# Bellabeat

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## Introduction

This project report presents a comprehensive data analysis case study of Bellabeat, a high-tech manufacturer of health-focused products for women. The aim of this study is to perform real-world data analysis tasks and answer key business questions using the data analysis process, including asking, preparing, processing, analyzing, sharing, and acting.

## About the company Bellabeat

Bellabeat is a successful small company that specializes in manufacturing health-focused smart products for women. Founded in 2013 by Urška Sršen and Sando Mur, Bellabeat has rapidly grown to become a tech-driven wellness company. Their products collect data on various aspects of women's health and habits, such as activity, sleep, stress, and reproductive health, empowering women with knowledge about their own well-being.

## Problem Statement

Bellabeat needs to gain a deeper understanding of how women utilize their smart devices in order to refine their products, develop targeted marketing campaigns, and provide personalized recommendations. They lack comprehensive insights into user behavior, daily habits, activity levels, sleep patterns, and stress levels. By analyzing the available data, Bellabeat aims to extract meaningful insights to enhance their understanding of user behavior and improve their products, marketing strategies, and user experience.

## Questions for the Analysis

In this phase, I tried to better undestand the data and the problem I'm trying to solve. And to do that, I had to do more research and ask more questions.

1. What are the trends in smart device usage, and how can these trends influence Bellabeat's marketing strategy? This question aims to help the company target their marketing efforts based on customers' usage of fitness smart devices and provide high-level recommendations for the marketing strategy.
2. Who are the main stakeholders involved in the analysis? The main stakeholders identified are Urška Sršen (Bellabeat's co-founder and Chief Creative Officer), Sando Mur (Mathematician and Bellabeat's co-founder), and the Bellabeat marketing analytics team.

#### Downloading the data

Bellabeat provided access to public data from FitBit Fitness Tracker Data, which explores the daily habits of smart device users. The dataset includes minute-level data on physical activity, heart rate, and sleep monitoring. It was obtained from thirty Fitbit users who consented to share their personal tracker data. The dataset consists of 18 CSV files.

Here is the link to download the dataset:

- FitBit Fitness Tracker Data : https://www.kaggle.com/arashnic/fitbit.

**Loading packages**

```
install.packages("tidyverse") install.packages("lubridate")
install.packages("dplyr") install.packages("ggplot2")
install.packages("tidyr") install.packages("here")
install.packages("skimr") install.packages("janitor")
```

Loading of the packages

```
library(tidyverse) library(lubridate)
library(dplyr) library(ggplot2)
library(tidyr) library(here)
library(skimr) library(janitor)
```

**Importing dataset**

Importing of the dataset used for analysis.

- dailyActivity_merged.csv

```
Activity <- read.csv("dailyActivity_merged.csv") head(Activity)
```

```
##                                  Id ActivityDate TotalSteps TotalDistance TrackerDistance
## 1 1503960366 4/12/2016 13162 8.50 8.50 ## 2 1503960366 4/13/2016 10735 6.97
6.97 ## 3 1503960366 4/14/2016 10460 6.74 6.74 ## 4 1503960366 4/15/2016 9762 6.28
6.28 ## 5 1503960366 4/16/2016 12669 8.16 8.16 ## 6 1503960366 4/17/2016 9705 6.48
6.48
##                  LoggedActivitiesDistance VeryActiveDistance ModeratelyActiveDistance
## 1                                        0                1.88                       0.55
## 2                                        0                1.57                       0.69
## 3                                        0                2.44                       0.40
## 4                                        0                2.14                       1.26
## 5                                        0                2.71                       0.41
## 6                                        0                3.19                       0.78
##                LightActiveDistance SedentaryActiveDistance VeryActiveMinutes
## 1      6.06      0          25 ## 2  4.71      0          21 ## 3  3.91      0          30 ## 4
       2.83      0          29 ## 5  5.04      0          36


## 6                          2.51                                0                      38
##                FairlyActiveMinutes LightlyActiveMinutes SedentaryMinutes Calories
## 1 13 328 728 1985 ## 2 19 217 776 1797 ## 3 11 181 1218 1776 ## 4 34 209 726 1745 ##
5 10 221 773 1863
## 6                           20                       164                539         1728
```

```
colnames(Activity)
```

```
## [1] "Id"                                "ActivityDate"
## [3] "TotalSteps"                        "TotalDistance"
## [5] "TrackerDistance"                   "LoggedActivitiesDistance"
## [7] "VeryActiveDistance"                "ModeratelyActiveDistance"
```

```
## [9] "LightActiveDistance"                "SedentaryActiveDistance"
## [11] "VeryActiveMinutes"                 "FairlyActiveMinutes"
## [13] "LightlyActiveMinutes"              "SedentaryMinutes"
## [15] "Calories"
```

```
str(Activity)
```

```
## 'data.frame':                940 obs. of 15 variables:
## $ Id                                    : num 1.5e+09 1.5e+09 1.5e+09 1.5e+09 1.5e+09 ...
## $ ActivityDate                          : chr "4/12/2016" "4/13/2016" "4/14/2016" "4/15/2016" ...
## $ TotalSteps                            : int 13162 10735 10460 9762 12669 9705 13019 15506 10544 9819 ...
## $ TotalDistance          : num 8.5 6.97 6.74 6.28 8.16 ... ## $ TrackerDistance:
num 8.5 6.97 6.74 6.28 8.16 ...
## $ LoggedActivitiesDistance: num 0 0 0 0 0 0 0 0 0 0 ...
## $ VeryActiveDistance    : num 1.88 1.57 2.44 2.14 2.71 ... ## $
ModeratelyActiveDistance: num 0.55 0.69 0.4 1.26 0.41 ...
## $ LightActiveDistance                   : num 6.06 4.71 3.91 2.83 5.04 ...
## $ SedentaryActiveDistance : num 0 0 0 0 0 0 0 0 0 0 ...
## $ VeryActiveMinutes                     : int 25 21 30 29 36 38 42 50 28 19 ...
## $ FairlyActiveMinutes                   : int 13 19 11 34 10 20 16 31 12 8 ...
## $ LightlyActiveMinutes                  : int 328 217 181 209 221 164 233 264 205 211 ...
## $ SedentaryMinutes                      : int 728 776 1218 726 773 539 1149 775 818 838 ...
## $ Calories                              : int 1985 1797 1776 1745 1863 1728 1921 2035 1786 1775 ...
```

