

# EDA

```
library(tidyverse)
library(zoo)
library(ggplot2)
library(gridExtra)
library(scales)
library(lme4)
library(geepack)
```

Warning: package 'geepack' was built under R version 4.4.3

```
library(viridis)
library(here)
```

## input data

```
data <- read.csv(here("Data/nursebp.csv"), header = TRUE)

data$SNUM <- as.factor(data$SNUM)
data$PHASE <- as.factor(data$PHASE)
data$DAY <- as.factor(data$DAY)
data$POSTURE <- as.factor(data$POSTURE)
data$FH123 <- as.factor(data$FH123)

data <- data %>%
  mutate(
    # in hours
    hour_of_day = floor(time / 60),
    # 20-minute
```

```
time_20 = floor(time / 20) * 20/60,  
time2 = time^2  
)
```

## Number of unique subjects

```
n_subjects <- length(unique(data$SNUM))  
n_subjects #
```

```
[1] 203
```

## Average observations per subject

```
nrow(data)/n_subjects
```

```
[1] 47.15764
```

```
#
```

## Missing values by column

```
missing_values <- sapply(data, function(x) sum(is.na(x)))  
print(missing_values[missing_values > 0])
```

|        |     |     |     |
|--------|-----|-----|-----|
| MNACT5 | STR | HAP | TIR |
| 985    | 754 | 755 | 755 |

## Summary statistics

```

num_vars <- c("SYS", "DIA", "HRT", "MNACT5", "STR", "HAP", "TIR", "AGE")
summary_stats <- data %>%
  select(all_of(num_vars)) %>%
  summary()
print(summary_stats)

```

| SYS     |        | DIA     |         | HRT     |         | MNACT5  |        |
|---------|--------|---------|---------|---------|---------|---------|--------|
| Min.    | : 75.0 | Min.    | : 40.00 | Min.    | : 35.00 | Min.    | : 0.0  |
| 1st Qu. | :108.0 | 1st Qu. | : 63.00 | 1st Qu. | : 71.00 | 1st Qu. | :160.2 |
| Median  | :117.0 | Median  | : 71.00 | Median  | : 80.00 | Median  | :207.0 |
| Mean    | :118.2 | Mean    | : 71.38 | Mean    | : 80.03 | Mean    | :190.4 |
| 3rd Qu. | :127.0 | 3rd Qu. | : 79.00 | 3rd Qu. | : 88.00 | 3rd Qu. | :236.4 |
| Max.    | :200.0 | Max.    | :120.00 | Max.    | :144.00 | Max.    | :359.4 |
|         |        |         |         |         |         | NA's    | :985   |

| STR     |       | HAP     |        | TIR     |        | AGE     |        |
|---------|-------|---------|--------|---------|--------|---------|--------|
| Min.    | :1.00 | Min.    | :1.000 | Min.    | :1.000 | Min.    | :24.00 |
| 1st Qu. | :1.00 | 1st Qu. | :2.000 | 1st Qu. | :1.000 | 1st Qu. | :33.00 |
| Median  | :1.00 | Median  | :3.000 | Median  | :2.000 | Median  | :38.00 |
| Mean    | :1.51 | Mean    | :3.099 | Mean    | :1.954 | Mean    | :37.82 |
| 3rd Qu. | :2.00 | 3rd Qu. | :4.000 | 3rd Qu. | :3.000 | 3rd Qu. | :43.00 |
| Max.    | :5.00 | Max.    | :5.000 | Max.    | :5.000 | Max.    | :50.00 |
| NA's    | :754  | NA's    | :755   | NA's    | :755   |         |        |

```

vars <- c("PHASE", "DAY", "POSTURE", "FH123")
for (var in vars) {
  cat(var)
  print(table(data[[var]]))
  cat("Percentages")
  print(round(prop.table(table(data[[var]])) * 100, 1))
}

```

```

PHASE
  F    L
4737 4836
Percentages
  F    L
49.5 50.5
DAY
  NW    W
4116 5457

```

Percentages

NW W

43 57

POSTURE

|  | RECLINE | SIT | STAND |
|--|---------|-----|-------|
|  | 586     | 631 | 4101  |

Percentages

|  | RECLINE | SIT | STAND |
|--|---------|-----|-------|
|  | 6.1     | 6.6 | 42.8  |

FH123

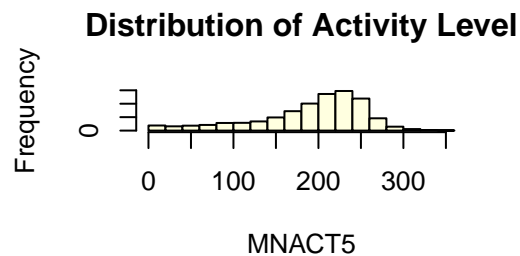
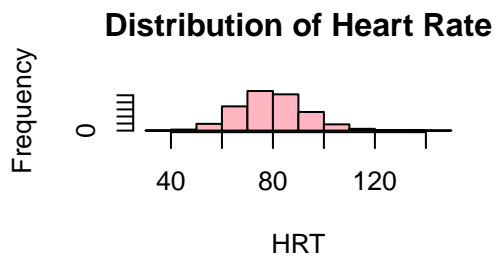
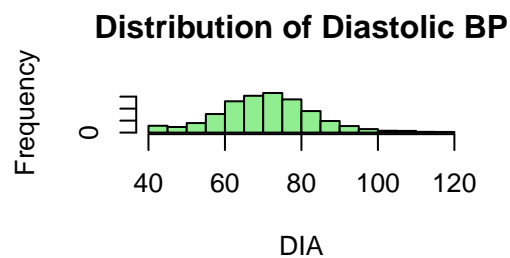
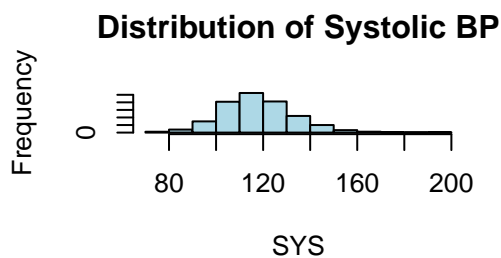
|  | NO   | YES  | YESYES |
|--|------|------|--------|
|  | 5298 | 3633 | 642    |

