Case_Study_2_Bellabeat

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R Markdown

1 Load necessary packages

```
library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1 ──
```

```
## ✓ ggplot2 3.3.6     ✓ purrr   0.3.4
## ✓ tibble  3.1.7     ✓ dplyr   1.0.9
## ✓ tidyr   1.2.0     ✓ stringr 1.4.0
## ✓ readr   2.1.2     ✓ forcats 0.5.1
```

```
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✕ dplyr::filter() masks stats::filter()
## ✕ dplyr::lag()    masks stats::lag()
```

```
library(readr)
library(janitor)
```

```
##
## Attaching package: 'janitor'
```

```
## The following objects are masked from 'package:stats':
##
##     chisq.test, fisher.test
```

```
library(dplyr)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

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

2 Load data

```
setwd("Dataset_Bellabeat")

weight_log <- read.csv("weightLogInfo_merged.csv")
sleep_day <- read.csv("sleepDay_merged.csv")
minute_steps_wide <- read.csv("minuteStepsWide_merged.csv")
minute_steps_narrow <- read.csv("minuteStepsNarrow_merged.csv")
minute_sleep <- read.csv("minuteSleep_merged.csv")
minute_METs_narrow <- read.csv("minuteMETsNarrow_merged.csv")
minute_intensities_wide <- read.csv("minuteIntensitiesWide_merged.csv")
minute_intensities_narrow <- read.csv("minuteIntensitiesNarrow_merged.csv")
minute_calories_wide <- read.csv("minuteCaloriesWide_merged.csv")
minute_calories_narrow <- read.csv("minuteCaloriesNarrow_merged.csv")
hourly_steps <- read.csv("hourlySteps_merged.csv")
hourly_intensities <- read.csv("hourlyIntensities_merged.csv")
hourly_calories <- read.csv("hourlyCalories_merged.csv")
heartrate_seconds <- read.csv("heartrate_seconds_merged.csv")
daily_steps <- read.csv("dailySteps_merged.csv")
daily_intensities <- read.csv("dailyIntensities_merged.csv")
daily_calories <- read.csv("dailyCalories_merged.csv")
daily_activity <- read.csv("dailyActivity_merged.csv")
```

3 The sqldf package is loaded to use SQL syntax to determine if the values of daily_calories, daily_intensities, and daily_steps are contained in daily_activity.

```
library(sqldf)
```

```
## Loading required package: gsubfn
```

```
## Loading required package: proto
```

```
## Loading required package: RSQLite
```

```
check1_daily_activity <- daily_activity %>% select (Id,ActivityDate,Calories)
head(check1_daily_activity)
```

```
##           Id ActivityDate Calories
## 1 1503960366    4/12/2016     1985
## 2 1503960366    4/13/2016     1797
## 3 1503960366    4/14/2016     1776
## 4 1503960366    4/15/2016     1745
## 5 1503960366    4/16/2016     1863
## 6 1503960366    4/17/2016     1728
```

```
sql_check_calories <- sqldf('SELECT * FROM daily_calories INTERSECT SELECT * FROM daily_calor
ies')
head(sql_check_calories)
```

```
##           Id ActivityDay Calories
## 1 1503960366   4/12/2016     1985
## 2 1503960366   4/13/2016     1797
## 3 1503960366   4/14/2016     1776
## 4 1503960366   4/15/2016     1745
## 5 1503960366   4/16/2016     1863
## 6 1503960366   4/17/2016     1728
```

```
check2_daily_activity <- daily_activity %>% select (Id,ActivityDate,TotalSteps)
head(check2_daily_activity)
```

```
##           Id ActivityDate TotalSteps
## 1 1503960366    4/12/2016      13162
## 2 1503960366    4/13/2016      10735
## 3 1503960366    4/14/2016      10460
## 4 1503960366    4/15/2016       9762
## 5 1503960366    4/16/2016      12669
## 6 1503960366    4/17/2016       9705
```

```
sql_check_steps <- sqldf('SELECT * FROM daily_steps INTERSECT SELECT * FROM daily_steps')
head(sql_check_steps)
```