- dailyCalories_merged.csv

```
Calories <- read.csv("dailyCalories_merged.csv") head(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
```

```
colnames(Calories)
```

```
## [1] "Id"                 "ActivityDay" "Calories"
```

```
str(Calories)
```

```
## 'data.frame':                940 obs. of 3 variables:
## $ Id                          : num 1.5e+09 1.5e+09 1.5e+09 1.5e+09 1.5e+09 ...
## $ ActivityDay: chr "4/12/2016" "4/13/2016" "4/14/2016" "4/15/2016" ...
## $ Calories                    : int 1985 1797 1776 1745 1863 1728 1921 2035 1786 1775 ...
```

- dailyIntensities_merged.csv

```
Intensities <- read.csv("dailyIntensities_merged.csv") head(Intensities)
```

```
##                          Id ActivityDay SedentaryMinutes LightlyActiveMinutes
## 1 1503960366 4/12/2016 728 328 ## 2 1503960366 4/13/2016 776 217 ## 3
1503960366 4/14/2016 1218 181 ## 4 1503960366 4/15/2016 726 209 ## 5
1503960366 4/16/2016 773 221 ## 6 1503960366 4/17/2016 539 164 ##
FairlyActiveMinutes VeryActiveMinutes SedentaryActiveDistance
```

```
## 1      13        25        0 ## 2    19        21        0 ## 3    11        30        0 ## 4
         34        29        0 ## 5    10        36        0 ## 6    20        38        0
##              LightActiveDistance ModeratelyActiveDistance VeryActiveDistance
## 1      6.06      0.55      1.88 ## 2          4.71      0.69      1.57 ## 3          3.91
         0.40      2.44 ## 4          2.83      1.26      2.14 ## 5          5.04      0.41
         2.71
## 6                          2.51                                0.78                          3.19
```

```
colnames(Intensities)
```

```
## [1] "Id"                                    "ActivityDay"
## [3] "SedentaryMinutes"                      "LightlyActiveMinutes"
## [5] "FairlyActiveMinutes"                   "VeryActiveMinutes"
## [7] "SedentaryActiveDistance" "LightActiveDistance"
## [9] "ModeratelyActiveDistance" "VeryActiveDistance"
```

```
str(Intensities)
```

```
## 'data.frame':                  940 obs. of 10 variables:
## $ Id                                        : num 1.5e+09 1.5e+09 1.5e+09 1.5e+09 1.5e+09 ...
## $ ActivityDay                               : chr "4/12/2016" "4/13/2016" "4/14/2016" "4/15/2016" ...
## $ SedentaryMinutes                          : int 728 776 1218 726 773 539 1149 775 818 838 ...
## $ LightlyActiveMinutes                      : int 328 217 181 209 221 164 233 264 205 211 ...
## $ FairlyActiveMinutes                       : int 13 19 11 34 10 20 16 31 12 8 ...
## $ VeryActiveMinutes                         : int 25 21 30 29 36 38 42 50 28 19 ...
## $ SedentaryActiveDistance : num 0 0 0 0 0 0 0 0 0 0 ...
## $ LightActiveDistance    : num 6.06 4.71 3.91 2.83 5.04 ... ## $
ModeratelyActiveDistance: num 0.55 0.69 0.4 1.26 0.41 ...
## $ VeryActiveDistance                        : num 1.88 1.57 2.44 2.14 2.71 ...
```

