Effects of Reducing Visible Light on Sleep Quality

2024 Spring 241 Final Project

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```
library(data.table)
library(sandwich)
library(lmtest)
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:data.table':
##
##     yearmon, yearqtr
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library(ggplot2)
library(knitr)
library(stargazer)
```

```
##
## Please cite as:
```

```
##  Hlavac, Marek (2022). stargazer: Well-Formatted Regression and Summary Statistics Tables.
```

```
##  R package version 5.2.3. https://CRAN.R-project.org/package=stargazer
```

```
library(kableExtra)
```

```
## Warning: package 'kableExtra' was built under R version 4.3.3
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.3.3
```

```
##
## Attaching package: 'dplyr'

## The following object is masked from 'package:kableExtra':
##
##     group_rows

## The following objects are masked from 'package:data.table':
##
##     between, first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggpubr)
```

```
## Warning: package 'ggpubr' was built under R version 4.3.3
```

```
# Short Format Table
data <- fread("../data/cleaned_data.csv")
data[, avg_ss := rowMeans(.SD, na.rm = TRUE), .SDcols = c("day1_ss", "day2_ss", "day3_ss", "day4_ss")]

# Long Format Table
data_long <- fread("../data/cleaned_data_long.csv")
data_long <- na.omit(data_long)

# Base Model
model_base <- lm(avg_ss ~ treat, data = data)
robust_base <- sqrt(diag(vcovHC(model_base, type="HC1")))

# Model adding with participants' Demographic Info
model_prevsleep <- lm(avg_ss ~ treat + sleep_quality +
                        trouble_sleep + total_sleep,
                      data = data)
robust_prevsleep <- sqrt(diag(vcovHC(model_prevsleep, type="HC1")))

# Model adding with participants' Demographic Info
model_demog <- lm(
  avg_ss ~ treat + sleep_quality + trouble_sleep +
    total_sleep + age_group + gender,
  data = data)
robust_demog <- sqrt(diag(vcovHC(model_demog, type="HC1")))

# Model with participants' Fixed Effects
model_fixed <- lm(
  avg_ss ~ treat + as.factor(participant_id),
  data = data)
```

```r
robust_complete <- sqrt(diag(vcovHC(model_fixed, type="HC1")))

# Model with participants' individual data points
# data_long$participant_id <- factor(data_long$participant_id)
model_individual <- lm(
  sleep_score ~ treat + as.factor(participant_id),
  data = data_long)
robust_individual <- sqrt(diag(vcovHC(model_individual, type="HC1")))
```

```r
data_survey <- select(
  data, c('sleep_quality','trouble_sleep','total_sleep',
          'phase_sq', 'phase_ts', 'treat', 'age_group', 'gender', 'participant_id')
  )
stargazer(data_survey, type = "text", title="Descriptive statistics", digits=1)
```

```
##
## Descriptive statistics
## ========================================
## Statistic      N  Mean St. Dev. Min Max
## ----------------------------------------
## sleep_quality  44 3.3    0.7     2   4
## trouble_sleep  44 3.1    0.9     1   4
## total_sleep    44 8.3    2.5     5  19
## phase_sq       44 3.2    0.8     1   5
## phase_ts       44 2.6    0.8     1   4
## treat          44 0.5    0.5     0   1
## age_group      44 2.7    1.1     2   6
## gender         44 0.5    0.5     0   1
## participant_id 44 10.5   6.4     0  21
## ----------------------------------------
```

```r
data_demog <- data_survey[ , .(
  age_group = mean(age_group),
  gender = mean(gender)
  ),
  by = participant_id]

data_demog[, Gender := 'Female']
data_demog[gender == 0, Gender := 'Male']
data_demog[, Age := '25-34']
data_demog[age_group == 3, Age := '35-44']
data_demog[age_group == 4, Age := '45-54']
data_demog[age_group == 5, Age := '55-64']
data_demog[age_group == 6, Age := '65+']