Percentages

|  | NO   | YES  | YESYES |
|--|------|------|--------|
|  | 55.3 | 38.0 | 6.7    |

#box plot

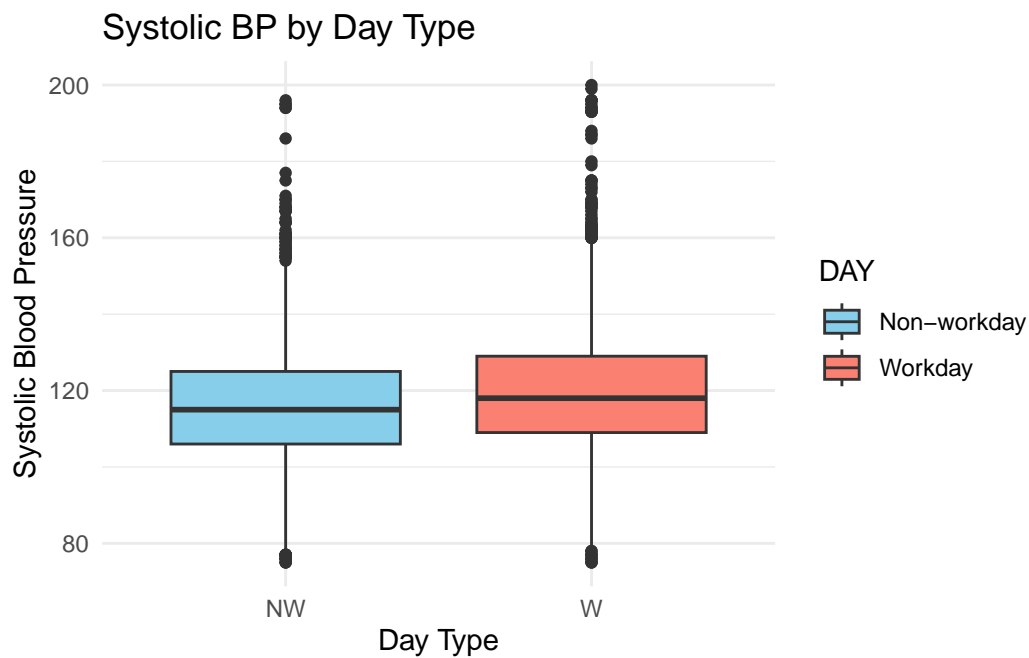
```
par(mfrow = c(2, 2))
hist(data$SYS, main = "Distribution of Systolic BP", xlab = "SYS", col = "lightblue")
hist(data$DIA, main = "Distribution of Diastolic BP", xlab = "DIA", col = "lightgreen")
hist(data$HRT, main = "Distribution of Heart Rate", xlab = "HRT", col = "lightpink")
hist(data$MNACT5, main = "Distribution of Activity Level", xlab = "MNACT5", col = "lightyellow")
```



```
par(mfrow = c(1, 1))
```

```
bp_by_day <- ggplot(data, aes(x = DAY, y = SYS, fill = DAY)) +
  geom_boxplot() +
  labs(title = "Systolic BP by Day Type",
       x = "Day Type",
       y = "Systolic Blood Pressure") +
  scale_fill_manual(values = c("skyblue", "salmon"),
                   labels = c("Non-workday", "Workday")) +
  theme_minimal()

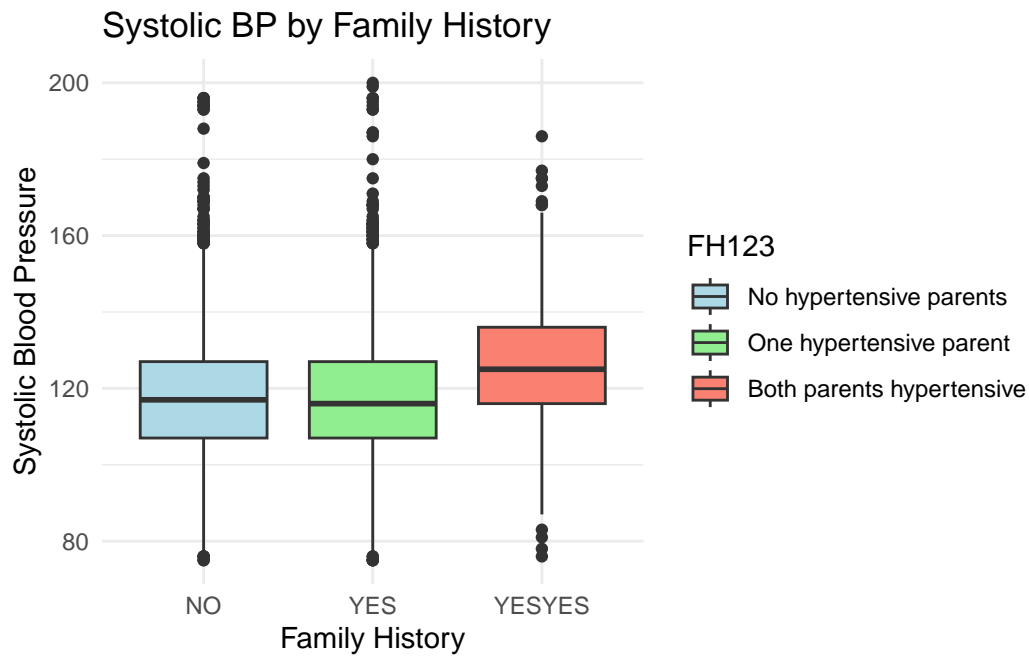
print(bp_by_day)
```



```
bp_by_fh <- ggplot(data, aes(x = FH123, y = SYS, fill = FH123)) +
  geom_boxplot() +
  labs(title = "Systolic BP by Family History",
       x = "Family History",
       y = "Systolic Blood Pressure") +
  scale_fill_manual(values = c("lightblue", "lightgreen", "salmon"),
                   labels = c("No hypertensive parents",
                              "One hypertensive parent",
                              "Both parents hypertensive")) +
```

```
theme_minimal()

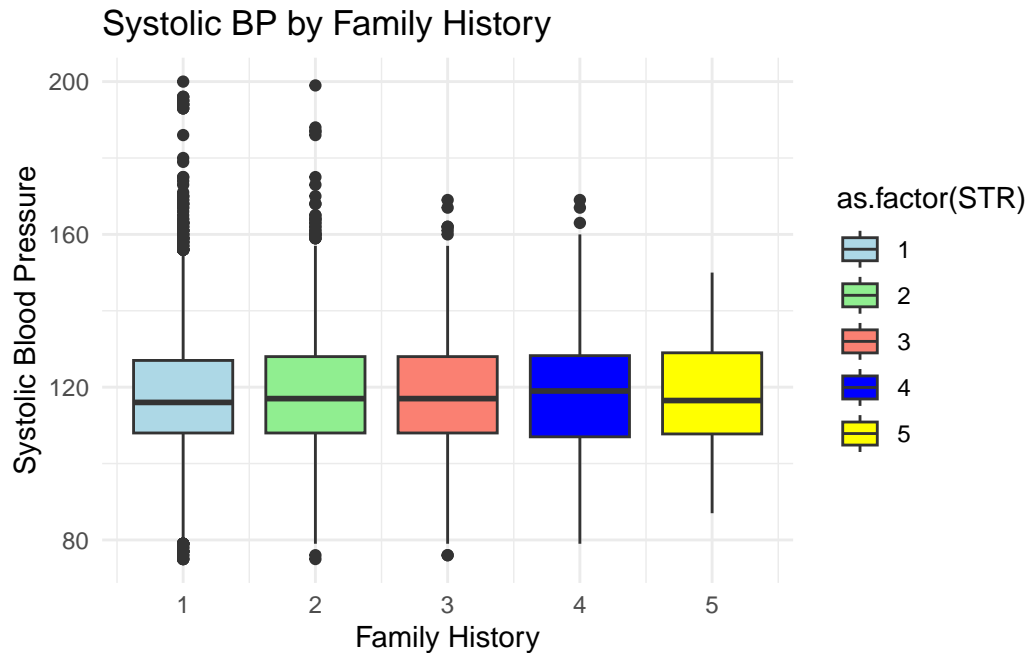
print(bp_by_fh)
```



```
bp_by_str <- ggplot(data, aes(x = STR, y = SYS, fill = as.factor(STR))) +
  geom_boxplot() +
  labs(title = "Systolic BP by Family History",
       x = "Family History",
       y = "Systolic Blood Pressure") +
  scale_fill_manual(values = c("lightblue", "lightgreen", "salmon", "blue", "yellow"),
                    labels = c("1", "2", "3", "4", "5")) +
  theme_minimal()

print(bp_by_str)
```

Warning: Removed 754 rows containing missing values or values outside the scale range (`stat\_boxplot()`).

