0.00 | 0.08  | .935   | 0.01 [0.00, 0.01]               | 0.00 | 1.80  | .072   |
| Daylight hours $\times$ Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | 1.44  | .149   | 0.00 [0.00, 0.01]               | 0.00 | 1.30  | .192   |
| Sleep regularity (z)                                   |                              |      |       |        |                                 |      |       |        |
| (Intercept)  | 0.52 [0.27, 0.77]            | 0.13 | 4.08  | < .001 | 0.65 [0.38, 0.93]               | 0.14 | 4.61  | < .001 |
| Physical activity                                      | 0.41 [0.28, 0.55]            | 0.07 | 5.98  | < .001 | 0.27 [0.17, 0.37]               | 0.05 | 5.31  | < .001 |
| Daylight hours   | 0.00 [-0.02, 0.01]           | 0.01 | -0.65 | .518   | 0.00 [-0.02, 0.01]              | 0.01 | -0.38 | .704   |
| Physical activity <sup>2</sup>                         | -0.01 [-0.06, 0.03]          | 0.02 | -0.58 | .560   | -0.01 [-0.08, 0.05]             | 0.03 | -0.44 | .662   |
| Age  | 0.00 [0.00, 0.01]            | 0.00 | 0.82  | .419   | 0.00 [0.00, 0.00]               | 0.00 | -0.04 | .971   |
| Physical activity $\times$ daylight hours              | -0.02 [-0.03, 0.00]          | 0.01 | -2.68 | .007   | -0.01 [-0.02, -0.01]            | 0.00 | -3.44 | .001   |
| Daylight hours $\times$ Physical activity <sup>2</sup> | 0.00 [-0.01, 0.00]           | 0.00 | -0.96 | .342   | 0.00 [-0.01, 0.01]              | 0.00 | -0.11 | .916   |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

*Sleep predicting physical activity controlling for SES, age, sex, and BMI*

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <b>Sleep duration (z)</b>                      |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                    | 1.50 [1.07, 1.93]            | 0.22 | 6.79  | < .001 | 1.49 [1.23, 1.75]               | 0.13 | 11.41 | < .001 |
| Sleep duration                                 | 0.09 [0.02, 0.16]            | 0.04 | 2.45  | .014   | 0.05 [-0.02, 0.12]              | 0.04 | 1.31  | .190   |
| Daylight hours                                 | 0.02 [0.01, 0.03]            | 0.01 | 3.09  | .002   | 0.00 [-0.01, 0.01]              | 0.00 | -0.26 | .793   |
| Sleep duration <sup>2</sup>                    | 0.00 [-0.04, 0.04]           | 0.02 | 0.01  | .991   | 0.02 [-0.02, 0.05]              | 0.02 | 0.86  | .391   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -6.07 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.88 | .001   |
| Sleep duration × daylight hours                | -0.01 [-0.01, 0.00]          | 0.00 | -2.66 | .008   | 0.00 [-0.01, 0.00]              | 0.00 | -1.30 | .194   |
| Daylight hours × Sleep duration <sup>2</sup>   | 0.00 [0.00, 0.00]            | 0.00 | -0.72 | .470   | 0.00 [-0.01, 0.00]              | 0.00 | -1.41 | .159   |
| <b>Sleep efficiency (z)</b>                    |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                    | 1.48 [1.05, 1.91]            | 0.22 | 6.70  | < .001 | 1.51 [1.25, 1.77]               | 0.13 | 11.34 | < .001 |
| Sleep efficiency                               | 0.02 [-0.05, 0.09]           | 0.04 | 0.51  | .609   | -0.02 [-0.09, 0.05]             | 0.04 | -0.50 | .614   |
| Daylight hours                                 | 0.02 [0.01, 0.03]            | 0.01 | 3.32  | .001   | 0.00 [-0.01, 0.01]              | 0.00 | -0.51 | .609   |
| Sleep efficiency <sup>2</sup>                  | 0.00 [-0.03, 0.04]           | 0.02 | 0.18  | .858   | 0.00 [-0.04, 0.03]              | 0.02 | -0.18 | .854   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -6.08 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.82 | .001   |
| Sleep efficiency × daylight hours              | 0.00 [-0.01, 0.00]           | 0.00 | -0.55 | .580   | 0.00 [-0.01, 0.01]              | 0.00 | 0.03  | .975   |
| Daylight hours × Sleep efficiency <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | -0.17 | .869   | 0.00 [0.00, 0.00]               | 0.00 | -0.09 | .927   |
| <b>Sleep onset (z)</b>                         |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                    | 1.48 [1.05, 1.91]            | 0.22 | 6.70  | < .001 | 1.52 [1.27, 1.78]               | 0.13 | 11.62 | < .001 |
| Sleep onset                                    | -0.02 [-0.10, 0.06]          | 0.04 | -0.42 | .677   | 0.04 [-0.04, 0.12]              | 0.04 | 0.98  | .329   |
| Daylight hours                                 | 0.02 [0.01, 0.03]            | 0.01 | 3.27  | .001   | 0.00 [-0.01, 0.01]              | 0.00 | -0.79 | .432   |
| Sleep onset <sup>2</sup>                       | 0.00 [-0.05, 0.05]           | 0.02 | 0.11  | .911   | -0.03 [-0.08, 0.02]             | 0.02 | -1.24 | .214   |
| Age  | -0.02 [-0.03, -0.02]         | 0.00 | -6.08 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.92 | .001   |

Table 19 continued

| Term   | Physical activity volume (z) |                |      |       |        | Physical activity intensity (z) |                |      |       |        |
|--|------------------------------|----------------|------|-------|--------|---------------------------------|----------------|------|-------|--------|
|  | $\beta$                      | [95% CI]       | SE   | t     | p      | $\beta$                         | [95% CI]       | SE   | t     | p      |
| Sleep onset × daylight hours                   | 0.00                         | [0.01, 0.01]   | 0.00 | 0.42  | .677   | 0.00                            | [-0.01, 0.01]  | 0.00 | -0.49 | .625   |
| Daylight hours × Sleep onset <sup>2</sup>      | 0.00                         | [0.00, 0.00]   | 0.00 | -0.41 | .683   | 0.00                            | [0.00, 0.01]   | 0.00 | 0.99  | .323   |
| Sleep regularity (z)                           |                              |                |      |       |        |                                 |                |      |       |        |
| (Intercept)                                    | 1.45                         | [1.03, 1.88]   | 0.22 | 6.70  | < .001 | 1.49                            | [1.24, 1.75]   | 0.13 | 11.51 | < .001 |
| Sleep regularity                               | 0.14                         | [0.06, 0.22]   | 0.04 | 3.47  | .001   | 0.16                            | [0.08, 0.24]   | 0.04 | 4.08  | < .001 |
| Daylight hours                                 | 0.02                         | [0.01, 0.03]   | 0.01 | 2.91  | .004   | 0.00                            | [-0.01, 0.01]  | 0.00 | -0.88 | .380   |
| Sleep regularity <sup>2</sup>                  | -0.04                        | [-0.10, 0.01]  | 0.03 | -1.65 | .099   | -0.04                           | [-0.09, 0.01]  | 0.03 | -1.58 | .114   |
| Age  | -0.02                        | [-0.03, -0.02] | 0.00 | -6.06 | .005   | -0.02                           | [-0.03, -0.02] | 0.00 | -9.02 | .001   |
| Sleep regularity × daylight hours              | 0.00                         | [-0.01, 0.00]  | 0.00 | -1.11 | .266   | -0.01                           | [-0.01, 0.00]  | 0.00 | -2.60 | .009   |
| Daylight hours × Sleep regularity <sup>2</sup> | 0.00                         | [0.00, 0.01]   | 0.00 | 1.24  | .215   | 0.00                            | [0.00, 0.01]   | 0.00 | 1.03  | .301   |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 20

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <b>Sleep duration (z)</b>                         |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | 0.80 [0.47, 1.13]            | 0.17 | 4.73  | < .001 | 0.72 [0.39, 1.06]               | 0.17 | 4.21  | < .001 |
| Physical activity                                 | 0.13 [0.09, 0.18]            | 0.02 | 5.56  | < .001 | 0.08 [0.04, 0.12]               | 0.02 | 3.54  | < .001 |
| Acc wear locwrst                                  | -0.71 [-1.06, -0.36]         | 0.18 | -3.99 | < .001 | -0.58 [-0.94, -0.22]            | 0.18 | -3.16 | .002   |
| Physical activity <sup>2</sup>                    | -0.04 [-0.08, 0.00]          | 0.02 | -2.00 | .046   | 0.01 [-0.03, 0.04]              | 0.02 | 0.32  | .748   |
| Age   | 0.00 [-0.01, 0.00]           | 0.00 | -0.91 | .363   | 0.00 [-0.01, 0.00]              | 0.00 | -1.08 | .280   |
| Physical activity × acc wear locwrst              | -0.04 [-0.10, 0.01]          | 0.03 | -1.46 | .144   | -0.02 [-0.07, 0.03]             | 0.03 | -0.70 | .482   |
| Acc wear locwrst × Physical activity <sup>2</sup> | 0.04 [0.00, 0.08]            | 0.02 | 1.73  | .084   | 0.00 [-0.04, 0.03]              | 0.02 | -0.18 | .858   |
| <b>Sleep efficiency (z)</b>                       |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | -0.38 [-0.55, -0.22]         | 0.08 | -4.54 | < .001 | -0.52 [-0.68, -0.35]            | 0.09 | -6.01 | < .001 |
| Physical activity                                 | 0.19 [0.14, 0.23]            | 0.02 | 8.18  | < .001 | 0.08 [0.04, 0.13]               | 0.02 | 3.87  | < .001 |
| Acc wear locwrst                                  | 0.81 [0.67, 0.95]            | 0.07 | 11.10 | < .001 | 0.92 [0.78, 1.07]               | 0.08 | 12.26 | < .001 |
| Physical activity <sup>2</sup>                    | -0.10 [-0.13, -0.06]         | 0.02 | -4.71 | < .001 | -0.01 [-0.04, 0.02]             | 0.02 | -0.79 | .431   |
| Age   | 0.00 [0.00, 0.00]            | 0.00 | 1.24  | .215   | 0.00 [0.00, 0.00]               | 0.00 | 1.33  | .183   |
| Physical activity × acc wear locwrst              | -0.22 [-0.27, -0.16]         | 0.03 | -7.50 | < .001 | -0.10 [-0.15, -0.05]            | 0.03 | -3.81 | < .001 |
| Acc wear locwrst × Physical activity <sup>2</sup> | 0.10 [0.06, 0.14]            | 0.02 | 4.84  | < .001 | 0.02 [-0.01, 0.06]              | 0.02 | 1.17  | .241   |
| <b>Sleep onset (z)</b>                            |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | -1.03 [-1.43, -0.62]         | 0.21 | -4.96 | < .001 | -1.03 [-1.44, -0.63]            | 0.21 | -5.02 | < .001 |
| Physical activity                                 | -0.02 [-0.05, 0.01]          | 0.02 | -1.24 | .216   | -0.03 [-0.06, 0.00]             | 0.02 | -1.82 | .068   |
| Acc wear locwrst                                  | 1.34 [0.90, 1.78]            | 0.22 | 5.99  | < .001 | 1.28 [0.84, 1.71]               | 0.22 | 5.75  | < .001 |
| Physical activity <sup>2</sup>                    | -0.02 [-0.04, 0.01]          | 0.01 | -1.14 | .256   | -0.02 [-0.04, 0.00]             | 0.01 | -1.53 | .125   |
| Age   | 0.00 [-0.01, 0.00]           | 0.00 | -1.36 | .177   | 0.00 [0.00, 0.00]               | 0.00 | -1.01 | .315   |

Table 20 continued

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Physical activity $\times$ acc wear locwrist              | -0.13 [-0.17, -0.09]         | 0.02 | -6.10 | < .001 | -0.07 [-0.11, -0.04]            | 0.02 | -3.88 | < .001 |
| Acc wear locwrist $\times$ Physical activity <sup>2</sup> | 0.03 [0.00, 0.06]            | 0.01 | 2.10  | .036   | 0.01 [-0.02, 0.03]              | 0.01 | 0.65  | .513   |
| Sleep regularity (z)                                      |                              |      |       |        |                                 |      |       |        |
| (Intercept)   | 0.27 [-0.03, 0.57]           | 0.15 | 1.77  | .077   | 0.16 [-0.16, 0.48]              | 0.16 | 0.99  | .323   |
| Physical activity   | 0.22 [0.18, 0.26]            | 0.02 | 10.20 | < .001 | 0.25 [0.21, 0.29]               | 0.02 | 12.24 | < .001 |
| Acc wear locwrist   | 0.32 [0.00, 0.64]            | 0.16 | 1.97  | .049   | 0.67 [0.33, 1.01]               | 0.17 | 3.88  | < .001 |
| Physical activity <sup>2</sup>                            | -0.16 [-0.19, -0.12]         | 0.02 | -8.26 | < .001 | -0.09 [-0.12, -0.06]            | 0.02 | -6.06 | < .001 |
| Age   | 0.00 [0.00, 0.00]            | 0.00 | 0.19  | .855   | 0.00 [-0.01, 0.00]              | 0.00 | -1.12 | .267   |
| Physical activity $\times$ acc wear locwrist              | -0.02 [-0.07, 0.03]          | 0.03 | -0.68 | .494   | -0.21 [-0.26, -0.16]            | 0.02 | -8.65 | < .001 |
| Acc wear locwrist $\times$ Physical activity <sup>2</sup> | 0.13 [0.09, 0.17]            | 0.02 | 6.72  | < .001 | 0.08 [0.04, 0.11]               | 0.02 | 4.61  | < .001 |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 21

*Sleep predicting physical activity controlling for SES, age, sex, and BMI*

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <b>Sleep duration (z)</b>                         |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | 0.47 [-0.02, 0.95]           | 0.25 | 1.88  | .060   | 1.17 [0.88, 1.45]               | 0.15 | 7.94  | < .001 |
| Sleep duration                                    | -0.02 [-0.04, 0.00]          | 0.01 | -1.74 | .082   | -0.03 [-0.05, -0.01]            | 0.01 | -2.68 | .007   |
| Acc wear locwrist                                 | 1.53 [0.98, 2.09]            | 0.28 | 5.45  | < .001 | 0.41 [0.07, 0.75]               | 0.17 | 2.39  | .020   |
| Sleep duration <sup>2</sup>                       | -0.01 [-0.02, 0.00]          | 0.01 | -1.57 | .117   | -0.02 [-0.03, -0.01]            | 0.01 | -3.27 | .001   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -6.99 | .002   | -0.03 [-0.03, -0.02]            | 0.00 | -9.94 | < .001 |
| Sleep duration × acc wear locwrist                | 0.02 [-0.01, 0.04]           | 0.01 | 1.30  | .192   | 0.05 [0.02, 0.08]               | 0.01 | 3.66  | < .001 |
| Acc wear locwrist × Sleep duration <sup>2</sup>   | 0.00 [-0.02, 0.01]           | 0.01 | -0.75 | .456   | 0.01 [0.00, 0.03]               | 0.01 | 1.96  | .050   |
| <b>Sleep efficiency (z)</b>                       |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | 0.46 [-0.03, 0.95]           | 0.25 | 1.85  | .064   | 1.14 [0.85, 1.44]               | 0.15 | 7.70  | < .001 |
| Sleep efficiency                                  | 0.00 [-0.02, 0.03]           | 0.01 | 0.21  | .837   | -0.02 [-0.05, 0.01]             | 0.01 | -1.47 | .146   |
| Acc wear locwrist                                 | 1.53 [0.97, 2.08]            | 0.28 | 5.41  | < .001 | 0.44 [0.09, 0.78]               | 0.17 | 2.51  | .015   |
| Sleep efficiency <sup>2</sup>                     | 0.00 [-0.01, 0.01]           | 0.00 | -0.22 | .829   | -0.01 [-0.01, 0.00]             | 0.00 | -1.80 | .073   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -7.01 | .002   | -0.03 [-0.03, -0.02]            | 0.00 | -9.96 | < .001 |
| Sleep efficiency × acc wear locwrist              | 0.00 [-0.04, 0.03]           | 0.02 | -0.28 | .783   | 0.00 [-0.03, 0.04]              | 0.02 | 0.27  | .785   |
| Acc wear locwrist × Sleep efficiency <sup>2</sup> | 0.01 [0.00, 0.02]            | 0.01 | 2.00  | .046   | 0.00 [-0.01, 0.01]              | 0.01 | 0.57  | .566   |
| <b>Sleep onset (z)</b>                            |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                       | 0.48 [0.00, 0.96]            | 0.25 | 1.95  | .052   | 1.16 [0.87, 1.46]               | 0.15 | 7.78  | < .001 |
| Sleep onset                                       | 0.03 [-0.02, 0.07]           | 0.02 | 1.13  | .264   | 0.07 [0.02, 0.12]               | 0.02 | 2.89  | .008   |
| Acc wear locwrist                                 | 1.52 [0.97, 2.07]            | 0.28 | 5.43  | < .001 | 0.42 [0.07, 0.76]               | 0.17 | 2.39  | .020   |
| Sleep onset <sup>2</sup>                          | -0.01 [-0.05, 0.04]          | 0.02 | -0.38 | .708   | 0.03 [-0.01, 0.08]              | 0.02 | 1.40  | .175   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -7.01 | .002   | -0.03 [-0.03, -0.02]            | 0.00 | -9.88 | < .001 |

Table 21 continued

| Term  | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|---|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|   | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| Sleep onset × acc wear locwrist                   | -0.06                        | [-0.11, -0.01] | 0.03 | -2.42 | .017                            | -0.07   | [-0.12, -0.01] | 0.03 | -2.48 | .018   |
| Acc wear locwrist × Sleep onset <sup>2</sup>      | 0.01                         | [0.03, 0.06]   | 0.02 | 0.59  | .561                            | -0.04   | [-0.09, 0.01]  | 0.02 | -1.47 | .156   |
| Sleep regularity (z)                              |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                                       | 0.44                         | [-0.03, 0.92]  | 0.24 | 1.82  | .069                            | 1.15    | [0.86, 1.44]   | 0.15 | 7.78  | < .001 |
| Sleep regularity                                  | 0.11                         | [0.08, 0.14]   | 0.01 | 8.51  | < .001                          | 0.14    | [0.11, 0.16]   | 0.01 | 10.82 | < .001 |
| Acc wear locwrist                                 | 1.49                         | [0.95, 2.03]   | 0.28 | 5.38  | < .001                          | 0.40    | [0.06, 0.74]   | 0.17 | 2.29  | .026   |
| Sleep regularity <sup>2</sup>                     | -0.01                        | [-0.02, 0.00]  | 0.01 | -1.43 | .152                            | 0.00    | [-0.02, 0.01]  | 0.01 | -0.69 | .491   |
| Age   | -0.02                        | [-0.03, -0.02] | 0.00 | -6.96 | .002                            | -0.03   | [-0.03, -0.02] | 0.00 | -9.86 | < .001 |
| Sleep regularity × acc wear locwrist              | -0.02                        | [-0.06, 0.01]  | 0.02 | -1.32 | .192                            | -0.12   | [-0.15, -0.09] | 0.02 | -7.65 | < .001 |
| Acc wear locwrist × Sleep regularity <sup>2</sup> | 0.00                         | [-0.02, 0.02]  | 0.01 | 0.02  | .988                            | 0.00    | [-0.02, 0.02]  | 0.01 | -0.30 | .763   |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

Table 22

*Physical activity predicting sleep controlling for SES, age, sex, and BMI.*

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |      |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p    |
| <b>Sleep duration (z)</b>                        |                              |      |       |        |                                 |      |       |      |
| (Intercept)                                      | 0.23 [-0.03, 0.49]           | 0.13 | 1.76  | .078   | 0.27 [0.02, 0.52]               | 0.13 | 2.12  | .034 |
| Physical activity                                | 0.10 [0.05, 0.15]            | 0.03 | 4.11  | < .001 | 0.04 [0.00, 0.08]               | 0.02 | 1.77  | .076 |
| Pa mostactivehr                                  | 0.00 [0.00, 0.00]            | 0.00 | -0.87 | .385   | 0.00 [0.00, 0.00]               | 0.00 | -0.14 | .887 |
| Physical activity <sup>2</sup>                   | -0.01 [-0.02, 0.00]          | 0.01 | -1.39 | .166   | 0.02 [-0.01, 0.04]              | 0.01 | 1.41  | .159 |
| Age  | 0.00 [-0.01, 0.00]           | 0.00 | -0.94 | .348   | 0.00 [-0.01, 0.00]              | 0.00 | -1.24 | .216 |
| Physical activity × pa mostactivehr              | 0.00 [0.00, 0.00]            | 0.00 | 0.08  | .934   | 0.00 [0.00, 0.01]               | 0.00 | 1.88  | .060 |
| Pa mostactivehr × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | 0.08  | .936   | 0.00 [0.00, 0.00]               | 0.00 | -1.35 | .176 |
| <b>Sleep efficiency (z)</b>                      |                              |      |       |        |                                 |      |       |      |
| (Intercept)                                      | 0.22 [-0.03, 0.46]           | 0.13 | 1.71  | .087   | 0.26 [0.01, 0.52]               | 0.13 | 2.01  | .044 |
| Physical activity                                | 0.04 [-0.01, 0.09]           | 0.02 | 1.50  | .134   | 0.00 [-0.04, 0.04]              | 0.02 | 0.11  | .912 |
| Pa mostactivehr                                  | 0.00 [0.00, 0.00]            | 0.00 | -0.03 | .974   | 0.00 [0.00, 0.00]               | 0.00 | -0.12 | .907 |
| Physical activity <sup>2</sup>                   | -0.01 [-0.02, 0.01]          | 0.01 | -1.13 | .257   | 0.01 [-0.01, 0.04]              | 0.01 | 0.89  | .371 |
| Age  | 0.00 [0.00, 0.01]            | 0.00 | 1.11  | .266   | 0.00 [0.00, 0.01]               | 0.00 | 0.60  | .548 |
| Physical activity × pa mostactivehr              | 0.00 [0.00, 0.01]            | 0.00 | 1.37  | .170   | 0.00 [0.00, 0.00]               | 0.00 | 0.82  | .414 |
| Pa mostactivehr × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | -0.73 | .464   | 0.00 [0.00, 0.00]               | 0.00 | -0.02 | .982 |
| <b>Sleep onset (z)</b>                           |                              |      |       |        |                                 |      |       |      |
| (Intercept)                                      | -0.02 [-0.35, 0.31]          | 0.17 | -0.10 | .919   | -0.04 [-0.35, 0.28]             | 0.16 | -0.22 | .824 |
| Physical activity                                | -0.09 [-0.13, -0.06]         | 0.02 | -5.13 | < .001 | -0.04 [-0.07, -0.01]            | 0.01 | -2.83 | .005 |
| Pa mostactivehr                                  | 0.00 [0.00, 0.01]            | 0.00 | 3.03  | .002   | 0.00 [0.00, 0.00]               | 0.00 | 2.00  | .045 |
| Physical activity <sup>2</sup>                   | 0.01 [0.00, 0.01]            | 0.00 | 1.16  | .248   | -0.02 [-0.04, 0.00]             | 0.01 | -2.13 | .033 |
| Age  | 0.00 [0.00, 0.00]            | 0.00 | -0.82 | .415   | 0.00 [0.00, 0.00]               | 0.00 | -0.64 | .522 |

Table 22 continued

| Term   | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|--|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|  | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| Physical activity × pa mostactivehr              | 0.00 [0.00, 0.00]            | 0.00 | -0.35 | .723   | 0.00 [-0.01, 0.00]              | 0.00 | -3.16 | .002   |
| Pa mostactivehr × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | 0.33  | .745   | 0.00 [0.00, 0.00]               | 0.00 | 1.86  | .063   |
| Sleep regularity (z)                             |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                      | 0.51 [0.29, 0.72]            | 0.11 | 4.65  | < .001 | 0.65 [0.41, 0.89]               | 0.12 | 5.31  | < .001 |
| Physical activity                                | 0.19 [0.14, 0.24]            | 0.02 | 7.97  | < .001 | 0.09 [0.05, 0.12]               | 0.02 | 4.54  | < .001 |
| Pa mostactivehr                                  | 0.00 [0.00, 0.00]            | 0.00 | -0.93 | .354   | 0.00 [0.00, 0.00]               | 0.00 | -0.65 | .515   |
| Physical activity <sup>2</sup>                   | -0.03 [-0.04, -0.01]         | 0.01 | -4.21 | < .001 | -0.01 [-0.04, 0.01]             | 0.01 | -1.09 | .278   |
| Age  | 0.00 [0.00, 0.01]            | 0.00 | 0.56  | .584   | 0.00 [0.00, 0.00]               | 0.00 | -0.11 | .911   |
| Physical activity × pa mostactivehr              | 0.00 [0.00, 0.01]            | 0.00 | 1.68  | .094   | 0.00 [0.00, 0.00]               | 0.00 | 0.74  | .457   |
| Pa mostactivehr × Physical activity <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | -0.99 | .322   | 0.00 [0.00, 0.00]               | 0.00 | -0.23 | .817   |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the column headers.

Table 23

*Sleep predicting physical activity controlling for SES, age, sex, and BMI*

| Term  | Physical activity volume (z) |      |       |        | Physical activity intensity (z) |      |       |        |
|---|------------------------------|------|-------|--------|---------------------------------|------|-------|--------|
|   | $\beta$ [95% CI]             | SE   | t     | p      | $\beta$ [95% CI]                | SE   | t     | p      |
| <b>Sleep duration (z)</b>                       |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 1.65 [1.25, 2.06]            | 0.21 | 7.92  | < .001 | 1.44 [1.21, 1.67]               | 0.12 | 12.33 | < .001 |
| Sleep duration                                  | 0.01 [-0.02, 0.04]           | 0.01 | 0.45  | .654   | 0.04 [0.01, 0.07]               | 0.01 | 2.46  | .014   |
| Pa mostactivehr                                 | 0.00 [0.00, 0.01]            | 0.00 | 3.09  | .002   | 0.00 [0.00, 0.00]               | 0.00 | 2.27  | .023   |
| Sleep duration <sup>2</sup>                     | -0.01 [-0.02, 0.00]          | 0.01 | -1.32 | .187   | 0.00 [-0.01, 0.02]              | 0.01 | 0.51  | .607   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.95 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.78 | .001   |
| Sleep duration × pa mostactivehr                | 0.00 [0.00, 0.00]            | 0.00 | -1.09 | .277   | 0.00 [0.00, 0.00]               | 0.00 | -2.58 | .010   |
| Pa mostactivehr × Sleep duration <sup>2</sup>   | 0.00 [0.00, 0.00]            | 0.00 | -0.31 | .757   | 0.00 [0.00, 0.00]               | 0.00 | -1.93 | .054   |
| <b>Sleep efficiency (z)</b>                     |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 1.65 [1.23, 2.06]            | 0.21 | 7.81  | < .001 | 1.45 [1.22, 1.68]               | 0.12 | 12.16 | < .001 |
| Sleep efficiency                                | -0.03 [-0.06, 0.00]          | 0.02 | -1.76 | .079   | -0.04 [-0.08, -0.01]            | 0.02 | -2.70 | .007   |
| Pa mostactivehr                                 | 0.00 [0.00, 0.01]            | 0.00 | 3.47  | .001   | 0.00 [0.00, 0.00]               | 0.00 | 1.96  | .050   |
| Sleep efficiency <sup>2</sup>                   | 0.00 [-0.01, 0.01]           | 0.00 | -0.10 | .923   | 0.00 [-0.01, 0.00]              | 0.00 | -0.99 | .323   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.94 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.75 | .001   |
| Sleep efficiency × pa mostactivehr              | 0.00 [0.00, 0.00]            | 0.00 | 1.90  | .058   | 0.00 [0.00, 0.00]               | 0.00 | 1.82  | .069   |
| Pa mostactivehr × Sleep efficiency <sup>2</sup> | 0.00 [0.00, 0.00]            | 0.00 | 0.33  | .745   | 0.00 [0.00, 0.00]               | 0.00 | 0.18  | .860   |
| <b>Sleep onset (z)</b>                          |                              |      |       |        |                                 |      |       |        |
| (Intercept)                                     | 1.65 [1.23, 2.06]            | 0.21 | 7.82  | < .001 | 1.46 [1.23, 1.69]               | 0.12 | 12.42 | < .001 |
| Sleep onset                                     | -0.03 [-0.06, 0.00]          | 0.02 | -1.67 | .097   | -0.01 [-0.04, 0.02]             | 0.02 | -0.37 | .715   |
| Pa mostactivehr                                 | 0.00 [0.00, 0.01]            | 0.00 | 3.18  | .001   | 0.00 [0.00, 0.00]               | 0.00 | 1.18  | .238   |
| Sleep onset <sup>2</sup>                        | 0.00 [-0.02, 0.02]           | 0.01 | -0.20 | .838   | -0.01 [-0.04, 0.01]             | 0.01 | -1.29 | .195   |
| Age   | -0.02 [-0.03, -0.02]         | 0.00 | -5.96 | .005   | -0.02 [-0.03, -0.02]            | 0.00 | -8.87 | .001   |

Table 23 continued

| Term  | Physical activity volume (z) |                |      |       | Physical activity intensity (z) |         |                |      |       |        |
|---|------------------------------|----------------|------|-------|---------------------------------|---------|----------------|------|-------|--------|
|   | $\beta$                      | [95% CI]       | SE   | t     | p                               | $\beta$ | [95% CI]       | SE   | t     | p      |
| Sleep onset × pa mostactivehr                   | 0.00                         | [0.00, 0.00]   | 0.00 | 1.93  | .054                            | 0.00    | [0.00, 0.00]   | 0.00 | 1.97  | .049   |
| Pa mostactivehr × Sleep onset <sup>2</sup>      | 0.00                         | [0.00, 0.00]   | 0.00 | -0.53 | .599                            | 0.00    | [0.00, 0.00]   | 0.00 | 0.71  | .478   |
| Sleep regularity (z)                            |                              |                |      |       |                                 |         |                |      |       |        |
| (Intercept)                                     | 1.60                         | [1.20, 2.01]   | 0.21 | 7.77  | < .001                          | 1.44    | [1.21, 1.67]   | 0.12 | 12.35 | < .001 |
| Sleep regularity                                | 0.06                         | [0.03, 0.10]   | 0.02 | 3.85  | < .001                          | 0.02    | [-0.01, 0.05]  | 0.02 | 1.41  | .158   |
| Pa mostactivehr                                 | 0.00                         | [0.00, 0.01]   | 0.00 | 2.32  | .021                            | 0.00    | [0.00, 0.00]   | 0.00 | 0.52  | .605   |
| Sleep regularity <sup>2</sup>                   | -0.03                        | [-0.05, -0.01] | 0.01 | -3.11 | .002                            | -0.04   | [-0.06, -0.02] | 0.01 | -4.06 | < .001 |
| Age   | -0.02                        | [-0.03, -0.01] | 0.00 | -5.96 | .005                            | -0.02   | [-0.03, -0.02] | 0.00 | -8.96 | .001   |
| Sleep regularity × pa mostactivehr              | 0.00                         | [0.00, 0.00]   | 0.00 | 2.31  | .022                            | 0.00    | [0.00, 0.01]   | 0.00 | 2.98  | .003   |
| Pa mostactivehr × Sleep regularity <sup>2</sup> | 0.00                         | [0.00, 0.00]   | 0.00 | 2.22  | .026                            | 0.00    | [0.00, 0.00]   | 0.00 | 2.88  | .004   |

Note. Adjusted for SES, age, sex, and BMI. Outcomes variables are listed in the row headers.