# Crosstable Gender-Age
xtab_ag <- xtabs(~ Gender + Age, data=data_demog)
xtab_ag %>%
  kable(format = "latex", booktabs = T, caption = "Age Group - Gender Distribution")
```

Table 1: Sleep Score Regression Results

	Dependent variable:				
	Mean Sleep Score				Sleep Score
	Base Model	Previous Sleep Info	Demographic Info	FE by Participant	Individual Datapoints
	(1)	(2)	(3)	(4)	(5)
(Intercept)	78.212^{***}	55.475^{***}	64.531^{***}	75.949^{***}	76.059^{***}
	(2.170)	(13.103)	(12.568)	(1.233)	(3.472)
Sunglasses Treatment	−0.564	−0.564	−0.564	−0.564	−0.470
	(3.217)	(2.971)	(2.792)	(1.205)	(1.382)
Sleep Quality		6.169^{**}	6.094^{**}		
		(2.633)	(2.424)		
Trouble Sleeping		−0.746	−1.695		
		(2.281)	(1.832)		
Typical Total Sleep		0.554^{*}	0.854^{***}		
		(0.294)	(0.292)		
Age Group			-3.574^{*}		
			(1.923)		
Gender (Female)			3.129		
			(2.619)		
Participant Fixed effects	No	No	No	Yes	Yes
Observations	44	44	44	44	172
R^2	0.001	0.209	0.337	0.930	0.592
Adjusted R^2	−0.023	0.128	0.229	0.857	0.532
Residual Std. Error	10.670 (df = 42)	9.852 (df = 39)	9.260 (df = 37)	3.996 (df = 21)	9.050 (df = 149)
F Statistic	0.031 (df = 1; 42)	2.574^{*} (df = 4; 39)	3.134^{**} (df = 6; 37)	12.666^{***} (df = 22; 21)	9.836^{***} (df = 22; 149)

Note: *p<0.1; **p<0.05; ***p<0.01
HC robust standard errors in parantheses.

Table 2: Previous Sleep - Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
Sleep Quality (Likert 1-5)	22	3.3	0.7	2	4
TroubleSleep (Likert 1-5)	22	3.1	0.9	1	4
Total Sleep (Hours)	22	8.3	2.6	5	19

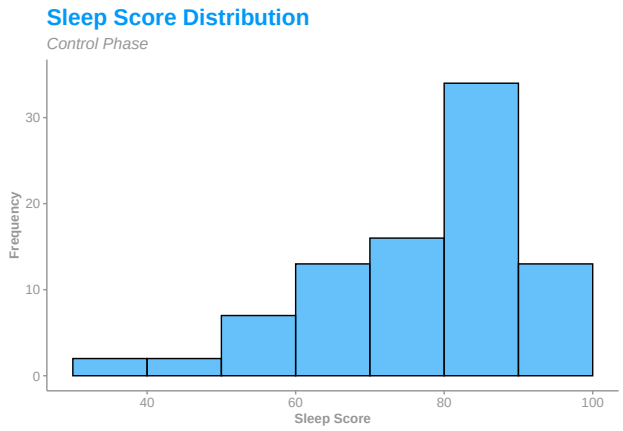
Table 3: Age Group - Gender Distribution

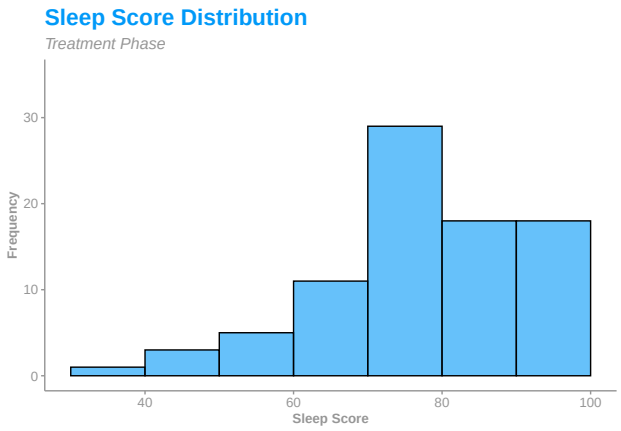
	25-34	35-44	45-54	55-64	65+
Female	6	1	1	1	1
Male	7	4	1	0	0

```
data <- fread("../data/paired_cleaned_data.csv")