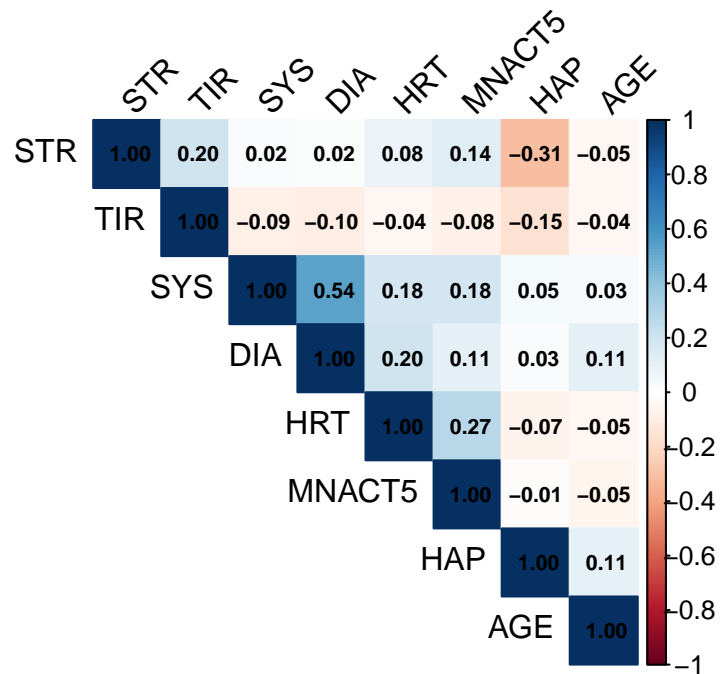


## Correlation

```
corr_vars <- c("SYS", "DIA", "HRT", "MNACT5", "STR", "HAP", "TIR", "AGE")
correlation_matrix <- cor(data[, corr_vars], use = "pairwise.complete.obs")
print(correlation_matrix[1,])
```

|     | SYS         | DIA        | HRT        | MNACT5     | STR        | HAP        |
|-----|-------------|------------|------------|------------|------------|------------|
| SYS | 1.00000000  | 0.53557471 | 0.18468989 | 0.18214753 | 0.02153487 | 0.04767398 |
| TIR |             | AGE        |            |            |            |            |
|     | -0.08736763 | 0.03479532 |            |            |            |            |

```
corrplot::corrplot(correlation_matrix,
  method = "color",
  type = "upper",
  order = "hclust",
  tl.col = "black",
  tl.srt = 45,
  addCoef.col = "black",
  number.cex = 0.7)
```



#bars

```
fh_summary <- data %>%
  group_by(FH123) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  )

print(fh_summary)
```

```
# A tibble: 3 x 5
  FH123 mean_SYS sd_SYS      n se_SYS
<fct>   <dbl>   <dbl> <int> <dbl>
1 NO      118.    15.4  5298  0.212
2 YES     117.    15.4  3633  0.256
3 YESYES  126.    15.5   642  0.612
```

```
subject_fh_data <- data %>%
  group_by(SNUM, FH123) %>%
```



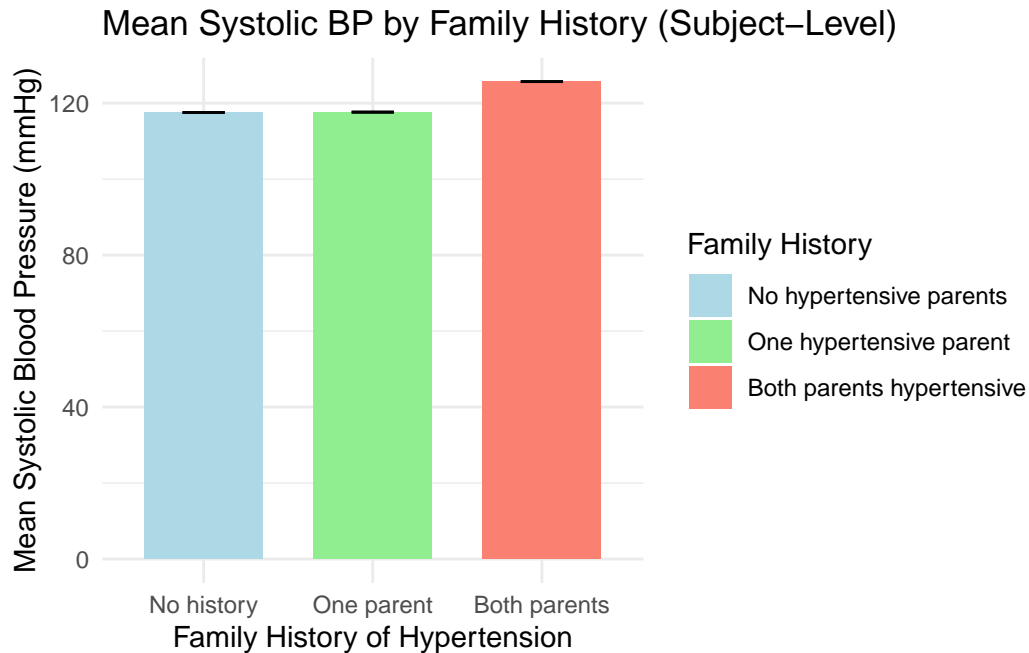
```
summarise(mean_SYS = mean(SYS, na.rm = TRUE)) %>%
ungroup()
```

`summarise()` has grouped output by 'SNUM'. You can override using the  
`.groups` argument.

```
subject_fh_summary <- subject_fh_data %>%
  group_by(FH123) %>%
  summarise(
    mean_SYS = mean(mean_SYS, na.rm = TRUE),
    sd_SYS = sd(mean_SYS, na.rm = TRUE), #????
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  )
print(subject_fh_summary)
```

```
# A tibble: 3 x 5
  FH123 mean_SYS sd_SYS      n se_SYS
<fct>   <dbl>   <dbl> <int> <dbl>
1 NO      118.     NA    112    NA
2 YES     118.     NA     77    NA
3 YESYES  126.     NA     14    NA
```

```
fh_plot <- ggplot(subject_fh_summary, aes(x = FH123, y = mean_SYS, fill = FH123)) +
  geom_bar(stat = "identity", position = position_dodge(), width = 0.7) +
  geom_errorbar(aes(ymin = mean_SYS, ymax = mean_SYS),
    width = 0.25, position = position_dodge(0.7)) +
  labs(title = "Mean Systolic BP by Family History (Subject-Level)",
    x = "Family History of Hypertension",
    y = "Mean Systolic Blood Pressure (mmHg)") +
  scale_x_discrete(labels = c("No history", "One parent", "Both parents")) +
  scale_fill_manual(values = c("lightblue", "lightgreen", "salmon"),
    name = "Family History",
    labels = c("No hypertensive parents",
      "One hypertensive parent",
      "Both parents hypertensive")) +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 0))
print(fh_plot)
```