```
##           Id ActivityDay StepTotal
## 1 1503960366   4/12/2016     13162
## 2 1503960366   4/13/2016     10735
## 3 1503960366   4/14/2016     10460
## 4 1503960366   4/15/2016      9762
## 5 1503960366   4/16/2016     12669
## 6 1503960366   4/17/2016      9705
```

-> Use data from daily_activity to analyse calories, intensities and steps in place of 3 other dfs

4 Check number of participants for each log

```
library(dplyr)
n_distinct(daily_activity$Id)
```

```
## [1] 33
```

```
n_distinct(weight_log$Id)
```

```
## [1] 8
```

```
n_distinct(sleep_day$Id)
```

```
## [1] 24
```

```
n_distinct(minute_steps_wide$Id)
```

```
## [1] 33
```

```
n_distinct(minute_steps_narrow$Id)
```

```
## [1] 33
```

```
n_distinct(minute_sleep$Id)
```

```
## [1] 24
```

```
n_distinct(minute_METs_narrow$Id)
```

```
## [1] 33
```

```
n_distinct(minute_intensities_wide$Id)
```

```
## [1] 33
```

```
n_distinct(minute_intensities_narrow$Id)
```

```
## [1] 33
```

```
n_distinct(heartrate_seconds$Id)
```

```
## [1] 14
```

-> Users mainly use their device to track steps, calories, and sleep. Tracking weight_log and heartrate_seconds have low number of participants so it’s not very reliable for analysis

5 The summary() function is used to pull key statistics about the data frames.

```
daily_activity %>%select(TotalSteps,    TotalDistance,  VeryActiveDistance, ModeratelyActiveD
istance,   LightActiveDistance,    SedentaryActiveDistance,    VeryActiveMinutes,FairlyActive
Minutes,LightlyActiveMinutes,SedentaryMinutes,Calories
) %>%
  summary()
```

```
##    TotalSteps    TotalDistance    VeryActiveDistance ModeratelyActiveDistance
##  Min.   :    0   Min.   : 0.000   Min.   : 0.000     Min.   :0.0000          
##  1st Qu.: 3790   1st Qu.: 2.620   1st Qu.: 0.000     1st Qu.:0.0000          
##  Median : 7406   Median : 5.245   Median : 0.210     Median :0.2400          
##  Mean   : 7638   Mean   : 5.490   Mean   : 1.503     Mean   :0.5675          
##  3rd Qu.:10727   3rd Qu.: 7.713   3rd Qu.: 2.053     3rd Qu.:0.8000          
##  Max.   :36019   Max.   :28.030   Max.   :21.920     Max.   :6.4800          
##  LightActiveDistance SedentaryActiveDistance VeryActiveMinutes
##  Min.   : 0.000      Min.   :0.000000        Min.   :  0.00   
##  1st Qu.: 1.945      1st Qu.:0.000000        1st Qu.:  0.00   
##  Median : 3.365      Median :0.000000        Median :  4.00   
##  Mean   : 3.341      Mean   :0.001606        Mean   : 21.16   
##  3rd Qu.: 4.782      3rd Qu.:0.000000        3rd Qu.: 32.00   
##  Max.   :10.710      Max.   :0.110000        Max.   :210.00   
##  FairlyActiveMinutes LightlyActiveMinutes SedentaryMinutes    Calories   
##  Min.   :  0.00      Min.   :  0.0        Min.   :   0.0   Min.   :   0  
##  1st Qu.:  0.00      1st Qu.:127.0        1st Qu.: 729.8   1st Qu.:1828  
##  Median :  6.00      Median :199.0        Median :1057.5   Median :2134  
##  Mean   : 13.56      Mean   :192.8        Mean   : 991.2   Mean   :2304  
##  3rd Qu.: 19.00      3rd Qu.:264.0        3rd Qu.:1229.5   3rd Qu.:2793  
##  Max.   :143.00      Max.   :518.0        Max.   :1440.0   Max.   :4900  
```

-> Average steps: 7638, Average distance: 5490, Sedentary minutes: 991.2, Calories: 2304, VeryActiveMinutes: 21.16

```
minute_METs_narrow %>% select(METs) %>% summary()
```

```
##       METs       
##  Min.   :  0.00  
##  1st Qu.: 10.00  
##  Median : 10.00  
##  Mean   : 14.69  
##  3rd Qu.: 11.00  
##  Max.   :157.00  
```

Average MET: 14.69

