# Analysis report for the Time Series Monitoring Data

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## CORRELATION OF STEPS, STRESS, AND BMI USING LONGITUDINAL DATA FROM 3 PATIENTS

### INTRODUCTION

The dataset titled "4_Time_series_Monitoring_data_Group_006.csv" contains longitudinal health monitoring data for three patients over a span of 42 months. Each entry corresponds to a specific date and includes a month number for time tracking. For each patient (Patients 1, 2, and 3), the dataset records three key health indicators: average daily step count, stress level, and body mass index (BMI). This time series structure enables the analysis of trends and relationships among physical activity, physiological stress, and body composition across extended periods, offering insights into individual health patterns and lifestyle influences.

### METHODS

The dataset was reshaped from wide to long to combine all patient data and to display them in a single plot. A bubble plot was generated using ggplot2, where the x-axis represented average daily step count, the y-axis represented stress level, and the bubble size encoded BMI.

Each point on the plot represented a unique month-patient combination, and colors were used to distinguish between patients. This visualization provided an intuitive overview of the joint distribution of physical activity, stress, and body composition across the full 42-month period.

To statistically assess the strength and direction of these observed relationships, Pearson correlation tests were conducted separately for each patient across the following variable pairs: (1) Steps vs. Stress, (2) Steps vs. BMI, (3) Stress vs. BMI.

The cor.test() function was used to compute correlation coefficients and associated p-values, testing the null hypothesis that there was no linear relationship between the paired variables. Significance was evaluated at a standard threshold ($\alpha = 0.05$), and the results were interpreted in the context of the patterns observed in the bubble plot.

### RESULTS

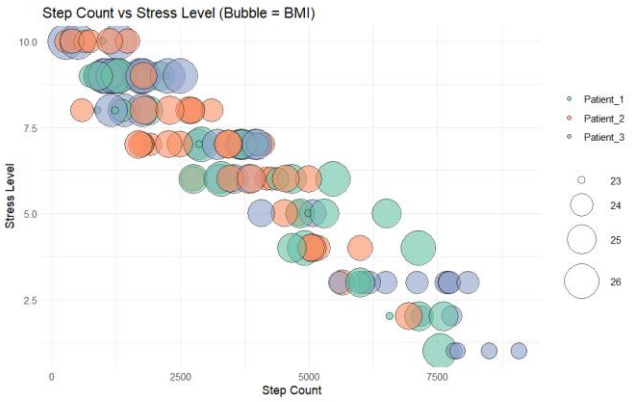


Figure 1. A bubble plot was generated to visualize the relationship between step count, stress level, and BMI for Patients 1, 2, and 3 over time. The x-axis represented step count, the y-axis represented stress level, and bubble size indicated BMI. Visually, more data points were concentrated in the upper-left region of the plot, indicating that high stress levels and low step counts occurred more frequently. A generally negative trend between stress and step count was apparent.

Table 1. Pearson Correlation Test Results for Steps vs. Stress, Steps vs. BMI, and Stress vs. BMI of each Patient

| PEARSON CORRELATION | | Steps vs Stress | Steps vs BMI | Stress vs BMI |
|---|---|---|---|---|
| Correlation Coefficient | Patient 1 | -0.9321 | 0.2123 | -0.1413 |
| | Patient 2 | -0.9135 | 0.3327 | -0.3319 |

| | | | | |
|---|---|---|---|---|
| | Patient 3 | -0.9705 | -0.9719 | 0.9997 |
| p-value | Patient 1 | <2.2e-16 | 0.1772 | 0.373 |
| | Patient 2 | <2.2e-16 | 0.0313 | 0.0318 |
| | Patient 3 | <2.2e-16 | <2.2e-16 | <2.2e-16 |

To confirm the outcome of the bubble plot, Pearson correlation tests were conducted for each patient and the following results were obtained: (1) Steps vs. Stress: All patients had correlation coefficients less than -0.9 with p-values < 2.2e-16, confirming a strong and statistically significant negative relationship; (2) Steps vs. BMI: Patient 1 showed no significant correlation; Patient 2 had a weak positive correlation (r = 0.3327); Patient 3 showed a strong negative correlation (r = -0.9719); (3) Stress vs. BMI: Patient 1 showed no significant correlation; Patient 2 had a weak negative correlation (r = -0.3319); Patient 3 showed a near-perfect positive correlation (r = 0.9997).

**ANALYSIS AND CONCLUSION**

The bubble plot revealed a clear pattern where patients more frequently experienced high stress levels and low step counts, as shown by the concentration of points in the upper-left region. A negative trend between step count and stress was visually apparent. Patient 1 maintained a consistently low BMI across conditions, while Patient 2 showed a stable BMI with little variation. Patient 3 exhibited the lowest BMI during periods of high activity and low stress, suggesting a more responsive physiological profile.

Pearson correlation tests supported these observations. All three patients showed a strong negative correlation between step count and stress (r < -0.9, p < 2.2e-16), confirming that increased physical activity was consistently associated with reduced stress. BMI relationships varied: Patient 1 showed no significant correlations, Patient 2 had weak correlations, and Patient 3 exhibited strong associations, particularly a nearly perfect positive correlation between stress and BMI (r = 0.9997). In conclusion, increased physical activity is strongly linked to reduced stress across patients, while BMI responses vary individually.