

Analysis on Nursing Care Activity Related Stress Level for Reduction of Caregiving Workload



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1 Introduction

Background

- In Japan, **rapidly aging population** is a problem

The demand for nursing homes
is increasing



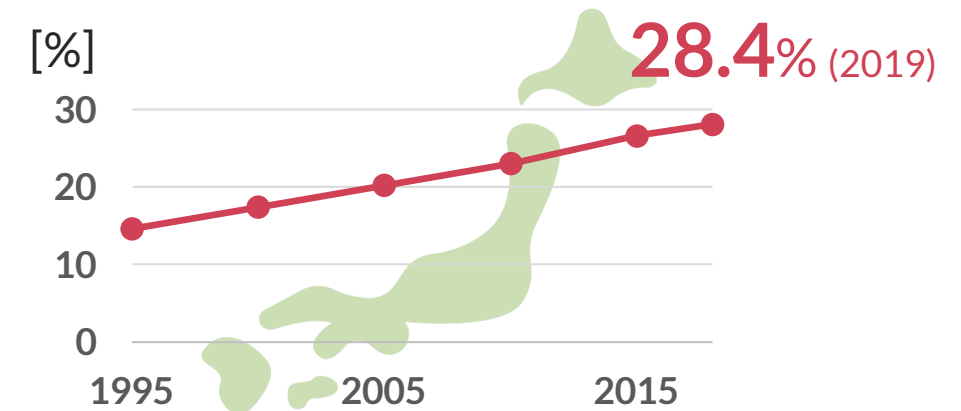
- **The shortage of caregivers** is becoming more serious[2]

Approx. two-thirds of facilities reported feeling a shortage

Fear of increased workload
for caregivers



A serious problem
of nursing homes



Percentage of people aged 65 and over [1]

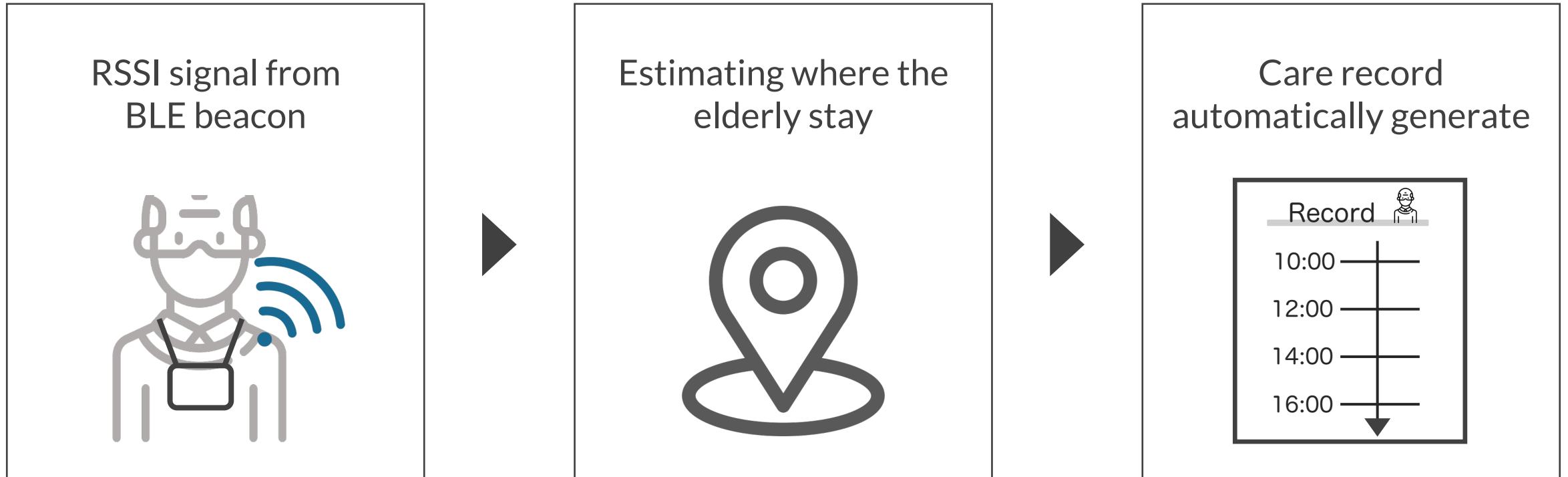
[1] 内閣府，令和2年度高齢者白書

[2] 公益財団法人介護労働安定センター，介護分野の現状等について

1 Introduction

Efforts to Reduce the Workload of Caregivers [3]

- Development of a platform for easy collection of caregiving behaviors



Dramatically reduce the work of creating nursing care records

[3]Tatsuya Morita et al., Beacon-based time-spatial recognition to-ward automatic daily care reporting for nursinghomes.Journal of Sensors, Vol. 2018, pp. 1-15,2018

1 Introduction

Aims of This Study

Isn't the stress of caregivers having a significant impact on operational efficiency?

Aims

Focusing on **the stress** of caregivers,
we aim **to acquire new knowledge** for reducing workload

If stress can be estimated ...

- ❑ An objective review of caregivers' own work styles
- ❑ Review of work plans
- ❑ Encourage leave for refreshment

etc...