```
sleep_day %>% select(TotalMinutesAsleep,    TotalTimeInBed) %>% summary()
```

```
##  TotalMinutesAsleep TotalTimeInBed 
##  Min.   : 58.0      Min.   : 61.0  
##  1st Qu.:361.0      1st Qu.:403.0  
##  Median :433.0      Median :463.0  
##  Mean   :419.5      Mean   :458.6  
##  3rd Qu.:490.0      3rd Qu.:526.0  
##  Max.   :796.0      Max.   :961.0  
```

Average TotalMinutesAsleep: 419.5, Average TotalTimeInBed:458.6

```
heartrate_seconds %>% select(Value) %>% summary()
```

```
##      Value       
##  Min.   : 36.00  
##  1st Qu.: 63.00  
##  Median : 73.00  
##  Mean   : 77.33  
##  3rd Qu.: 88.00  
##  Max.   :203.00  
```

Average: 77.33

```
weight_log %>% select(WeightKg,WeightPounds,BMI) %>%  summary ()
```

```
##     WeightKg       WeightPounds        BMI       
##  Min.   : 52.60   Min.   :116.0   Min.   :21.45  
##  1st Qu.: 61.40   1st Qu.:135.4   1st Qu.:23.96  
##  Median : 62.50   Median :137.8   Median :24.39  
##  Mean   : 72.04   Mean   :158.8   Mean   :25.19  
##  3rd Qu.: 85.05   3rd Qu.:187.5   3rd Qu.:25.56  
##  Max.   :133.50   Max.   :294.3   Max.   :47.54  
```