- heartrate_seconds_merged.csv

```
Heartrate <- read.csv("heartrate_seconds_merged.csv") head(Heartrate)
```

```
##          Id          Time Value ## 1 2022484408
4/12/2016 7:21:00 AM      97 ## 2 2022484408
4/12/2016 7:21:05 AM      102 ## 3 2022484408
4/12/2016 7:21:10 AM      105 ## 4 2022484408
4/12/2016 7:21:20 AM      103 ## 5 2022484408
4/12/2016 7:21:25 AM      101 ## 6 2022484408
4/12/2016 7:22:05 AM      95
```

```
colnames(Heartrate)
```

```
## [1] "Id"                "Time" "Value"
```

```
str(Heartrate)
```

```
## 'data.frame':                  2483658 obs. of 3 variables:
## $ Id                    : num 2.02e+09 2.02e+09 2.02e+09 2.02e+09 2.02e+09 ...
## $ Time : chr "4/12/2016 7:21:00 AM" "4/12/2016 7:21:05 AM" "4/12/2016 7:21:10 AM" "4/12/2016 7:21:2 ## $ Value: int 97 102
105 103 101 95 91 93 94 93 ...
```

- sleepDay_merged.csv

```
Sleep <- read.csv("sleepDay_merged.csv") head(Sleep)
```

```
##          Id          SleepDay TotalSleepRecords TotalMinutesAsleep ## 1 1503960366 4/12/2016
12:00:00 AM        1           327 ## 2 1503960366 4/13/2016 12:00:00 AM           2           384 ## 3
1503960366 4/15/2016 12:00:00 AM           1           412 ## 4 1503960366 4/16/2016 12:00:00
AM        2           340 ## 5 1503960366 4/17/2016 12:00:00 AM           1           700
## 6 1503960366 4/19/2016 12:00:00 AM                                      1                       304
##         TotalTimeInBed
## 1        346 ## 2 407 ## 3
            442 ## 4 367 ## 5
            712 ## 6 320
colnames(Sleep)
```

```
## [1] "Id"                 "SleepDay"           "TotalSleepRecords"
## [4] "TotalMinutesAsleep" "TotalTimeInBed"
```

```
str(Sleep)
```

```
## 'data.frame':                413 obs. of 5 variables:
## $ Id                       : num 1.5e+09 1.5e+09 1.5e+09 1.5e+09 1.5e+09 ...
## $ SleepDay      : chr "4/12/2016 12:00:00 AM" "4/13/2016 12:00:00 AM" "4/15/2016 12:00:00 AM" " ## $ TotalSleepRecords : int 1
2 1 2 1 1 1 1 1 1 ...
## $ TotalMinutesAsleep: int 327 384 412 340 700 304 360 325 361 430 ... ## $ TotalTimeInBed
            : int 346 407 442 367 712 320 377 364 384 449 ...
```

- weightLogInfo_merged.csv

```
Weight <- read.csv("weightLogInfo_merged.csv") head(Weight)
```

```
##                    Id                                 Date WeightKg WeightPounds Fat          BMI
## 1 1503960366 5/2/2016 11:59:59 PM       52.6        115.9631 22 22.65 ## 2 1503960366
5/3/2016 11:59:59 PM       52.6        115.9631 NA 22.65 ## 3 1927972279 4/13/2016
1:08:52 AM          133.5      294.3171 NA 47.54 ## 4 2873212765 4/21/2016 11:59:59 PM
            56.7        125.0021 NA 21.45 ## 5 2873212765 5/12/2016 11:59:59 PM 57.3
            126.3249 NA 21.69
## 6 4319703577 4/17/2016 11:59:59 PM                    72.4               159.6147 25 27.45
##          IsManualReport   LogId ## 1
            True 1.462234e+12 ## 2    True
1.462320e+12 ## 3           False
1.460510e+12 ## 4           True
1.461283e+12 ## 5           True
1.463098e+12 ## 6           True
1.460938e+12
colnames(Weight)
```

```
## [1] "Id"                 "Date"               "WeightKg"           "WeightPounds"
## [5] "Fat"                "BMI"                "IsManualReport" "LogId"
```

```
str(Weight)
```

```
## 'data.frame':                67 obs. of 8 variables:
## $ Id                         : num 1.50e+09 1.50e+09 1.93e+09 2.87e+09 2.87e+09 ...
## $ Date            : chr "5/2/2016 11:59:59 PM" "5/3/2016 11:59:59 PM" "4/13/2016 1:08:52 AM" "4/21/20 ## $ WeightKg   : num
52.6 52.6 133.5 56.7 57.3 ...
## $ WeightPounds : num 116 116 294 125 126 ...
```

```
## $ Fat                      : int 22 NA NA NA NA 25 NA NA NA NA ...
## $ BMI                      : num 22.6 22.6 47.5 21.5 21.7 ...
## $ IsManualReport: chr "True" "True" "False" "True" ...
## $ LogId                    : num 1.46e+12 1.46e+12 1.46e+12 1.46e+12 1.46e+12 ...
```