#calculate average sleep scores
data[, avg_ss_ctrl := rowMeans(.SD, na.rm = TRUE), .SDcols = c("day1_ss_ctrl", "day2_ss_ctrl", "day3_ss
data[, avg_ss_treat := rowMeans(.SD, na.rm = TRUE), .SDcols = c("day1_ss_treat", "day2_ss_treat", "day3
```

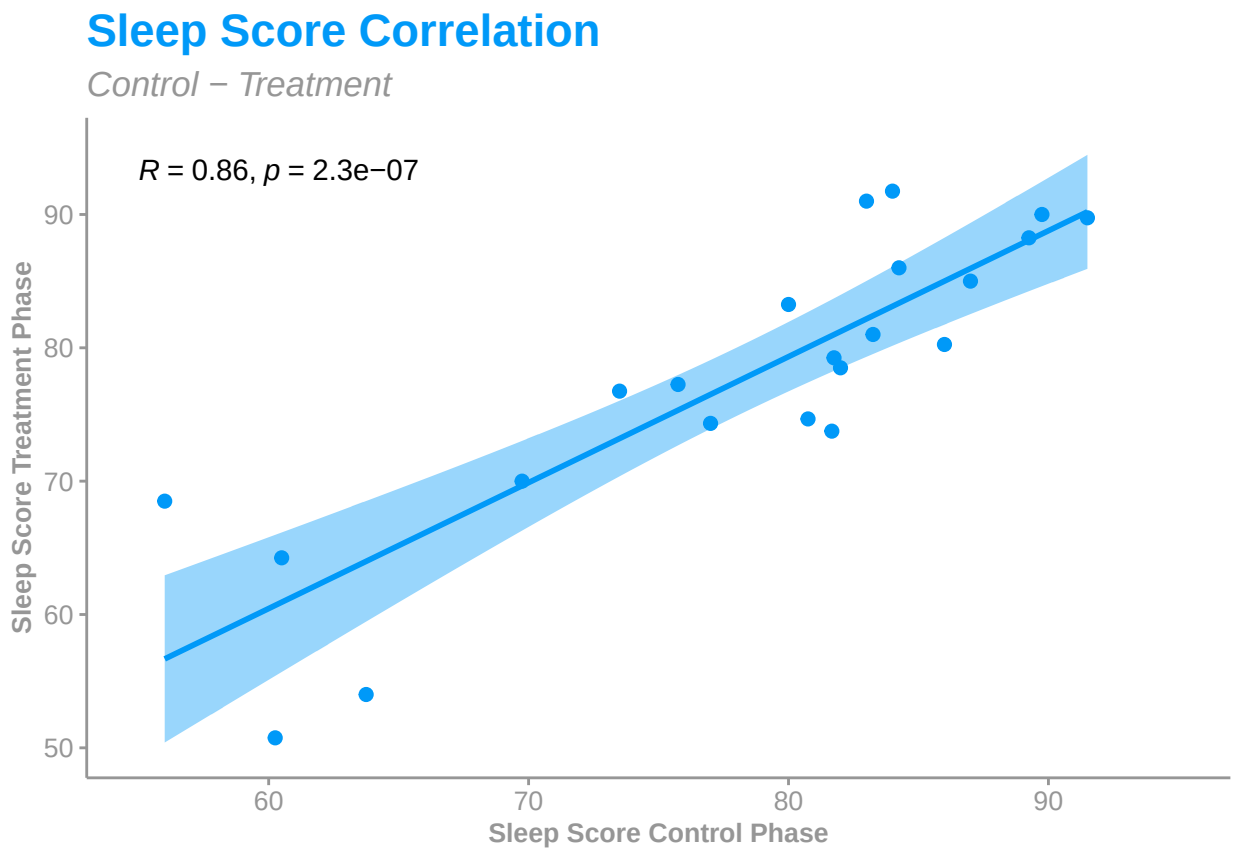
```
# cols_to_plot <- c("avg_ss_ctrl", "avg_ss_treat", "phase_sq_ctrl",
#                   "phase_sq_treat", "phase_ts_ctrl", "phase_ts_treat",
#                   "sleep_quality", "trouble_sleep", "total_sleep")
#
# for (col in cols_to_plot) {
#   hist(data[[col]], main=paste("Histogram of", col), xlab="Values", ylab="Frequency")
# }
```