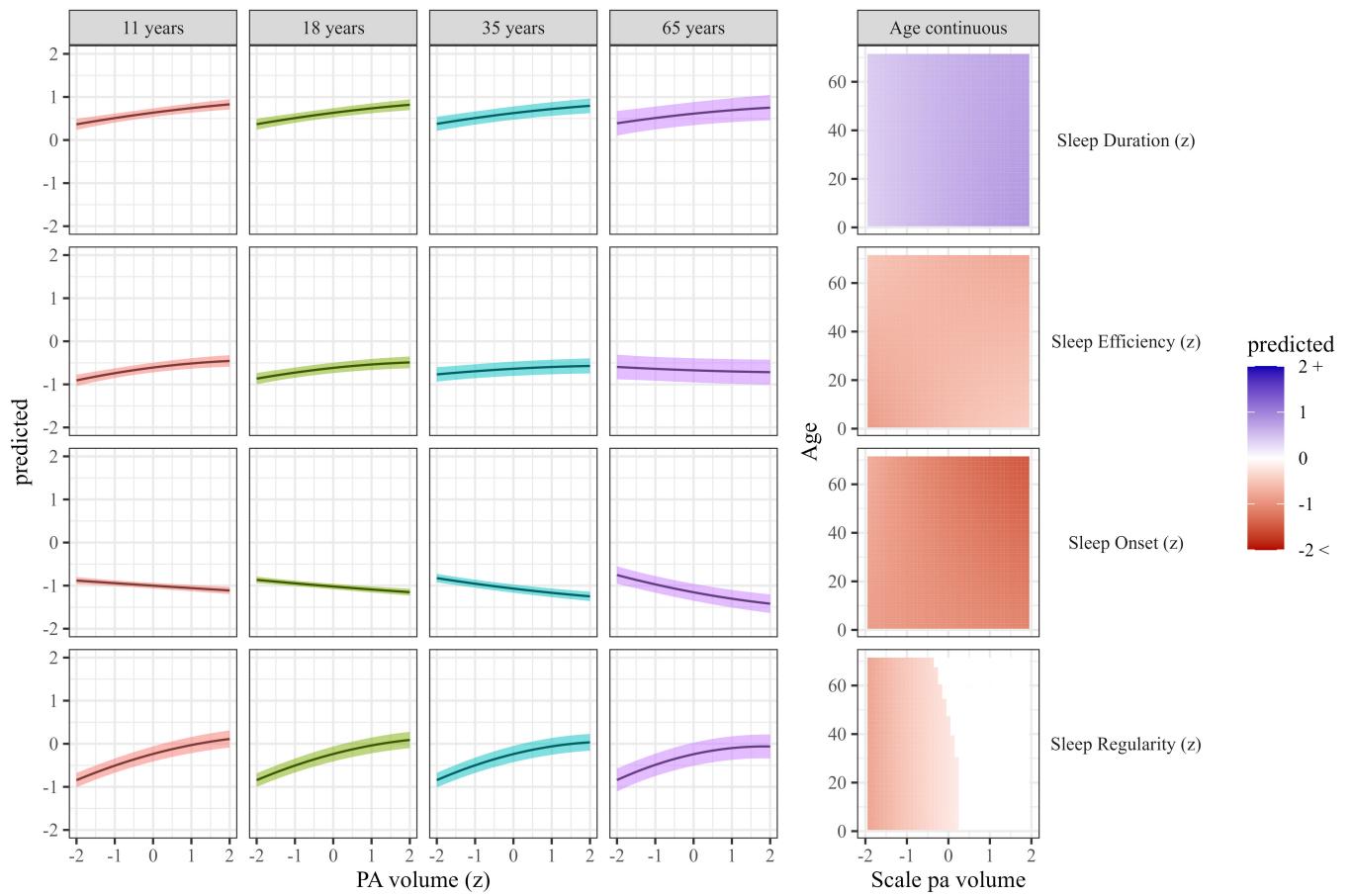


Figure 1. Sleep metrics on Physical activity volume

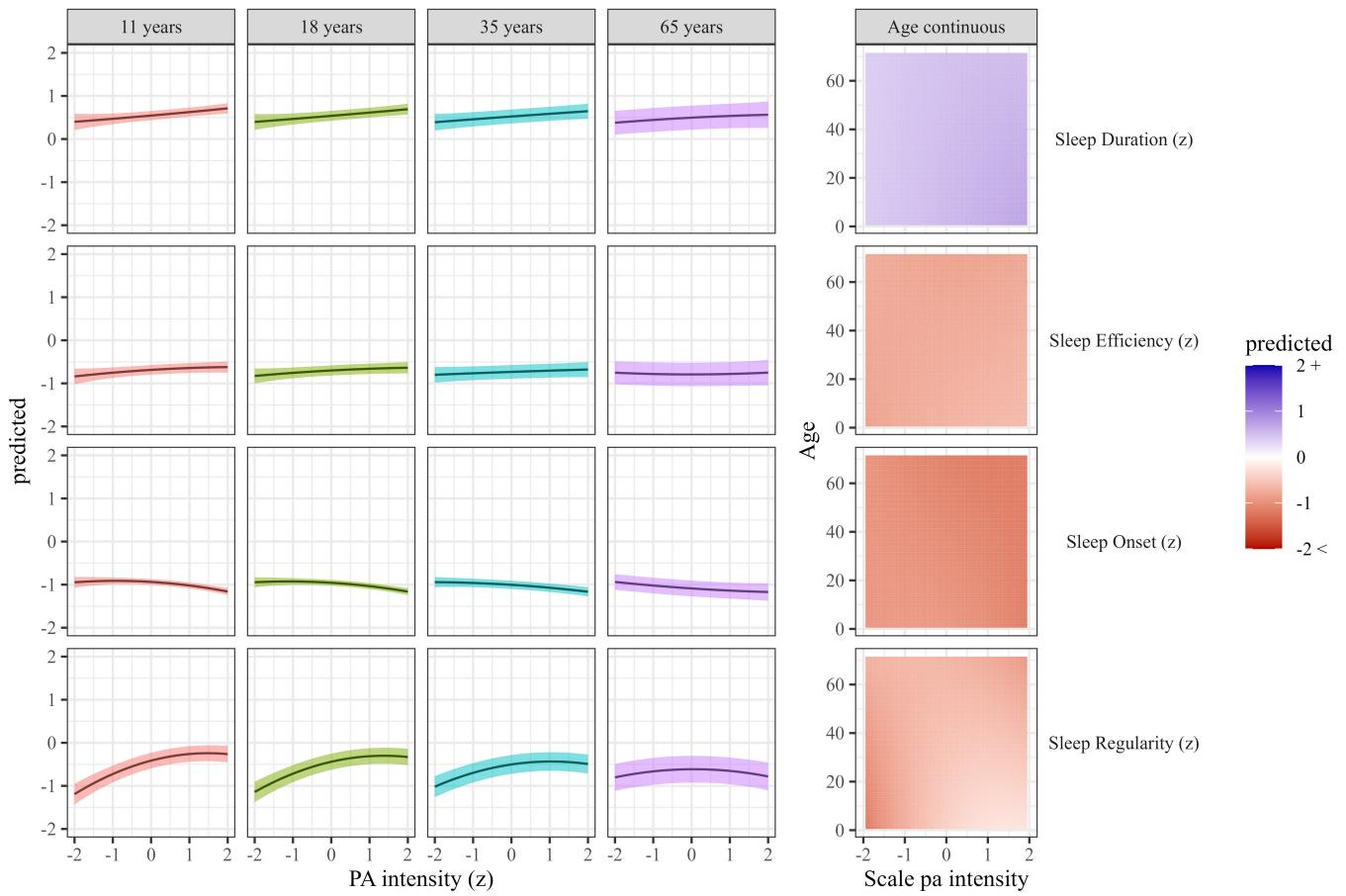


Figure 2. Sleep metrics on Physical activity intensity

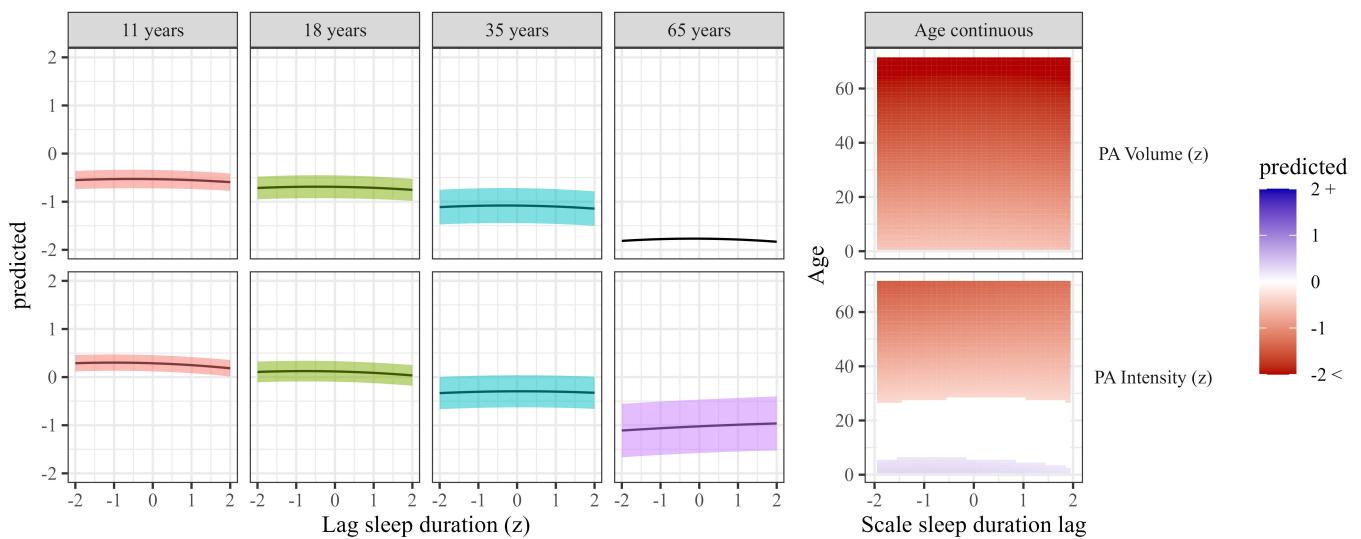


Figure 3. Physical activity by sleep duration

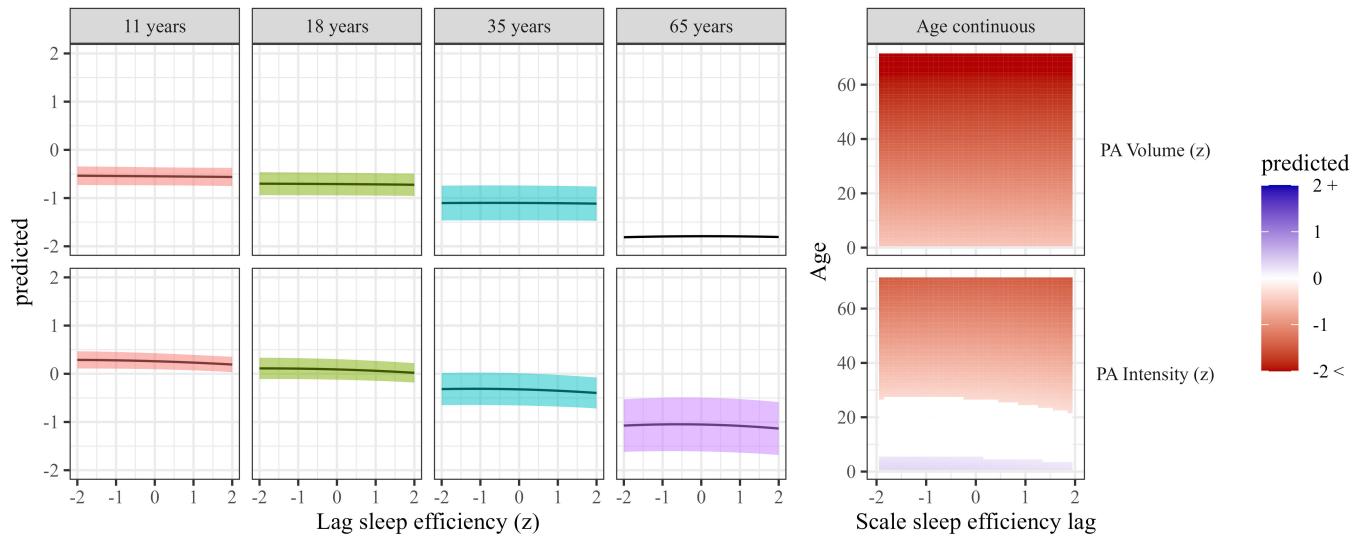


Figure 4. Physical activity by sleep efficiency

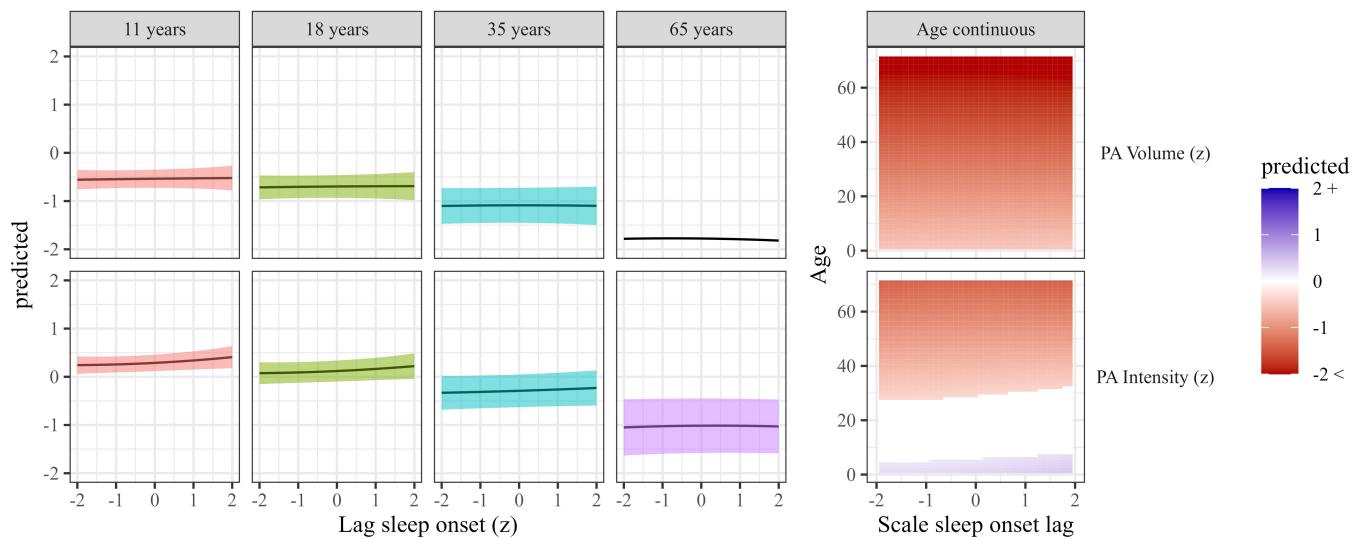


Figure 5. Physical activity by sleep onset

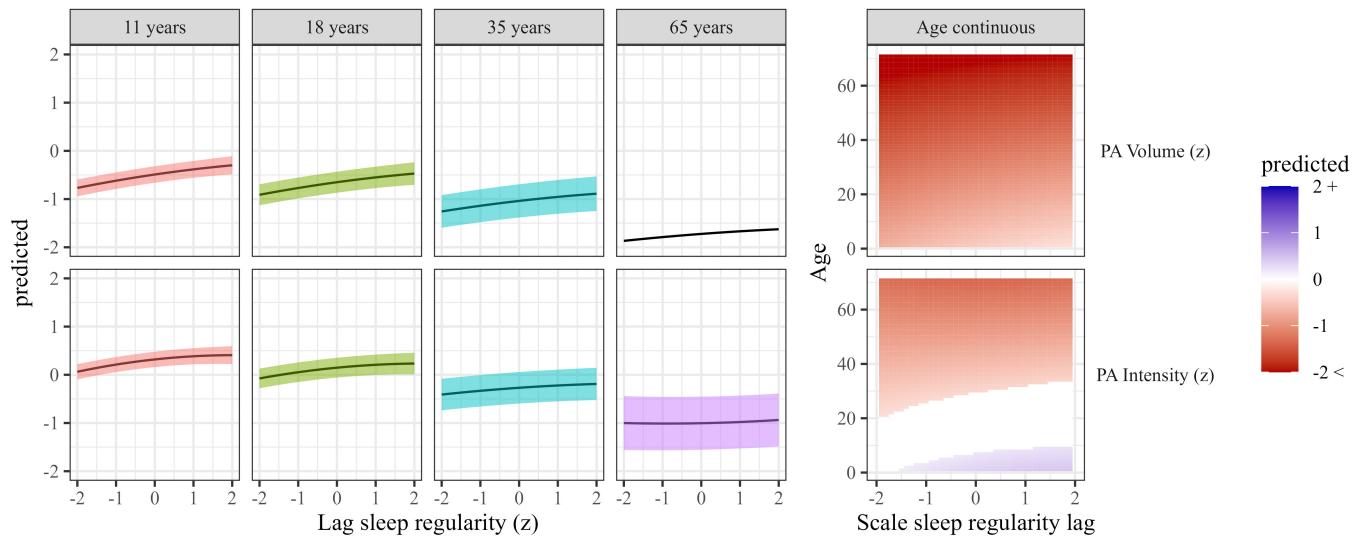


Figure 6. Physical activity by sleep regularity

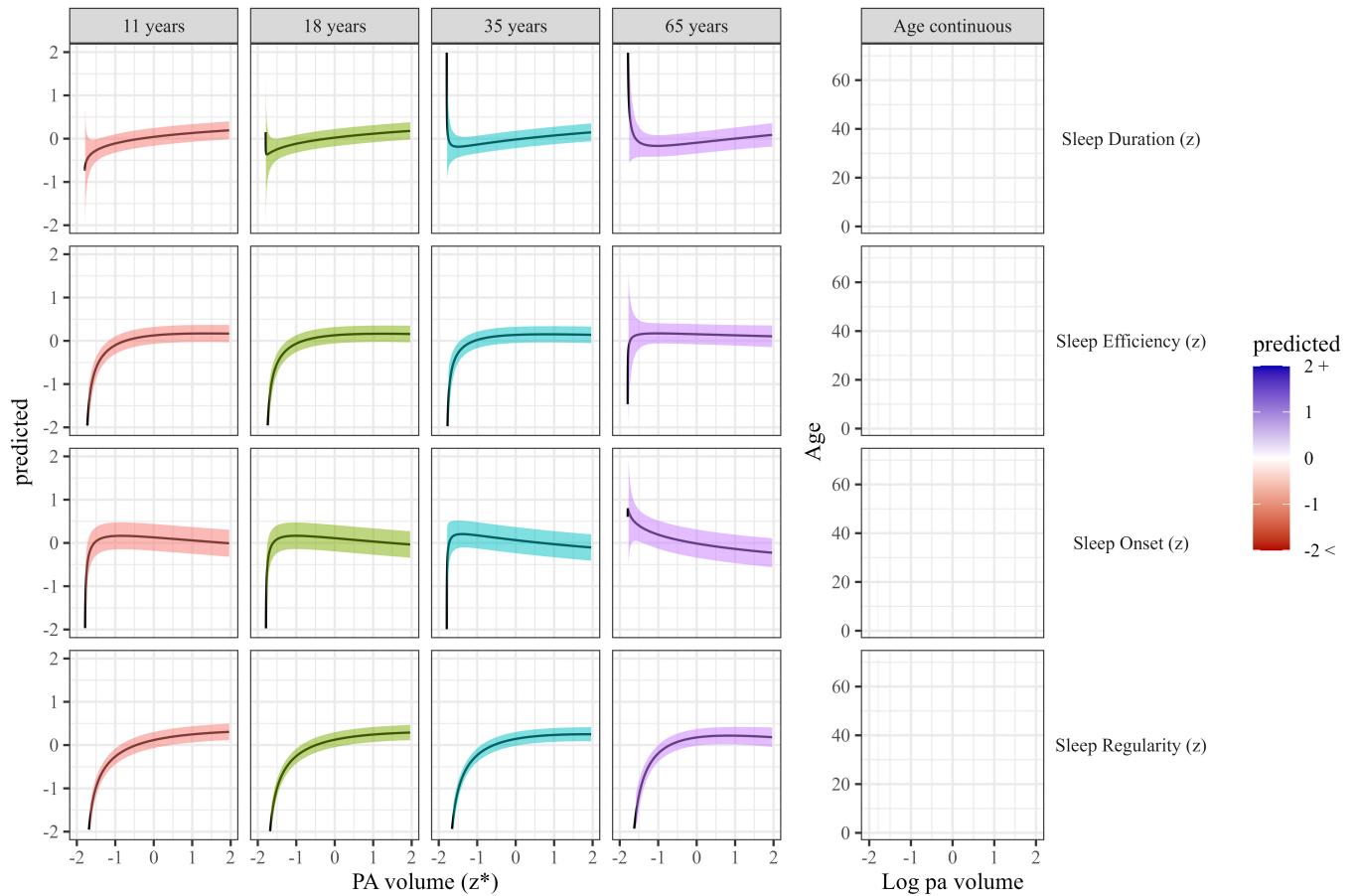


Figure 7. Sleep metrics on Physical activity volume

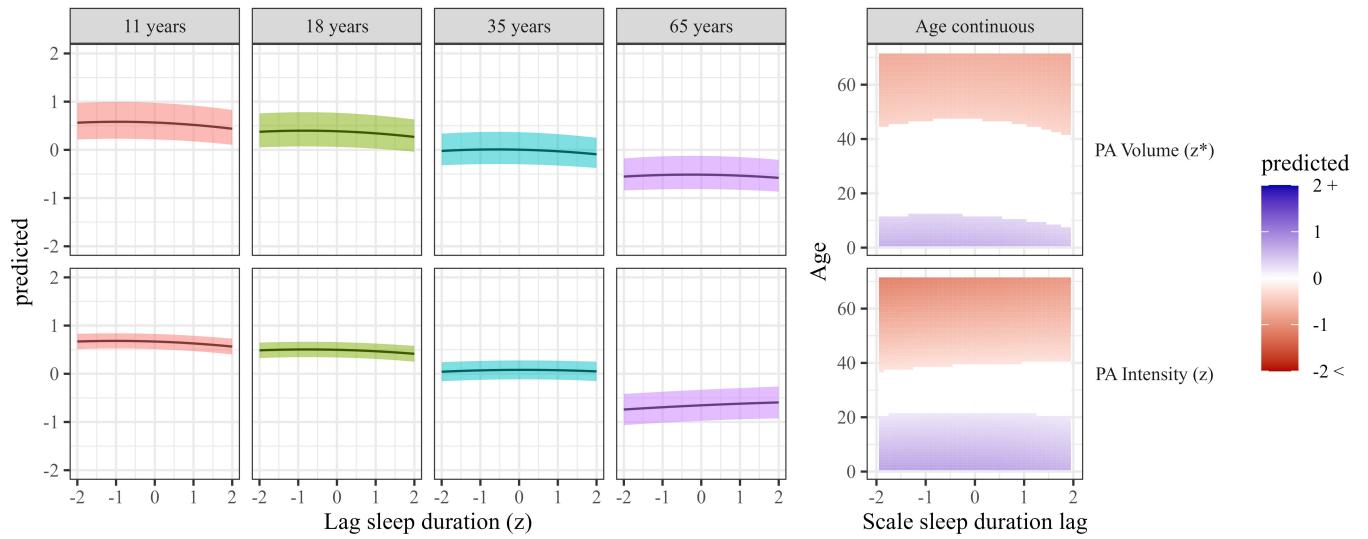


Figure 8. Physical activity by sleep duration