2 Related Work Stress Assessment Using Questionnaires

● The Brief Job Stress Questionnaire [4]

To prevent workers' own mental health problem

- ☐ Work-related stress factors
- ☐ Stress response
- ☐ Factors influencing stress (e.g., family, colleagues)

● WHOQOL-100 [5]

To evaluate QoL (Quality of life)

- | | |
|--|---|
| <input type="checkbox"/> Physical | <input type="checkbox"/> Social relationships |
| <input type="checkbox"/> Psychological | <input type="checkbox"/> Environment |
| <input type="checkbox"/> Independence | <input type="checkbox"/> Spirituality/Religious/Beliefs |



[4] Investigation research report concerning prevention of disease related to work in 1997 the Ministry of Labor: III Stress measurement research group report.

[5] The Whoqol Group. The world health organization qual-ity of life assessment (whoqol)

● The Brief Job Stress Questionnaire [4]

To prevent workers' own mental health problem

- ☐ Work-related stress factors
- ☐ Stress response
- ☐ Factors influencing stress (e.g., family, colleagues)

Number of questions

54

● WHOQOL-100 [5]

To evaluate QoL (Quality of life)

- ☐ Physical
- ☐ Psychological
- ☐ Independence
- ☐ Social relationships
- ☐ Environment
- ☐ Spirituality/Religious/Beliefs

Number of questions

100

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- The Brief Job Stress Questionnaire [4]

To prevent workers' own mental health problem

- ☐ Work-related stress factors

Number of questions

54

The number of question is very large and the burden on the respondents is heavy

To evaluate QoL (Quality of life)

- ☐ Physical
- ☐ Psychological
- ☐ Independence
- ☐ Social relationships
- ☐ Environment
- ☐ Spirituality/Religious/Beliefs

Number of questions

100

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2 Related Work

Stress Estimation Method Using Devices

- **Research by Fukuda et al. [6]**
 - Estimation of mental and physical state of office workers from sleep data acquired from wearable devices
- **Research by Gjoreski et al. [7]**
 - Estimating stress of students using data collected from smartphones (acceleration, GPS, Wi-Fi, etc.) in three levels

Not yet able to estimate stress **by activity**



[6] Shuichi Fukuda et al. Predicting de-pression and anxiety mood by wrist-worn sleepsensor. In WristSense 2020: 6th Workshop on Sensing Systems and Applications using WristWorn Smart Devices (WristSense 2020), 2020.

[7] Martin Gjoreski et al. Automatic detection of perceived stress in campus students using smart-phones. In 2015 International Conference on Intelligent Environments, pp. 132–135. IEEE, 2015.

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Not yet able to estimate stress **by activity**

Visualize and analyze the relationship between **caregiving behavior and stress state** using devices

[6] Shuichi Fukuda et al. Predicting de-pression and anxiety mood by wrist-worn sleepsensor. In WristSense 2020: 6th Workshop on Sensing Systems and Applications using WristWorn Smart Devices (WristSense 2020), 2020.

[7] Martin Gjoreski et al. Automatic detection of perceived stress in campus students using smart-phones. In 2015 International Conference on Intelligent Environments, pp. 132–135. IEEE, 2015.

Objective Stress Indicators (HRV)

- **The heart rate variability (HRV)**

Calculated from periodically fluctuating heartbeat intervals



Objective Stress Indicators (HRV - RRI)

- **The heart rate variability (HRV)**

Calculated from periodically fluctuating heartbeat intervals



□ RRI

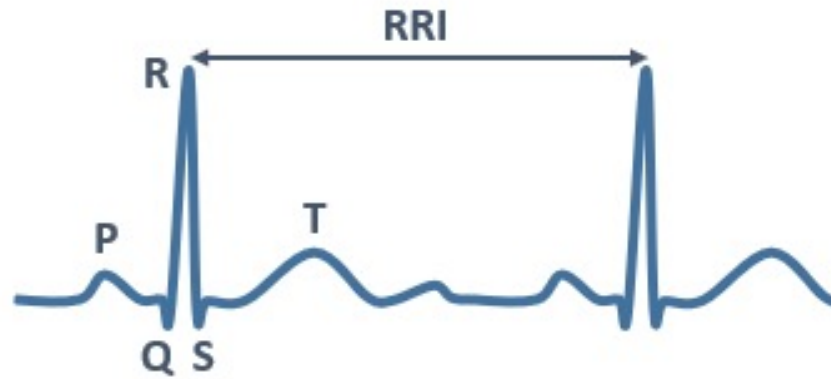
Calculated from the interval between the R wave, a characteristic wave of heart rate variability, and the next R wave

3 Method for Measuring Psychological Indicators

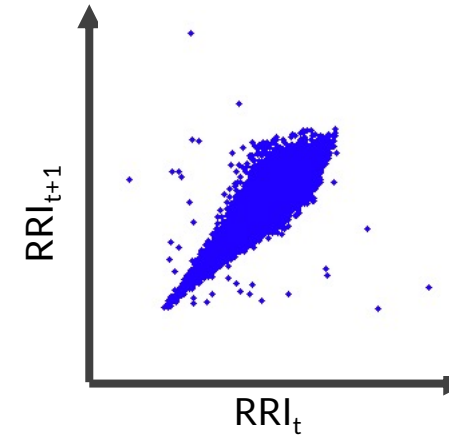
Objective Stress Indicators (HRV - RRI)