Average Weight(kg) : 72.04 Average Weight(pounds) :158.8 Average BMI :25.19

6 show level of activeness

6.1 Calculate total minutes across different activity levels

```
daily_activity <- daily_activity %>%
  mutate(TotalActiveMinutes = VeryActiveMinutes + FairlyActiveMinutes +
           LightlyActiveMinutes + SedentaryMinutes)
```

6.2 Calculate dailyActivityRatio

```
dailyActivityRatio <- daily_activity %>%
  summarise(sedentary=mean(SedentaryMinutes/TotalActiveMinutes),
            lightlyActive=mean(LightlyActiveMinutes/TotalActiveMinutes),
            fairlyActive=mean(FairlyActiveMinutes/TotalActiveMinutes),
            veryActive=mean(VeryActiveMinutes/TotalActiveMinutes)) %>%
  summarise(sedentary = round(sedentary*100,2), lightlyActive = round(lightlyActive*100,2), fairlyActive = round(fairlyActive*100,2), veryActive=round(veryActive*100,2))
```

6.3 create donut chart using plot_ly() function

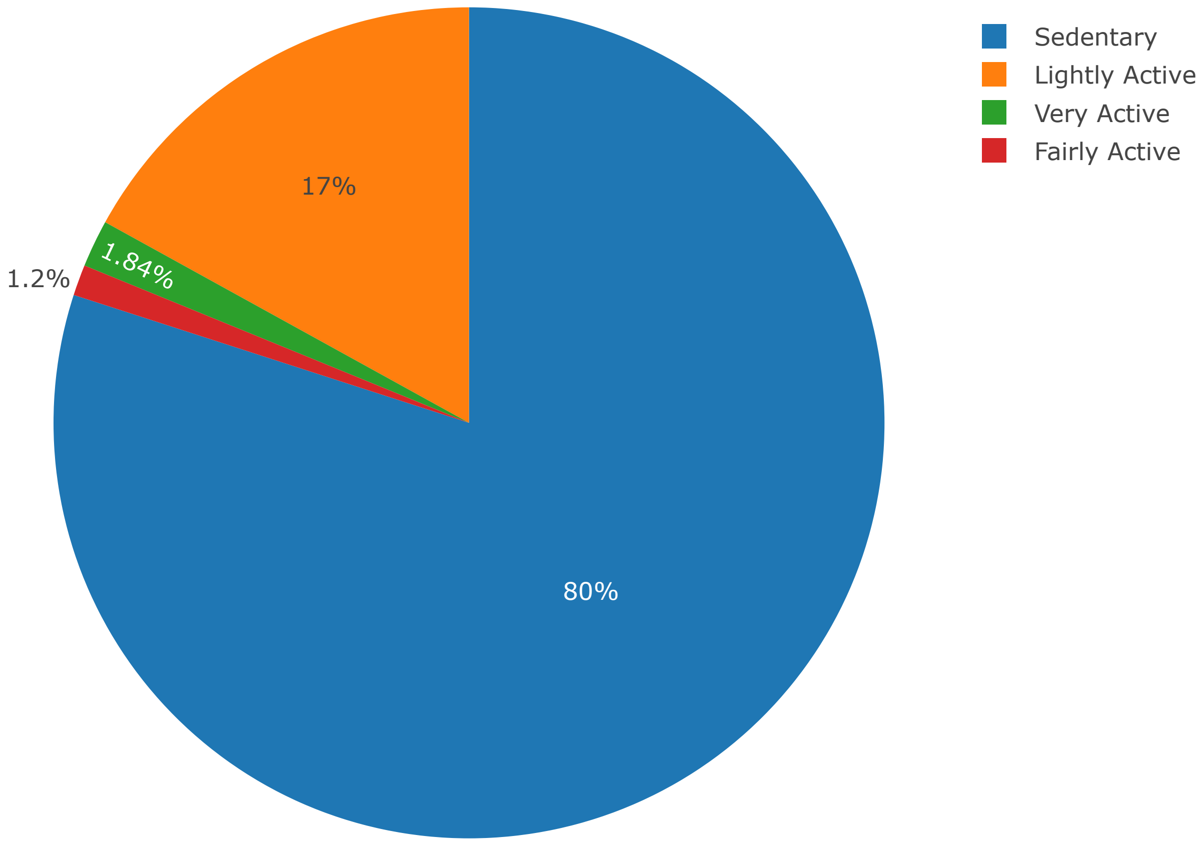
```
# load library plotly
library(plotly)
```