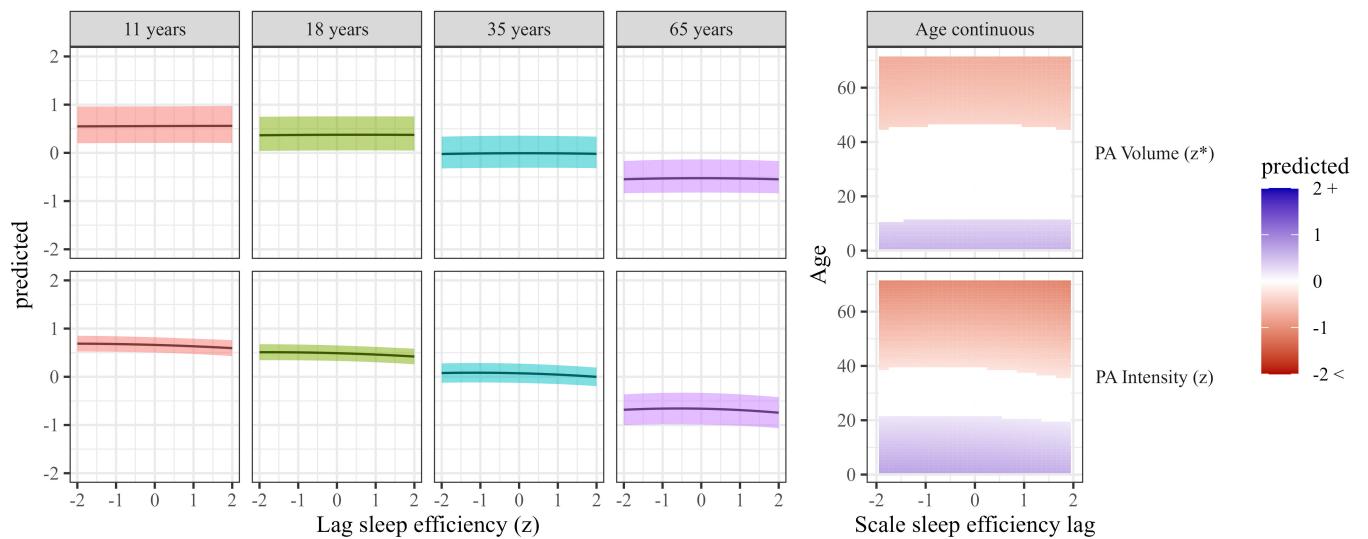


Figure 9. Physical activity by sleep efficiency

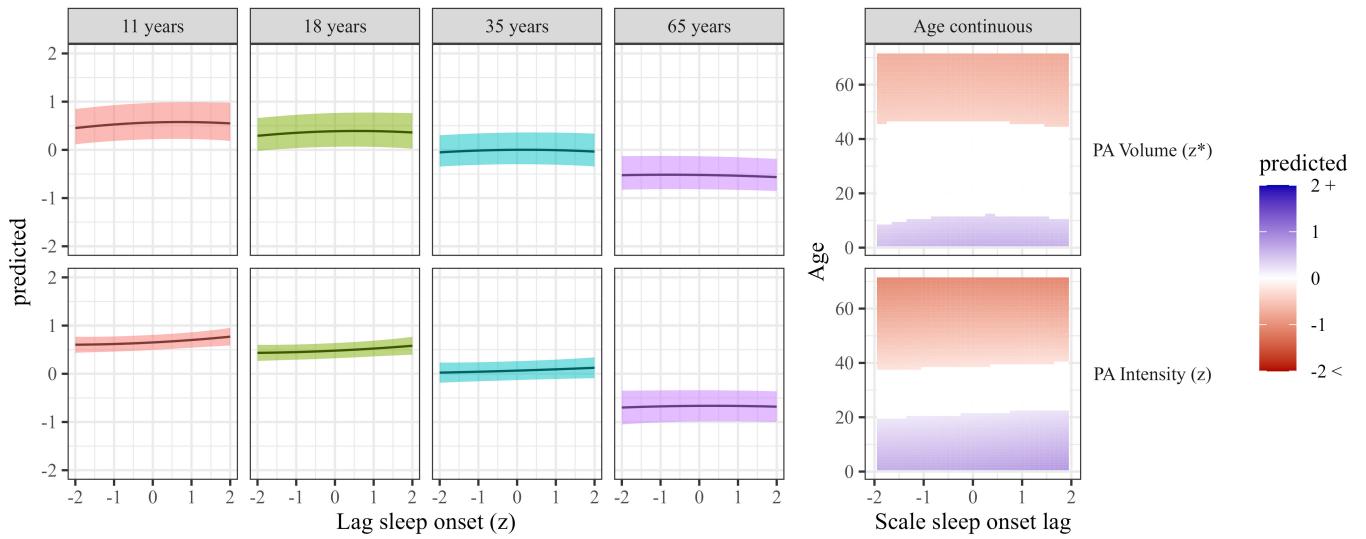


Figure 10. Physical activity by sleep onset

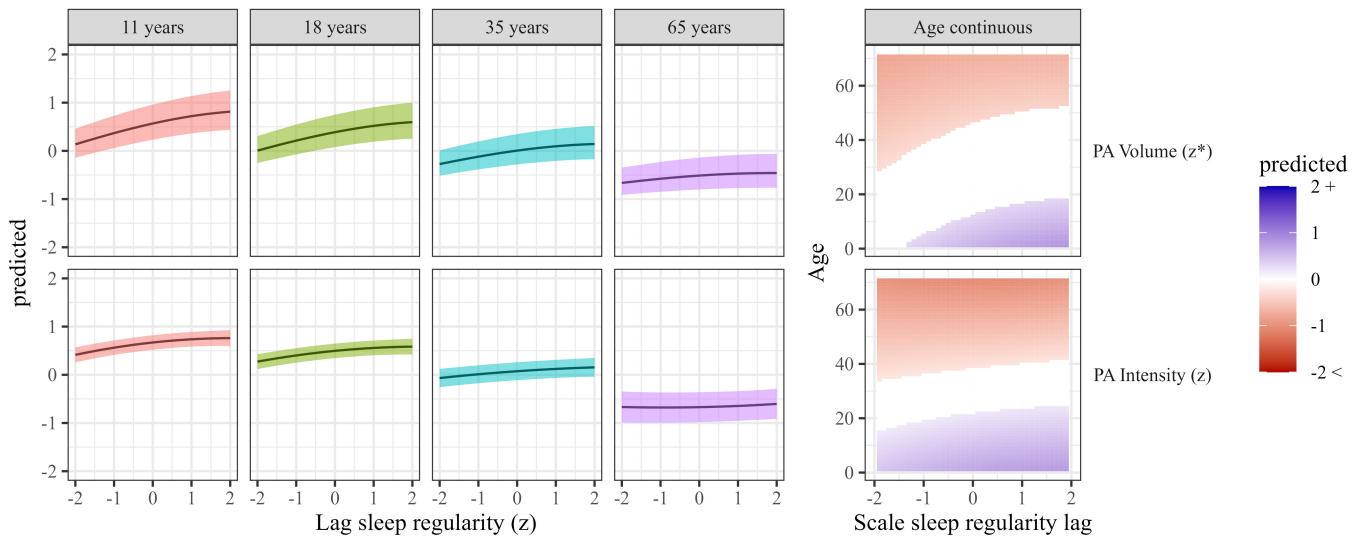


Figure 11. Physical activity by sleep regularity

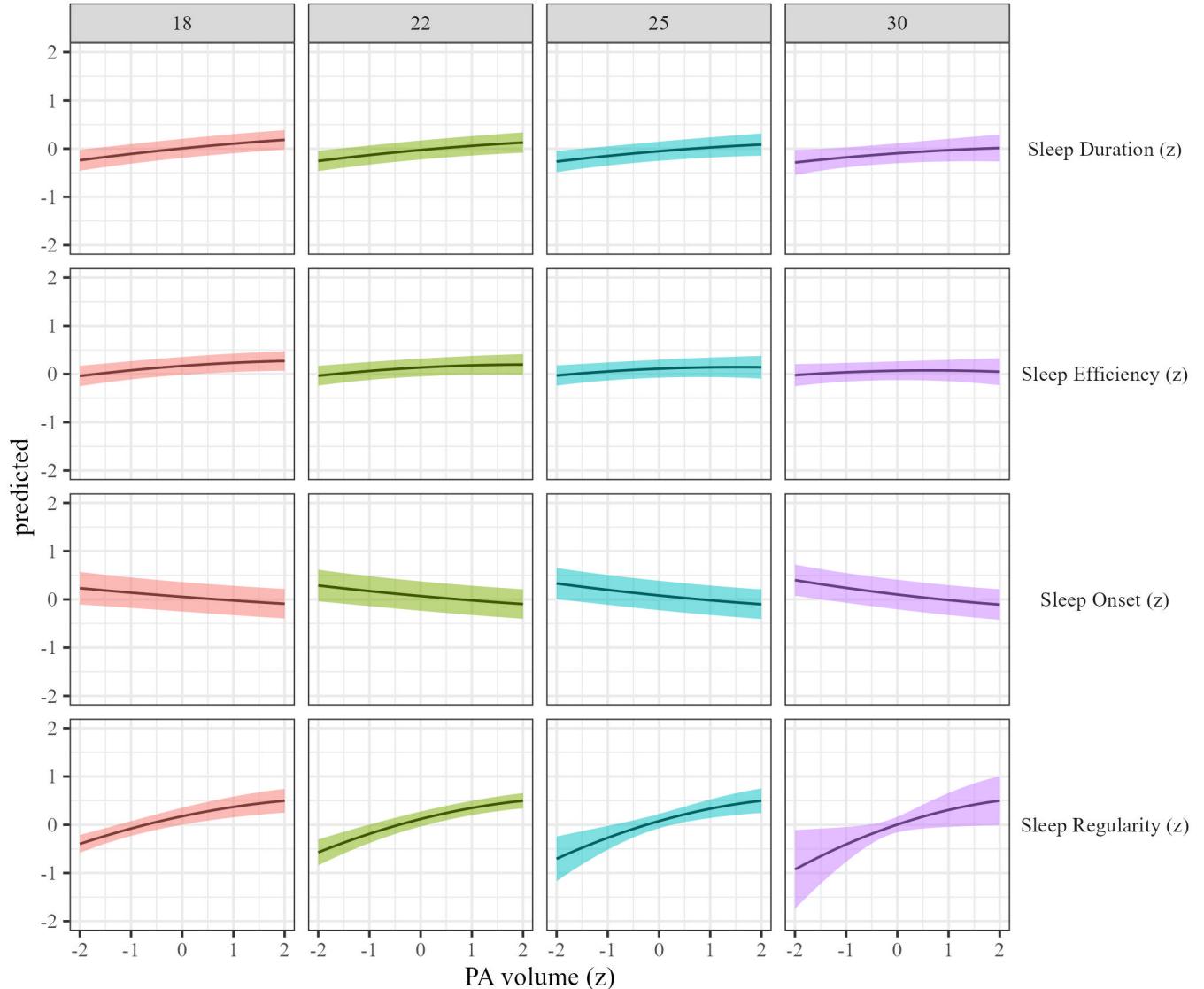


Figure 12. Sleep metrics on Physical activity volume by BMI

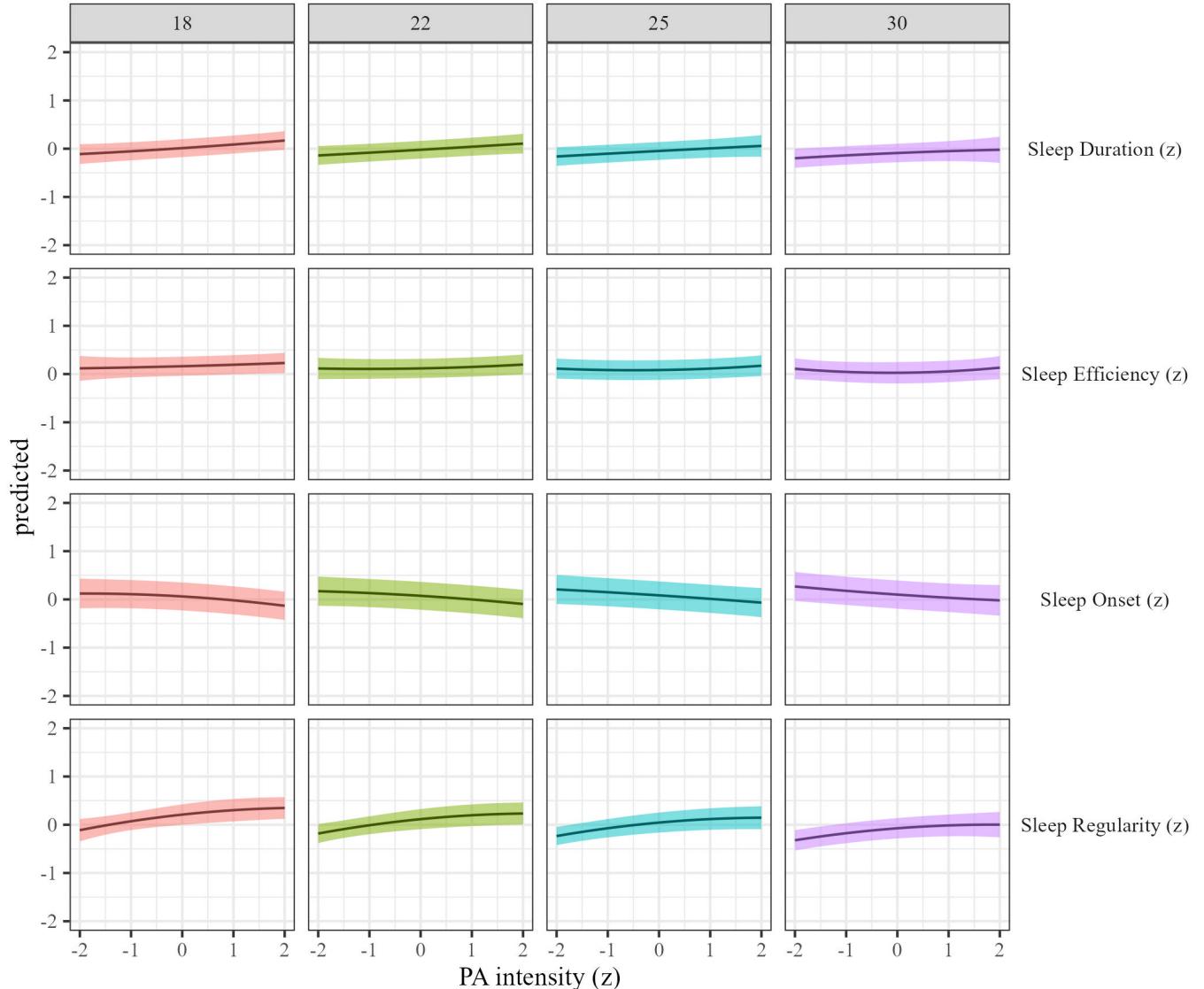


Figure 13. Sleep metrics on Physical activity intensity moderated by BMI

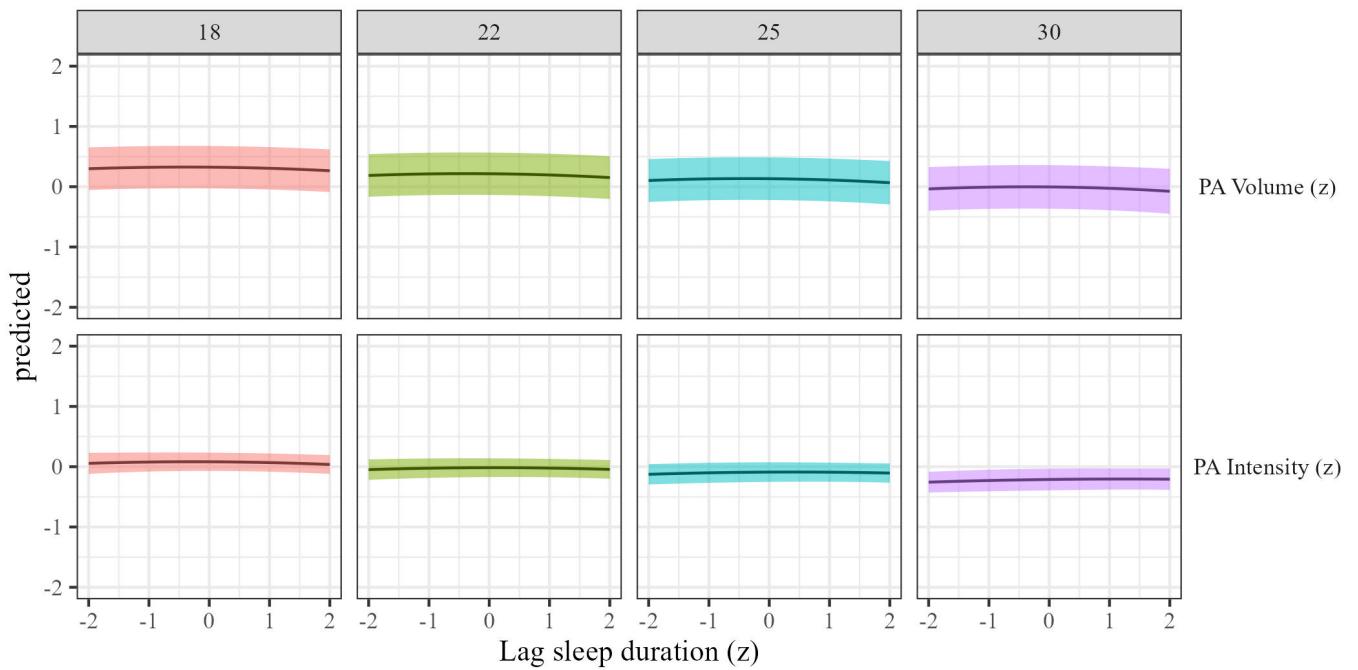


Figure 14. Physical activity by sleep duration moderated by BMI

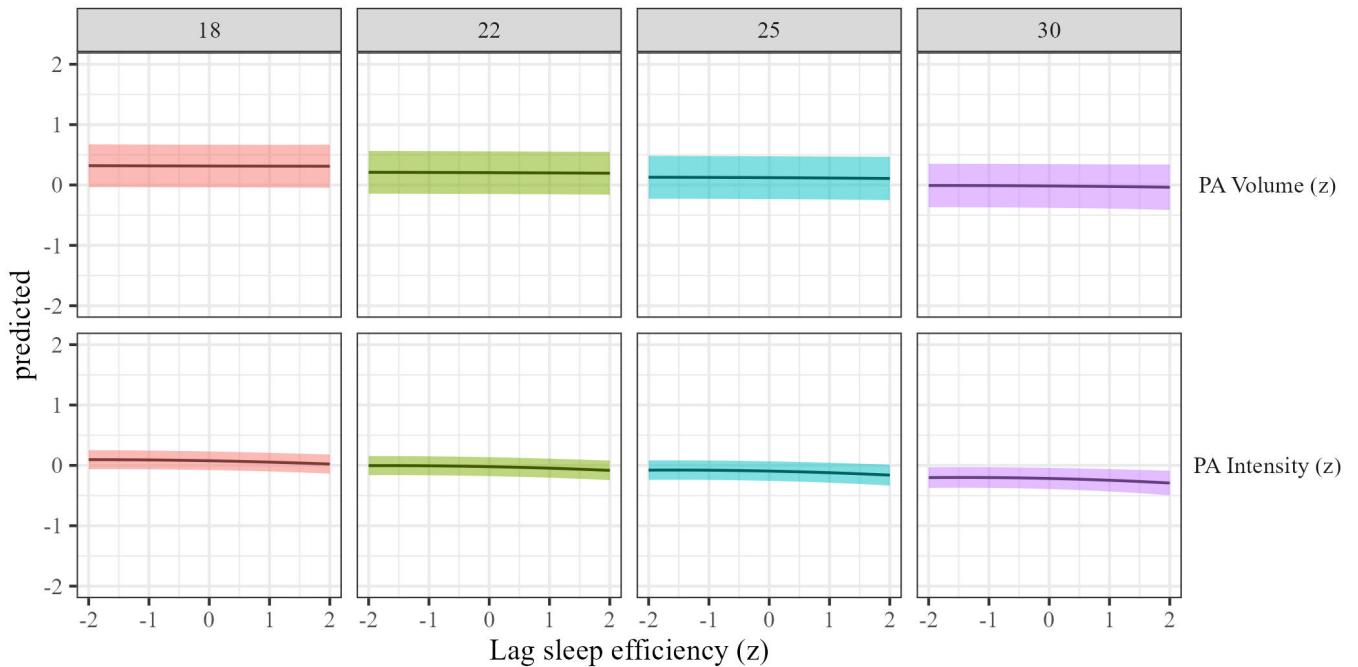
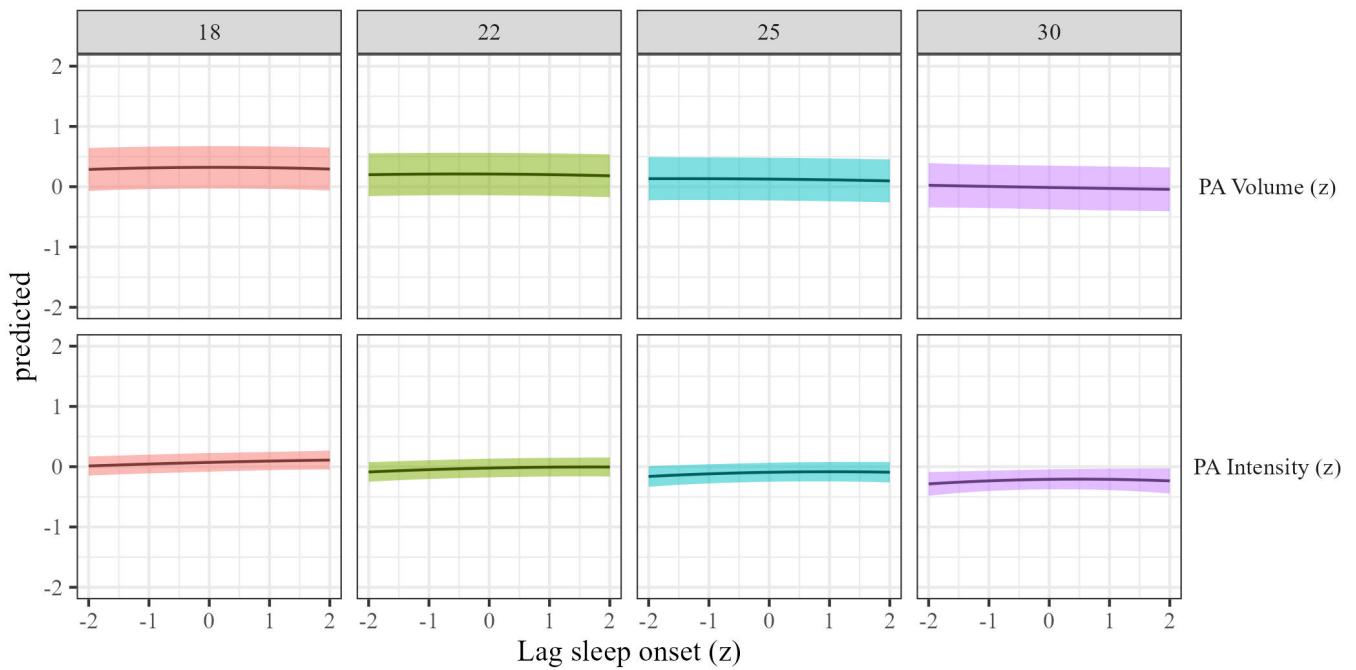
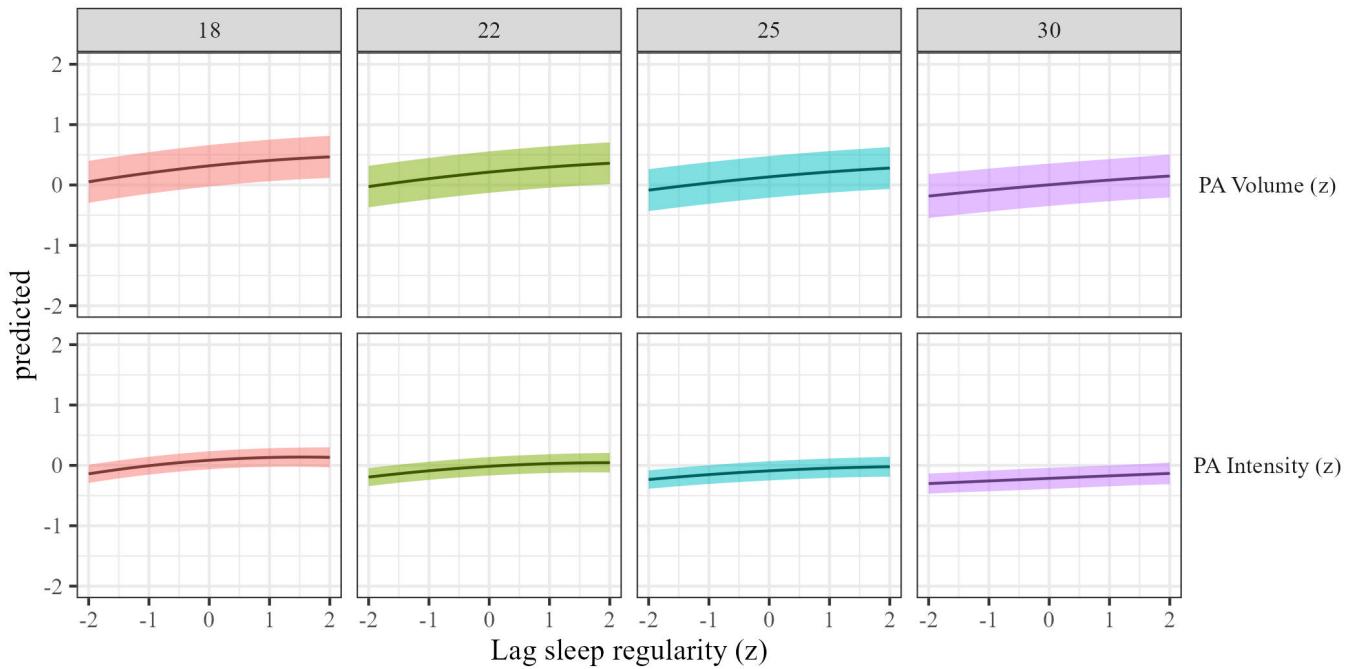