● Lorenz Plot

A method for estimating stress from RRI, expressing fluctuations in heart rate



RRI



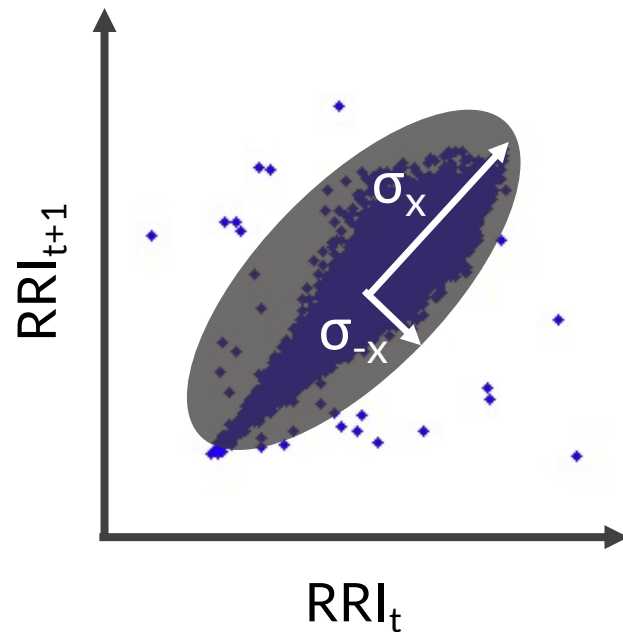
Lorenz Plot

3 Method for Measuring Psychological Indicators

Objective Stress Indicators (HRV - RRI)

● Lorenz Plot

A method for estimating stress from RRI, expressing fluctuations in heart rate



The area $S = \pi \times \sigma_x \times \sigma_{-x}$

Small area

Stress

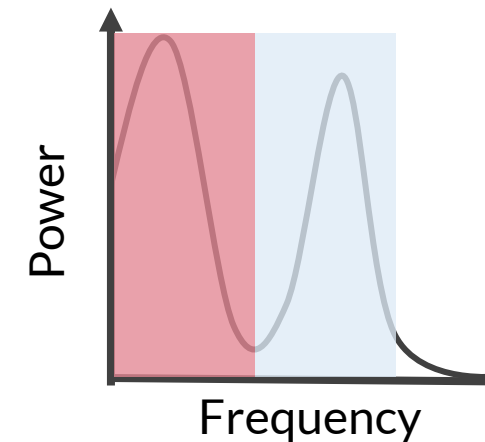
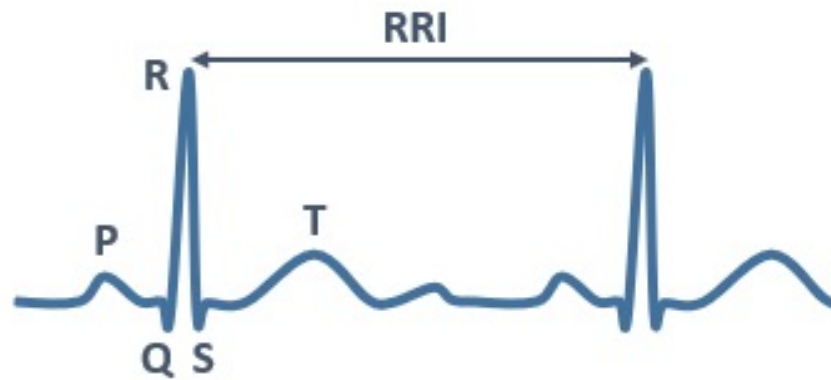
Large area

Relax

Objective Stress Indicators (HRV - LF/HF Ratio)

● LF/HF Ratio

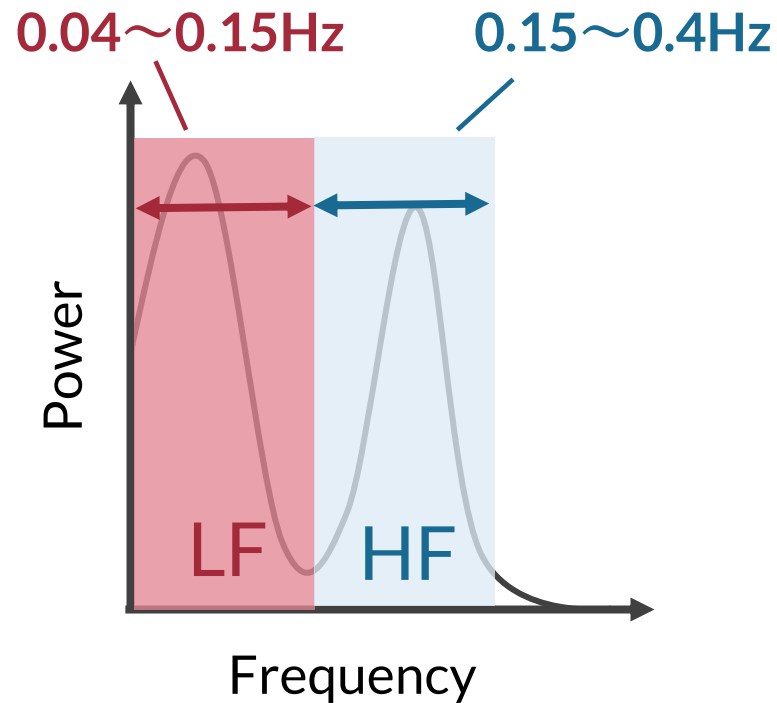
Calculated by converting RRI time series data into power spectrum