#Systolic BP by Stress Level

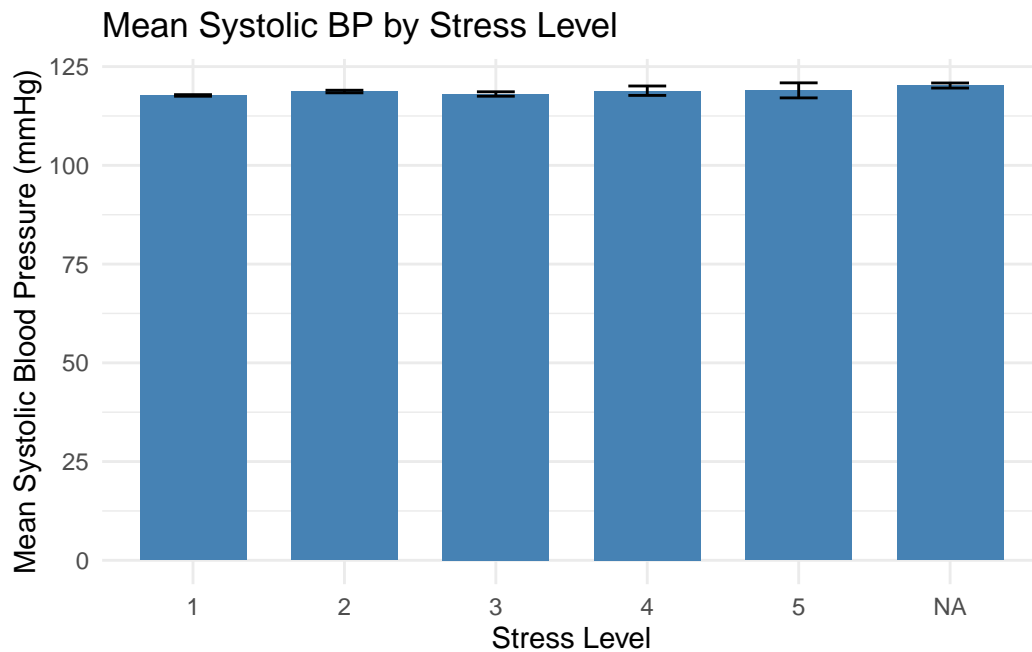
```
stress_summary <- data %>%
  group_by(STR) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  )

print(stress_summary)
```

```
# A tibble: 6 x 5
  STR mean_SYS sd_SYS      n se_SYS
<int>   <dbl>   <dbl> <int> <dbl>
1     1    118.    15.3  5599  0.204
2     2    119.    15.4  2243  0.326
3     3    118.    15.3   737  0.563
4     4    119.    16.2   184  1.19
5     5    119.    14.2    56  1.90
6    NA    120.    17.7   754  0.643
```

#stress level plot (no difference)

```
stress_plot <- ggplot(stress_summary, aes(x = factor(STR), y = mean_SYS)) +  
  geom_bar(stat = "identity", fill = "steelblue", width = 0.7) +  
  geom_errorbar(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS),  
                width = 0.25) +  
  labs(title = "Mean Systolic BP by Stress Level",  
        x = "Stress Level",  
        y = "Mean Systolic Blood Pressure (mmHg)") +  
  theme_minimal()  
print(stress_plot)
```



#Systolic BP by workday

```
workday_summary <- data %>%  
  group_by(DAY) %>%  
  summarise(  
    mean_SYS = mean(SYS, na.rm = TRUE),  
    sd_SYS = sd(SYS, na.rm = TRUE),  
    n = n(),  
    se_SYS = sd_SYS / sqrt(n)  
  )  
print("Systolic BP by Working Status:")
```

```
[1] "Systolic BP by Working Status:"
```

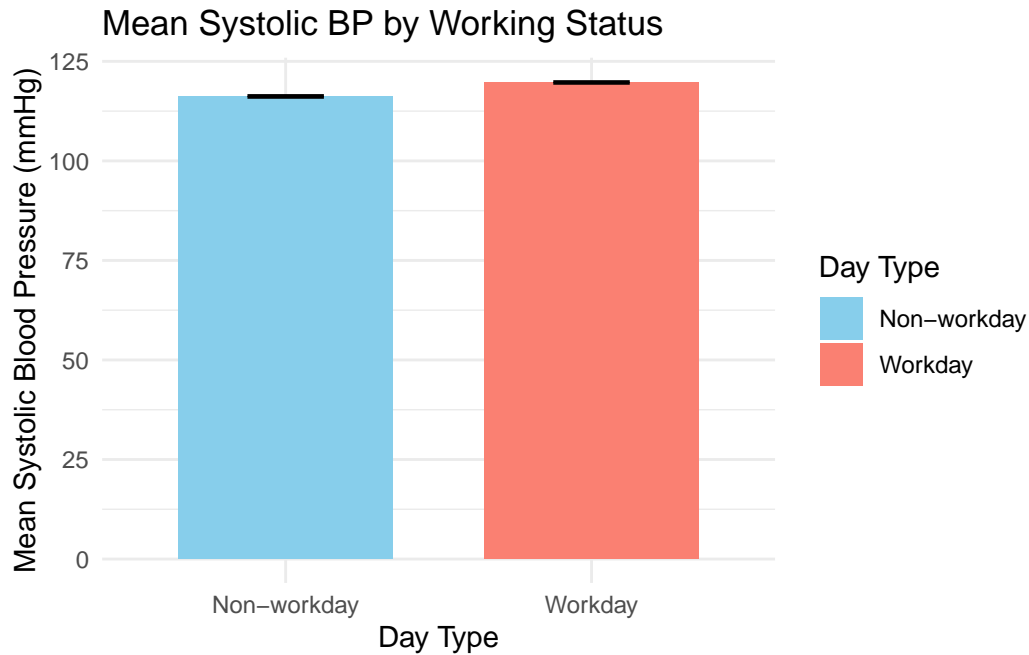
```
print(workday_summary)
```

```
# A tibble: 2 x 5
```

|   | DAY   | mean_SYS | sd_SYS | n     | se_SYS |
|---|-------|----------|--------|-------|--------|
|   | <fct> | <dbl>    | <dbl>  | <int> | <dbl>  |
| 1 | NW    | 116.     | 14.9   | 4116  | 0.232  |
| 2 | W     | 120.     | 15.9   | 5457  | 0.215  |

```
#small difference in workday
```

```
workday_plot <- ggplot(workday_summary, aes(x = DAY, y = mean_SYS, fill = DAY)) +  
  geom_bar(stat = "identity", position = position_dodge(), width = 0.7) +  
  geom_errorbar(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS),  
                width = 0.25, position = position_dodge(0.7)) +  
  labs(title = "Mean Systolic BP by Working Status",  
        x = "Day Type",  
        y = "Mean Systolic Blood Pressure (mmHg)") +  
  scale_x_discrete(labels = c("Non-workday", "Workday")) +  
  scale_fill_manual(values = c("skyblue", "salmon"),  
                    name = "Day Type",  
                    labels = c("Non-workday", "Workday")) +  
  theme_minimal()  
print(workday_plot)
```



#Average change over the day

```
hourly_summary <- data %>%
  group_by(hour_of_day) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  ) %>%
  filter(n >= 5)
print(hourly_summary)
```

```
# A tibble: 19 x 5
  hour_of_day mean_SYS sd_SYS      n se_SYS
    <dbl>      <dbl>   <dbl> <int> <dbl>
1         5      119    24.2     6  9.88
2         6     121.    13.9    162  1.09
3         7     119.    15.5   436  0.744
4         8     119.    15.2   532  0.659
5         9     118.    15.0   584  0.619
6        10     118.    15.8   608  0.641
7        11     118.    17.0   633  0.674
```