```
ggscatter(data, x = "avg_ss_ctrl", y = "avg_ss_treat",
          add = "reg.line", conf.int = TRUE,
          palette = "Blues", color = "#0099F8",
          cor.coef = TRUE, cor.method = "pearson",
          xlab = "Sleep Score Control Phase",
          ylab = "Sleep Score Treatment Phase") +
  theme_classic() +
  labs(
```

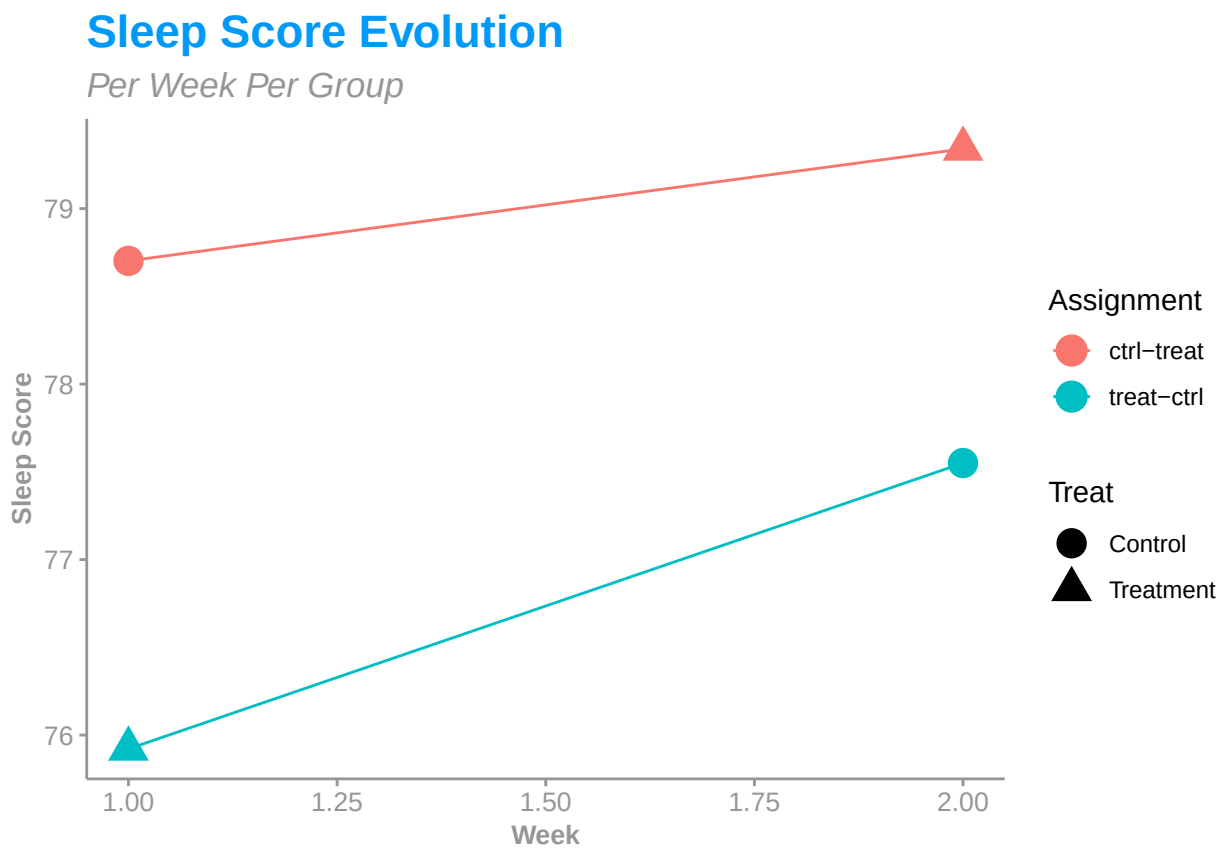
```
    title = "Sleep Score Correlation",
    subtitle = "Control - Treatment",
  )+
  theme(
    plot.title = element_text(color = "#0099F8",
                              size = 17,
                              face = "bold"),
    plot.subtitle = element_text(size = 13,
                                 face = "italic",
                                 color="#969696"),
    axis.title = element_text(color = "#969696",
                              size = 10,
                              face = "bold"),
    axis.text = element_text(color = "#969696", size = 10),
    axis.line = element_line(color = "#969696"),
    axis.ticks = element_line(color = "#969696")
  ) +
  xlim(55,95) +
  ylim(50,95)
```




```
week_treat <- data_long[ , .(
  sleep_score = mean(sleep_score)
  ),
  keyby = c('treat', 'week', 'Assignment')]
```

```
week_treat[treat == 0, Treat := "Control"]
week_treat[treat == 1, Treat := "Treatment"]

ggplot(week_treat) +
  geom_point(
    aes(x = week,
        y = sleep_score,
        shape = Treat,
        color = Assignment),
    size = 5
    ) +
  geom_line(aes(x = week,
        y = sleep_score,
        color = Assignment)) +
  theme_classic() +
  labs(
    title = "Sleep Score Evolution",
    subtitle = "Per Week Per Group",
    x = "Week",
    y = "Sleep Score"
  )+
  theme(
    plot.title = element_text(color = "#0099F8",
                              size = 17,
                              face = "bold"),
    plot.subtitle = element_text(size = 13,
                                 face = "italic",
                                 color="#969696"),
    axis.title = element_text(color = "#969696",
                              size = 10,
                              face = "bold"),
    axis.text = element_text(color = "#969696", size = 10),
    axis.line = element_line(color = "#969696"),
    axis.ticks = element_line(color = "#969696")
  )
```


Sleep Score Evolution
Per Week Per Group
Sleep Score
79
78
77
76
1.00
1.25
1.50
1.75
2.00
Week
Assignment
ctrl−treat
treat−ctrl
Treat
Control
Treatment