Objective Stress Indicators (HRV - LF/HF Ratio)

● LF/HF Ratio

Calculated by converting RRI time series data into power spectrum



LF/HF Ratio is **High**

Stress

LF/HF Ratio is **Low**

Relax

- **Questionnaire Index**

- **Work Engagement**

- A measure of how enthusiastic a person is about work

- **DAMS (Depression and Anxiety Mood Scale)**

- An index to measure positive, depressive, and anxious moods

Caregivers are asked them to answer questionnaires for three times
(Before work, During lunch breaks, and After work)

4 Experiment About

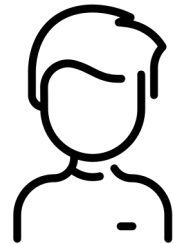
During

2020
11 / **20** ▶ **11** / **30**
2020

Total 10 days

Target

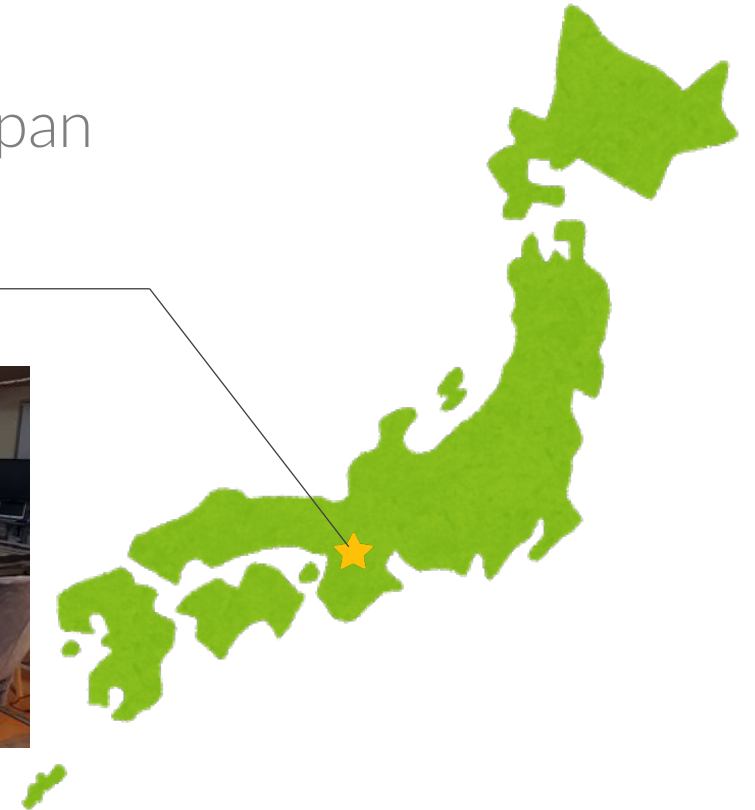
Five Caregivers



Place

Ikoma City, Nara, Japan

Ikoi-no-ie 26



4 Experiment About

Answer the preliminary questionnaire

Before the start of
the experiment



Status of caregivers
(Gender, Experience)

Wear the heart-rate sensor

Before work※



Heart-rate sensor
WHS-3



Caregiver

Answer the daily questionnaires

Before work, Lunch break
,and After work



Based on
DAMS & Work Engagement

※Wearing is not compulsory

Nursing Care Activity

- ☐ Toilet Assistance
- ☐ Bed Assistance
- ☐ Rehabilitation Instruction
- ☐ Recreation Instruction
- ☐ Work in the Living Room