```
## 
## Attaching package: 'plotly'
```

```
## The following object is masked from 'package:ggplot2':
## 
##     last_plot
## The following object is masked from 'package:stats':
##
##     filter
```

```
## The following object is masked from 'package:graphics':
##
##     layout
```

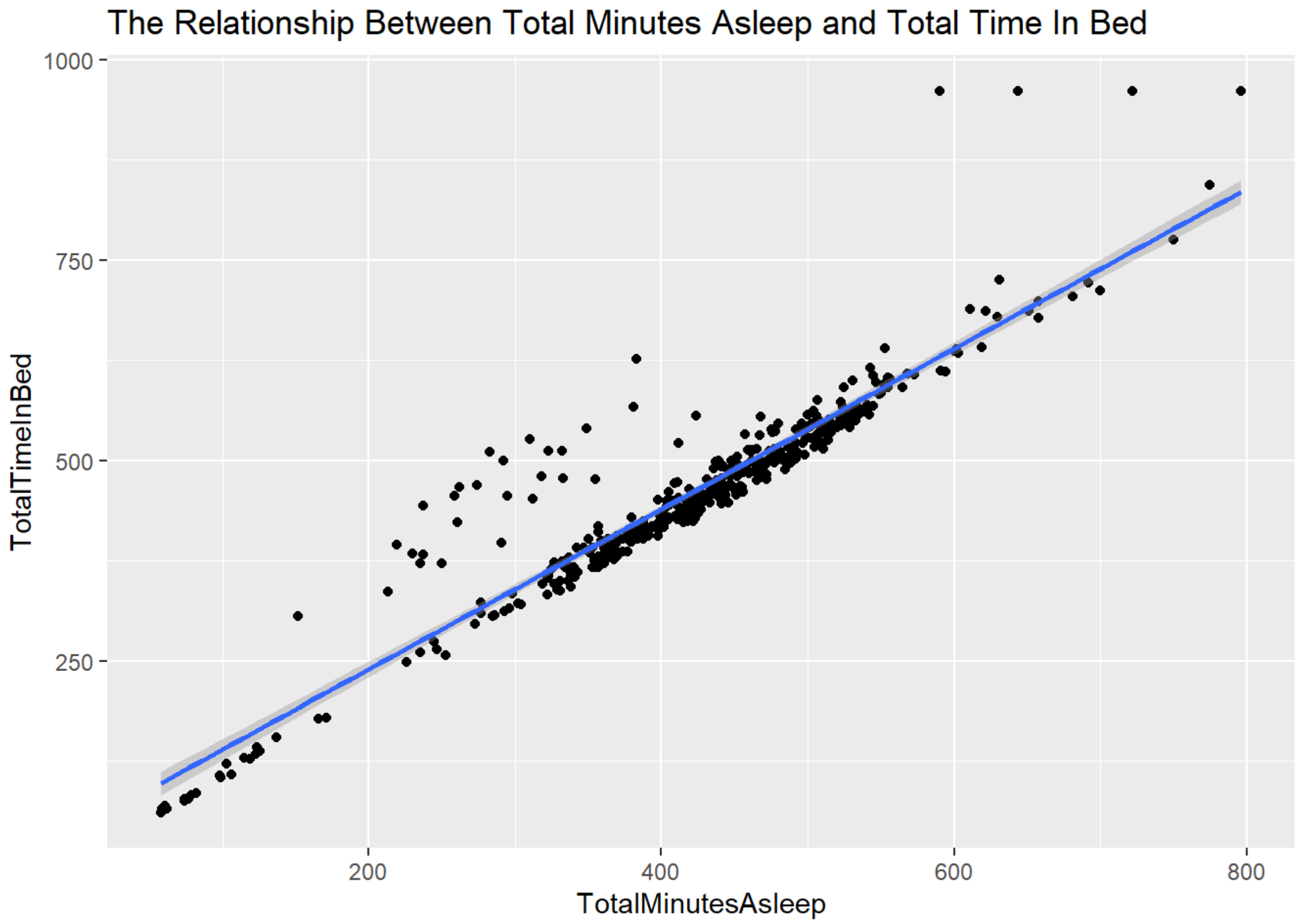
```
pie_dailyActivityRatio <- data.frame(group= c('Sedentary','Lightly Active', 'Fairly Active',
                                              'Very Active'),
                                     value= c(79.98,
                                              16.98,
                                              1.2,
                                              1.84))
plot_ly(pie_dailyActivityRatio) %>%
  add_pie(pie_dailyActivityRatio, labels = ~`group`, values = ~`value`)
```



7 Visualize relationship between total Minutes Asleep and Total time in bed

```
ggplot(sleep_day, aes(x=TotalMinutesAsleep, y =TotalTimeInBed)) + geom_point() + stat_smooth
(method=lm) + labs(title ="The Relationship Between Total Minutes Asleep and Total Time In Be
d")
```