## Cleaning the dataset

**Basics cleaning:**

I processed, cleaned, and organized the dataset for analysis. I used functions like glimpse() and skim_without_charts to review the data quickly. The data names were cleaned using clean_names(). Cleaning steps included identifying and removing duplicates in the Sleep data, and removing a column with many missing values in the Weight data. Overall, the data was checked for errors, formatted properly, and prepared for further analysis.

**Fixing formatting**

I spotted some problems with the timestamp data. So I have to convert it to date time format and split to date and time.

```
# Activity
Activity$ActivityDate=as.POSIXct(Activity$ActivityDate, format="%m/%d/%Y", tz=Sys.timezone()) Activity$date <-
format(Activity$ActivityDate, format = "%m/%d/%y")
Activity$ActivityDate=as.Date(Activity$ActivityDate, format="%m/%d/%Y", tz=Sys.timezone())
Activity$date=as.Date(Activity$date, format="%m/%d/%Y")


# Intensities Intensities$ActivityDay=as.Date(Intensities$ActivityDay, format="%m/%d/%Y", tz=Sys.timezone())


# Sleep
Sleep$SleepDay=as.POSIXct(Sleep$SleepDay, format="%m/%d/%Y %I:%M:%S %p", tz=Sys.timezone())
Sleep$date <- format(Sleep$SleepDay, format = "%m/%d/%y")
Sleep$date=as.Date(Sleep$date, "% m/% d/% y")
```

Now that everything is ready, I can start exploring and analyzing the data sets.

## Summarizing the dataset (Analyze Phase)

Now that all the data is stored appropriately and has been prepared for analysis, I can start putting it to work.

```
Activity %>% summarise(Activity_participants = n_distinct(Activity$Id))
```

```
##   Activity_participants
## 1                    33
```

```
n_distinct(Calories$Id)
```

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

```
n_distinct(Intensities$Id)
```

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

```
n_distinct(Heartrate$Id)
```

## [1] 14

```
n_distinct(Sleep$Id)
```

## [1] 24

```
n_distinct(Weight$Id)
```

## [1] 8

Quick summary statistics

```
# Activity
Activity %>% select(TotalSteps,
                    TotalDistance,
                    SedentaryMinutes, Calories) %>% summary()
```

```
##          TotalSteps           TotalDistance           SedentaryMinutes           Calories
## Min.           :     0       Min.        : 0.000       Min.       :    0.0       Min.       :   0
## 1st Qu.: 3790   1st Qu.: 2.620      1st Qu.: 729.8      1st Qu.:1828 ## Median : 7406
            Median : 5.245     Median :1057.5    Median :2134 ## Mean      : 7638     Mean
            : 5.490    Mean     : 991.2    Mean     :2304
## 3rd Qu.:10727 3rd Qu.: 7.713      3rd Qu.:1229.5     3rd Qu.:2793 ## Max.        :36019
            Max.       :28.030   Max.       :1440.0   Max.       :4900
```

Exploring the number of Intense active participants :

```
# Explore number of active minutes per category
Intensities %>% select(VeryActiveMinutes, FairlyActiveMinutes, LightlyActiveMinutes, SedentaryMinutes) %>% summary()
```

```
## VeryActiveMinutes FairlyActiveMinutes LightlyActiveMinutes SedentaryMinutes
## Min.            : 0.00           Min.        : 0.00              Min.        : 0.0                 Min.       :    0.0
## 1st Qu.: 0.00 1st Qu.: 0.00 1st Qu.:127.0 1st Qu.: 729.8 ## Median : 4.00 Median : 6.00 Median
:199.0 Median :1057.5 ## Mean : 21.16 Mean : 13.56 Mean :192.8 Mean : 991.2 ## 3rd Qu.: 32.00
3rd Qu.: 19.00 3rd Qu.:264.0 3rd Qu.:1229.5 ## Max. :210.00 Max. :143.00 Max. :518.0 Max. :1440.0
```

