Actigraphy, A Non-Invasive Digital Biomarker for Pain

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Objective

Use MotionWatch8 to detect non-invasive, digital biomarkers for pain in adults by monitoring sleep and motion following a COVID-19/Flu vaccination to better patient care and enhance data objectively in the future.

Background

- Pain has been found to be related to changes in sleep patterns but no prior studies related to localized pain.
- MotionWatch8 is used to measure Actigraphy which can provide valuable insight into an individual's pain experience by analyzing motion and activity levels.
- Based off of prior research, we hypothesize that low sleep efficiency (%), decreased actual sleep time (%), decreased immobile time (%), along with increased mobile time (%), as recorded through actigraphy, may correlate with higher levels of pain. These sleep parameters could serve as potential non-invasive, digital biomarkers for centralized pain in local skin sites.

Methods

MotionWatch8:

- Battery powered smartwatch that contains a miniature accelerometer to allow measurement and recording of the physical movement of the wrist which provides a close correlation to whole-body movement.
- The smartwatch samples acceleration data at 50 Hz, and processes it into epochs.

Participant recruitment:

- Six participants were recruited for the study of which 3 were controls and 3 were vaccinated.
- Subjects are eligible to participate if they age between 18-70, are not pregnant, and not clinically diagnosed as disabled.
- Each subject wore the device for 7 days. Five days were used for data analysis.
- Participants had 2 visits to receive/return the watch.

MotionWare and GraphPad Prism 6:

- The MotionWare software allows the user to easily access raw motion data recorded by the MotionWatch8 every 30s and up to 25 sleep parameters.
- The selected four parameters were inserted into GraphPad Prism 6, and each required statistical test was executed through pre-programmed
- algorithm that the software provides.

Data analysis using Statistical methods:

- Selected sleep parameters recorded by the device, such as sleep efficiency (%), actual sleep (%), mobile time (%), and immobile time (%), from five nights were taken to be analyzed through our statistical analysis procedure.
- For the inferential analysis procedure, Kruskal-Wallis and Mann-Whitney U test were conducted to find the non-invasive, digital biomarker discovery for longitudinal(an individual over 5 days) and cross-sectional study (two groups on the most painful day) respectively.
- Additionally, a pain log recorded by the user was compared to graphs of peak intensity and frequency average for each of the five nights.
- To prove the hypothesis, the relationship between the pain score from the journal and the sleep parameters was found using scatterplot and correlation coefficient (R).

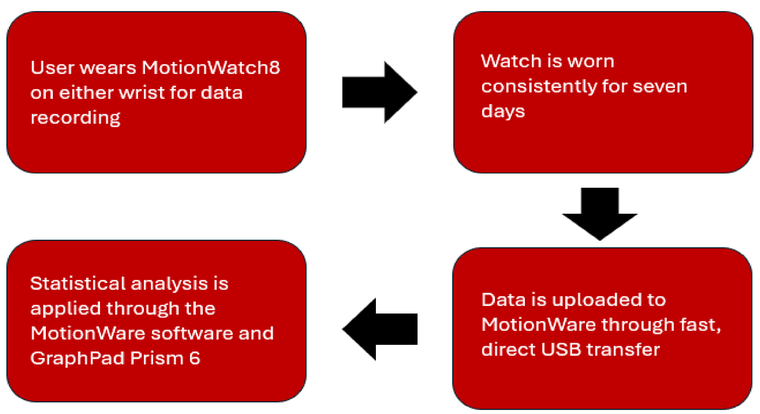

Figure 1: General system workflow

Results

- Kruskal Wallis test- not significant, cannot reject null hypothesis.
- Mann Whitney test- not significant, cannot reject null hypothesis
- Correlation- Strong positive relationship for all sleep parameters except mobile time(%).

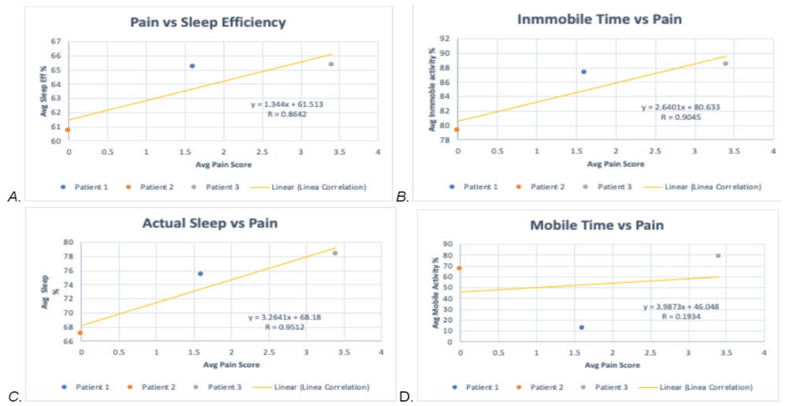

***Figure 2**: : Relationship between the pain score obtained from the pain journal and different sleep parameters. It also shows the correlation coefficient(R) of each sleep parameter with pain score.*

Conclusion

Our project explored the correlation between localized pain and sleep parameters. While few differences were observed between vaccinated and control subjects, our statistical analysis did not find significant differences over 5 days within individuals or between the two groups for each sleep parameter. Additionally, the correlation coefficient and scatter plot did not demonstrate the anticipated relationship between pain and sleep parameters. Our results concluded that our methodology could not serve as a non-invasive, digital biomarker for localized pain assessment due to the shortened sample size. A larger sample size would provide a more evident result. This underscores the complexity of the relationship between pain and sleep.

.Acknowledgements

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