```
## `geom_smooth()` using formula 'y ~ x'
```

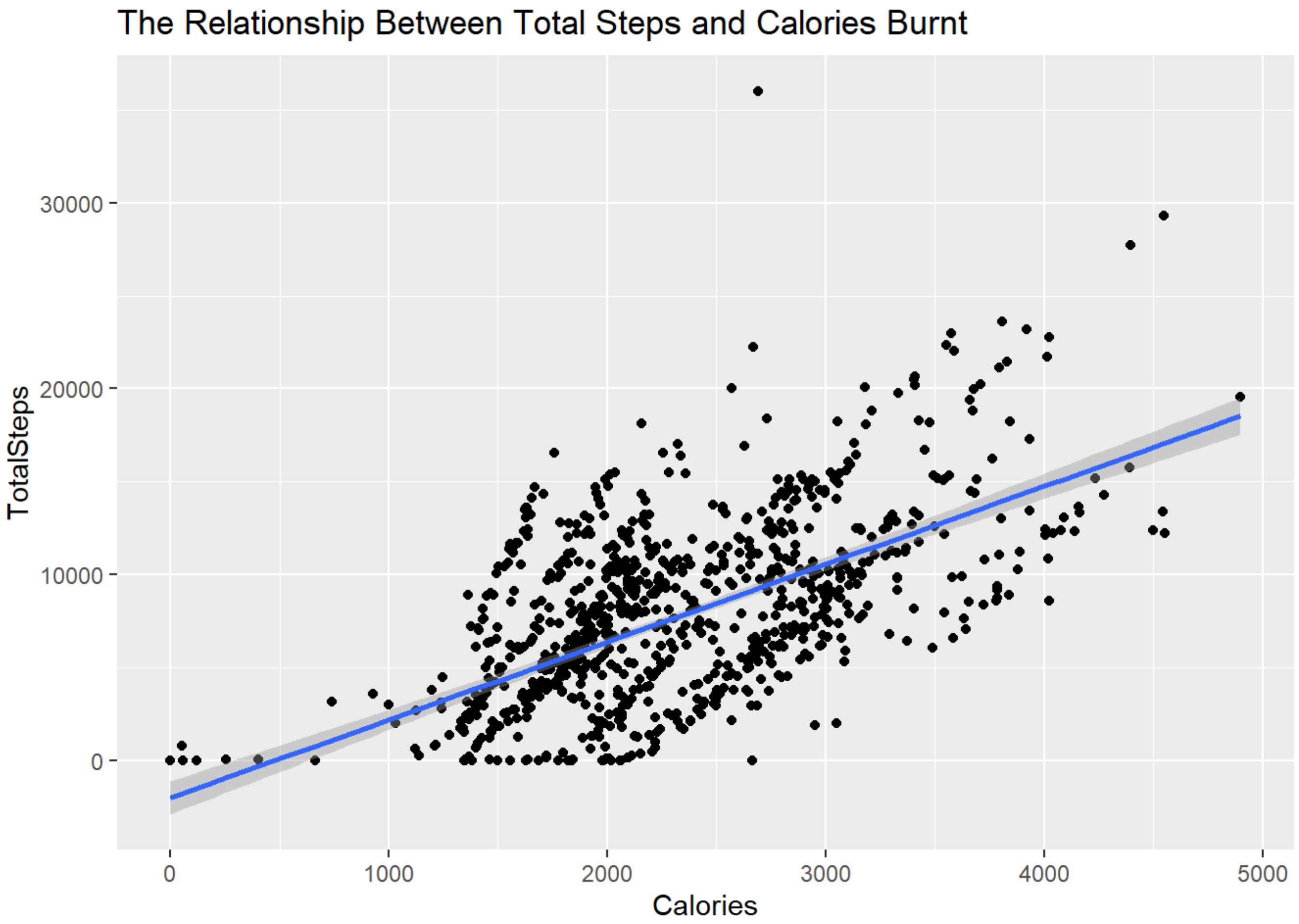


##### -> There is a clear similarity between the time participants spent asleep and the time they spent in bed.

8 Visualize relationship between total steps and Total calories burnt

```
ggplot(daily_activity, aes(x=Calories, y =TotalSteps)) + geom_point() + stat_smooth(method=l
m) + labs(title ="The Relationship Between Total Steps and Calories Burnt")
```