Figure 15. Physical activity by sleep efficiency moderated by BMI



*Figure 16.* Physical activity by sleep onset moderated by BMI



*Figure 17.* Physical activity by sleep regularity moderated by BMI

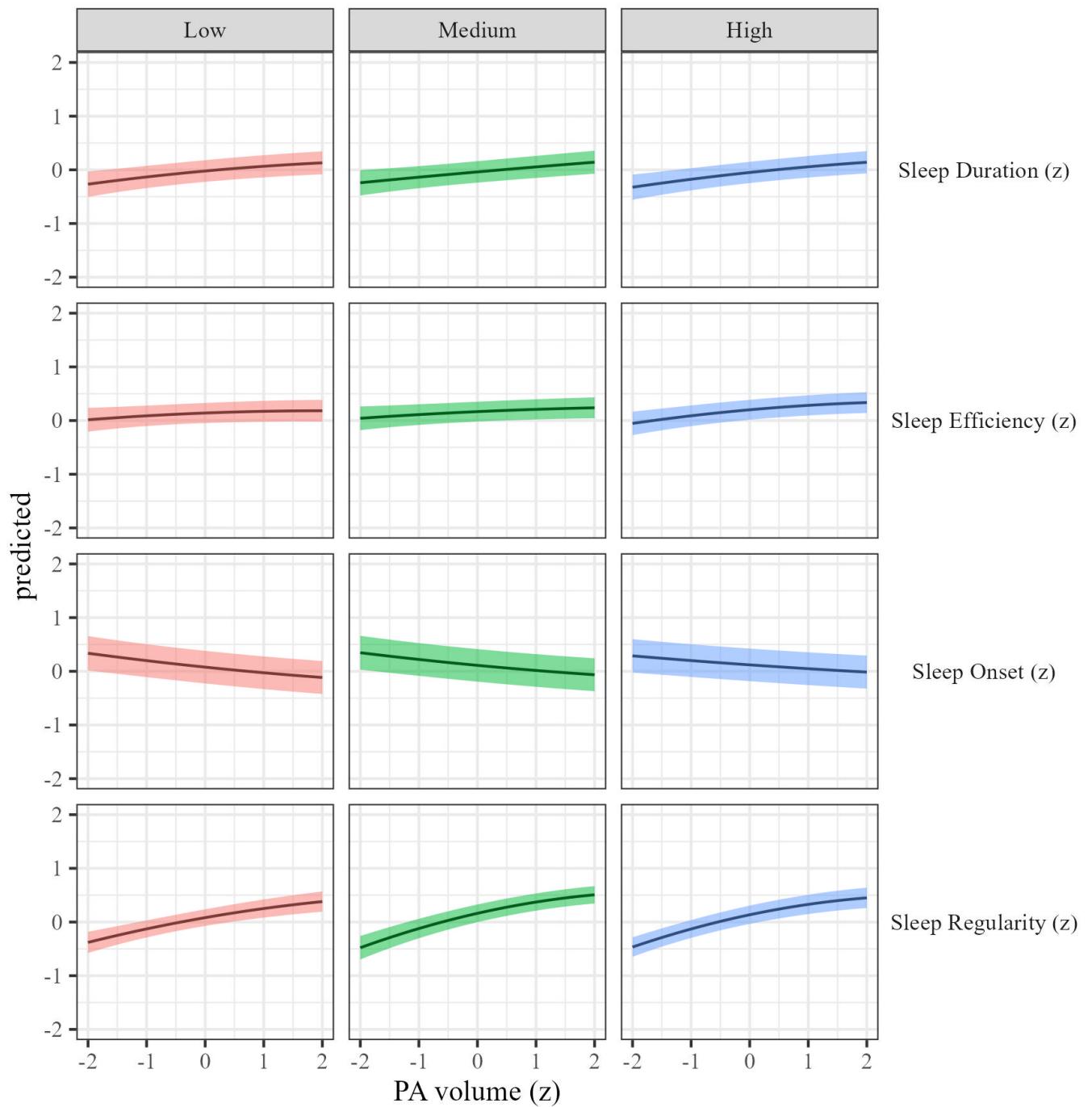


Figure 18. Sleep metrics on Physical activity volume by SES

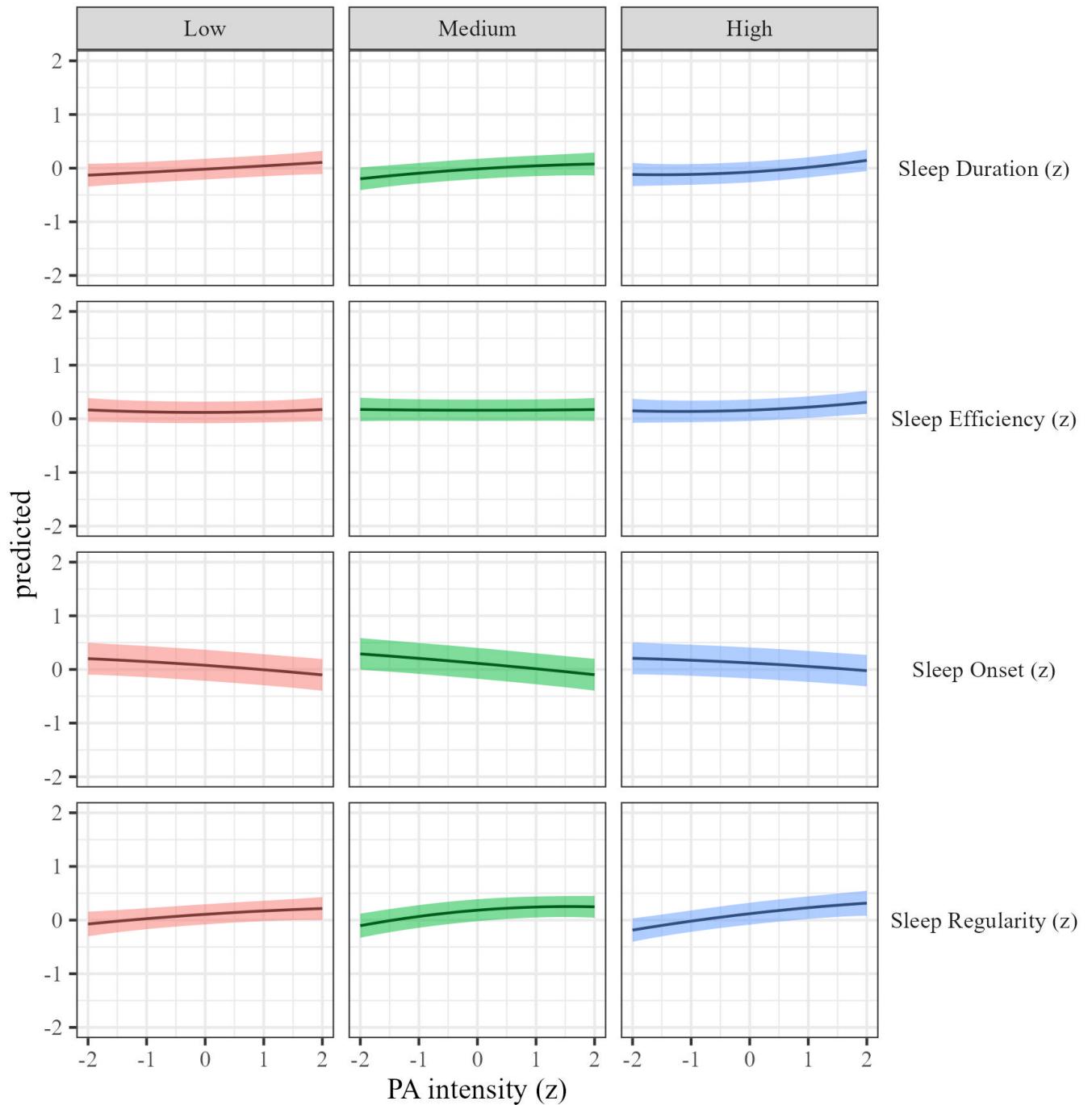


Figure 19. Sleep metrics on Physical activity intensity moderated by SES

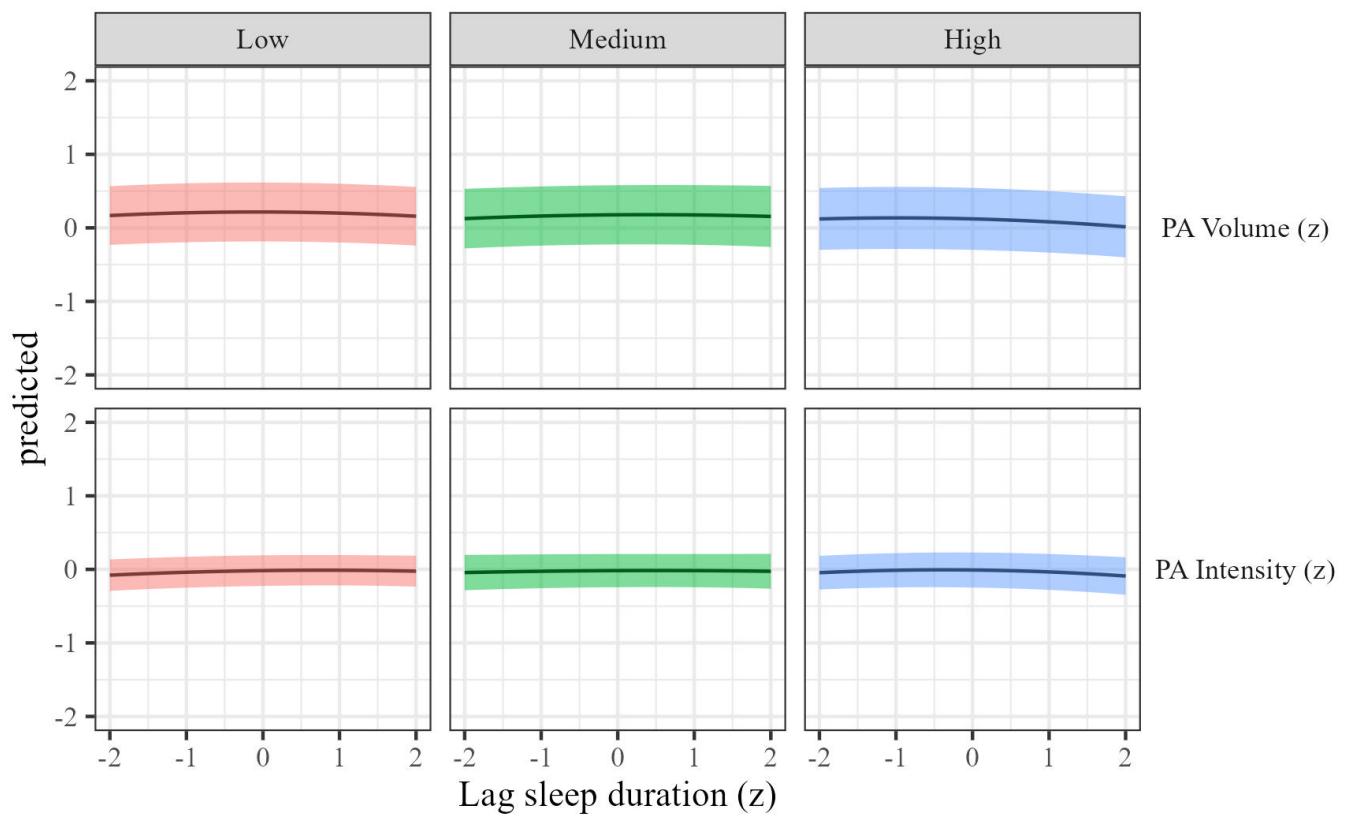


Figure 20. Physical activity by sleep duration moderated by SES

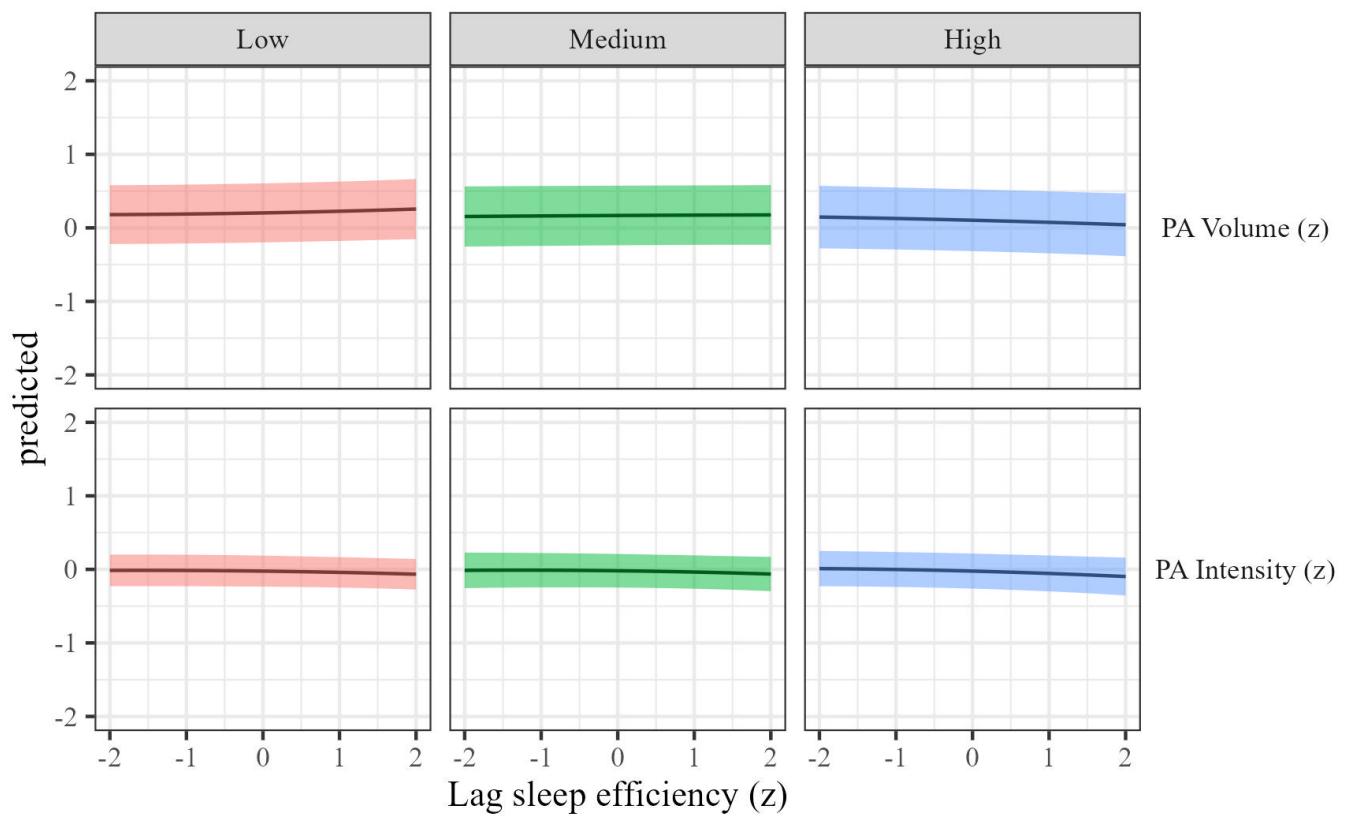


Figure 21. Physical activity by sleep efficiency moderated by SES

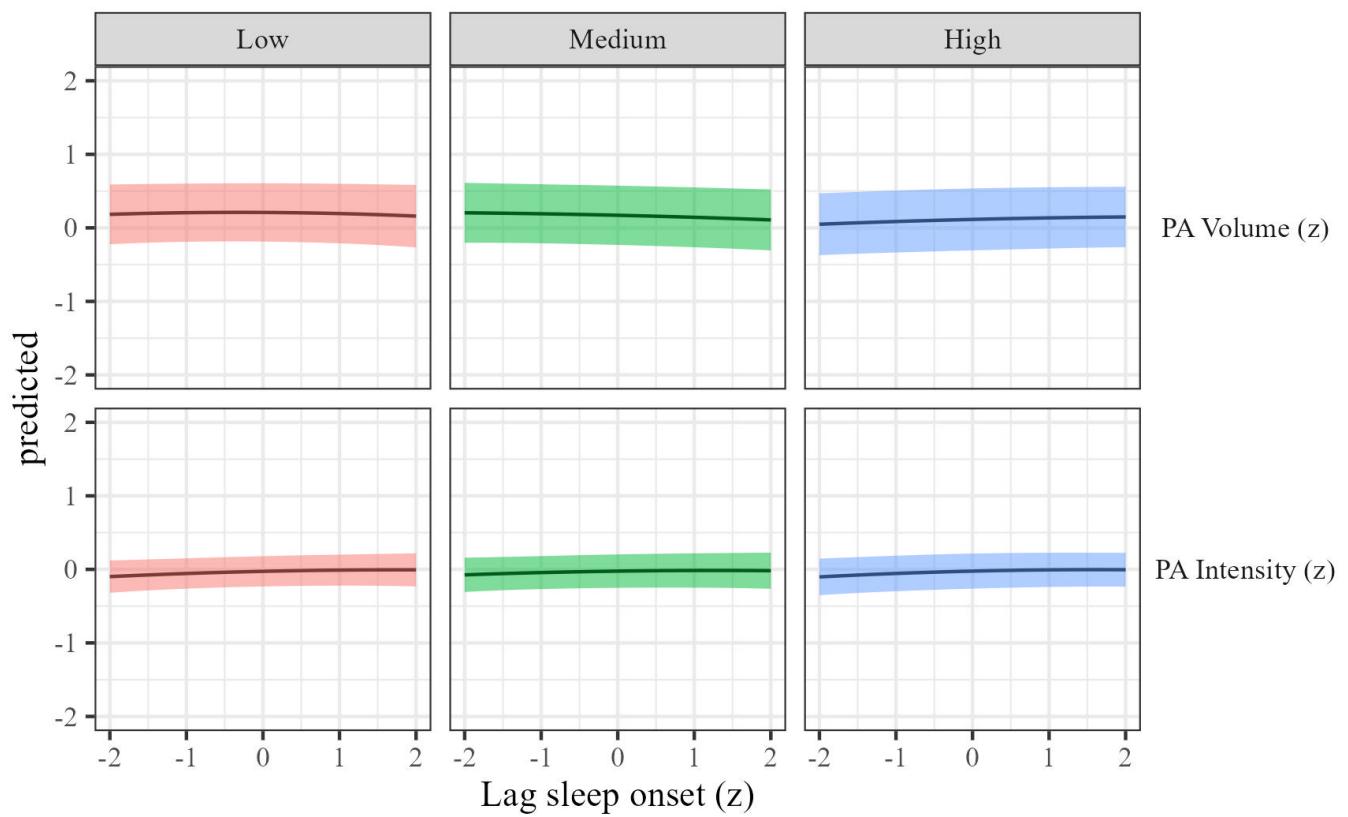


Figure 22. Physical activity by sleep onset moderated by SES

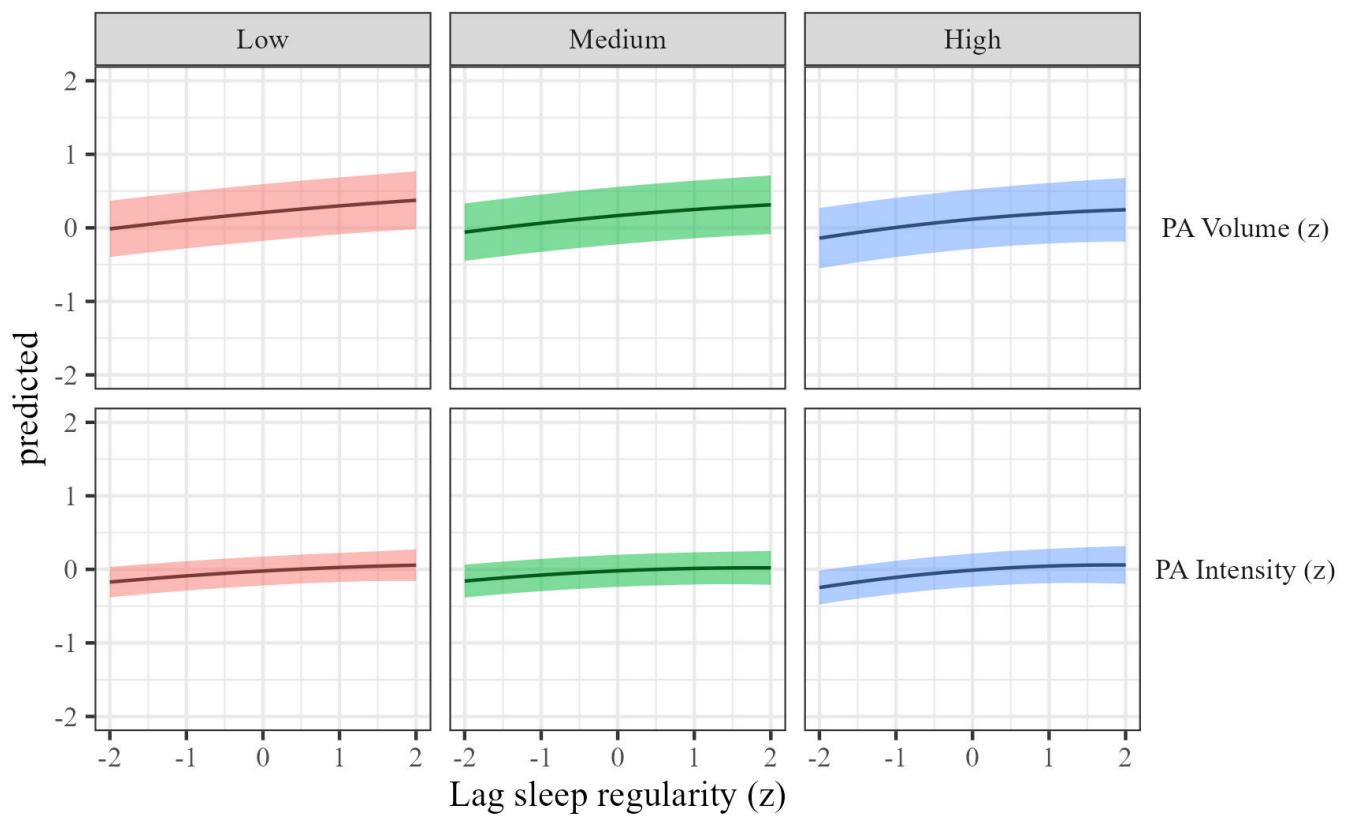


Figure 23. Physical activity by sleep regularity moderated by SES

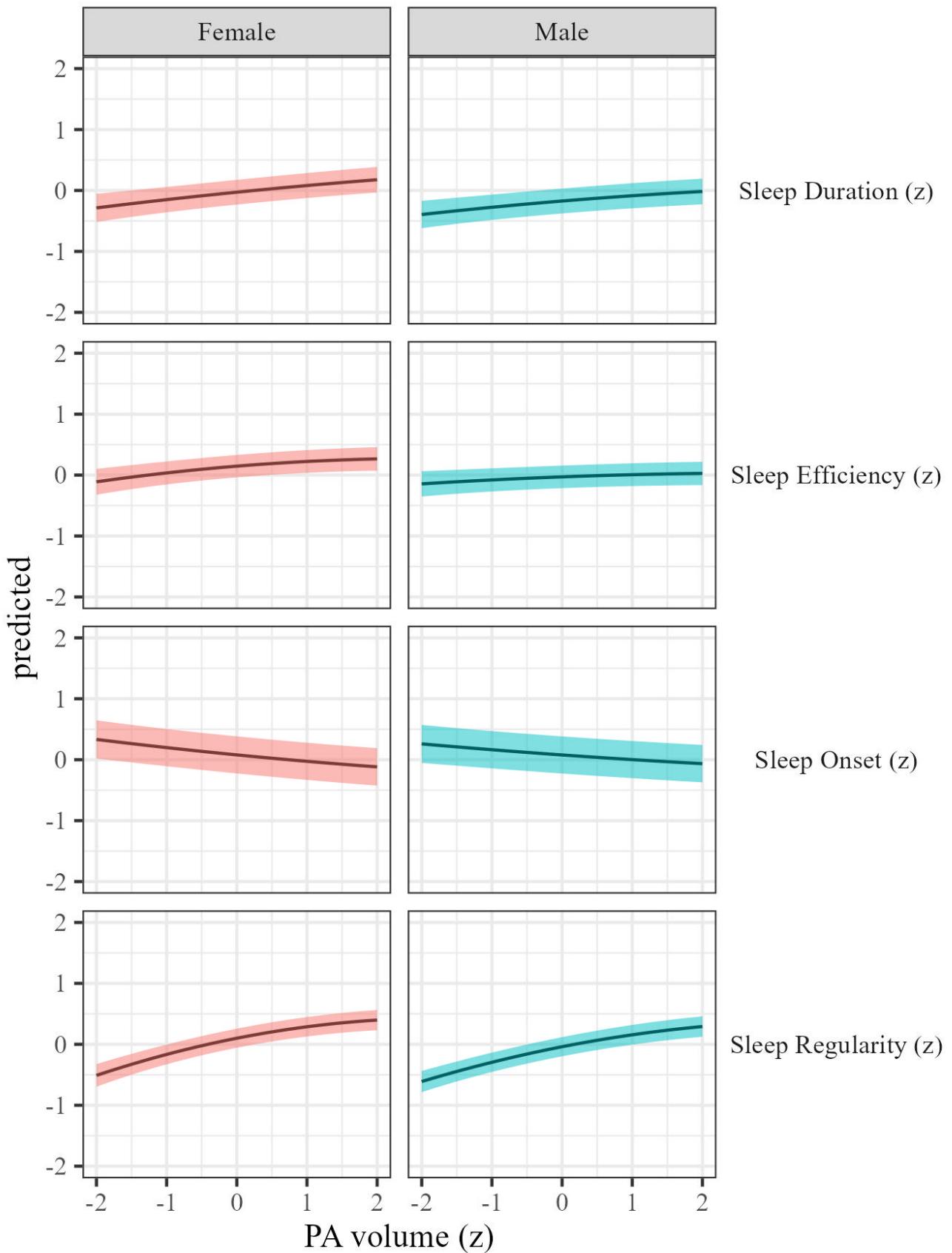


Figure 24. Sleep metrics on Physical activity volume by sex

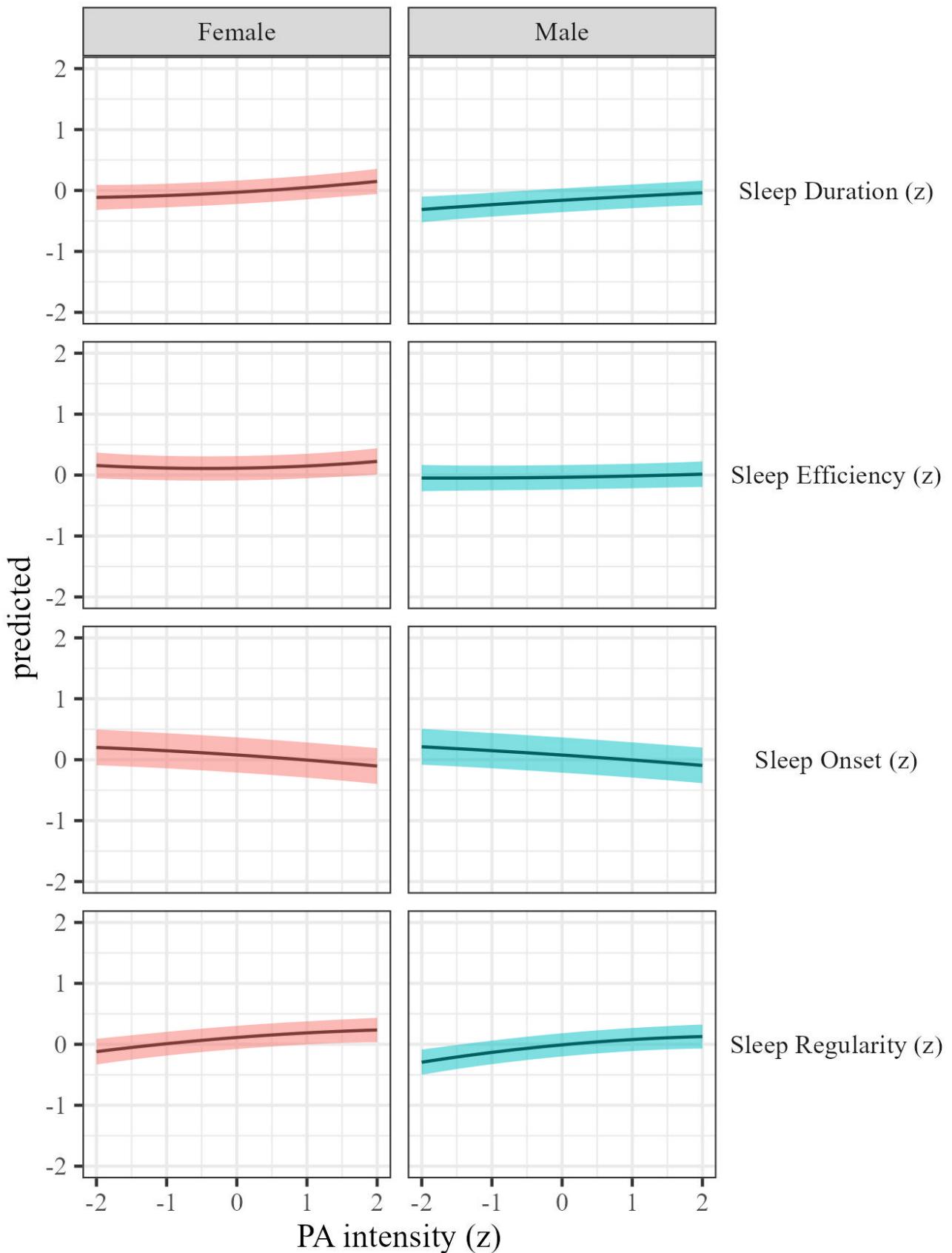


Figure 25. Sleep metrics on Physical activity intensity moderated by sex

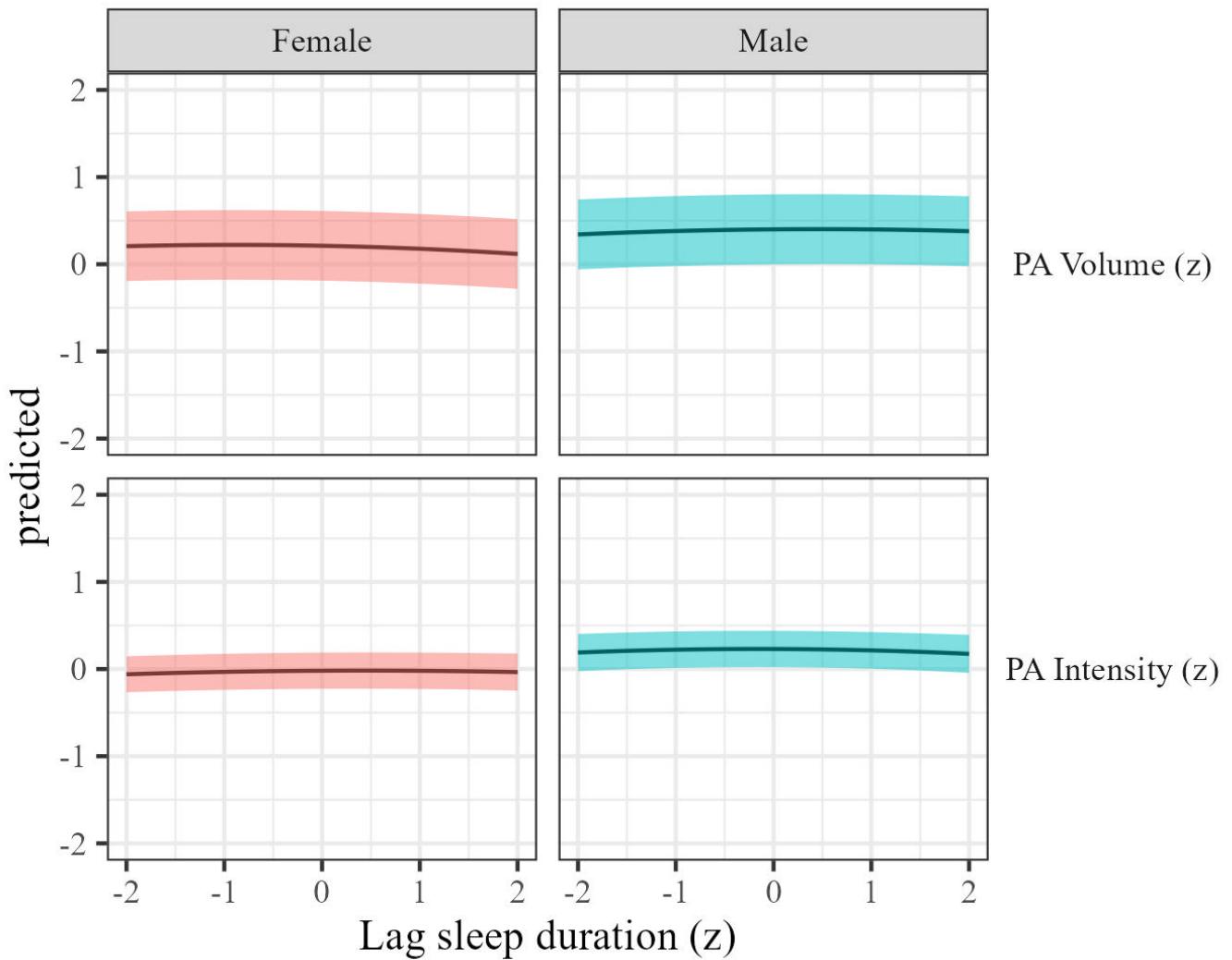


Figure 26. Physical activity by sleep duration moderated by sex

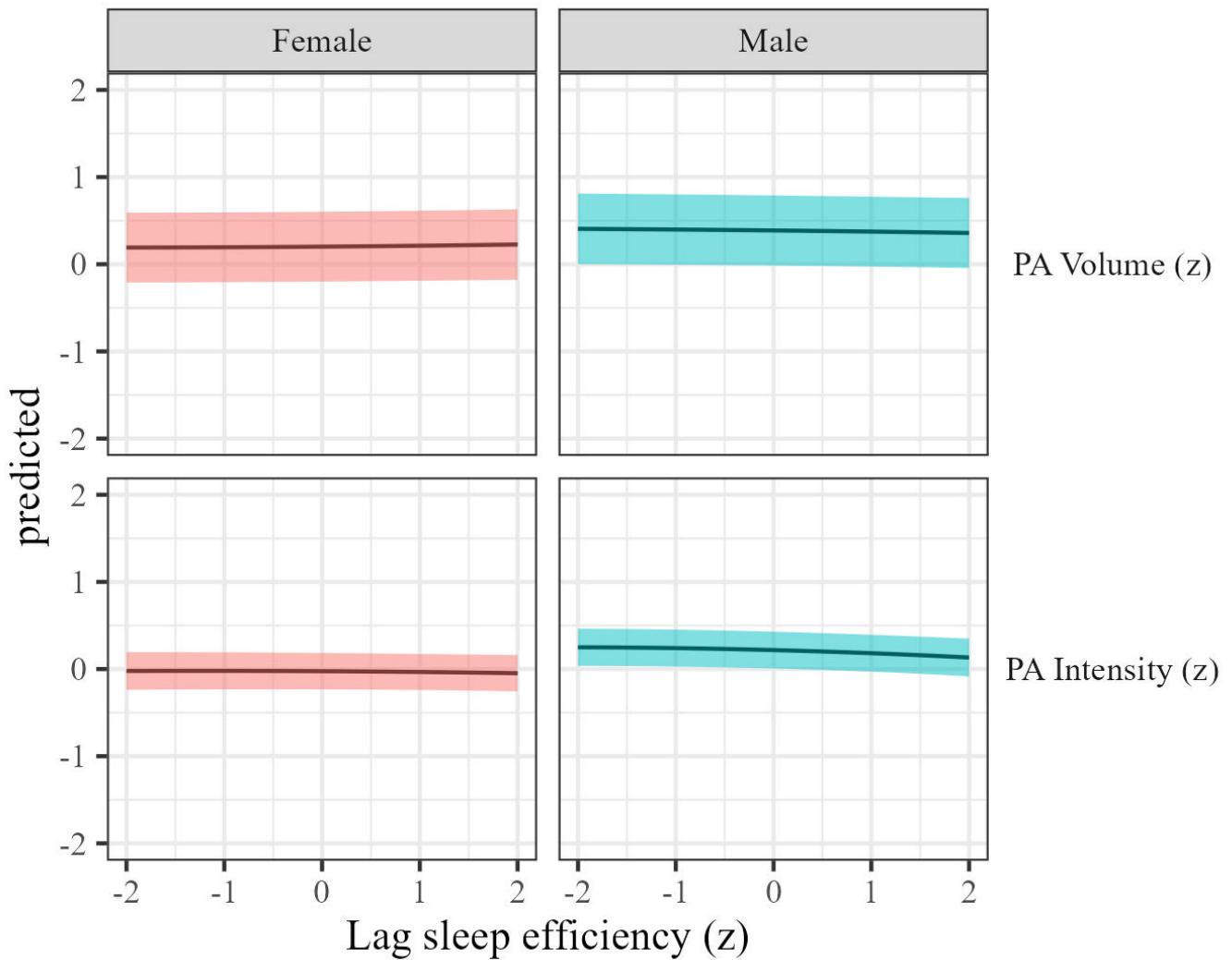