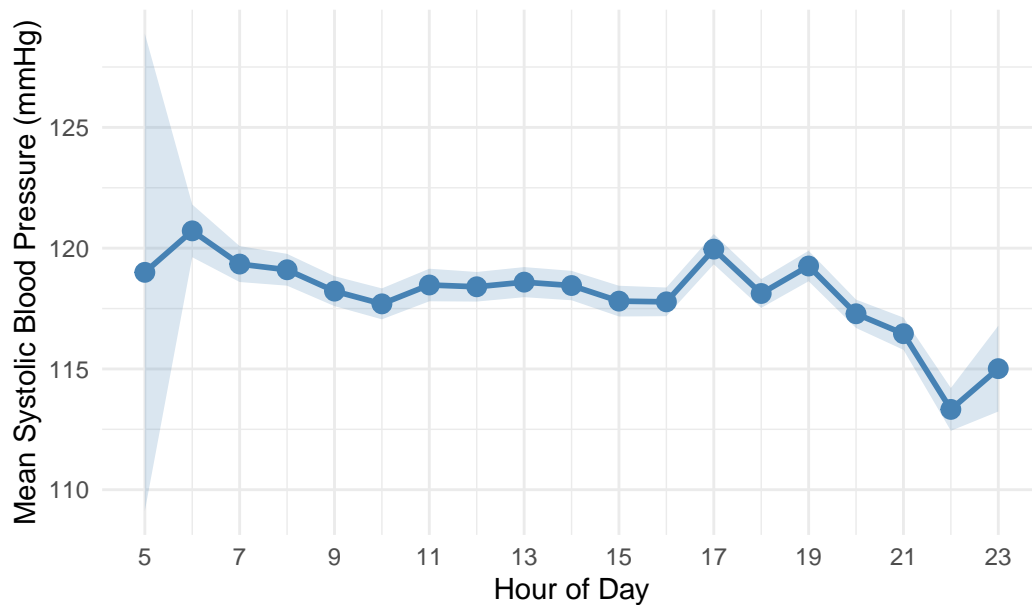
|    |    |      |      |     |       |
|----|----|------|------|-----|-------|
| 8  | 12 | 118. | 15.4 | 630 | 0.613 |
| 9  | 13 | 119. | 15.9 | 649 | 0.623 |
| 10 | 14 | 118. | 15.2 | 625 | 0.608 |
| 11 | 15 | 118. | 16.2 | 645 | 0.636 |
| 12 | 16 | 118. | 14.9 | 630 | 0.594 |
| 13 | 17 | 120. | 15.9 | 643 | 0.627 |
| 14 | 18 | 118. | 14.9 | 624 | 0.597 |
| 15 | 19 | 119. | 16.0 | 642 | 0.631 |
| 16 | 20 | 117. | 14.6 | 617 | 0.587 |
| 17 | 21 | 116. | 15.5 | 540 | 0.667 |
| 18 | 22 | 113. | 14.8 | 280 | 0.884 |
| 19 | 23 | 115. | 16.6 | 87  | 1.77  |

```
time_plot <- ggplot(hourly_summary, aes(x = hour_of_day, y = mean_SYS)) +
  geom_line(size = 1, color = "steelblue") +
  geom_point(size = 3, color = "steelblue") +
  geom_ribbon(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS),
             alpha = 0.2, fill = "steelblue") +
  labs(title = "Diurnal Pattern of Systolic BP",
       x = "Hour of Day",
       y = "Mean Systolic Blood Pressure (mmHg)") +
  scale_x_continuous(breaks = seq(5, 23, 2)) +
  theme_minimal()
```

Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.  
i Please use `linewidth` instead.

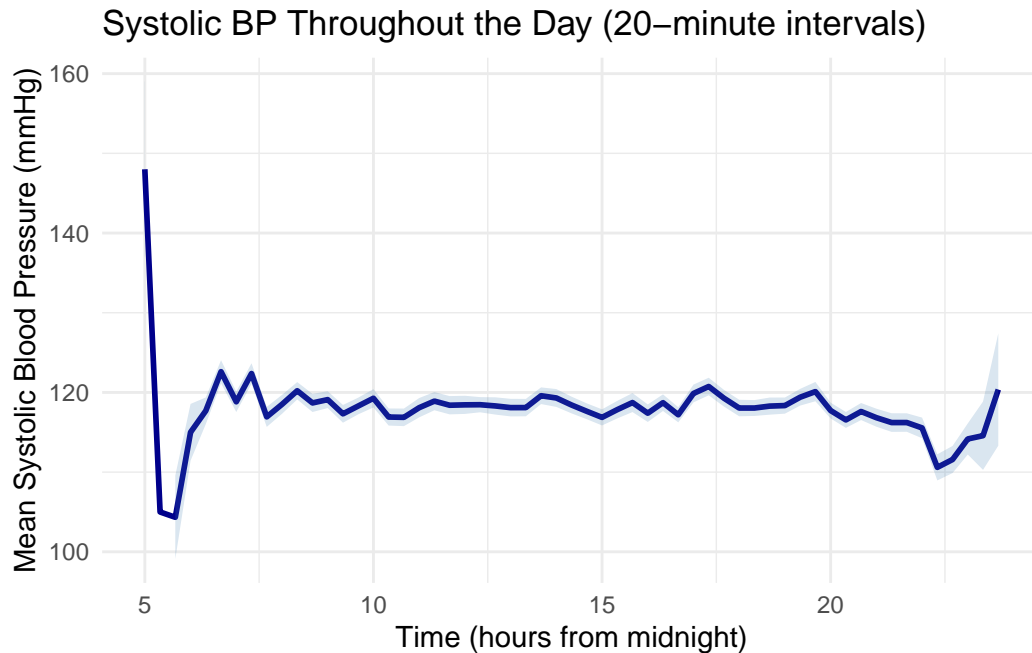
```
print(time_plot)
```

### Diurnal Pattern of Systolic BP



```
time20_summary <- data %>%
  group_by(time_20) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  )

time20_plot <- ggplot(time20_summary, aes(x = time_20, y = mean_SYS)) +
  geom_line(size = 1, color = "darkblue") +
  geom_ribbon(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS),
    alpha = 0.2, fill = "steelblue") +
  labs(title = "Systolic BP Throughout the Day (20-minute intervals)",
    x = "Time (hours from midnight)",
    y = "Mean Systolic Blood Pressure (mmHg)") +
  theme_minimal()
print(time20_plot)
```



#workday ggplot

```
time_workday <- data %>%
  group_by(hour_of_day, DAY) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n)
  ) %>%
  filter(n >= 5)
```

`summarise()` has grouped output by 'hour\_of\_day'. You can override using the `groups` argument.