```
## `geom_smooth()` using formula 'y ~ x'
```



##### -> The more steps they take, the more calories they burn

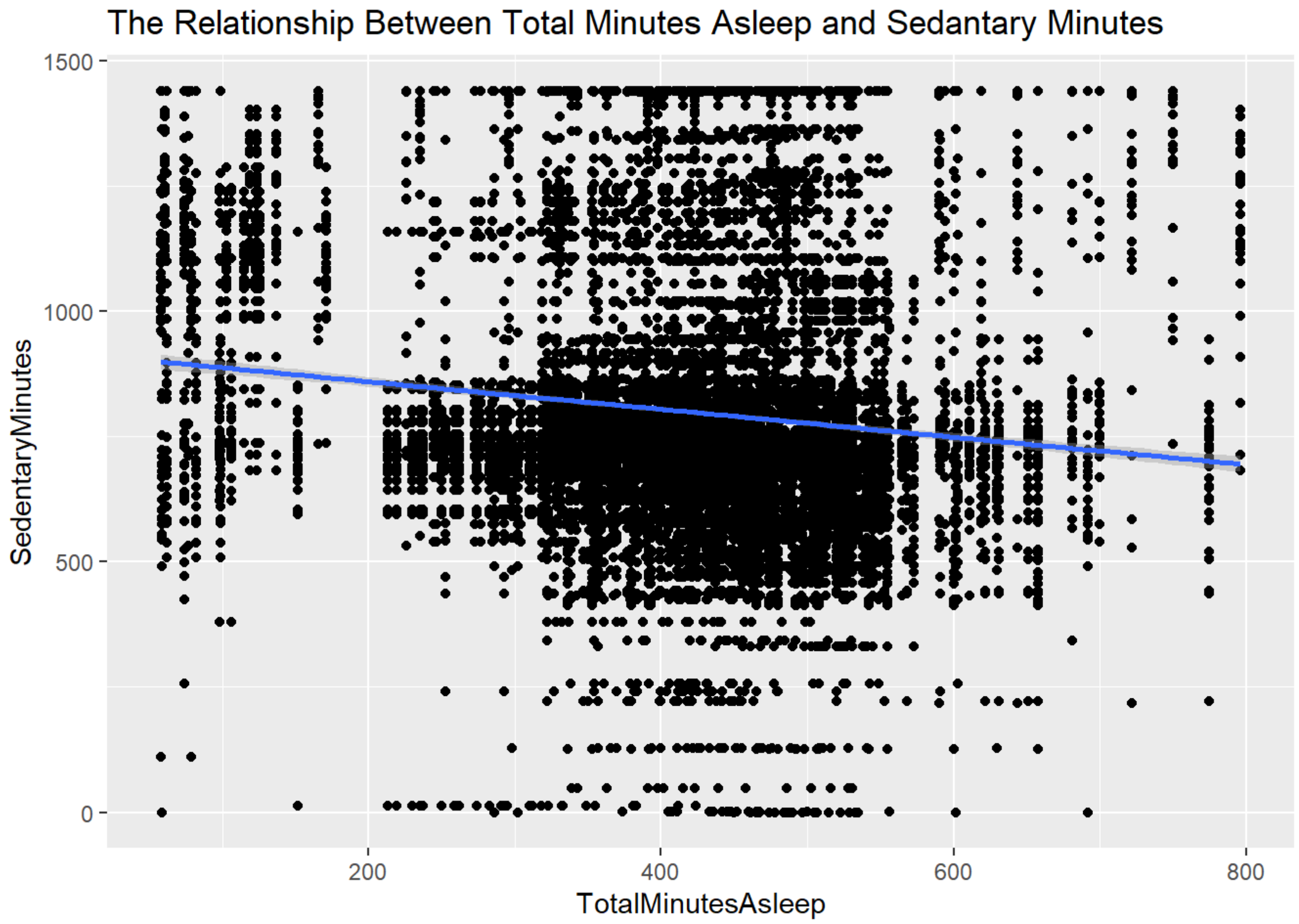
9. Visualize relationship between total Minutes Asleep and sedantaryminutes

```
merged_data <- merge(daily_activity, sleep_day,by = "Id", all.x = TRUE, all.y=TRUE)
ggplot(merged_data, aes(x=TotalMinutesAsleep, y =SedentaryMinutes)) + geom_point() + stat_smo
oth(method=lm) + labs(title ="The Relationship Between Total Minutes Asleep and Sedantary Min
utes")
```

```
## `geom_smooth()` using formula 'y ~ x'
```

```
## Warning: Removed 227 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 227 rows containing missing values (geom_point).
```



##### -> The more sedentary minutes they have, the less sleep they have ### 10 The relationship between good BMI and active level # Filter the participants with good BMI

```
  average_BMI_df <- weight_log %>%  filter( BMI > 18.5 & BMI < 24.9)
merged_data_2 <- merge(daily_activity, average_BMI_df,by = "Id", all.x = TRUE, all.y=TRUE)
merged_data_2 %>% select(VeryActiveMinutes, TotalSteps) %>% summary()
```