Figure 27. Physical activity by sleep efficiency moderated by sex

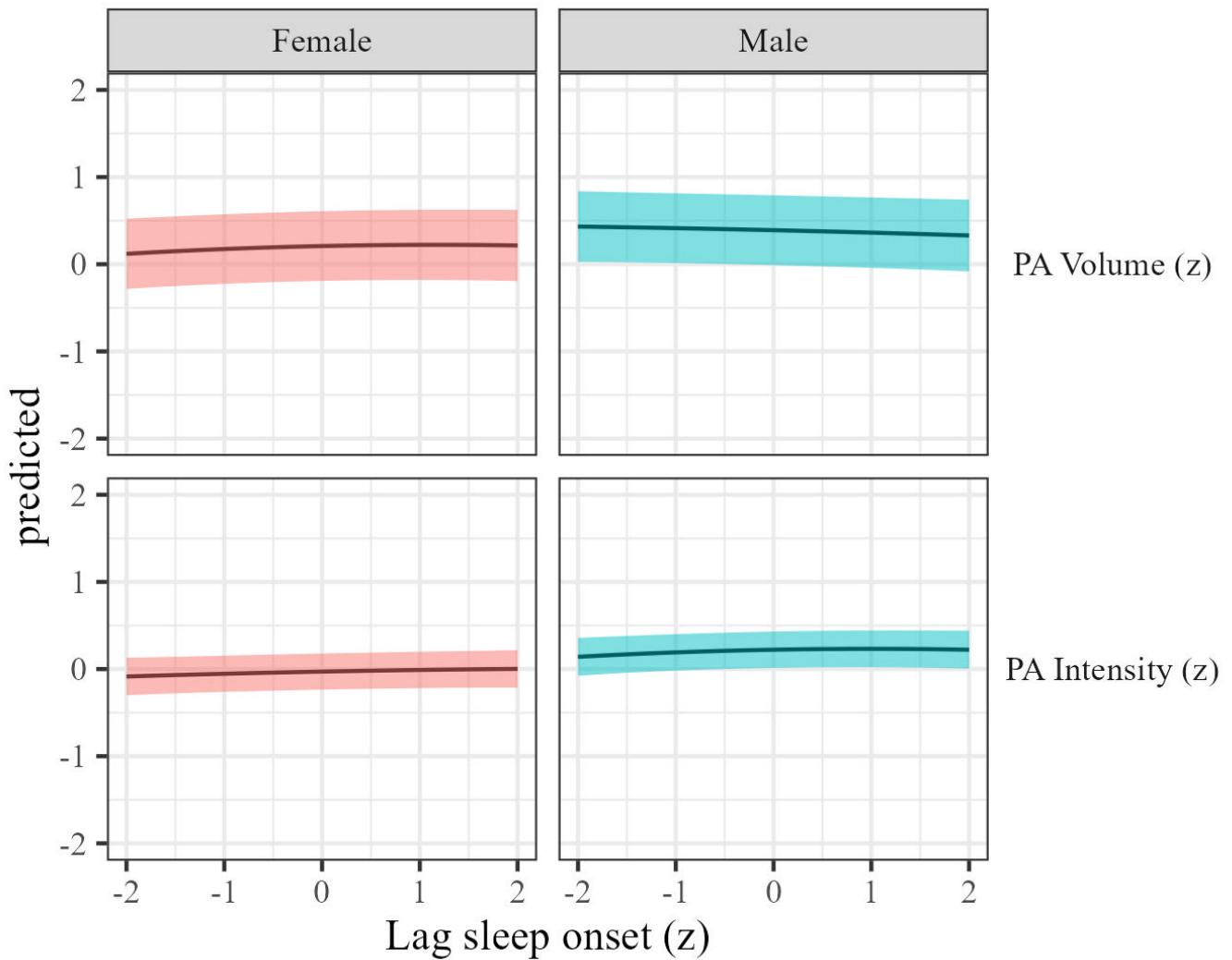


Figure 28. Physical activity by sleep onset moderated by sex

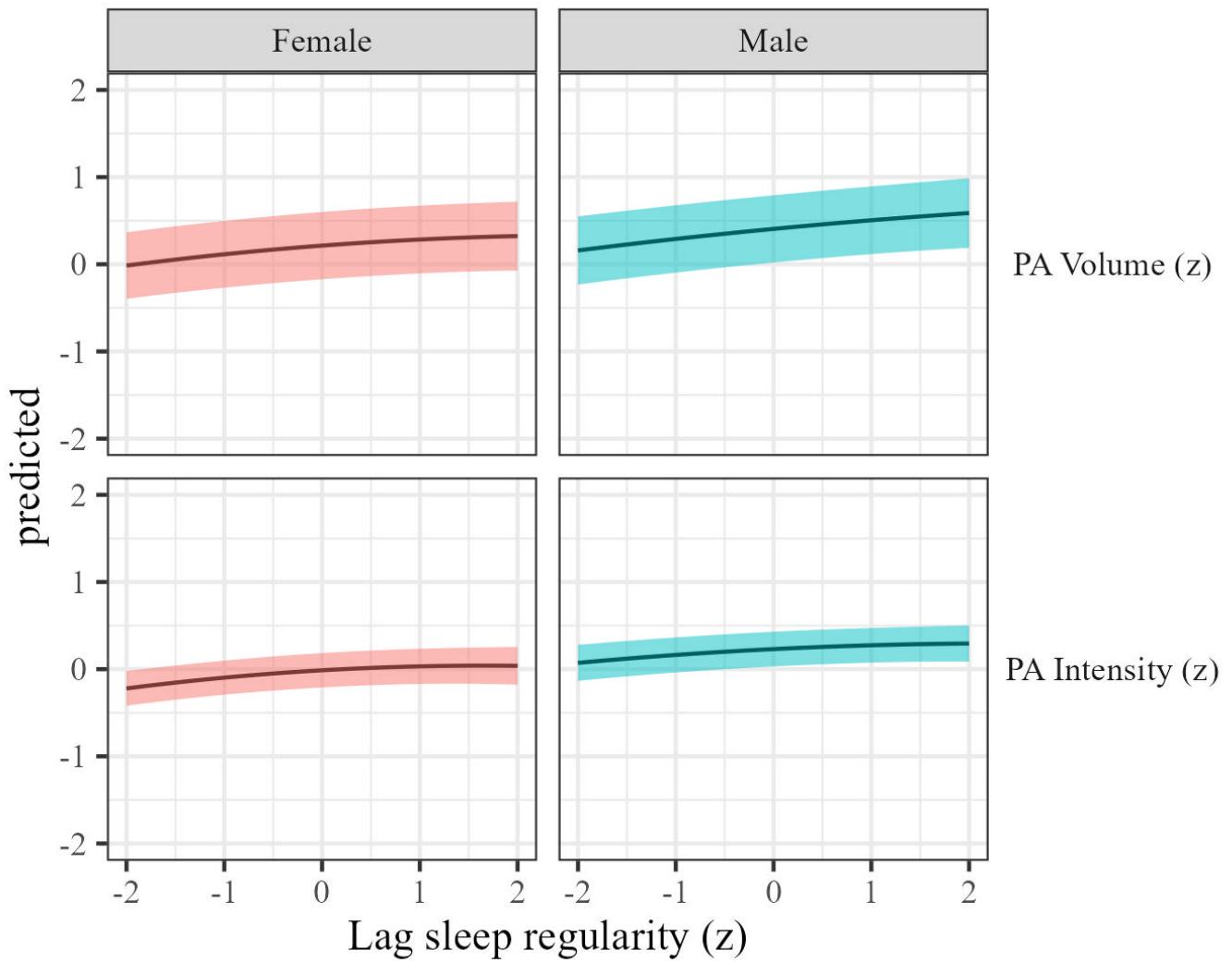


Figure 29. Physical activity by sleep regularity moderated by sex

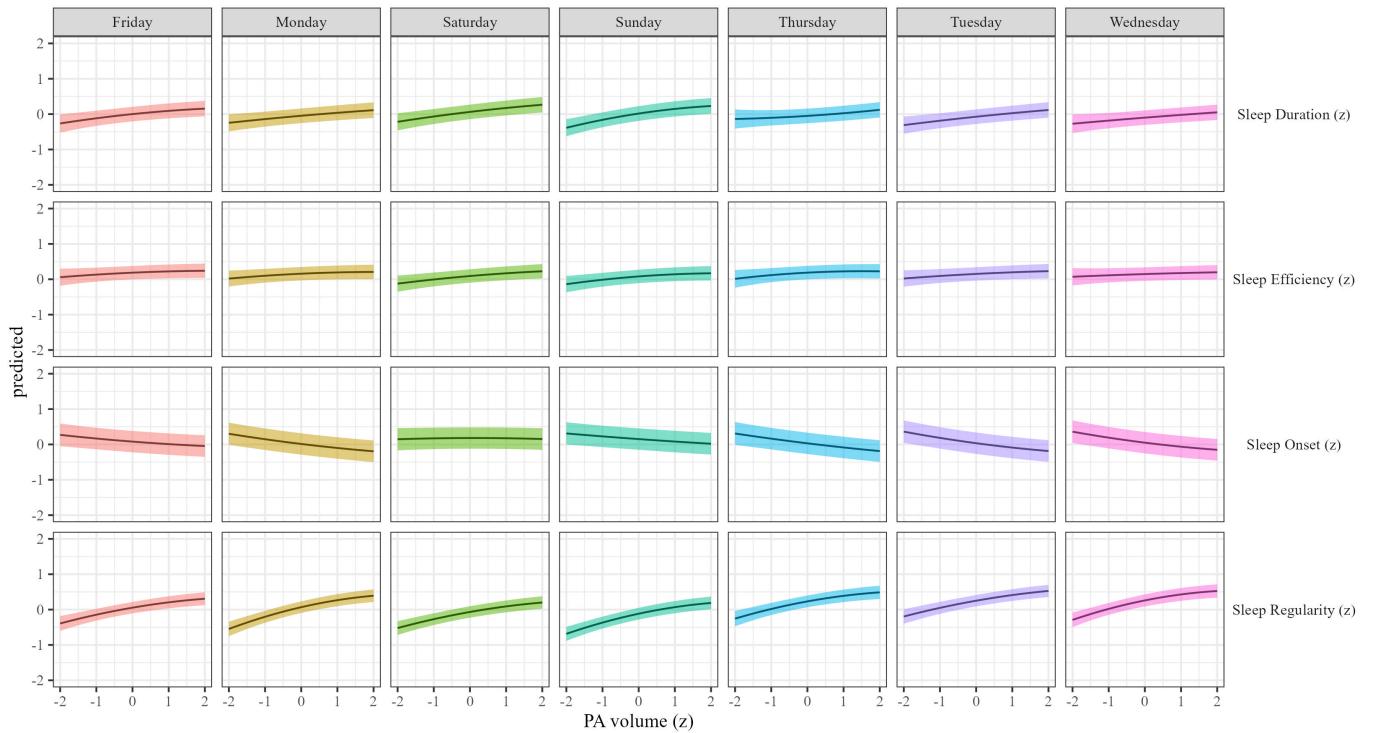


Figure 30. Sleep metrics on Physical activity volume by weekday

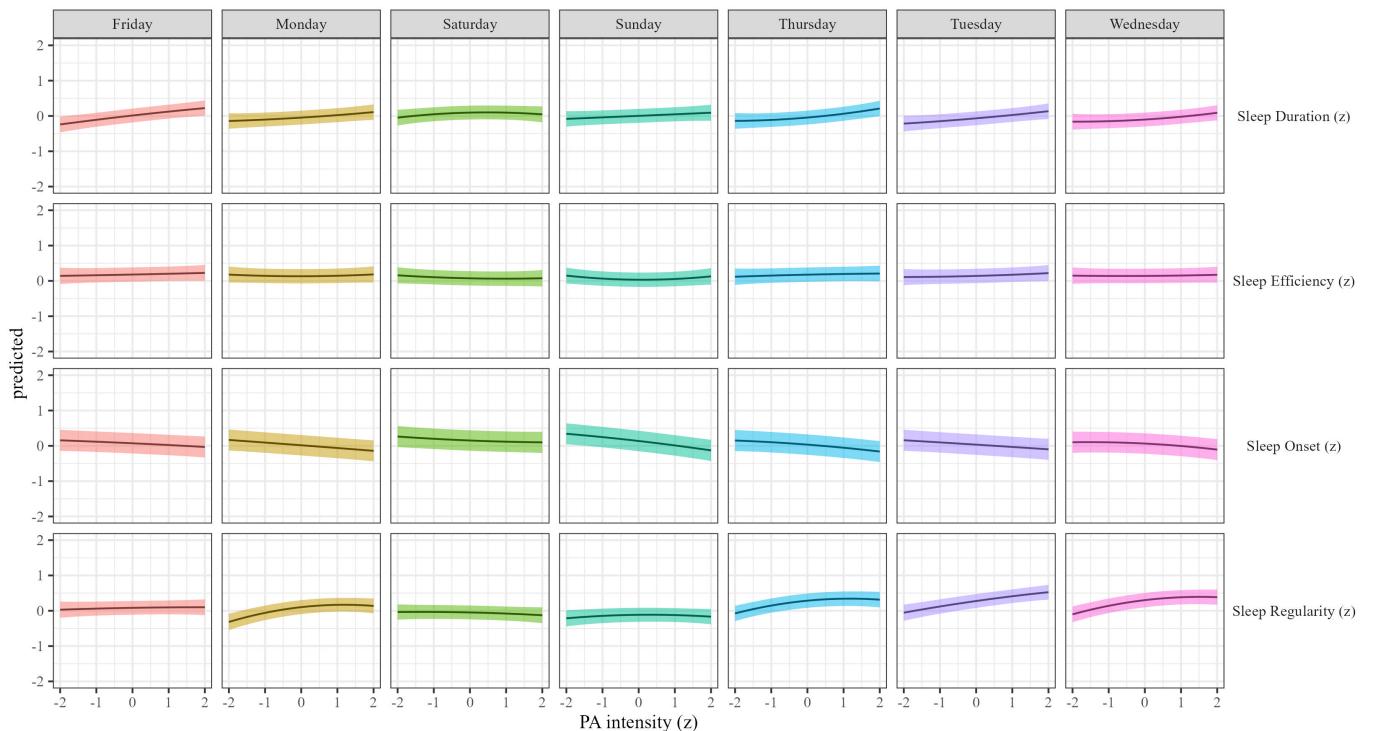


Figure 31. Sleep metrics on Physical activity intensity moderated by weekday

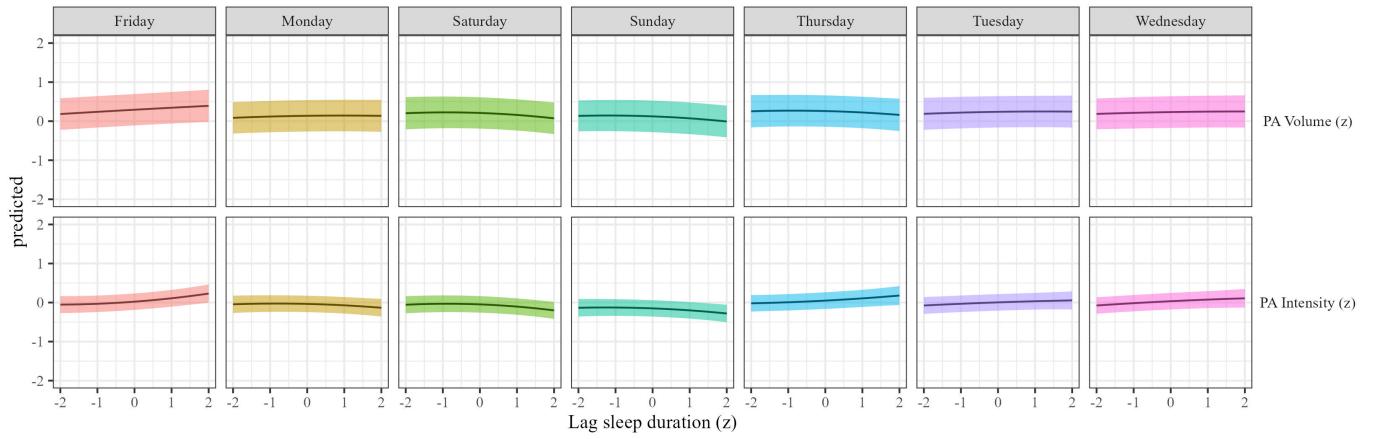


Figure 32. Physical activity by sleep duration moderated by weekday

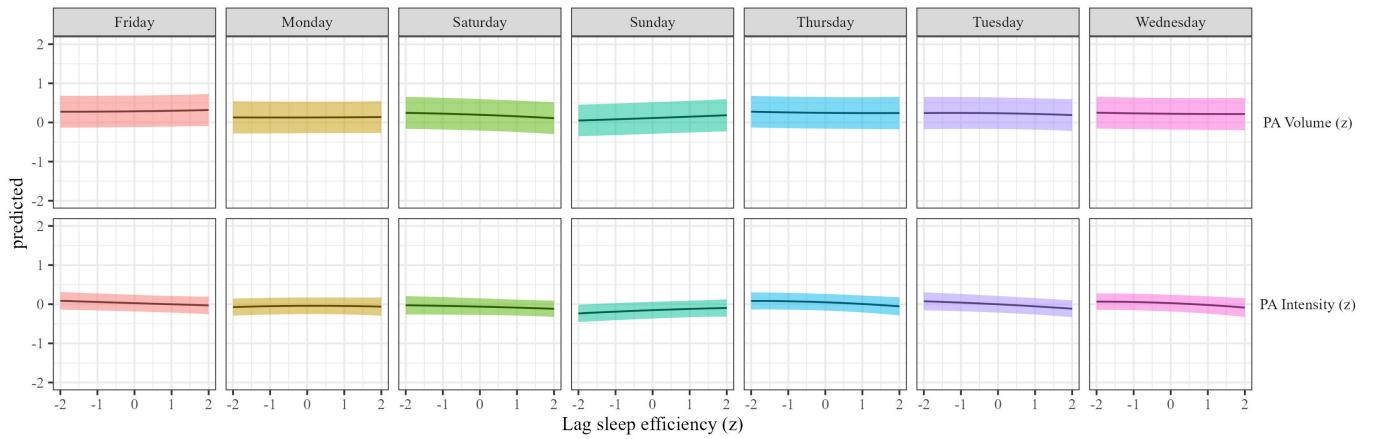


Figure 33. Physical activity by sleep efficiency moderated by weekday

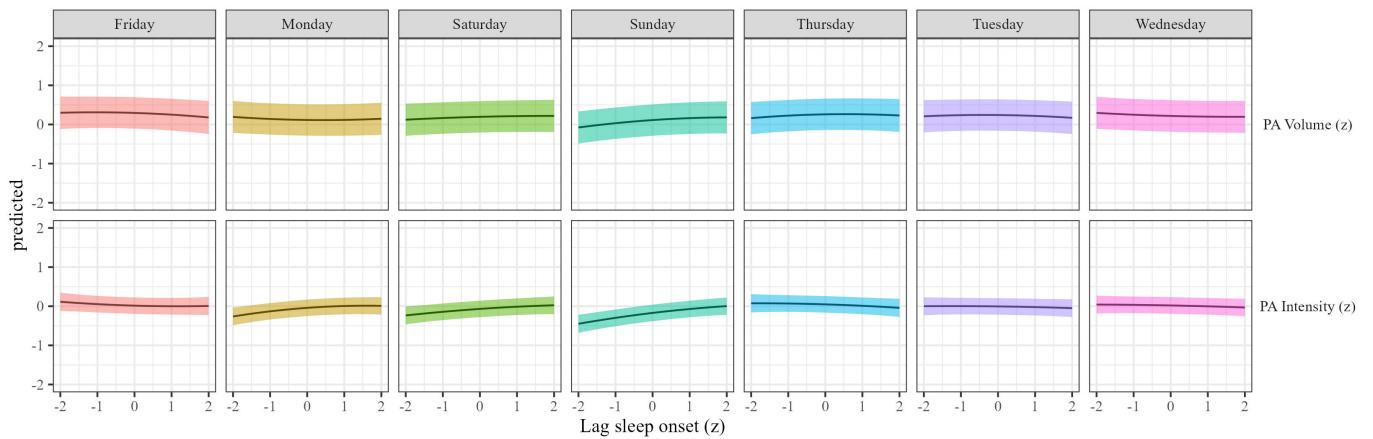


Figure 34. Physical activity by sleep onset moderated by weekday

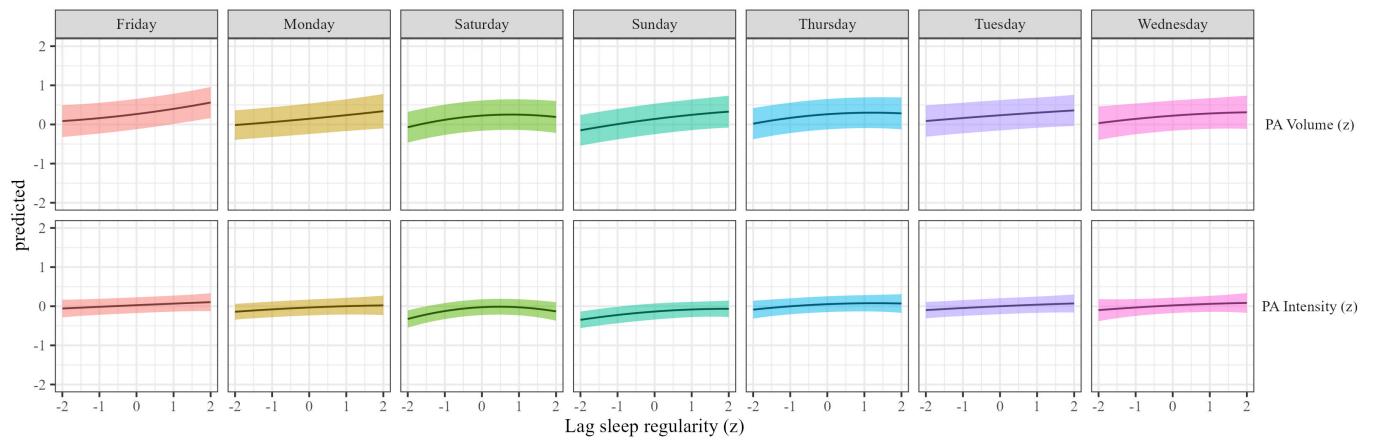


Figure 35. Physical activity by sleep regularity moderated by weekday

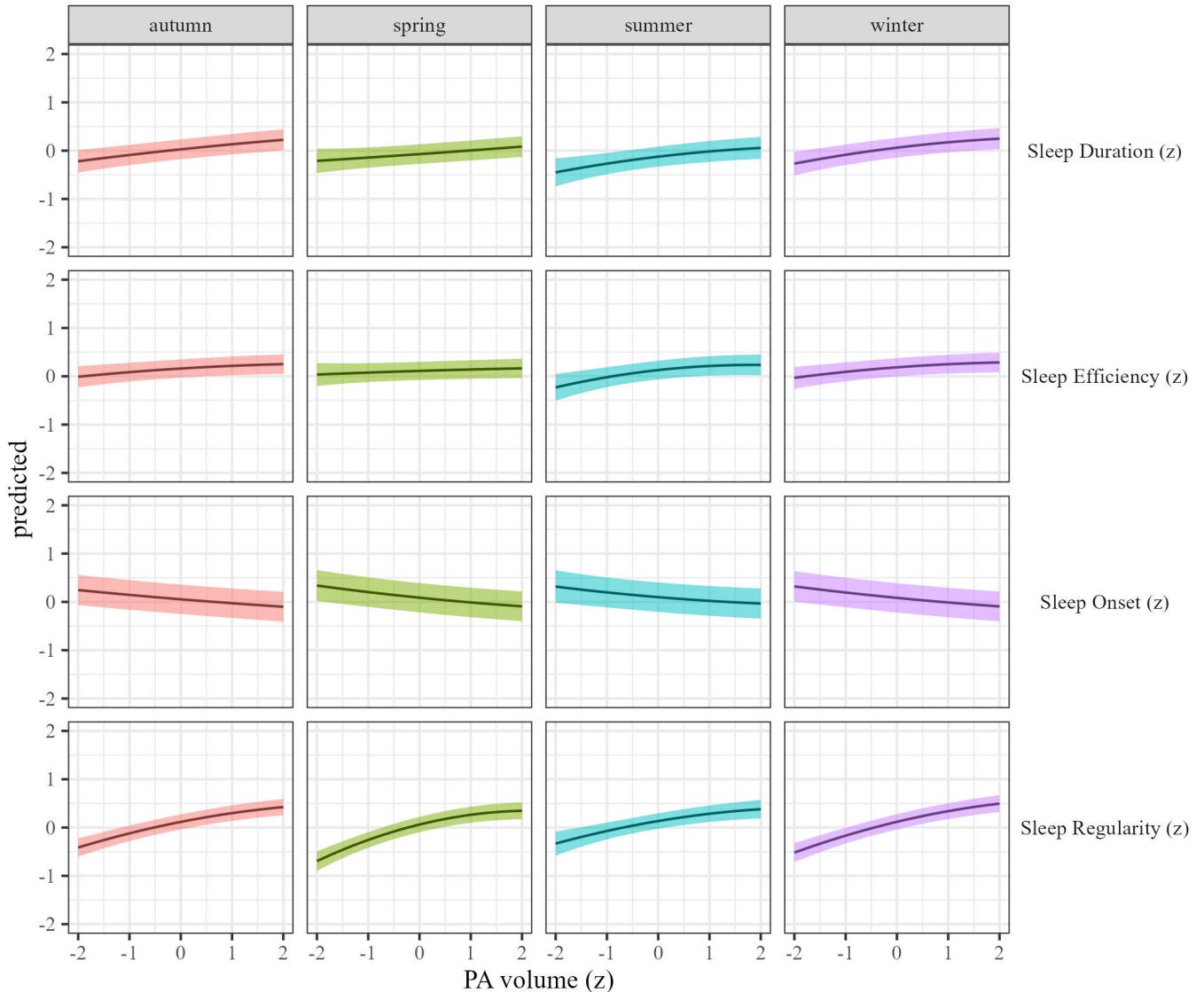


Figure 36. Sleep metrics on Physical activity volume by season

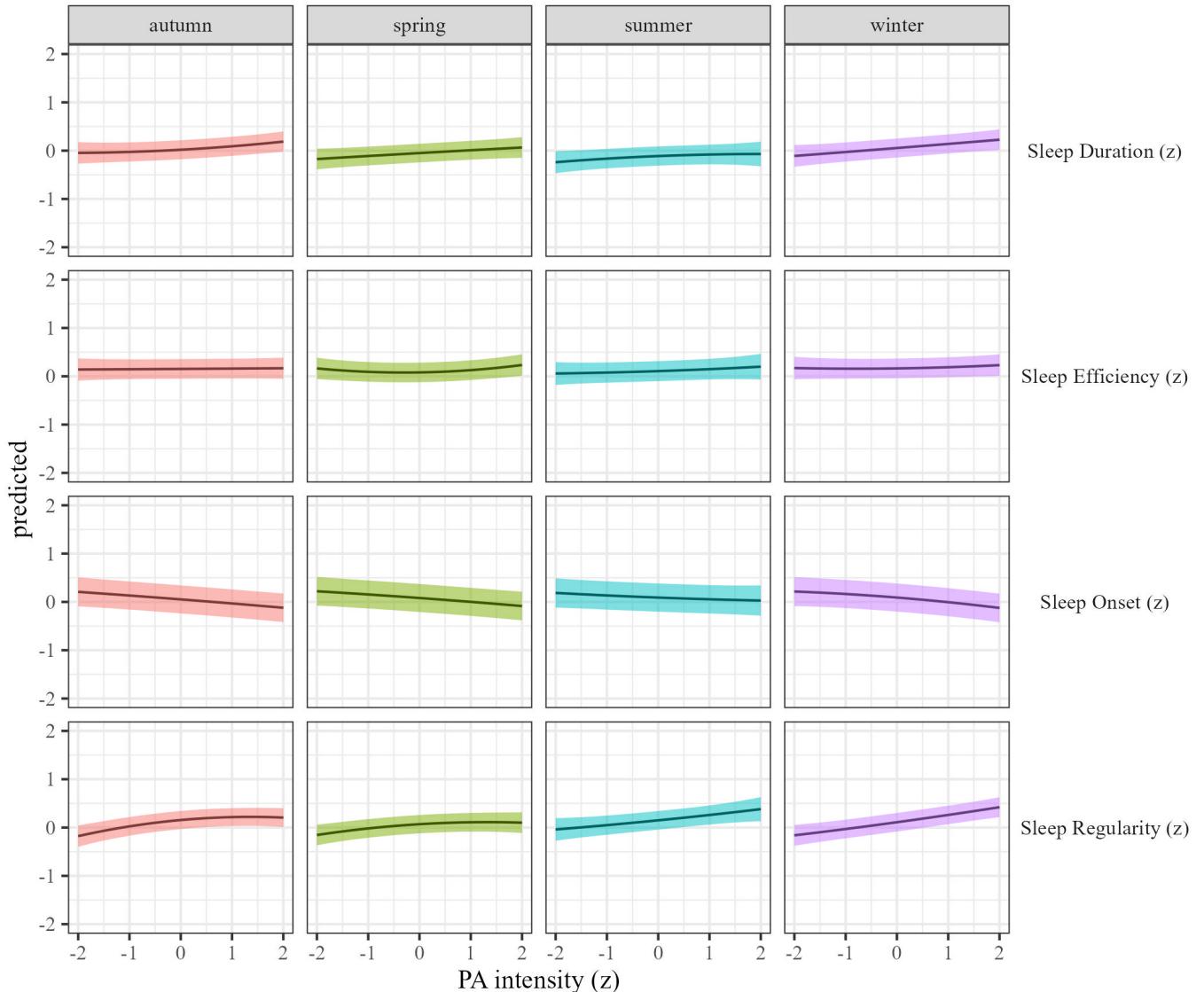
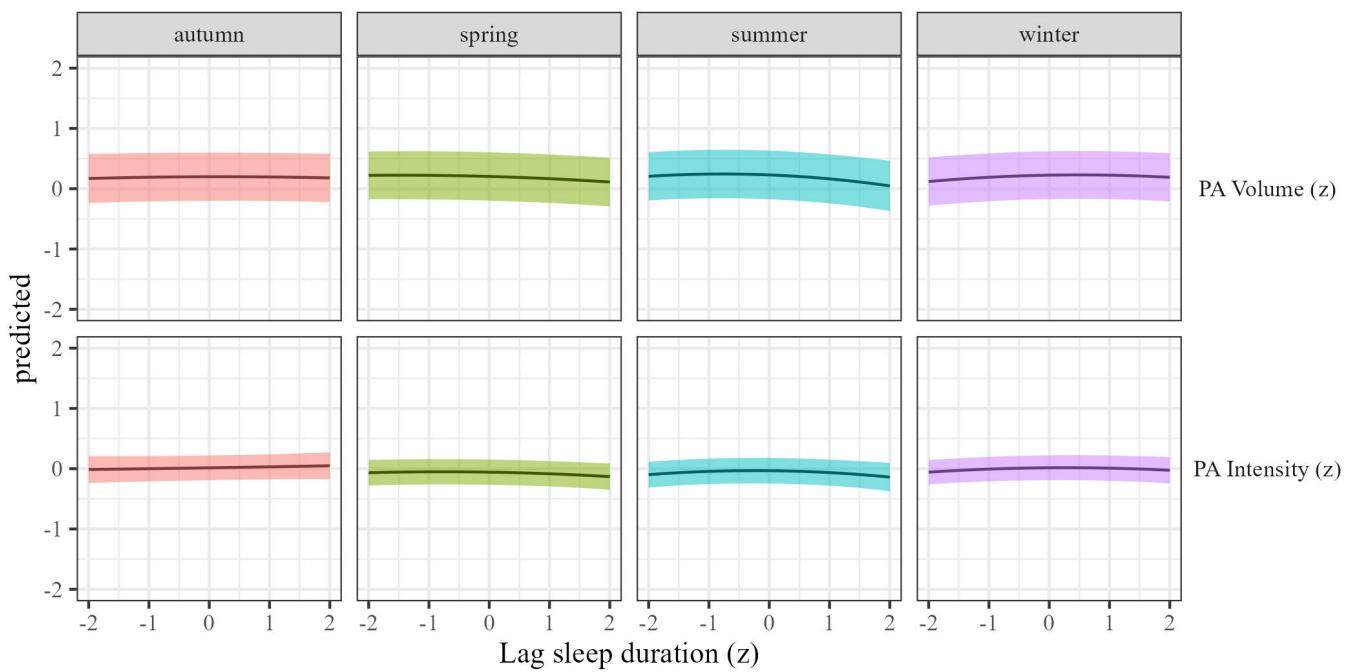
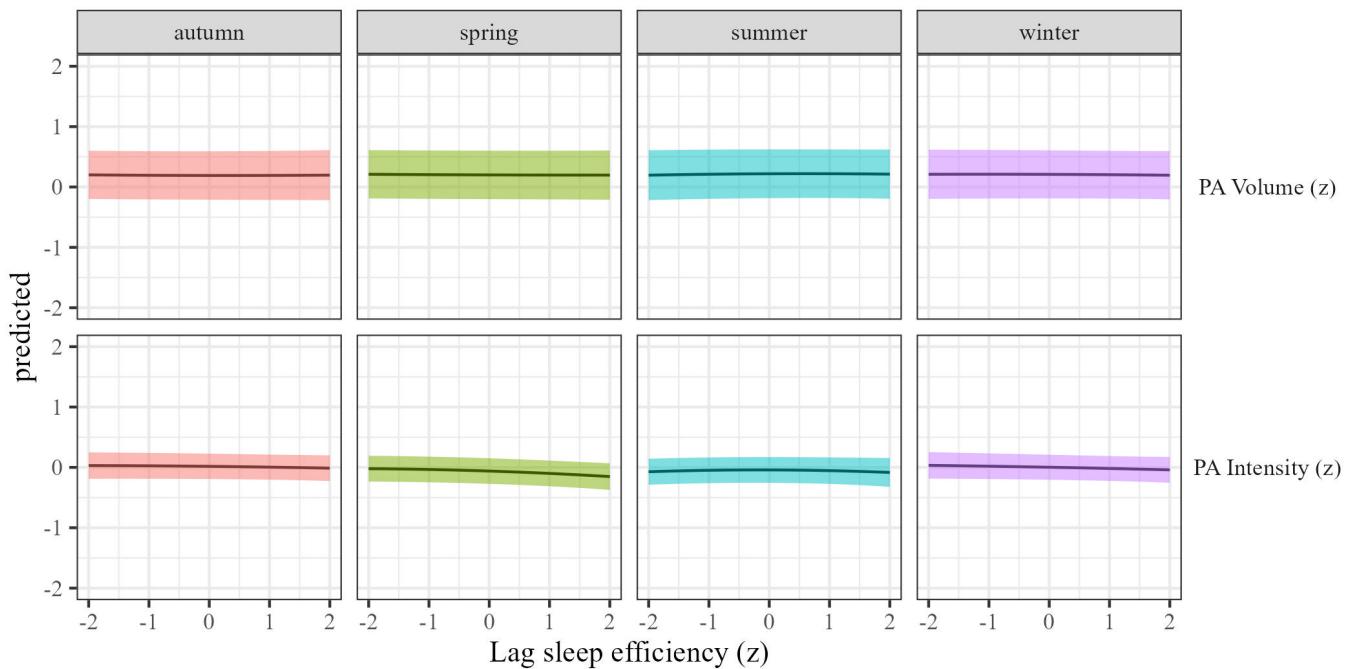