For the Calories dataframe:

```
# Calories
Calories %>% select(Calories) %>% summary()
```

```
##           Calories
## Min.           :    0
##  1st  Qu.:1828  ##
Median    :2134    ##
Mean  :2304  ##  3rd
Qu.:2793    ##    Max.
:4900
```

For the Sleep dataframe:

```
# Sleep
Sleep %>% select(TotalSleepRecords, TotalMinutesAsleep, TotalTimeInBed) %>% summary()
```

```
## TotalSleepRecords TotalMinutesAsleep TotalTimeInBed
## Min.            :1.000           Min.        : 58.0              Min.        : 61.0
```

```
## 1st Qu.:1.000 1st Qu.:361.0 1st Qu.:403.0 ## Median :1.000 Median
:433.0 Median :463.0 ## Mean :1.119 Mean :419.5 Mean :458.6 ## 3rd
Qu.:1.000 3rd Qu.:490.0 3rd Qu.:526.0 ## Max. :3.000 Max. :796.0
Max. :961.0
```

For the Weight dataframe:

```
# Weight
Weight %>% select(WeightKg, Fat) %>% summary()
##        WeightKg                    Fat
## Min.          : 52.60      Min.       :22.00
## 1st Qu.: 61.40             1st Qu.:22.75
## Median : 62.50             Median :23.50
## Mean          : 72.04      Mean       :23.50
## 3rd Qu.: 85.05             3rd Qu.:24.25
## Max.          :133.50      Max.       :25.00
##                            NA's       :65
```

**Key findings from this analysis :**

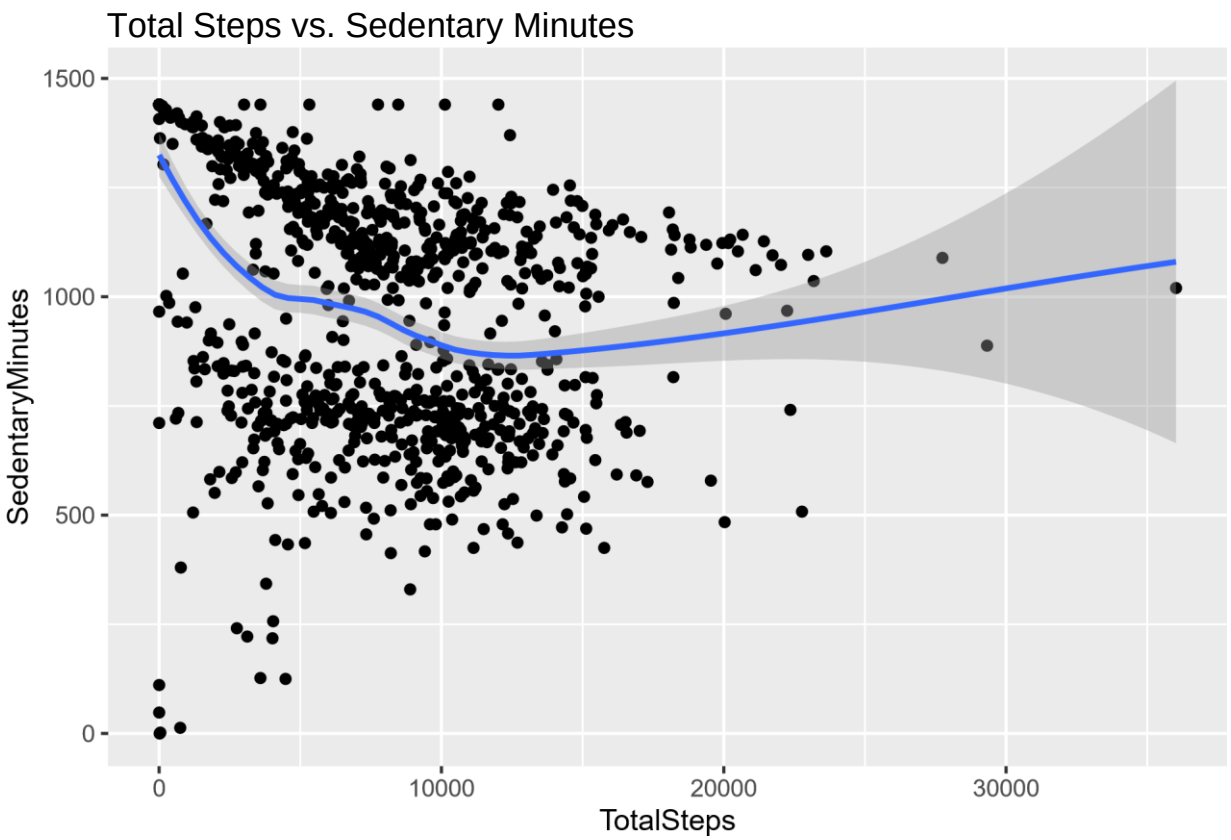
- The average sedentary time is excessively high, exceeding 16 hours, indicating a pressing need for a robust marketing strategy to encourage reduced sedentary behavior.
- A significant portion of the participants exhibit light activity levels, coupled with a high sedentary time.
- On average, participants sleep for approximately 7 hours per night.
- The average total number of steps per day is 7638, slightly below the CDC's recommended level. Research from the CDC suggests that taking 8,000 steps per day is associated with a 51% lower risk of all-cause mortality, while taking 12,000 steps per day is associated with a 65% lower risk compared to taking 4,000 steps.