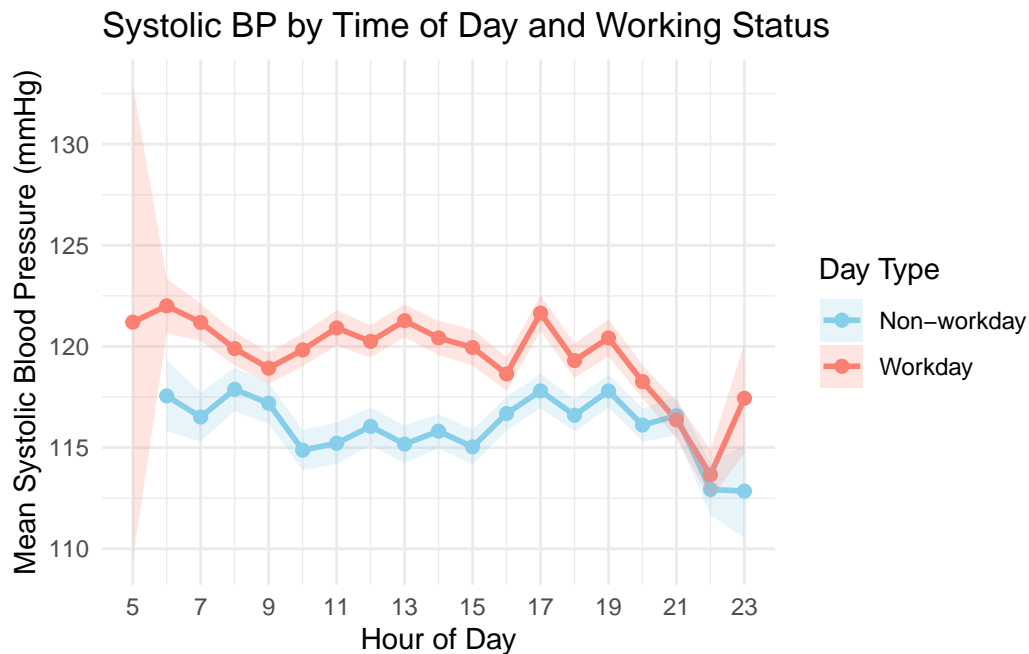
```
time_day_plot <- ggplot(time_workday, aes(x = hour_of_day, y = mean_SYS, color = DAY, group = DAY)) +
  geom_line(size = 1) +
  geom_point(size = 2) +
  geom_ribbon(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS, fill = DAY),
    alpha = 0.2, color = NA) +
  labs(title = "Systolic BP by Time of Day and Working Status",
    x = "Hour of Day",
```



```

    y = "Mean Systolic Blood Pressure (mmHg)" +
    scale_x_continuous(breaks = seq(5, 23, 2)) +
    scale_color_manual(values = c("skyblue", "salmon"),
                      name = "Day Type",
                      labels = c("Non-workday", "Workday")) +
    scale_fill_manual(values = c("skyblue", "salmon"),
                    name = "Day Type",
                    labels = c("Non-workday", "Workday")) +
    theme_minimal()
print(time_day_plot)

```



#Family history ggplot

```

time_fh_summary <- data %>%
  group_by(hour_of_day, FH123) %>%
  summarise(
    mean_SYS = mean(SYS, na.rm = TRUE),
    sd_SYS = sd(SYS, na.rm = TRUE),
    n = n(),
    se_SYS = sd_SYS / sqrt(n),
    .groups = "drop"
  ) %>%

```

```

filter(n >= 5)

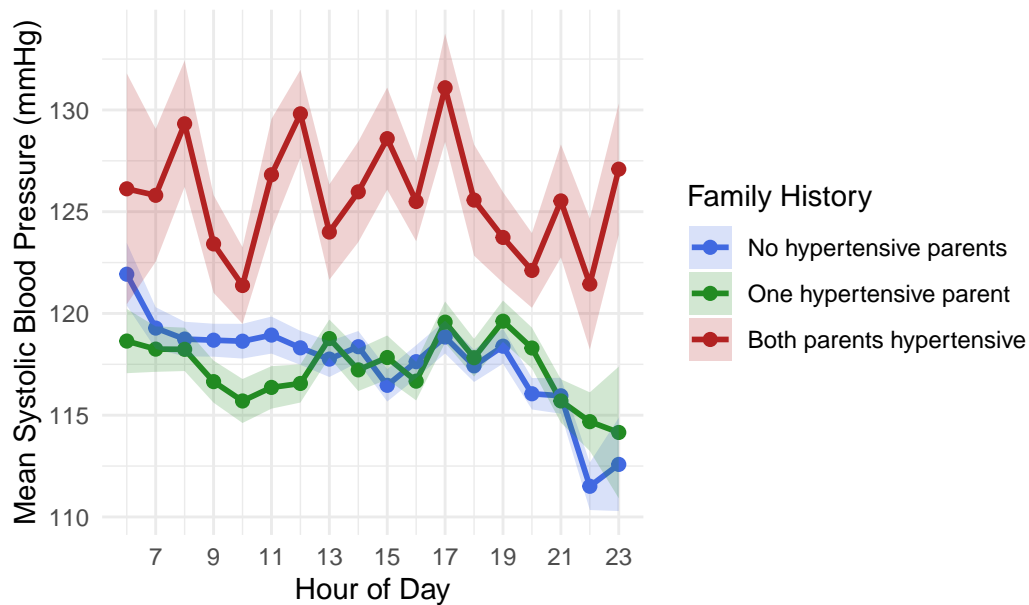
time_fh_plot <- ggplot(time_fh_summary, aes(x = hour_of_day, y = mean_SYS, color = FH123, group = FH123)) +
  geom_line(size = 1) +
  geom_point(size = 2) +
  geom_ribbon(aes(ymin = mean_SYS - se_SYS, ymax = mean_SYS + se_SYS, fill = FH123),
            alpha = 0.2, color = NA) +
  labs(title = "Systolic BP by Time of Day and Family History",
       x = "Hour of Day",
       y = "Mean Systolic Blood Pressure (mmHg)") +
  scale_x_continuous(breaks = seq(5, 23, 2)) +
  scale_color_manual(values = c("royalblue", "forestgreen", "firebrick"),
                    name = "Family History",
                    labels = c("No hypertensive parents",
                              "One hypertensive parent",
                              "Both parents hypertensive")) +
  scale_fill_manual(values = c("royalblue", "forestgreen", "firebrick"),
                   name = "Family History",
                   labels = c("No hypertensive parents",
                              "One hypertensive parent",
                              "Both parents hypertensive")) +

  theme_minimal()

print(time_fh_plot)

```

## Systolic BP by Time of Day and Family History



## Between-Subject vs. Within-Subject Variation

```
subject_means <- data %>%
  group_by(SNUM) %>%
  summarise(mean_SYS = mean(SYS, na.rm = TRUE))

overall_mean <- mean(subject_means$mean_SYS)
between_subject_sd <- sd(subject_means$mean_SYS)

#Between-subject variation
#Overall mean SYS
overall_mean
```

```
[1] 118.1433
```