Figure 37. Sleep metrics on Physical activity intensity moderated by season



*Figure 38.* Physical activity by sleep duration moderated by season



*Figure 39.* Physical activity by sleep efficiency moderated by season

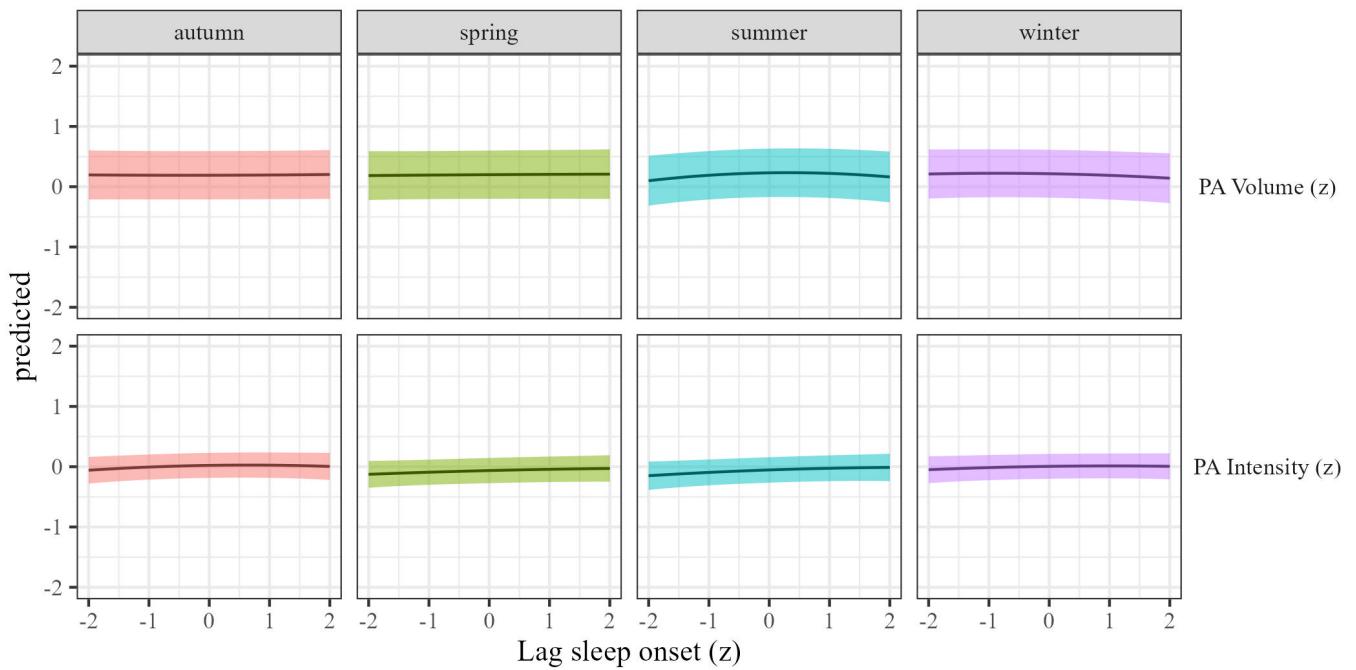


Figure 40. Physical activity by sleep onset moderated by season

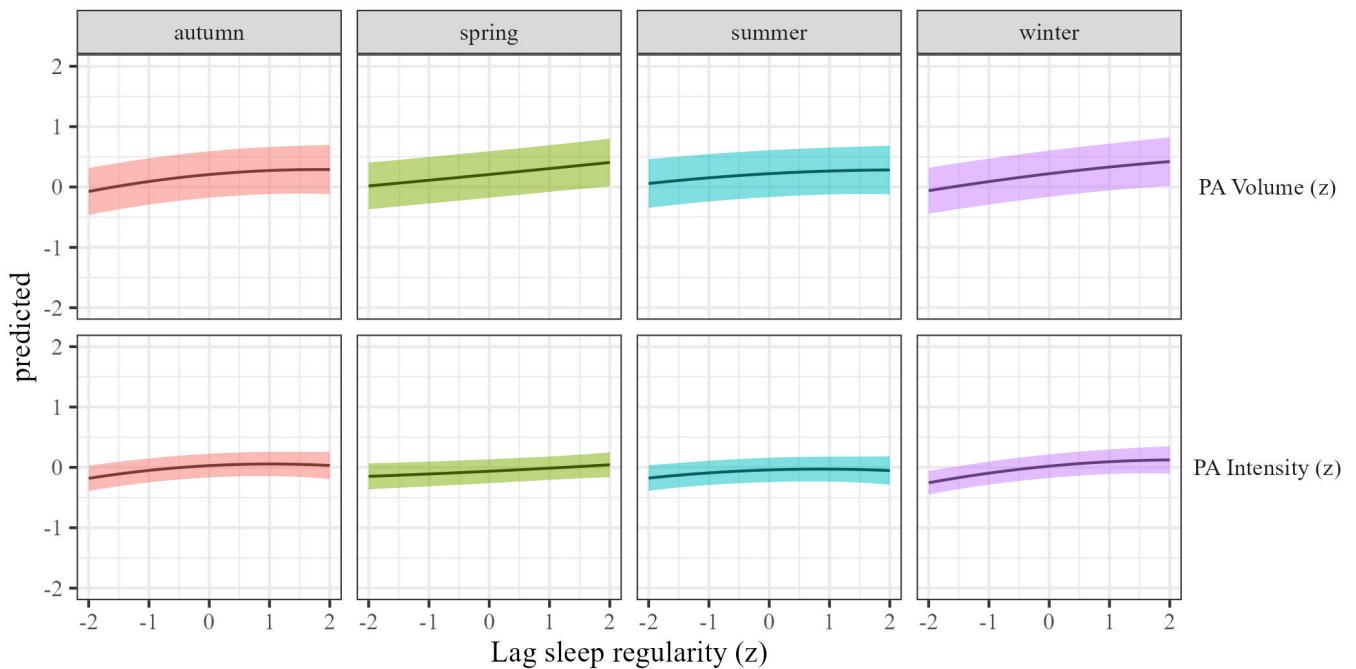


Figure 41. Physical activity by sleep regularity moderated by season

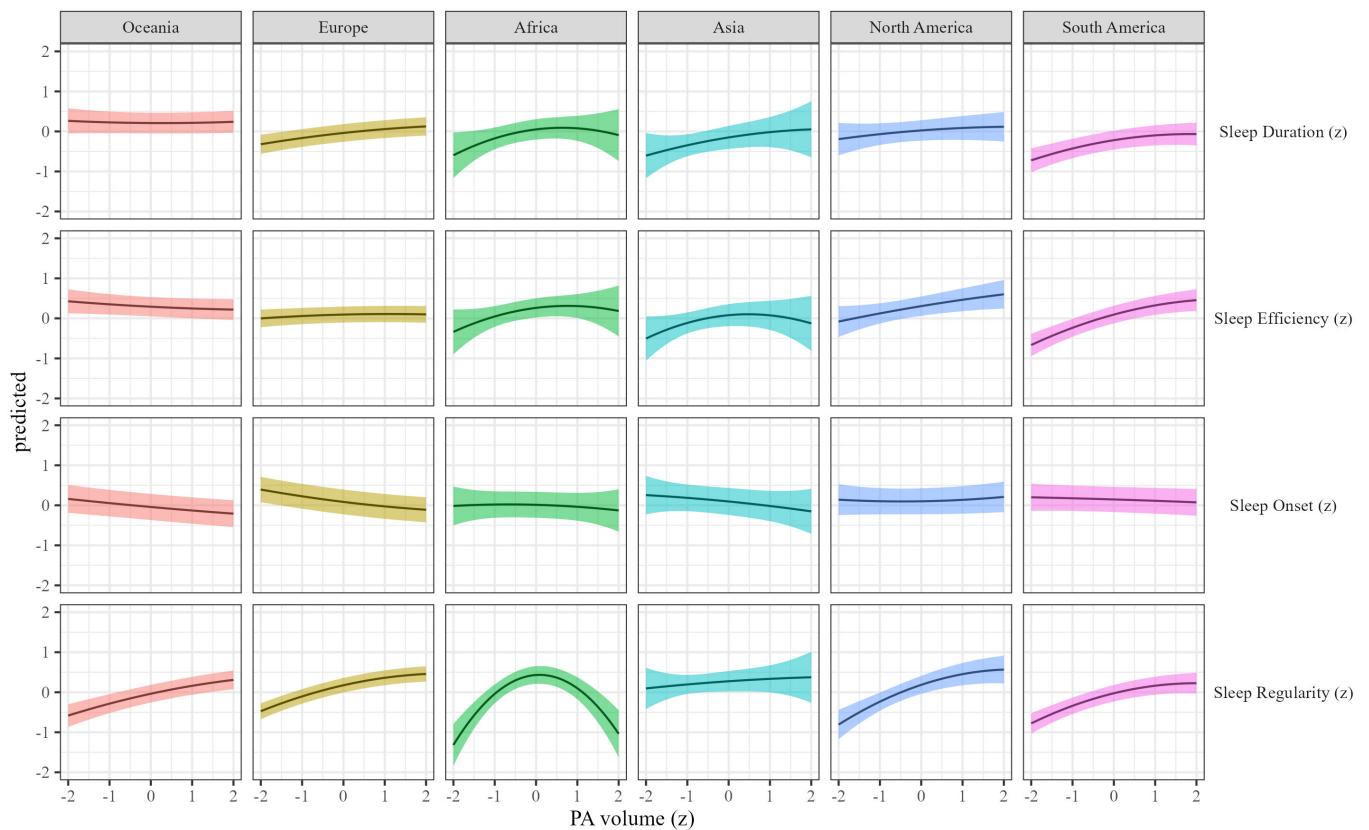


Figure 42. Sleep metrics on Physical activity volume by region

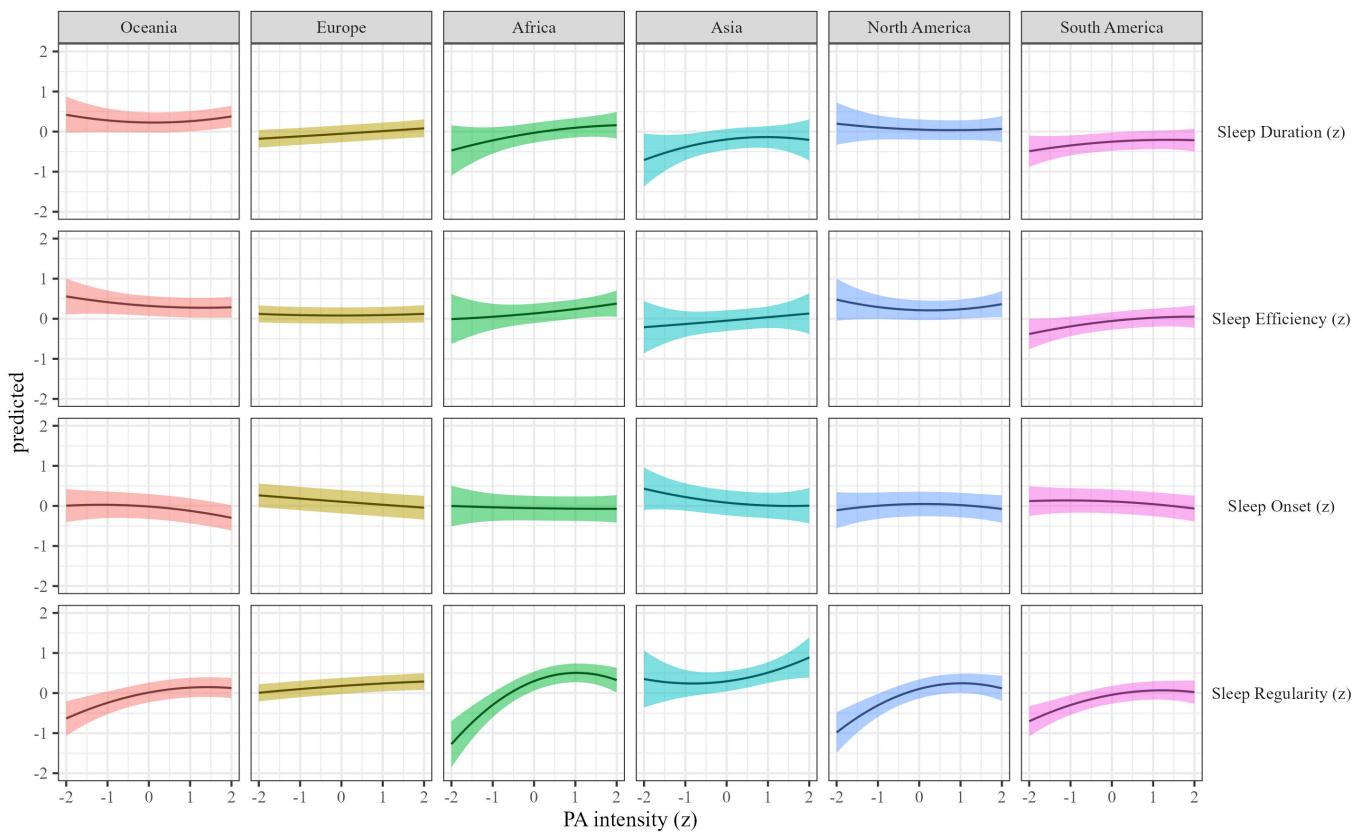


Figure 43. Sleep metrics on Physical activity intensity moderated by region

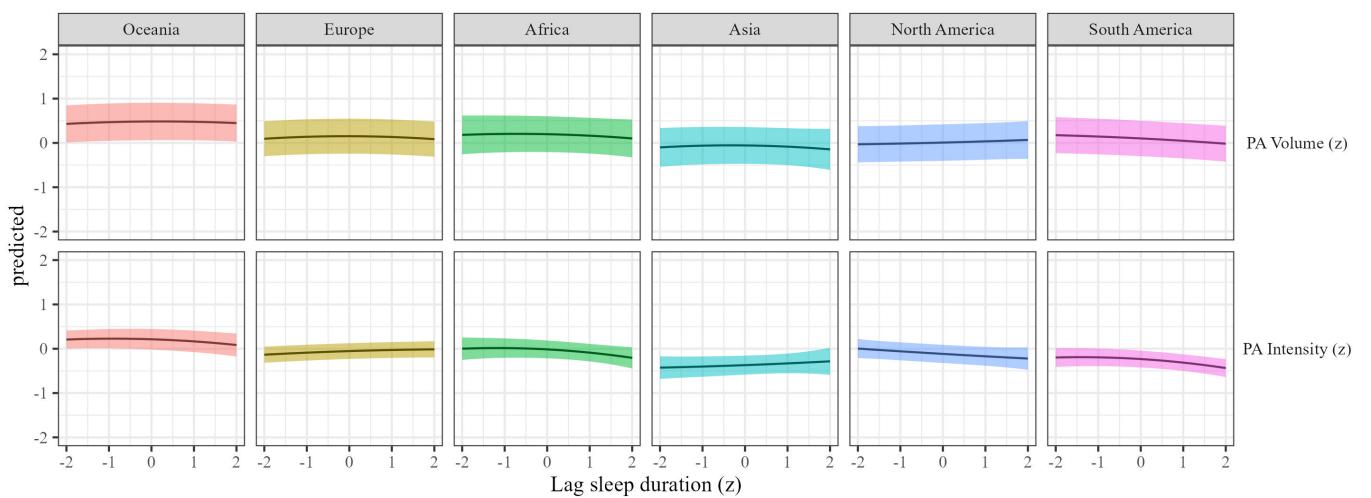


Figure 44. Physical activity by sleep duration moderated by region

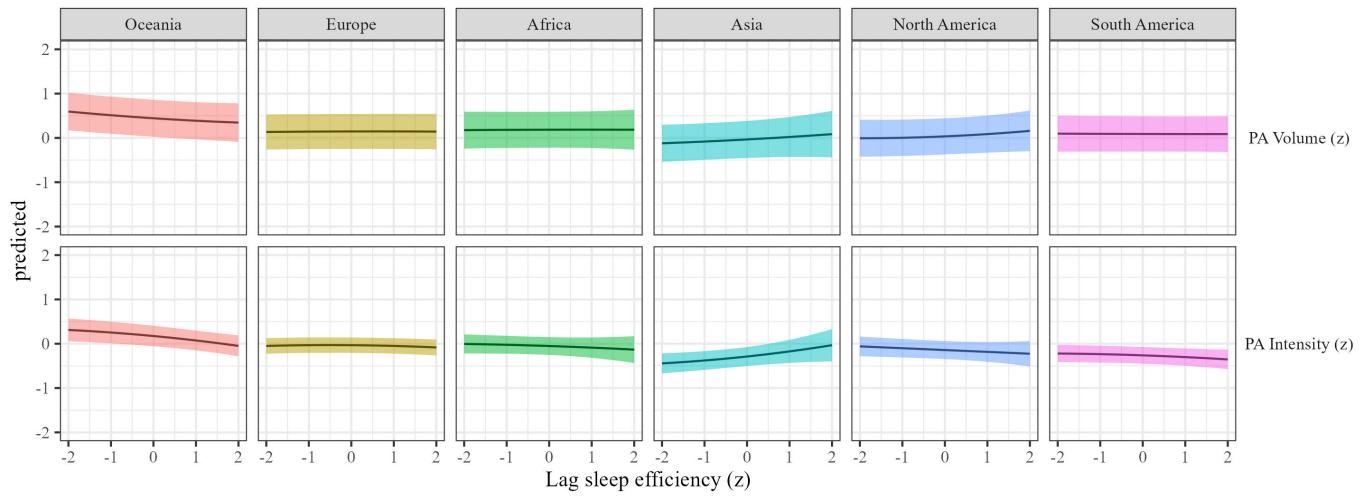


Figure 45. Physical activity by sleep efficiency moderated by region

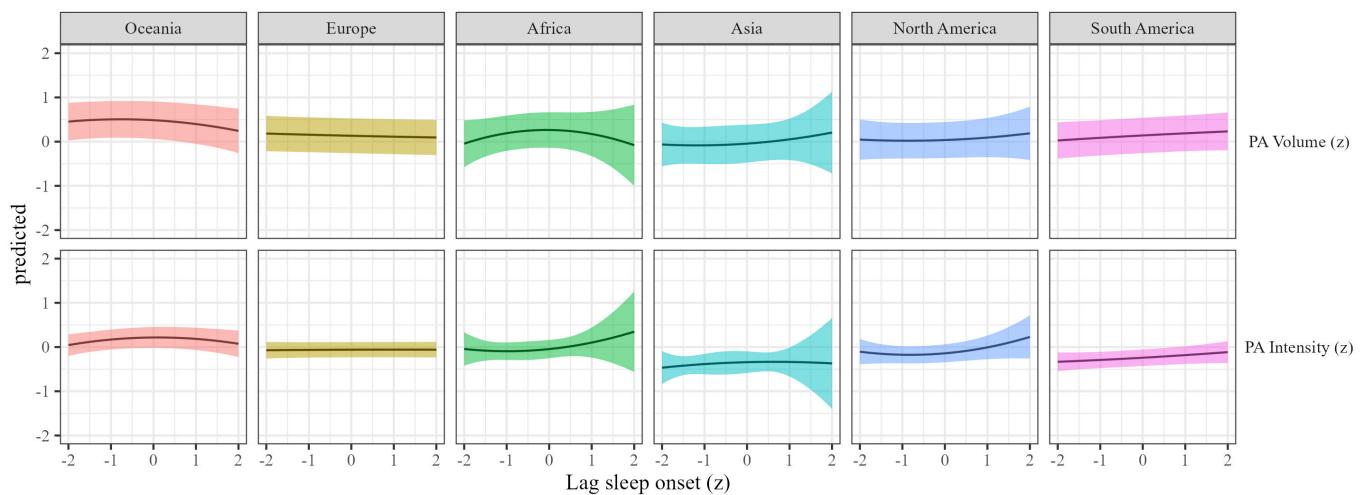


Figure 46. Physical activity by sleep onset moderated by region

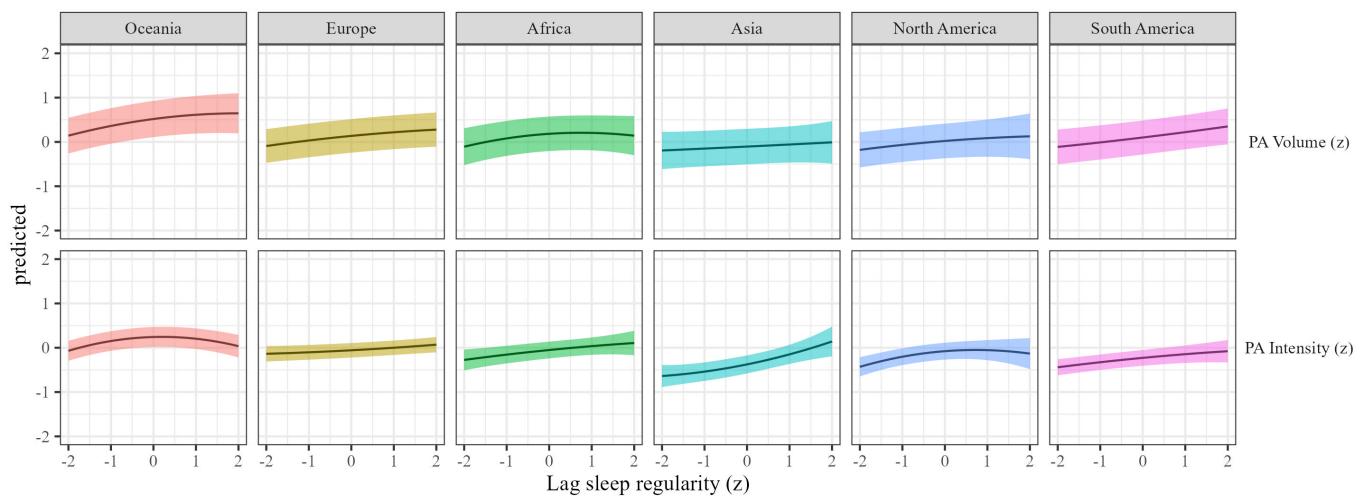