## Data visualization

**Relationship between Steps and Sedentary time**

What's the relationship between steps taken in a day and sedentary minutes?

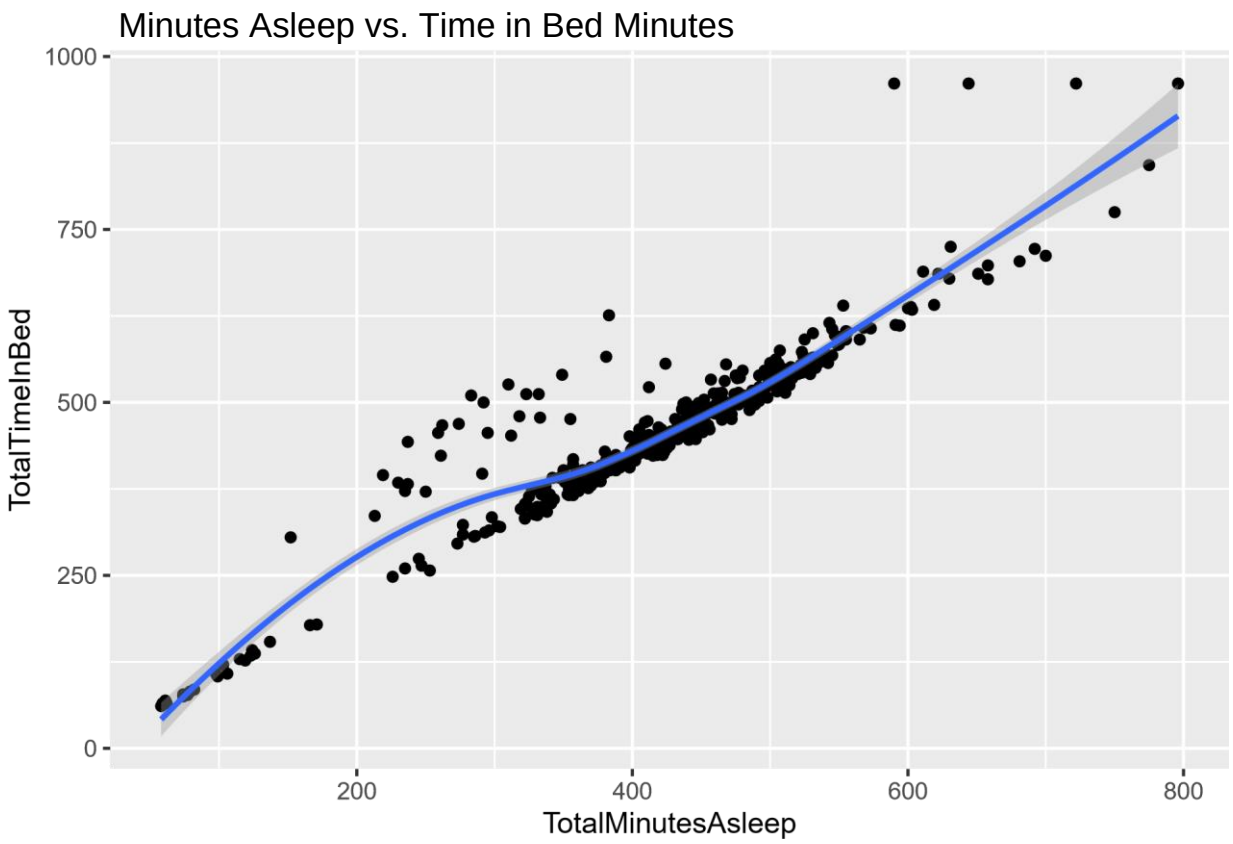
```
ggplot(data=Activity, aes(x=TotalSteps, y=SedentaryMinutes)) + geom_point() + geom_smooth() + labs(title
```




**Relationship between Minutes Asleep and Time in Bed**

What's the relationship between minutes asleep and time in bed?