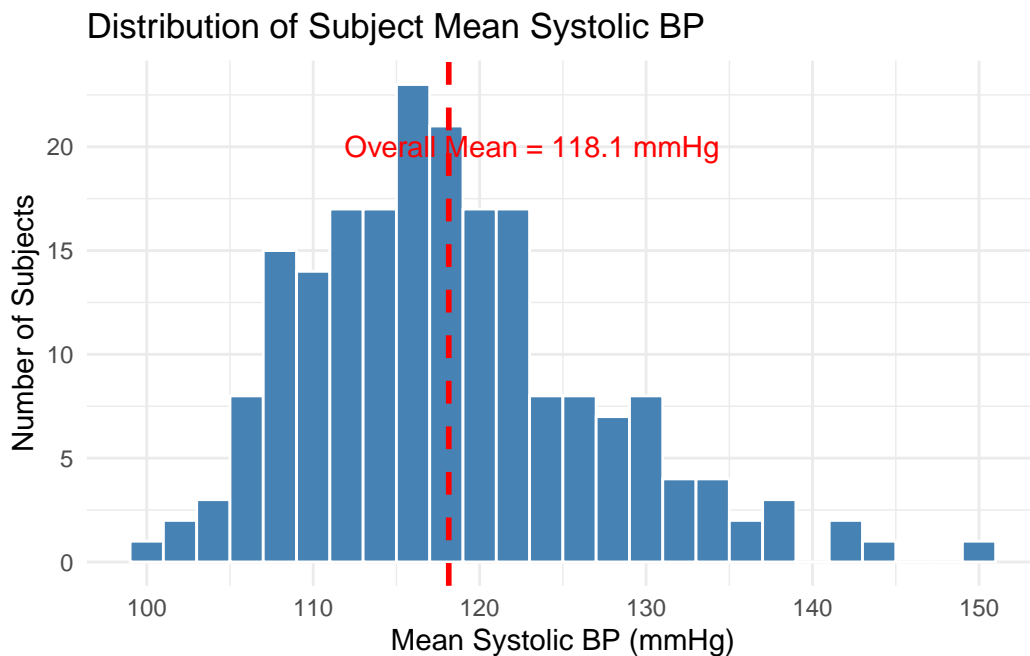
```
#SD of subject means
between_subject_sd
```

```
[1] 8.673331
```

```

subject_hist <- ggplot(subject_means, aes(x = mean_SYS)) +
  geom_histogram(binwidth = 2, fill = "steelblue", color = "white") +
  geom_vline(xintercept = overall_mean, color = "red", linetype = "dashed", size = 1) +
  labs(title = "Distribution of Subject Mean Systolic BP",
       x = "Mean Systolic BP (mmHg)",
       y = "Number of Subjects") +
  annotate("text", x = overall_mean + 5, y = 20,
          label = paste("Overall Mean =", round(overall_mean, 1), "mmHg"),
          color = "red") +
  theme_minimal()
print(subject_hist)

```



```

me_model <- lmer(SYS ~ time + DAY + HRT + MNACT5 + POSTURE + FH123 + TIR + (1 | SNUM),
                 data = data)
print(summary(me_model))

```

Linear mixed model fit by REML ['lmerMod']

Formula: SYS ~ time + DAY + HRT + MNACT5 + POSTURE + FH123 + TIR + (1 | SNUM)

Data: data

REML criterion at convergence: 62880.5

Scaled residuals:

| Min     | 1Q      | Median  | 3Q     | Max    |
|---------|---------|---------|--------|--------|
| -4.9818 | -0.5500 | -0.0390 | 0.5233 | 6.5197 |

Random effects:

| Groups   | Name        | Variance | Std.Dev. |
|----------|-------------|----------|----------|
| SNUM     | (Intercept) | 59.25    | 7.698    |
| Residual |             | 157.00   | 12.530   |

Number of obs: 7899, groups: SNUM, 183

Fixed effects:

|                | Estimate   | Std. Error | t value |
|----------------|------------|------------|---------|
| (Intercept)    | 1.027e+02  | 3.394e+00  | 30.246  |
| time           | 1.365e-04  | 6.003e-04  | 0.227   |
| DAYW           | 2.518e+00  | 1.186e+00  | 2.124   |
| HRT            | 1.013e-01  | 1.558e-02  | 6.504   |
| MNACT5         | 3.338e-02  | 2.671e-03  | 12.496  |
| POSTURERECLINE | -3.923e+00 | 3.013e+00  | -1.302  |
| POSTURESIT     | -1.992e-01 | 2.952e+00  | -0.067  |
| POSTURESTAND   | 8.528e-02  | 2.953e+00  | 0.029   |
| FH123YES       | -7.195e-03 | 1.253e+00  | -0.006  |
| FH123YESYES    | 7.186e+00  | 2.337e+00  | 3.075   |
| TIR            | -2.980e-01 | 1.825e-01  | -1.632  |

Correlation of Fixed Effects:

|             | (Intr) | time     | DAYW      | HRT    | MNACT5 | POSTURER | POSTURESIT | POSTUREST |
|-------------|--------|----------|-----------|--------|--------|----------|------------|-----------|
| time        | -0.100 |          |           |        |        |          |            |           |
| DAYW        | -0.182 | 0.017    |           |        |        |          |            |           |
| HRT         | -0.332 | -0.069   | -0.002    |        |        |          |            |           |
| MNACT5      | -0.098 | 0.077    | -0.008    | -0.193 |        |          |            |           |
| POSTURERECL | -0.865 | -0.035   | 0.006     | 0.023  | 0.083  |          |            |           |
| POSTURESIT  | -0.871 | -0.013   | 0.004     | 0.008  | 0.013  | 0.976    |            |           |
| POSTURESTAN | -0.858 | -0.002   | 0.001     | -0.023 | -0.005 | 0.972    | 0.994      |           |
| FH123YES    | -0.140 | -0.002   | -0.061    | 0.019  | 0.000  | 0.000    | 0.000      | 0.000     |
| FH123YESYES | -0.087 | -0.006   | 0.033     | 0.008  | 0.005  | 0.001    | -0.001     | 0.000     |
| TIR         | -0.087 | -0.372   | -0.048    | 0.074  | 0.005  | 0.007    | 0.024      | 0.024     |
|             |        | FH123YES | FH123YESY |        |        |          |            |           |
| time        |        |          |           |        |        |          |            |           |
| DAYW        |        |          |           |        |        |          |            |           |
| HRT         |        |          |           |        |        |          |            |           |
| MNACT5      |        |          |           |        |        |          |            |           |
| POSTURERECL |        |          |           |        |        |          |            |           |

```

POSTURESIT
POSTURESTAN
FH123YES
FH123YESYES 0.206
TIR          0.013    0.013

```

```

me_model2 <- lmer(SYS ~ time + time2 + DAY + HRT + MNACT5 + POSTURE + FH123 + TIR + (1 | SNUM)
              data = data)

```

Warning: Some predictor variables are on very different scales: consider rescaling

```

print(summary(me_model2))

```

Linear mixed model fit by REML ['lmerMod']

Formula: SYS ~ time + time2 + DAY + HRT + MNACT5 + POSTURE + FH123 + TIR +  
 (1 | SNUM)  
 Data: data

REML criterion at convergence: 62900.6

Scaled residuals:

| Min     | 1Q      | Median  | 3Q     | Max    |
|---------|---------|---------|--------|--------|
| -5.0284 | -0.5536 | -0.0421 | 0.5222 | 6.4754 |

Random effects:

| Groups | Name        | Variance | Std.Dev. |
|--------|-------------|----------|----------|
| SNUM   | (Intercept) | 59.22    | 7.696    |
|        | Residual    | 156.93   | 12.527   |

Number of obs: 7899, groups: SNUM, 183

Fixed effects:

|                | Estimate   | Std. Error | t value |
|----------------|------------|------------|---------|
| (Intercept)    | 1.058e+02  | 3.718e+00  | 28.444  |
| time           | -7.939e-03 | 4.005e-03  | -1.982  |
| time2          | 4.607e-06  | 2.259e-06  | 2.039   |
| DAYW           | 2.510e+00  | 1.185e+00  | 2.118   |
| HRT            | 1.050e-01  | 1.568e-02  | 6.696   |
| MNACT5         | 3.354e-02  | 2.672e-03  | 12.553  |
| POSTURERECLINE | -4.070e+00 | 3.013e+00  | -1.351  |
| POSTURESIT     | -2.372e-01 | 2.952e+00  | -0.080  |

|              |            |           |        |
|--------------|------------|-----------|--------|
| POSTURESTAND | 6.012e-02  | 2.952e+00 | 0.020  |
| FH123YES     | -3.328e-03 | 1.252e+00 | -0.003 |
| FH123YESYES  | 7.183e+00  | 2.337e+00 | 3.074  |
| TIR          | -3.831e-01 | 1.872e-01 | -2.046 |