5 ^{Result} The Answer of Preliminary Questionnaire

● Gender

- ☐ Man - **1** person
- ☐ Woman - **4** persons

● Experience

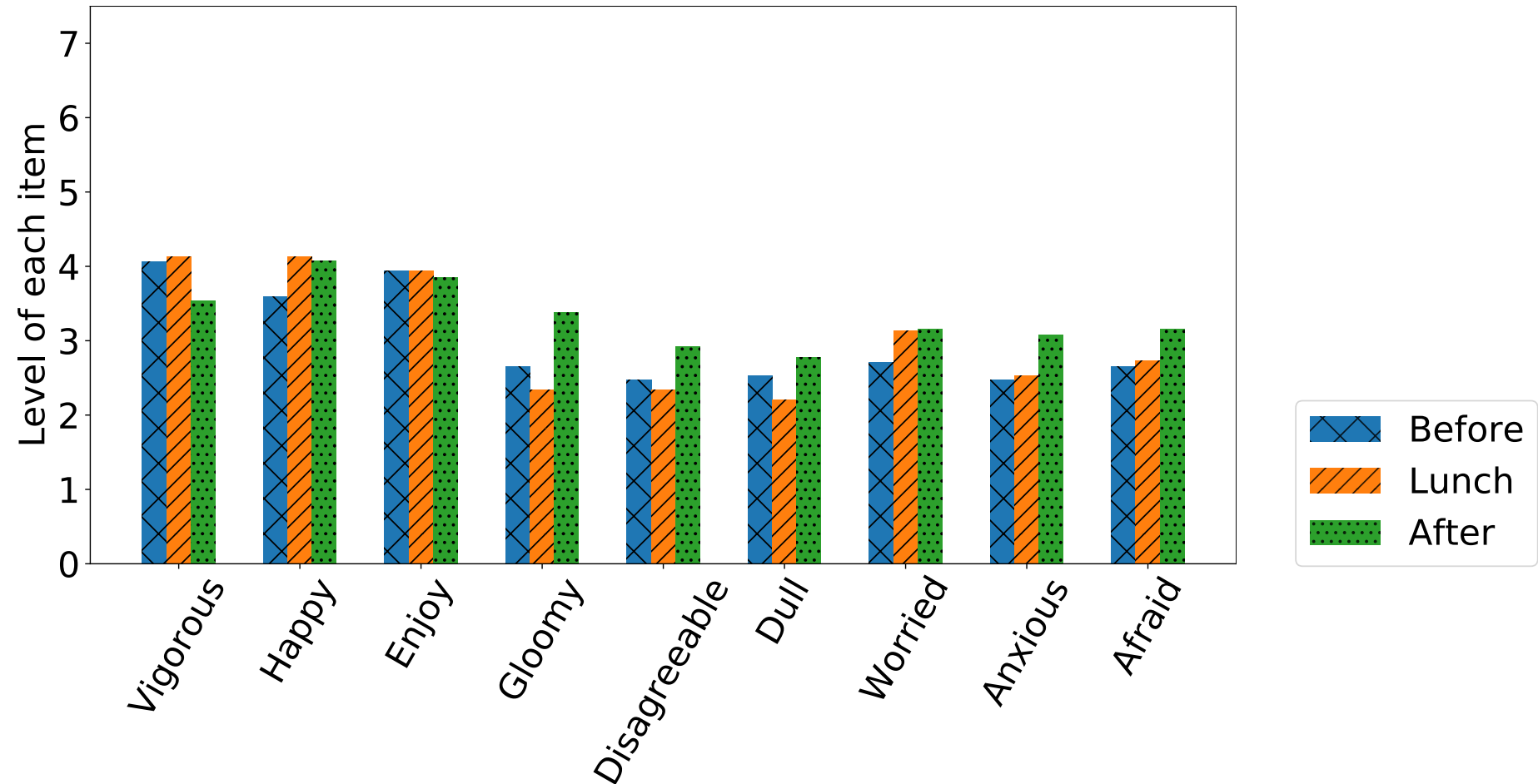
- ☐ More than **3** years,
Less than **5** years - **1** person
- ☐ More than **5** years,
Less than **10** years - **1** person
- ☐ More than **10** years - **3** persons