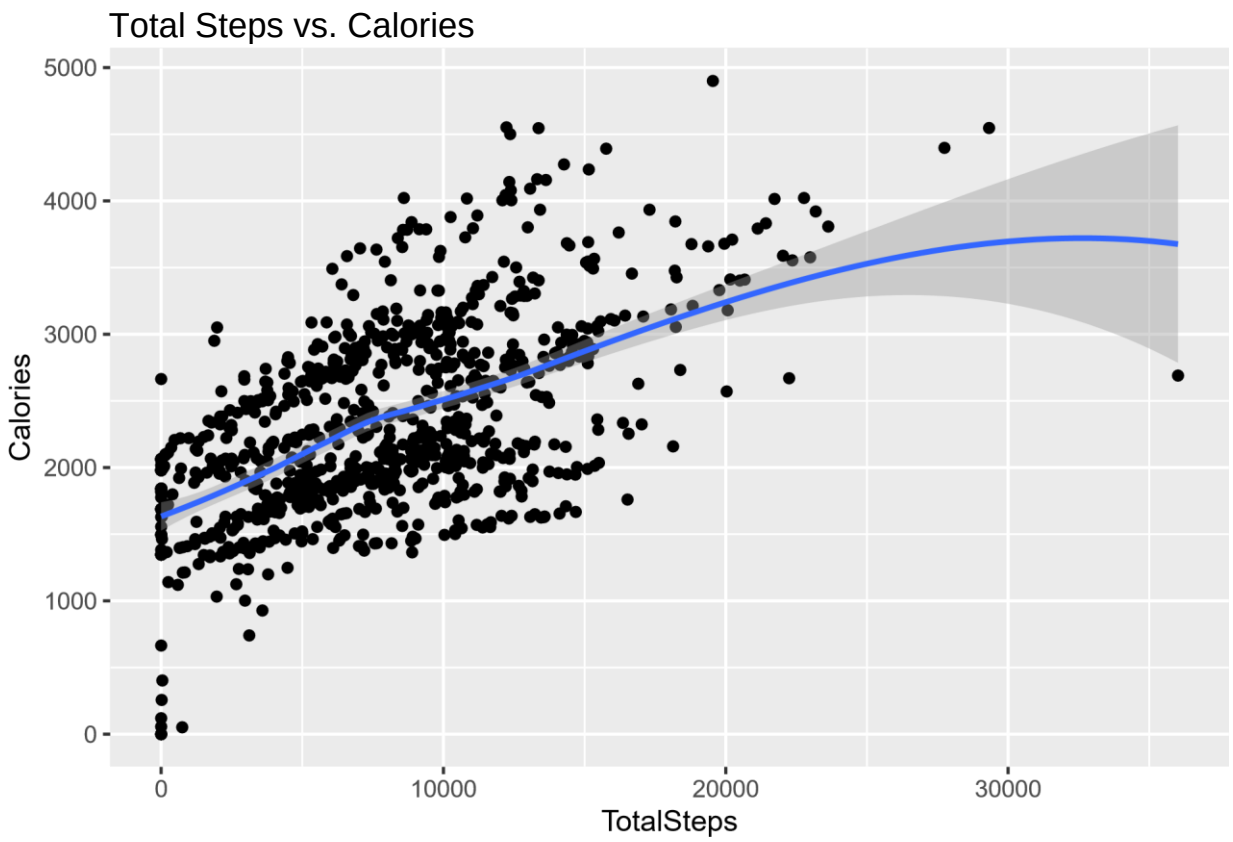
```
ggplot(data=Sleep, aes(x=TotalMinutesAsleep, y=TotalTimeInBed)) + geom_point()+ geom_smooth() + labs(tit
```




**Relationship between Steps and Calories**

What's the relationship between steps taken and Calories ?

```
ggplot(data=Activity, aes(x=TotalSteps, y=Calories)) + geom_point() + geom_smooth() +
   labs(title="Total Steps vs. Calories")
```