```
##  VeryActiveMinutes   TotalSteps
##  Min.   :  0.00    Min.   :    0
##  1st Qu.:  0.00    1st Qu.: 5454
##  Median : 13.00    Median : 9799
##  Mean   : 22.11    Mean   : 8730
##  3rd Qu.: 36.00    3rd Qu.:11835
##  Max.   :210.00    Max.   :36019
```

-> On average, People with good BMI tend to walk more and be more active

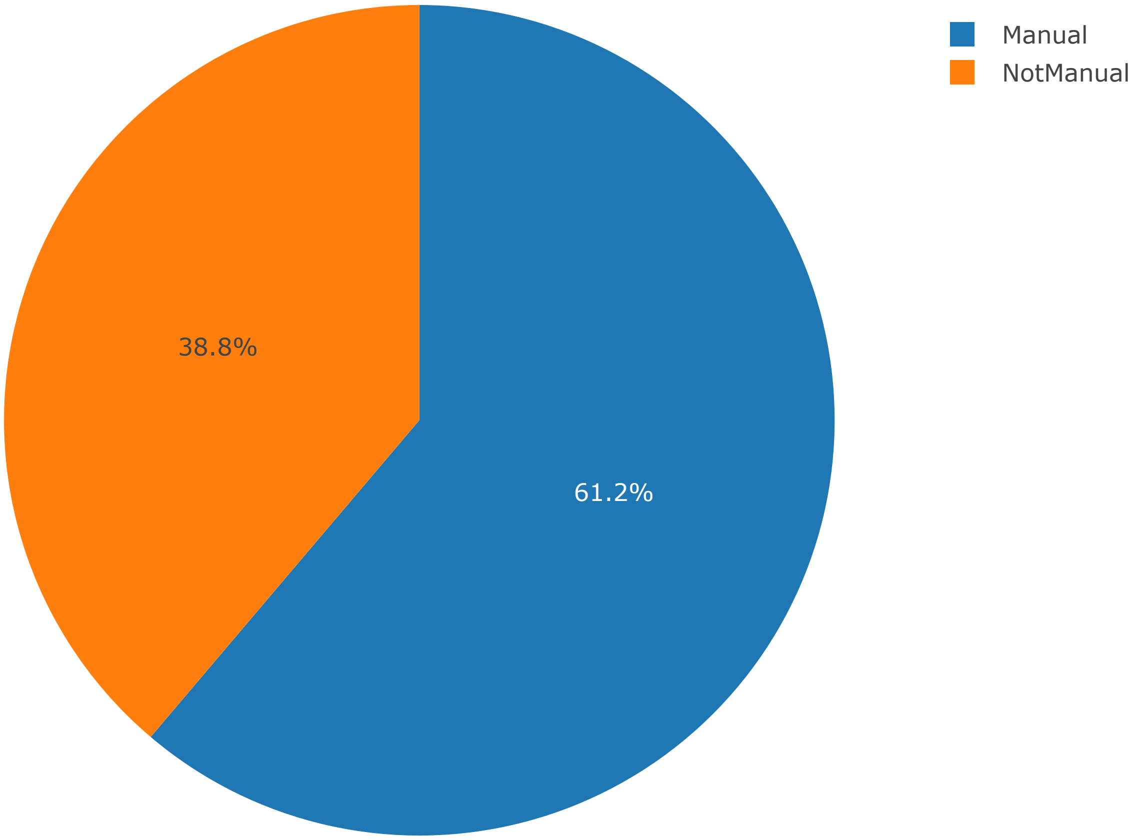
11 Check how many weight logs are mannually reported

```
weight_log %>% count(IsManualReport)
```

```
##   IsManualReport  n
## 1          False 26
## 2           True 41
```

Visualize data

```
pie_weight_log <- data.frame(group= c('Manual','NotManual'),
                             value= c(41, 26))
plot_ly(pie_weight_log) %>%
  add_pie(pie_weight_log, labels = ~`group`, values = ~`value`)
```



-> 61.2% weight data is mannually reported, which may explain the low participation rate

12 Recommendations

(1). Connect weight_log function with electric scales to reduce the need for manual log

(2). Add Reminders for users to be more active

(3). In-app articles about healthy BMI level, activity level, healthy sleep pattern

(4). Enable goals setting and remind users to reach their goal.

(5). Enable alert notifications if user’s resting heart rate varies significantly from their normal.

(6). Enable notifications to encourage activity if a user has been sedentary for an extended period of time.

(7). Enable users to make friends to track each other’s progress and send congratulations when reaching a goal