**Most people have
many years of experience**

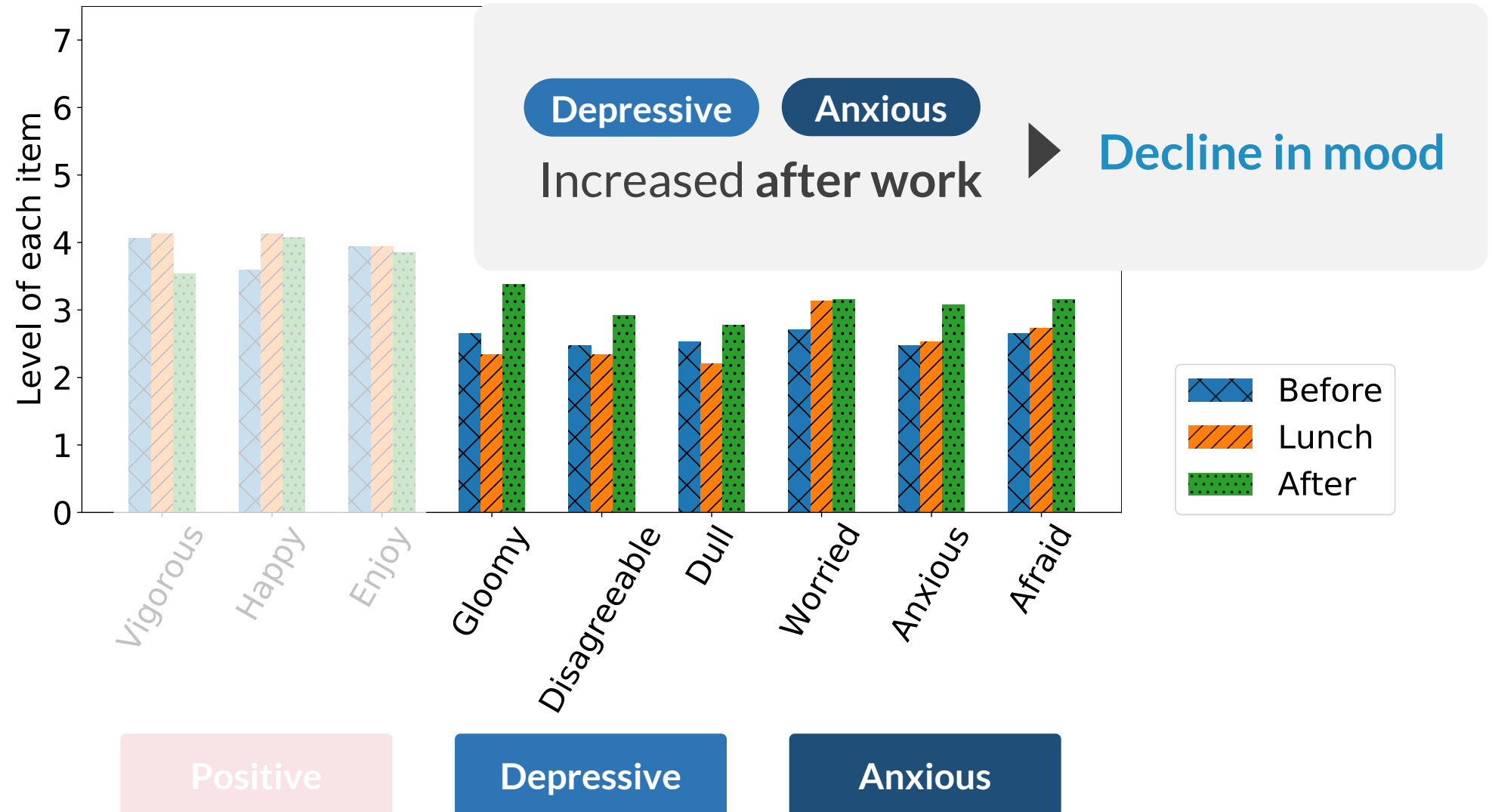
5 Result

The Answer of Daily Questionnaire



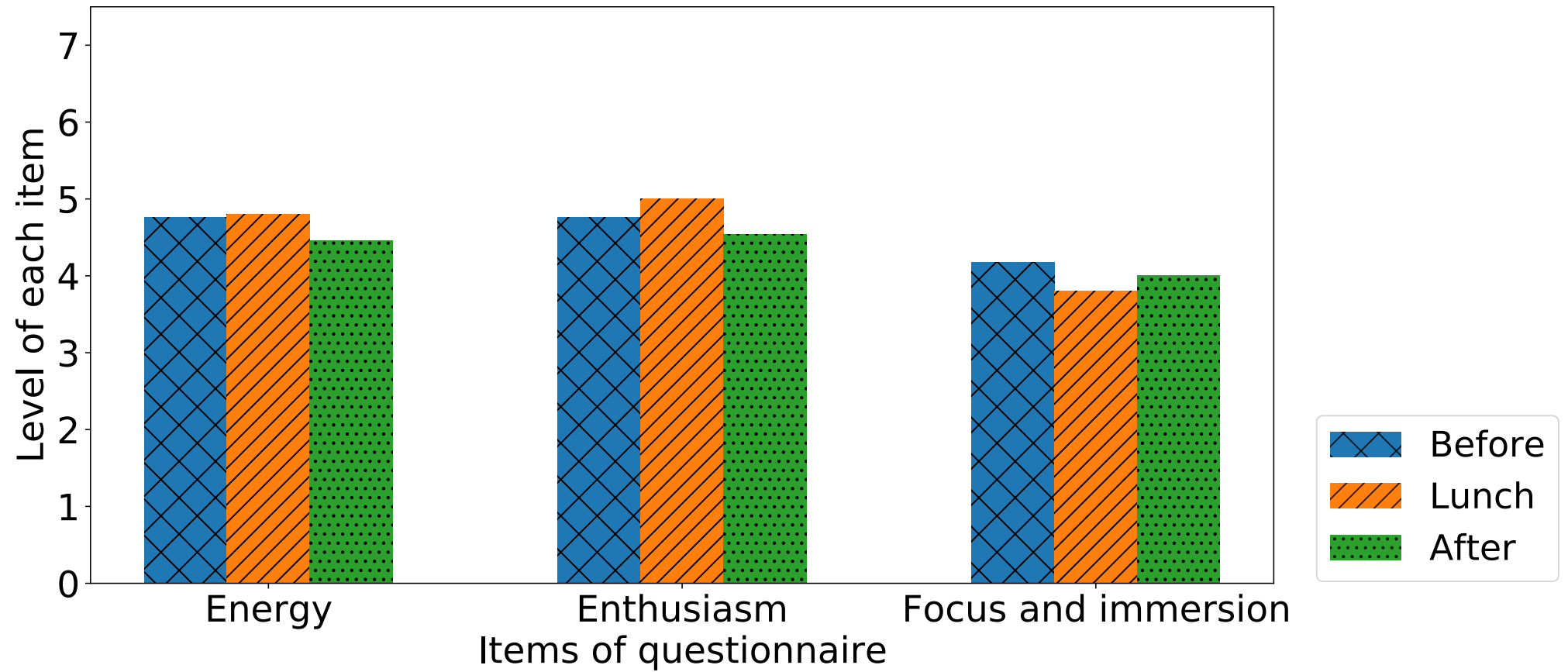
5 Result

The Answer of Daily Questionnaire



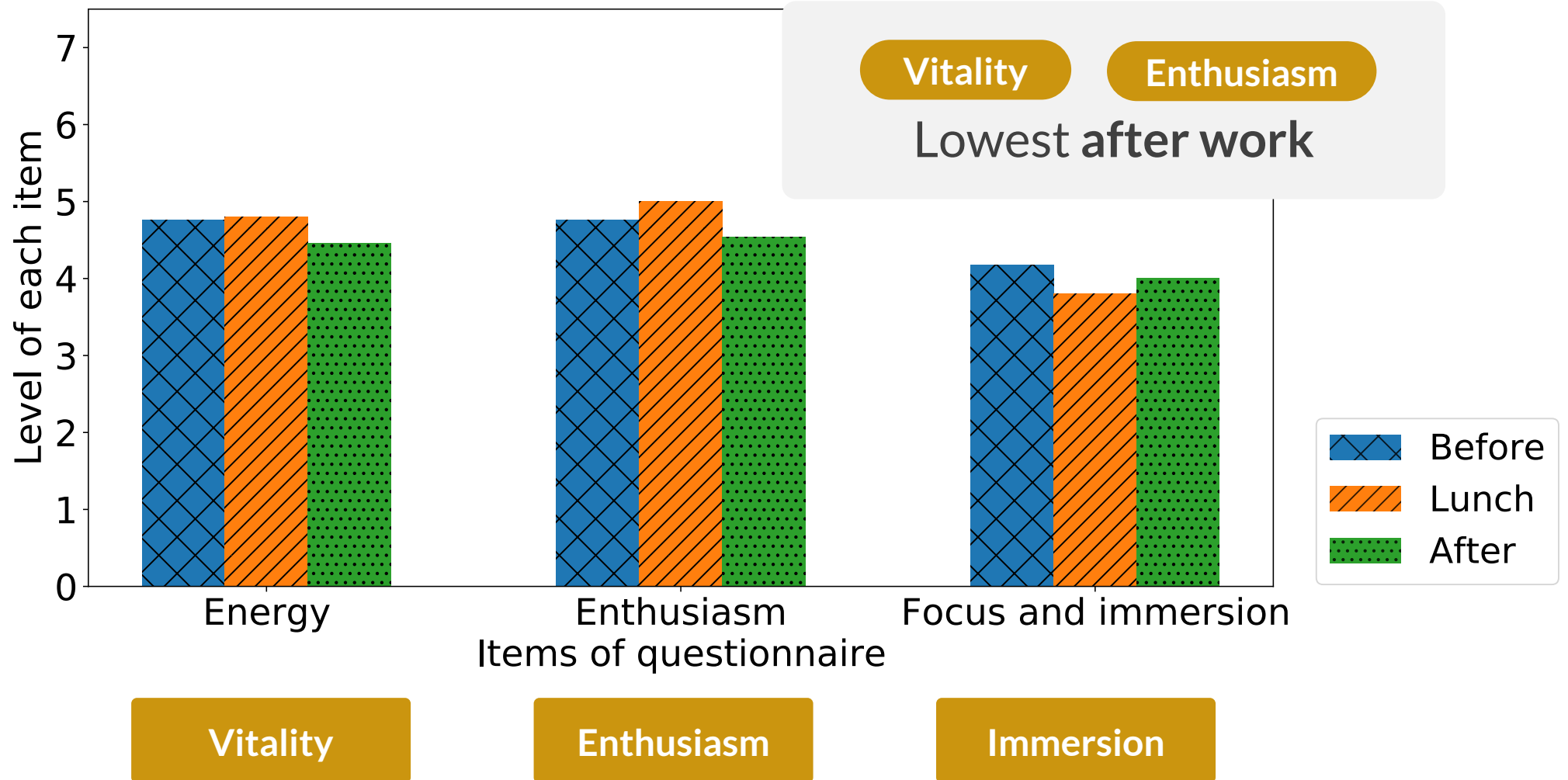
5 Result

Work Engagement



5 Result

Work Engagement



5 ^{Result} Overall Tendency

- We were not able to collect data on all subject
 - ❑ Wearing the heart rate sensor (WHS-3) was not compulsory
 - ❑ Wearing was insufficient