Correlation of Fixed Effects:

|             | (Intr) | time   | time2  | DAYW   | HRT    | MNACT5 | POSTURER | POSTURESIT | POSTURESTAN | FH123YES | FH123YESYES | TIR |
|-------------|--------|--------|--------|--------|--------|--------|----------|------------|-------------|----------|-------------|-----|
| time        | -0.418 |        |        |        |        |        |          |            |             |          |             |     |
| time2       | 0.409  | -0.989 |        |        |        |        |          |            |             |          |             |     |
| DAYW        | -0.168 | 0.006  | -0.003 |        |        |        |          |            |             |          |             |     |
| HRT         | -0.254 | -0.124 | 0.115  | -0.003 |        |        |          |            |             |          |             |     |
| MNACT5      | -0.078 | -0.017 | 0.029  | -0.008 | -0.188 |        |          |            |             |          |             |     |
| POSTURERECL | -0.799 | 0.018  | -0.024 | 0.007  | 0.020  | 0.082  |          |            |             |          |             |     |
| POSTURESIT  | -0.797 | 0.004  | -0.006 | 0.004  | 0.008  | 0.012  | 0.975    |            |             |          |             |     |
| POSTURESTAN | -0.785 | 0.004  | -0.004 | 0.001  | -0.023 | -0.005 | 0.971    | 0.994      |             |          |             |     |
| FH123YES    | -0.127 | -0.002 | 0.002  | -0.061 | 0.019  | 0.000  | 0.000    | 0.000      |             |          |             |     |
| FH123YESYES | -0.079 | 0.000  | -0.001 | 0.033  | 0.008  | 0.005  | 0.001    | -0.001     |             |          |             |     |
| TIR         | -0.169 | 0.166  | -0.223 | -0.046 | 0.046  | -0.002 | 0.012    | 0.025      |             |          |             |     |
|             |        |        |        |        |        |        |          |            |             |          |             |     |

|             |       |       |       |
|-------------|-------|-------|-------|
| time        |       |       |       |
| time2       |       |       |       |
| DAYW        |       |       |       |
| HRT         |       |       |       |
| MNACT5      |       |       |       |
| POSTURERECL |       |       |       |
| POSTURESIT  |       |       |       |
| POSTURESTAN |       |       |       |
| FH123YES    | 0.000 |       |       |
| FH123YESYES | 0.000 | 0.206 |       |
| TIR         | 0.024 | 0.013 | 0.013 |

fit warnings:

Some predictor variables are on very different scales: consider rescaling

## table

#summary table

| Variable | Min | Max | Mean  | Median |
|----------|-----|-----|-------|--------|
| SYS      | 75  | 200 | 118.2 | 117    |
| DIA      | 40  | 120 | 71.4  | 71     |
| HRT      | 35  | 144 | 80.0  | 80     |

| Variable | Min | Max   | Mean  | Median |
|----------|-----|-------|-------|--------|
| MNACT5   | 0   | 359.4 | 190.4 | 207    |
| STR      | 1   | 5     | 1.5   | 1      |
| HAP      | 1   | 5     | 3.1   | 3      |
| TIR      | 1   | 5     | 2.0   | 2      |
| AGE      | 24  | 50    | 37.8  | 38     |

## distribution table

| Variable | Category         | Count | Percentage |
|----------|------------------|-------|------------|
| PHASE    | L (luteal)       | 4,836 | 50.5%      |
|          | F (follicular)   | 4,737 | 49.5%      |
| DAY      | W (workday)      | 5,457 | 57.0%      |
|          | NW (non-workday) | 4,116 | 43.0%      |
| POSTURE  | SIT              | 4,101 | 45.6%      |
|          | STAND            | 4,255 | 47.3%      |
|          | RECLINE          | 631   | 7.0%       |
| FH123    | NO               | 5,298 | 55.3%      |
|          | YES              | 3,633 | 38.0%      |
|          | YESYES           | 642   | 6.7%       |

#Family history table by nurse

| Family History                     | Mean SYS | Count | SE   |
|------------------------------------|----------|-------|------|
| NO (no hypertensive parents)       | 117.6    | 112   | 0.79 |
| YES (one hypertensive parent)      | 117.6    | 77    | 0.96 |
| YESYES (both parents hypertensive) | 125.7    | 14    | 2.40 |



## Model 1 vs Model 3 Fixed Effects Between Models

**Table 1: Comparison of Fixed Effects Between Models**

| Variable            | Model1<br>(with DIA) |                | Model2<br>(without DIA) |                |
|---------------------|----------------------|----------------|-------------------------|----------------|
|                     | <b>Estimate (SE)</b> | <b>p-value</b> | <b>Estimate (SE)</b>    | <b>p-value</b> |
| Intercept           | 72.86 (4.21)         | <0.001***      | 99.48 (4.87)            | <0.001***      |
| AGE                 | -0.031 (0.074)       | 0.679          | 0.070 (0.092)           | 0.447          |
| DIA                 | 0.492 (0.012)        | <0.001***      | —                       | —              |
| FH123-YES           | -0.729 (1.015)       | 0.474          | -0.787 (1.265)          | 0.534          |
| FH123-<br>YESYES    | 4.548 (1.921)        | 0.019*         | 7.108 (2.391)           | 0.003**        |
| HRT                 | 0.040 (0.014)        | 0.006**        | 0.099 (0.016)           | <0.001***      |
| MNACT5              | 0.032 (0.002)        | <0.001***      | 0.033 (0.003)           | <0.001***      |
| STR2                | 0.217 (0.359)        | 0.606          | 0.512 (0.396)           | 0.196          |
| STR3                | -0.543 (0.579)       | 0.938          | -0.293 (0.640)          | 0.646          |
| STR4                | 1.224 (0.970)        | 0.262          | 2.044 (1.069)           | 0.056          |
| STR5                | 0.591 (1.681)        | 0.725          | 3.004 (1.850)           | 0.105          |
| TIR                 | -0.059 (0.185)       | 0.749          | -0.319 (0.208)          | 0.126          |
| DAYW                | 1.166 (0.960)        | 0.226          | 2.703 (1.194)           | 0.025*         |
| PHASEL              | 0.666 (0.959)        | 0.489          | 0.412 (1.195)           | 0.731          |
| POSTURE-<br>RECLINE | 0.574 (2.731)        | 0.833          | -3.629 (2.999)          | 0.226          |
| POSTURE-SIT         | 1.158 (2.670)        | 0.665          | 0.133 (2.932)           | 0.964          |
| POSTURE-<br>STAND   | 1.186 (2.669)        | 0.657          | 0.512 (2.931)           | 0.861          |
| time                | 0.192 (0.200)        | 0.338          | 0.063 (0.244)           | 0.796          |
| time <sup>2</sup>   | 0.137 (0.152)        | 0.367          | 0.354 (0.168)           | 0.035*         |

# Random effect model 1 vs model 3 Random Effects Components

**Table 2: Random Effects Components**

| Random Effect | Model1<br>(with DIA) |       | Model2<br>(without DIA) |       |
|---------------|----------------------|-------|-------------------------|-------|
|               | Variance             | SD    | Variance                | SD    |
| Intercept     | 38.78                | 6.23  | 61.04                   | 7.81  |
| time slope    | 3.20                 | 1.79  | 5.80                    | 2.41  |
| Residual      | 126.04               | 11.23 | 151.32                  | 12.30 |
| Correlation   | 0.25                 | —     | 0.21                    | —     |