Figure 47. Physical activity by sleep regularity moderated by region

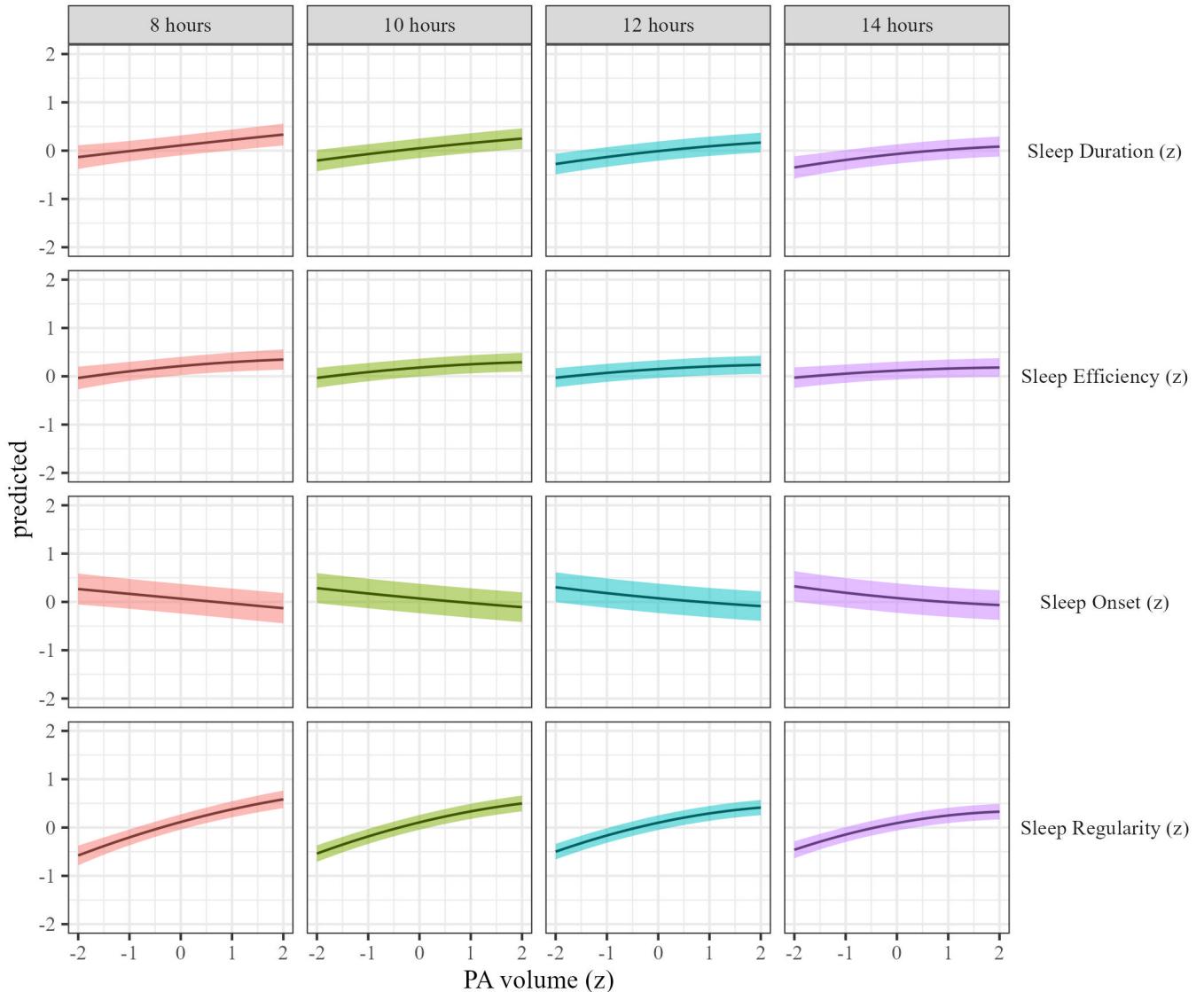


Figure 48. Sleep metrics on Physical activity volume by daylight hours

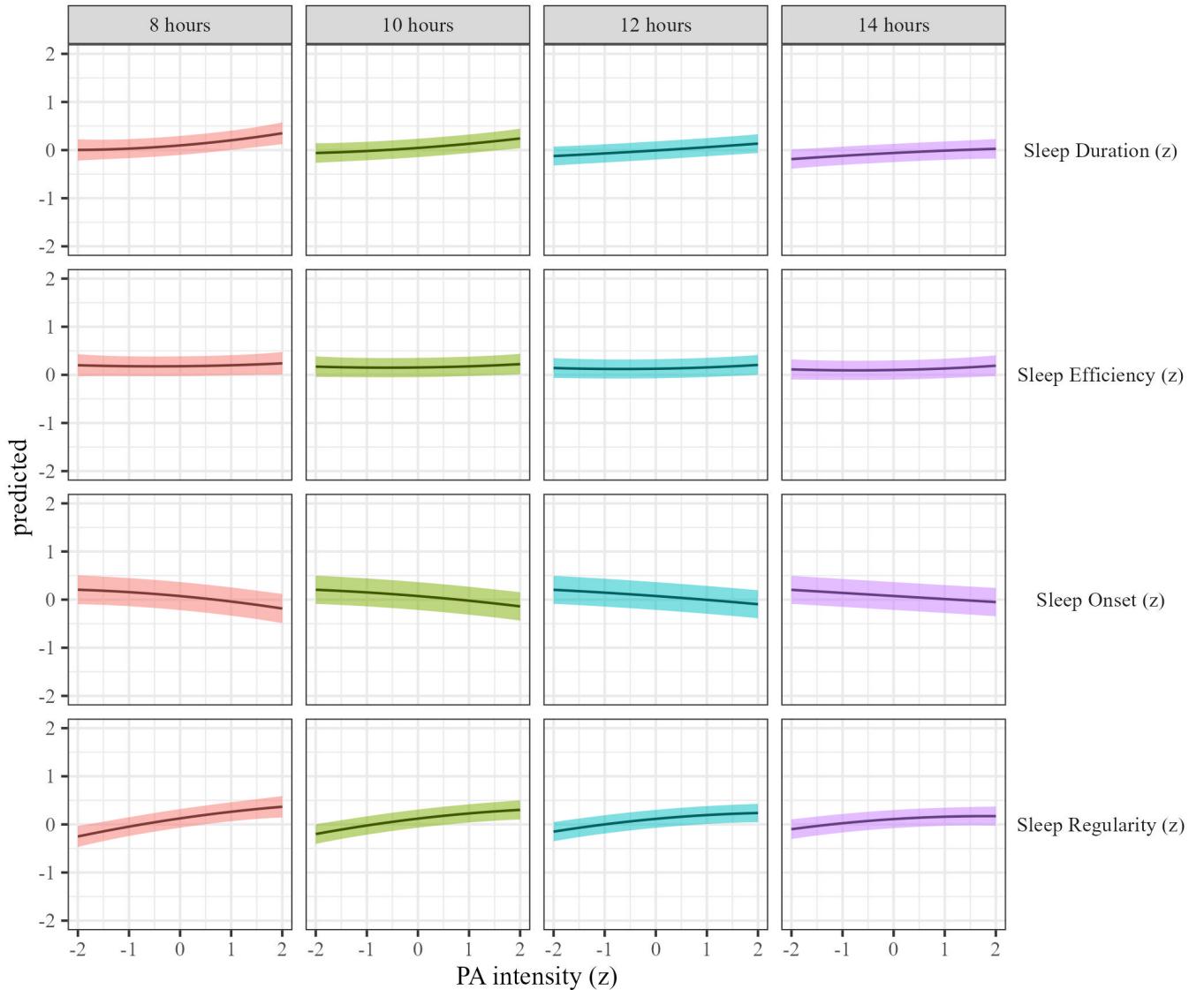
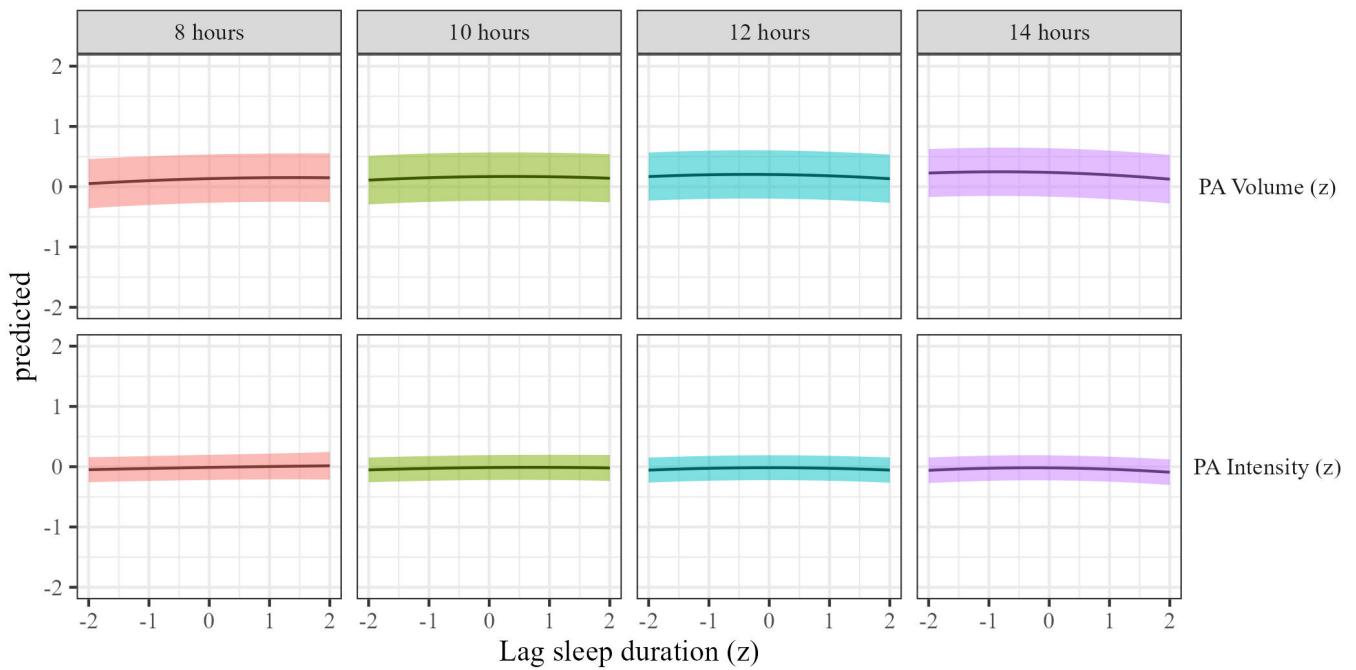
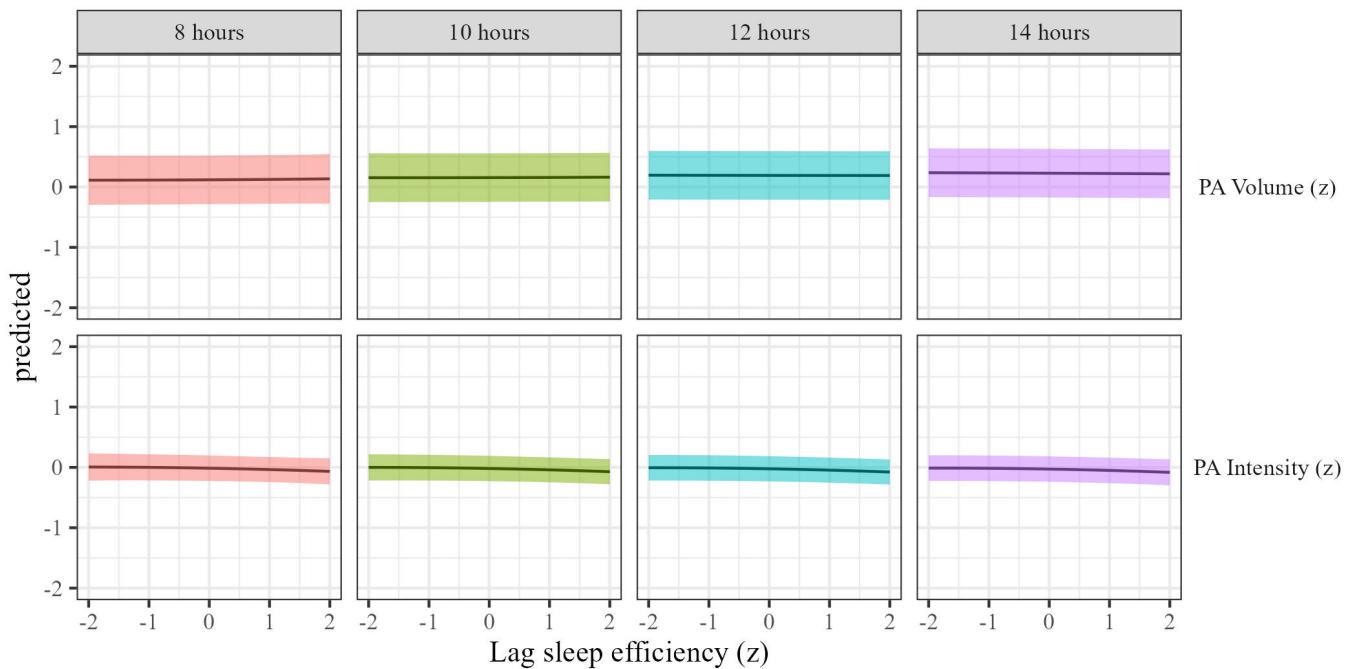


Figure 49. Sleep metrics on Physical activity intensity moderated by daylight hours



*Figure 50.* Physical activity by sleep duration moderated by daylight hours



*Figure 51.* Physical activity by sleep efficiency moderated by daylight hours

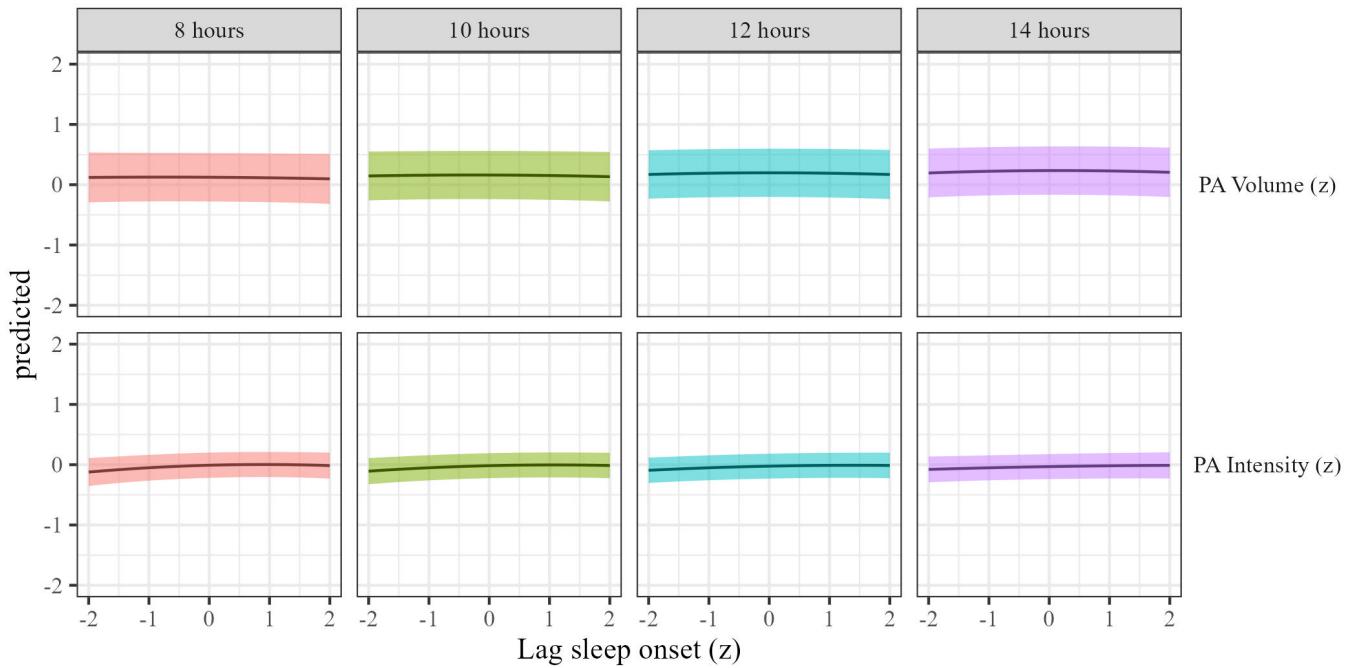


Figure 52. Physical activity by sleep onset moderated by daylight hours

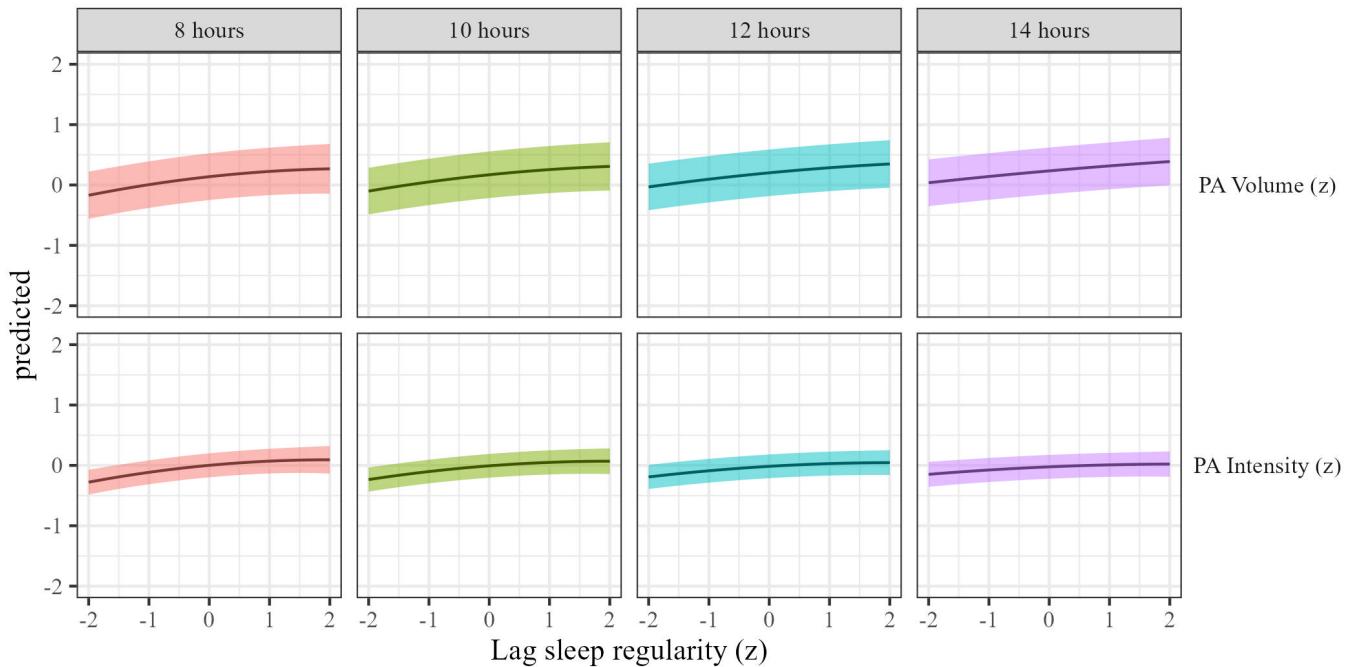


Figure 53. Physical activity by sleep regularity moderated by daylight hours

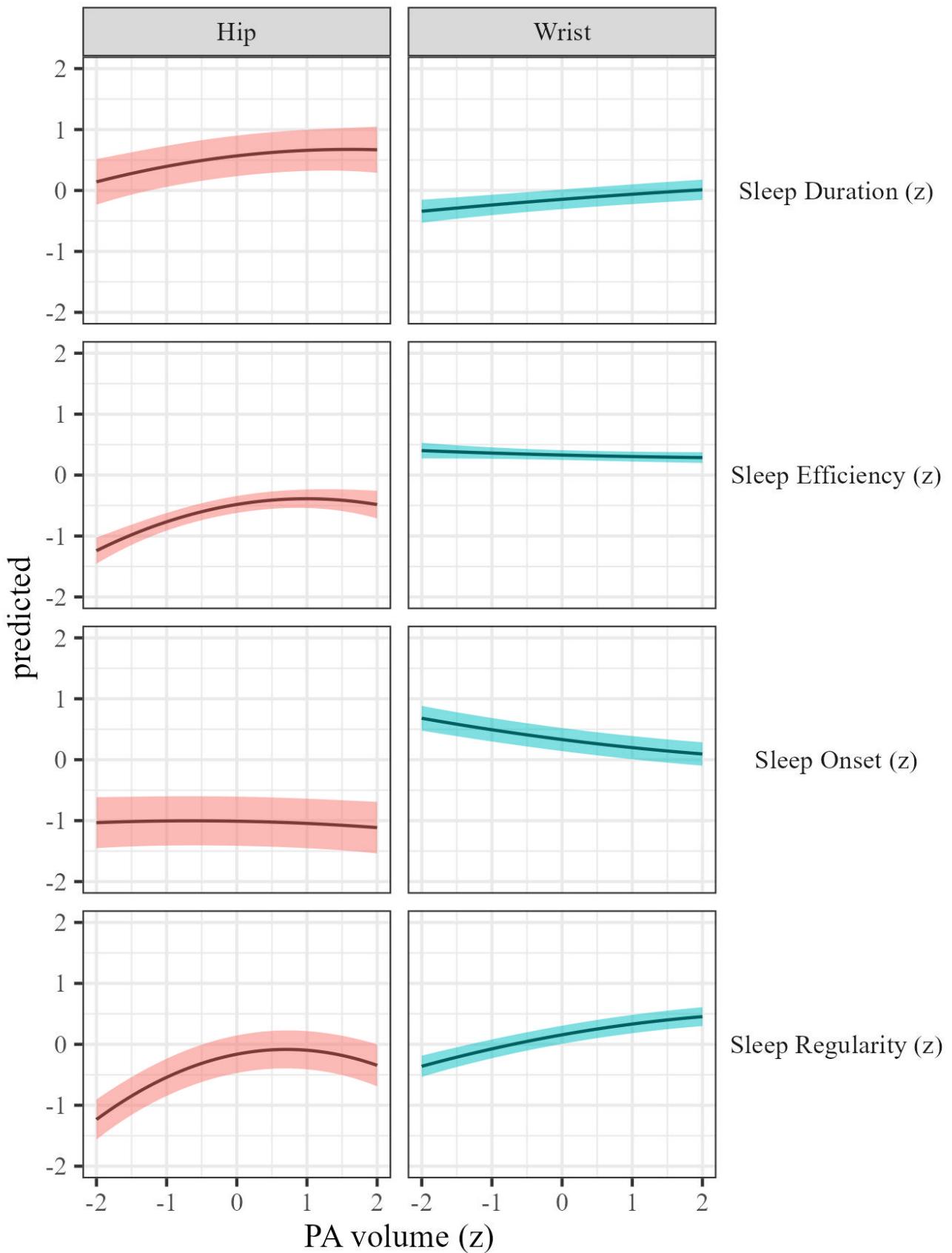


Figure 54. Sleep metrics on Physical activity volume by wear location

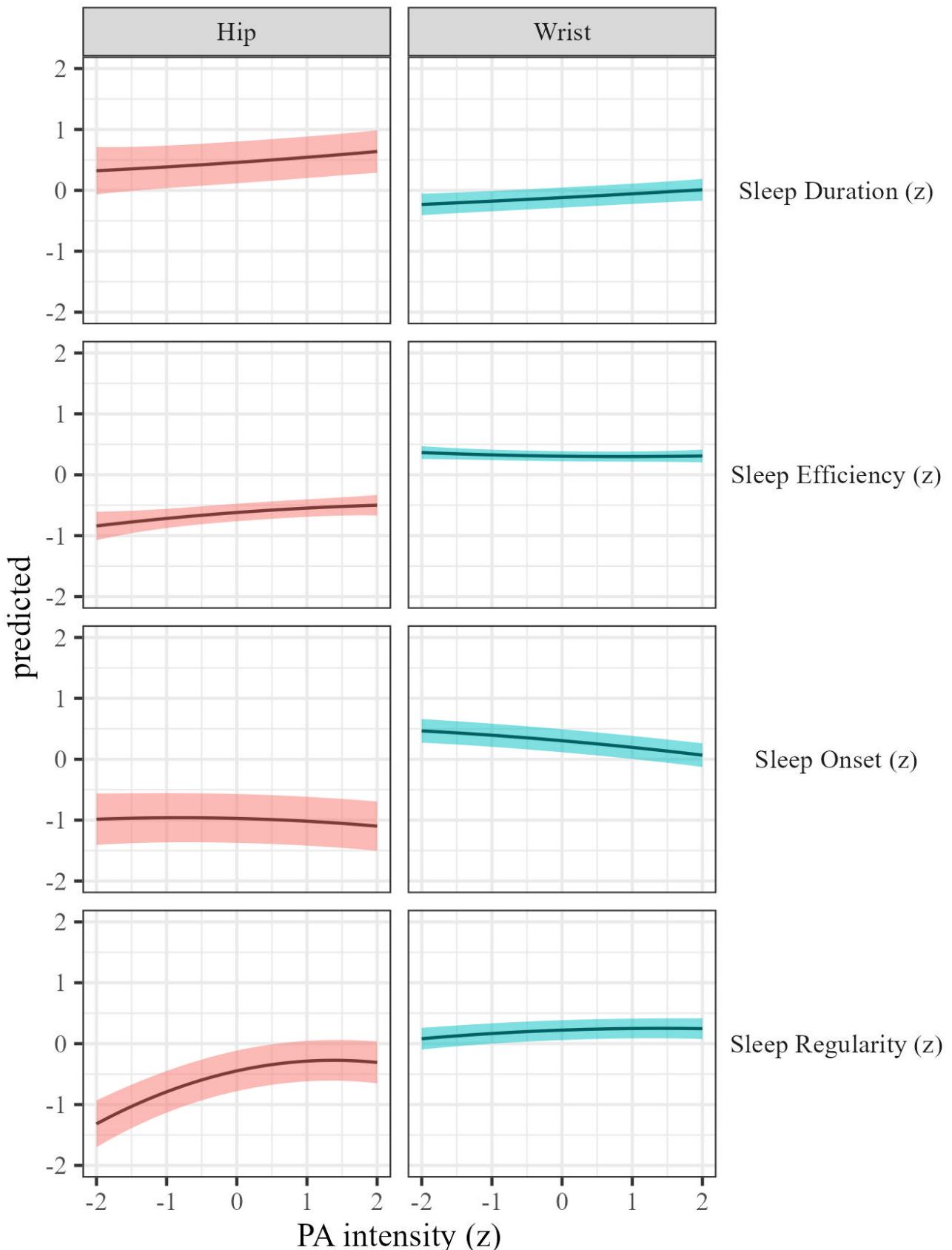


Figure 55. Sleep metrics on Physical activity intensity moderated by wear location