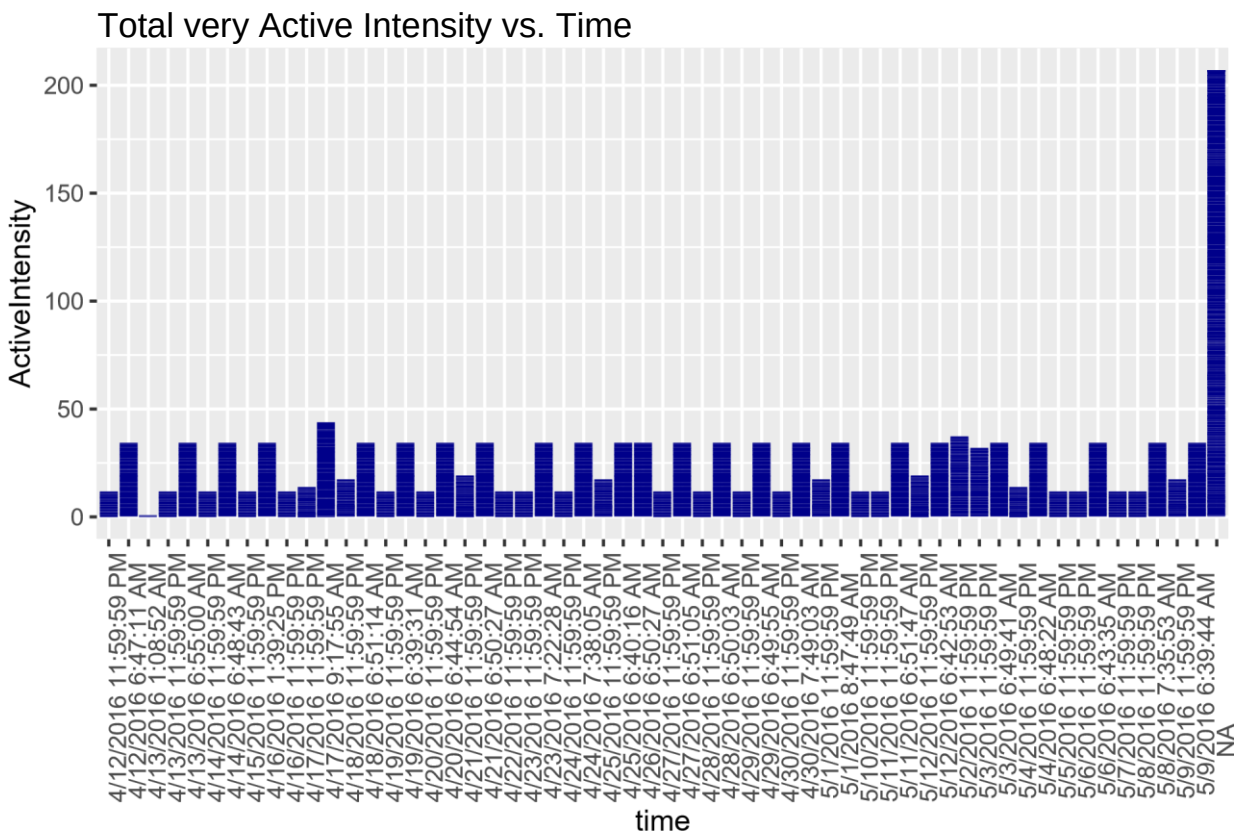



**Intensities data**

```
Intensities$ActiveIntensity <- (Intensities$VeryActiveMinutes)/60

Combined_data <- merge(Weight, Intensities, by="Id", all=TRUE) Combined_data$time <-
format(Combined_data$Date, format = "%H:%M:%S")

ggplot(data=Combined_data, aes(x=time, y=ActiveIntensity)) + geom_histogram(stat =                    "identity'
   = element_text(angle = 90)) + labs(title="Total very Active Intensity vs. Time ")                  fill='da
```




## Conclusions

- The average sedentary time is alarmingly high, exceeding 16 hours. To address this issue, it is crucial to implement a comprehensive marketing strategy that educates and motivates individuals to reduce sedentary behaviors.

- A majority of the participants exhibit light activity levels and have a significant amount of sedentary time. This highlights the need for interventions to promote physical activity and discourage prolonged periods of sitting.

- The average sleep duration among participants is 7 hours, indicating the need for strategies to improve sleep patterns and ensure an adequate amount of restorative sleep.

- The average daily step count falls slightly below the recommended level of 8,000 steps according to the CDC. Encouraging individuals to increase their daily step count can have significant health benefits.

**Recommendations**

Based on the findings above, I recommend the following actions;

1. Develop and implement a targeted marketing campaign that emphasizes the importance of reducing sedentary time and provides practical tips and resources to encourage active lifestyles.

2. Design interventions aimed at increasing physical activity levels among participants, such as workplace wellness programs, community fitness initiatives, and personalized activity plans.

3. Offer educational materials and workshops to raise awareness about the importance of sleep hygiene and provide practical strategies for improving sleep quality and duration.

4. Implement step-counting challenges, incentives, and supportive programs to motivate individuals to achieve and exceed the recommended daily step count.