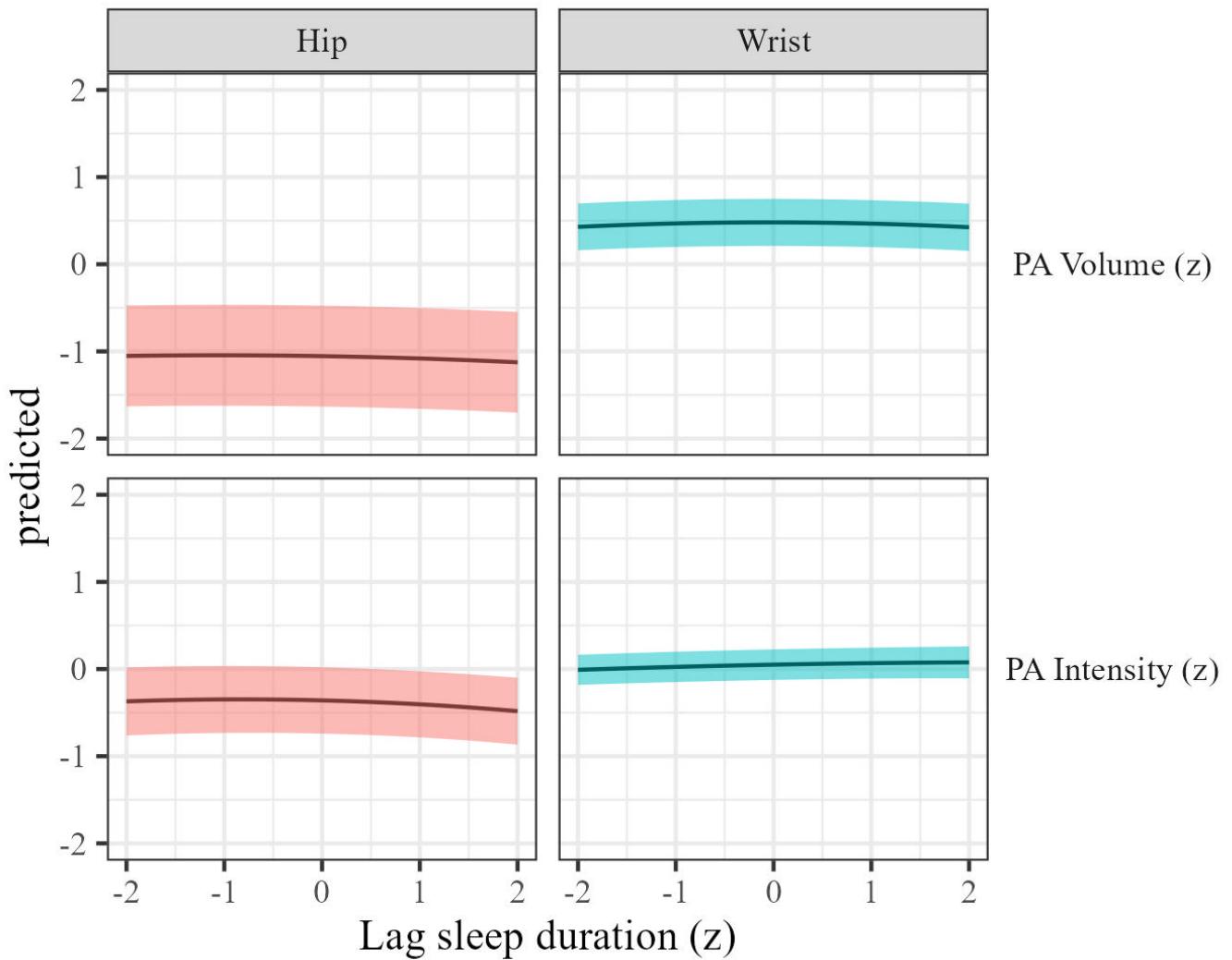


Figure 56. Physical activity by sleep duration moderated by wear location

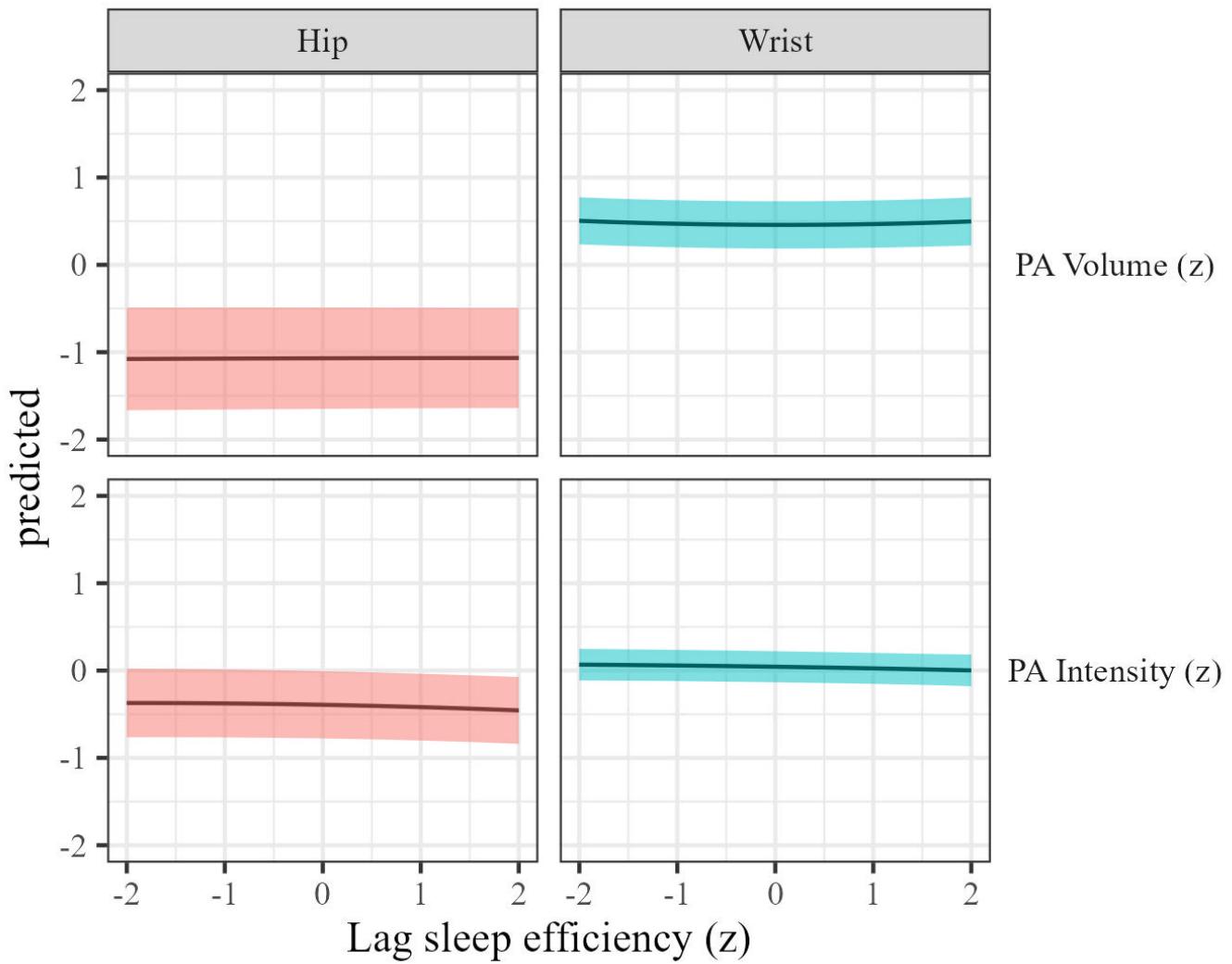


Figure 57. Physical activity by sleep efficiency moderated by wear location

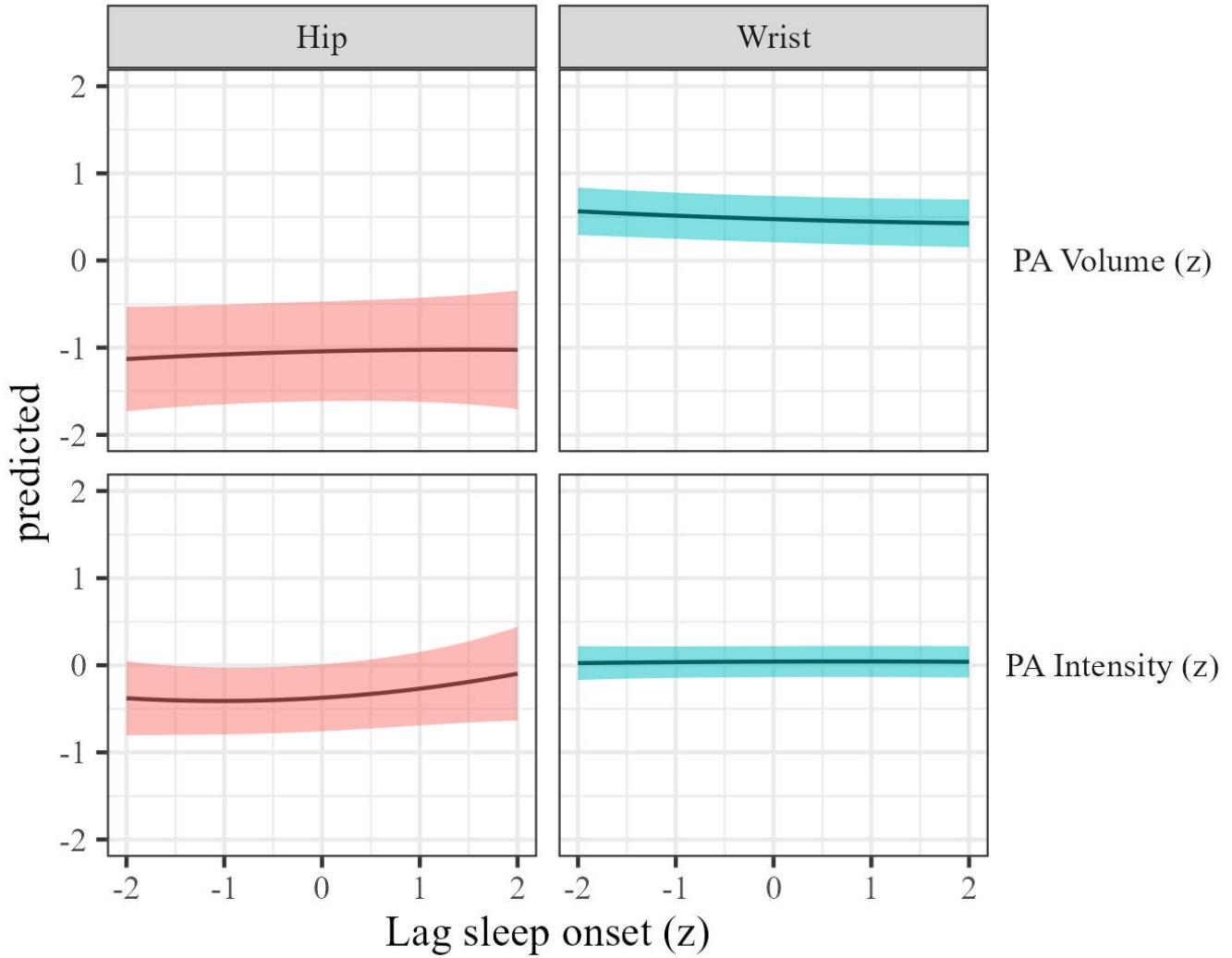


Figure 58. Physical activity by sleep onset moderated by wear location

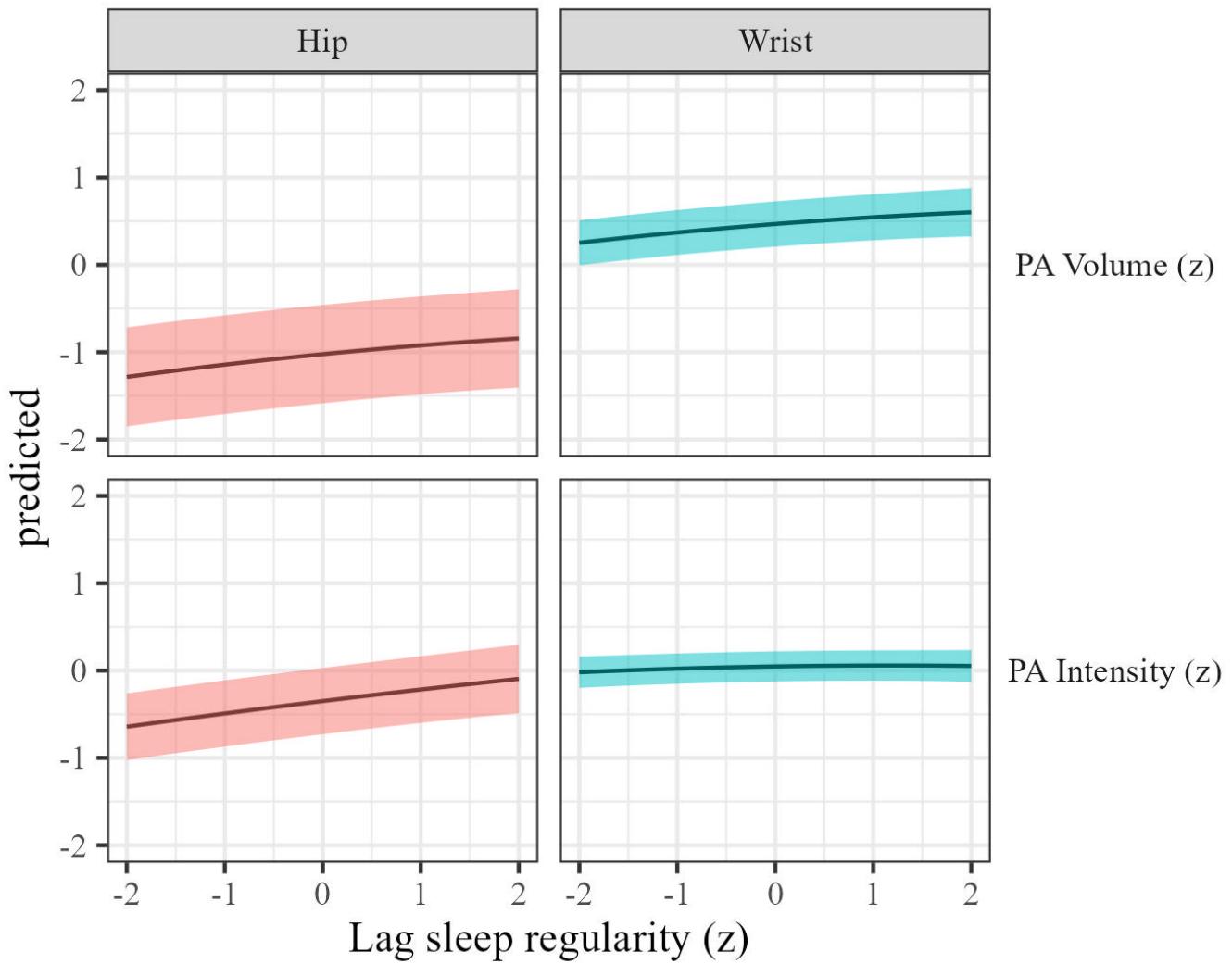


Figure 59. Physical activity by sleep regularity moderated by wear location

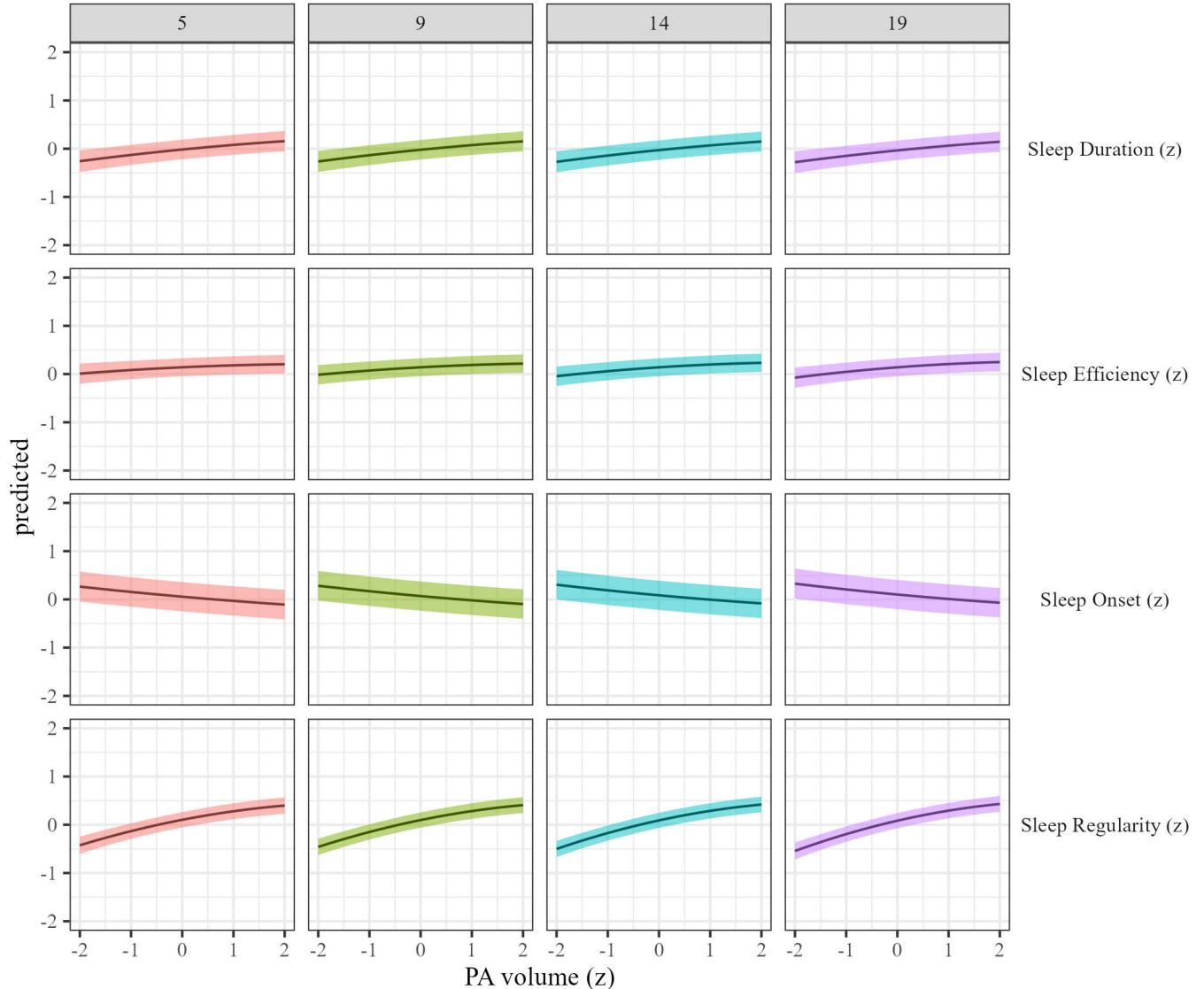


Figure 60. Sleep metrics on Physical activity volume by most active hour

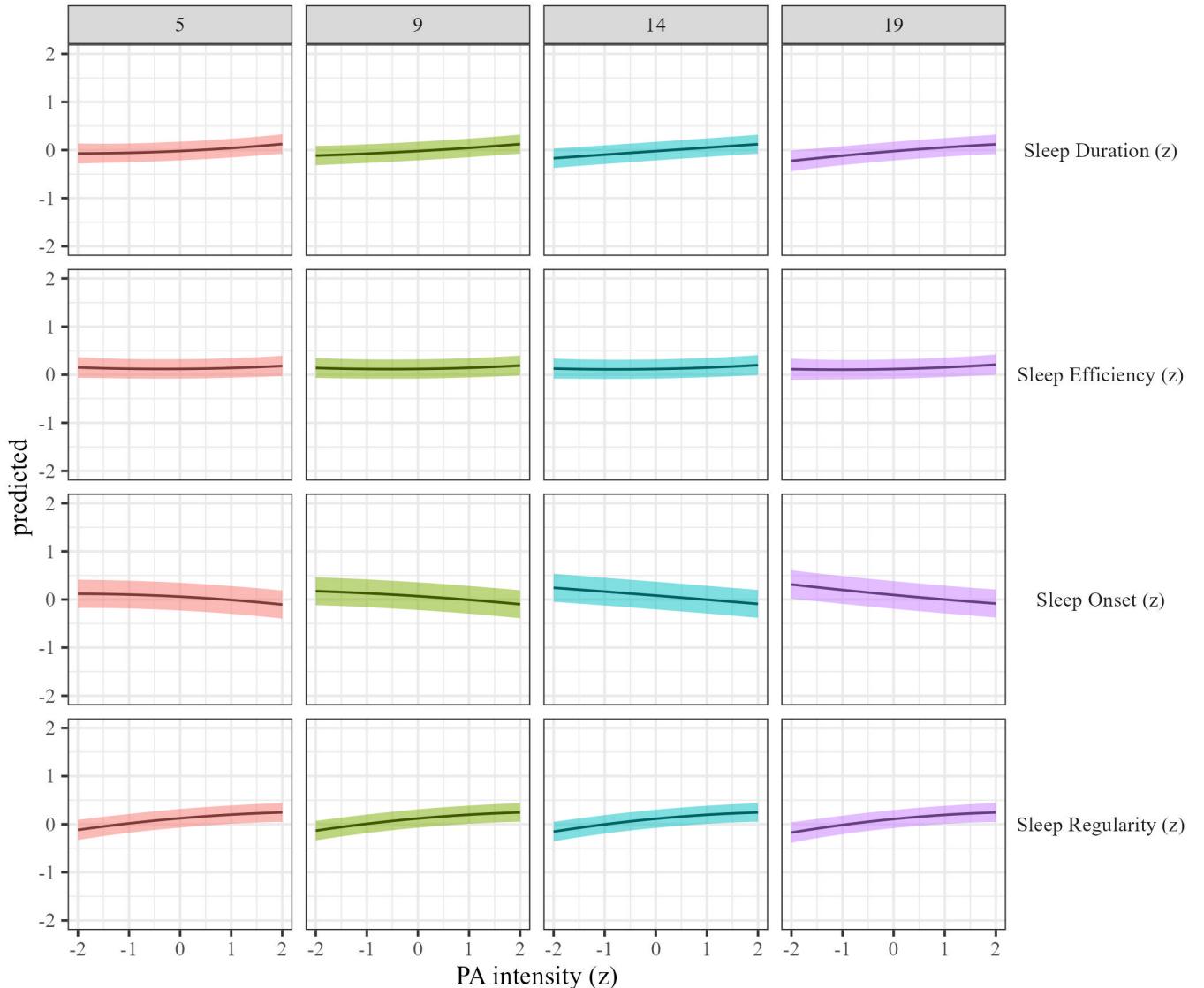


Figure 61. Sleep metrics on Physical activity intensity moderated by most active hour

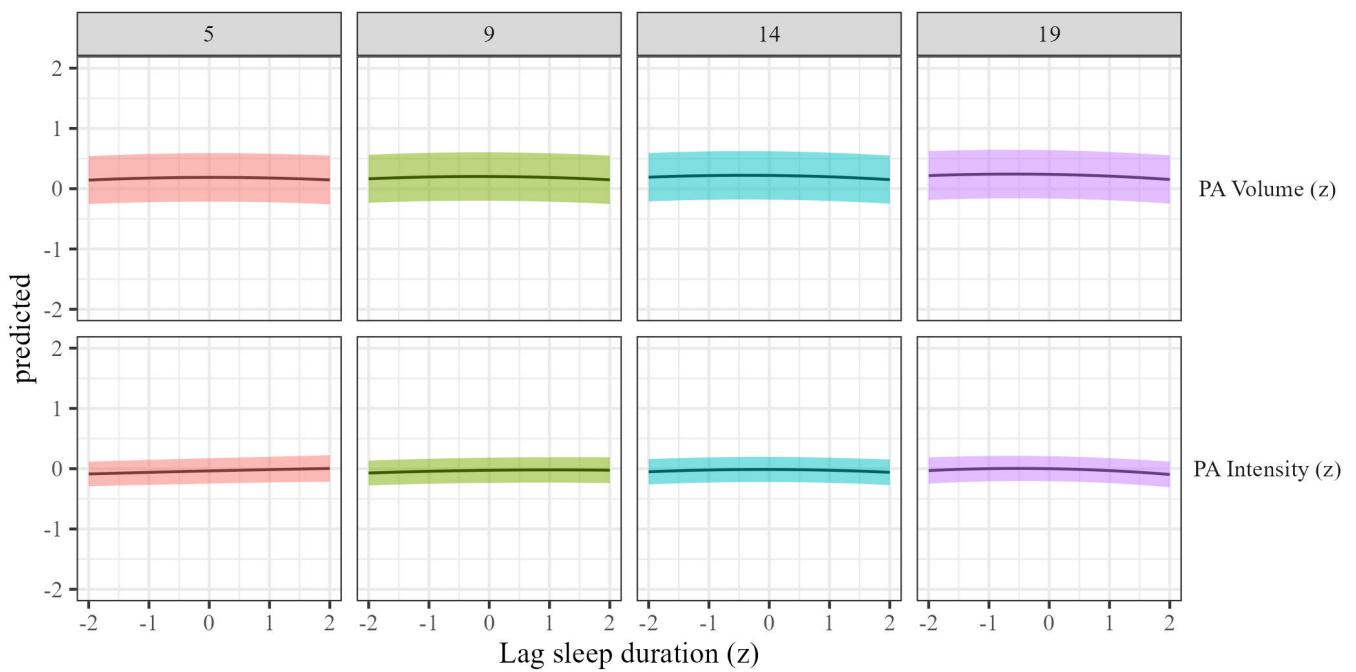


Figure 62. Physical activity by sleep duration moderated by most active hour

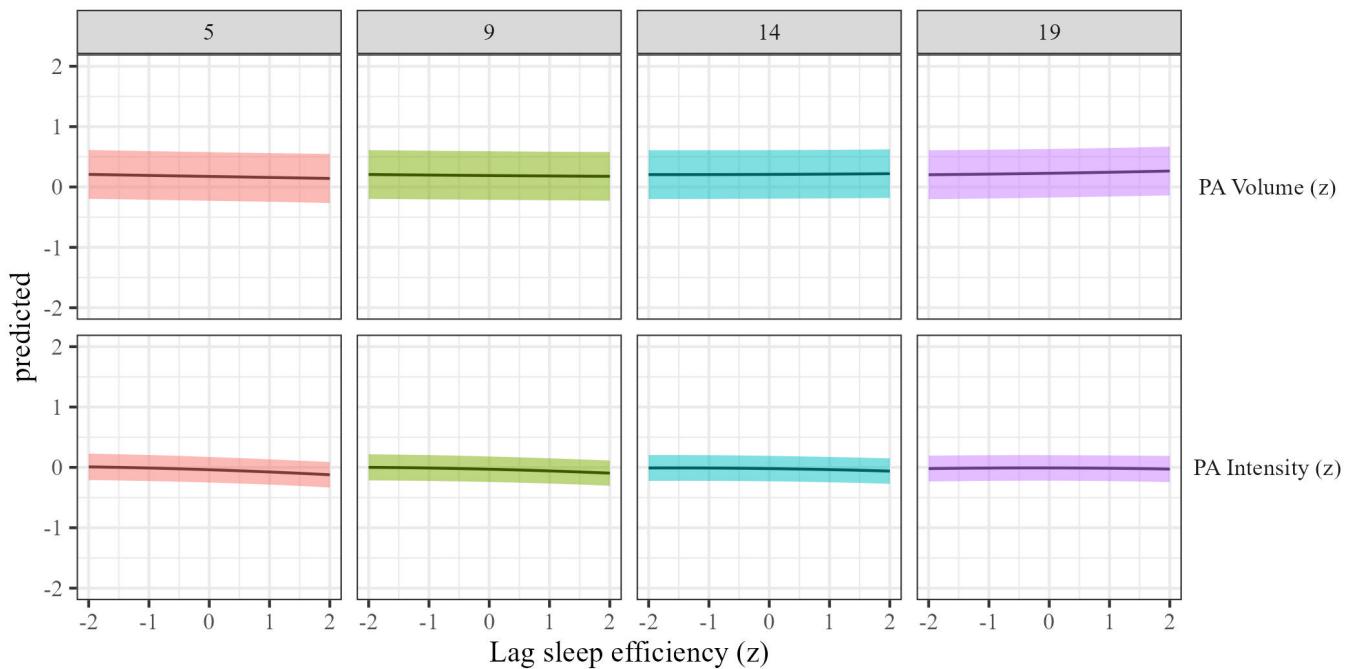


Figure 63. Physical activity by sleep efficiency moderated by most active hour

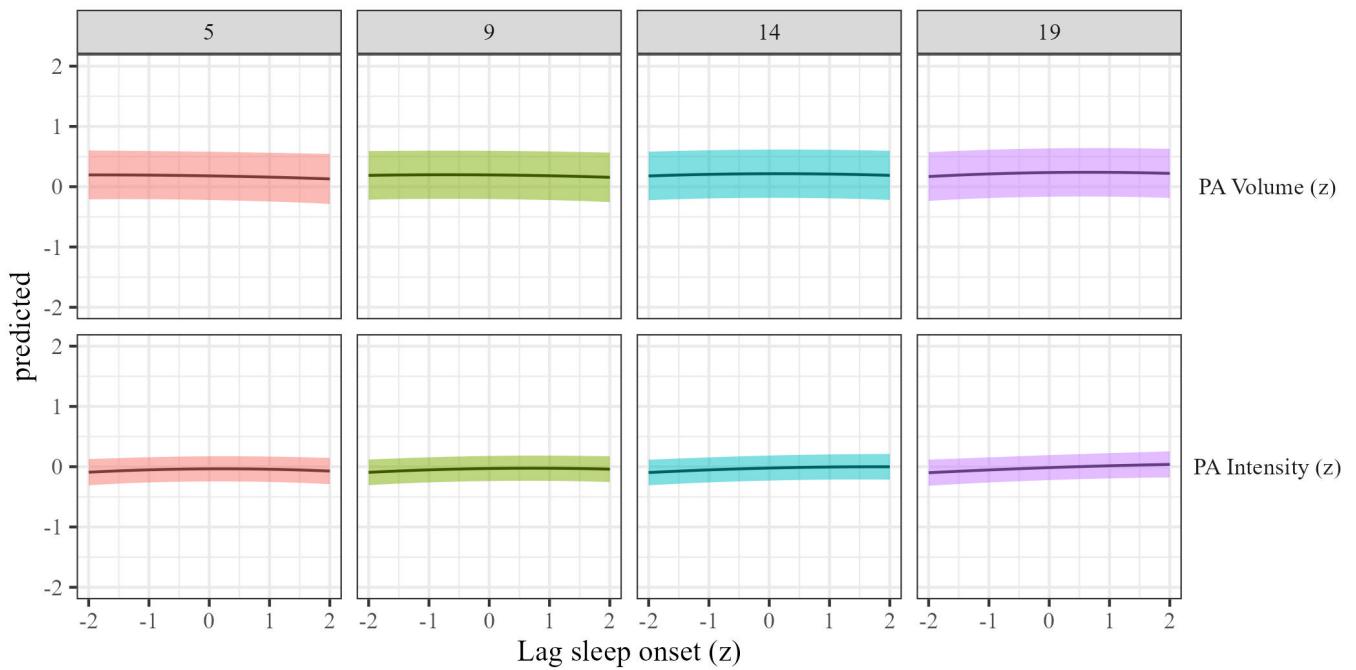


Figure 64. Physical activity by sleep onset moderated by most active hour

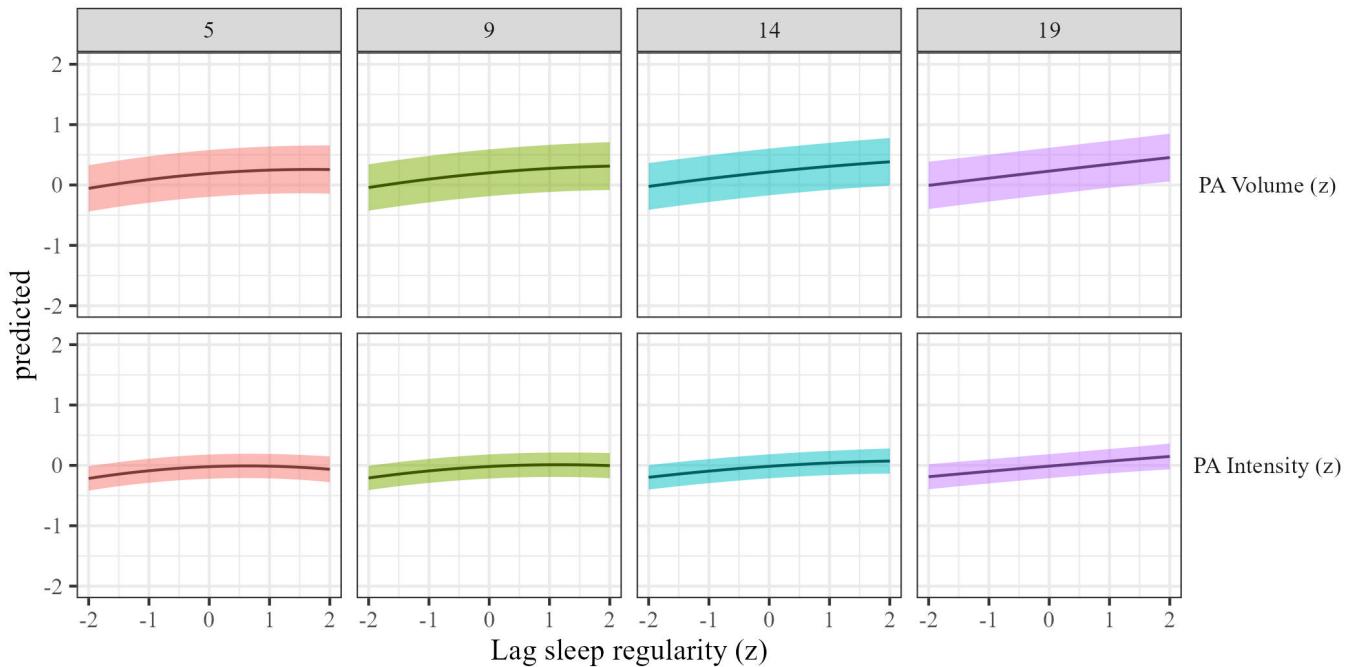


Figure 65. Physical activity by sleep regularity moderated by most active hour