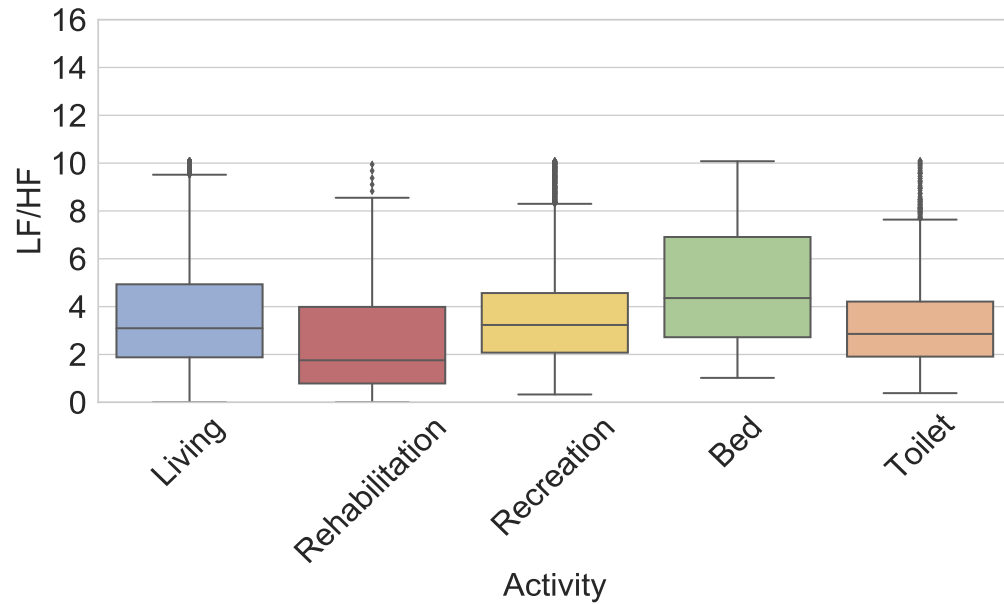


Data that could be collected in the end
2 caregivers, total of 6 days

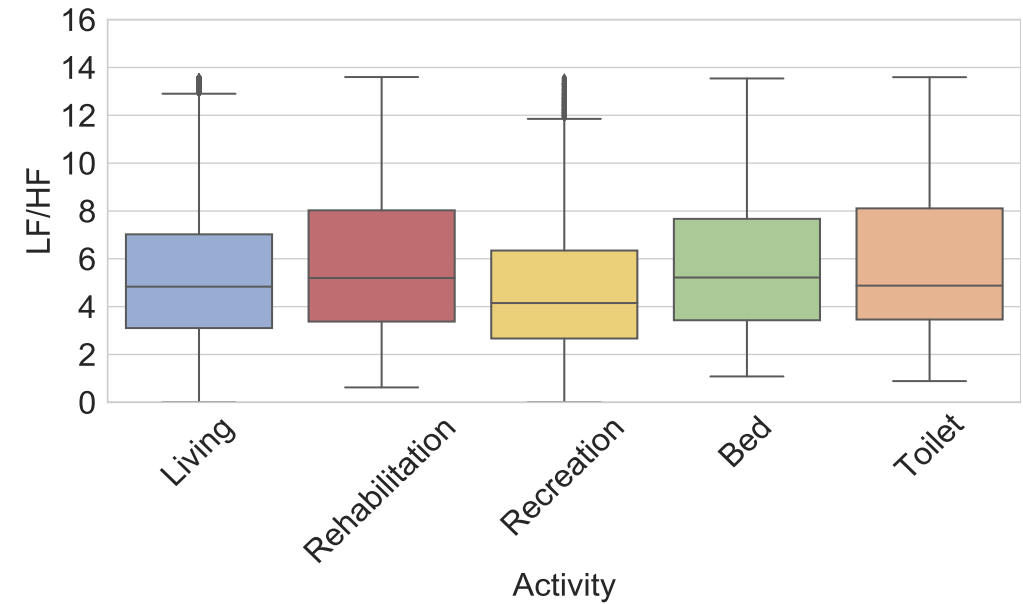
5 Result

LF/HF Ratio Boxplots

High LF/HF Ratio ► Stress



ID_01

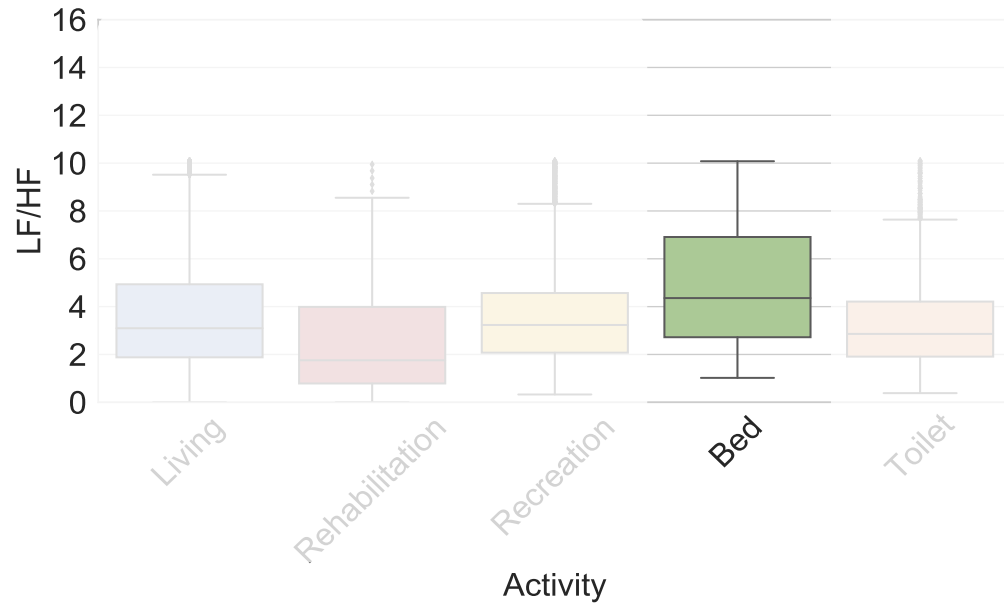


ID_02

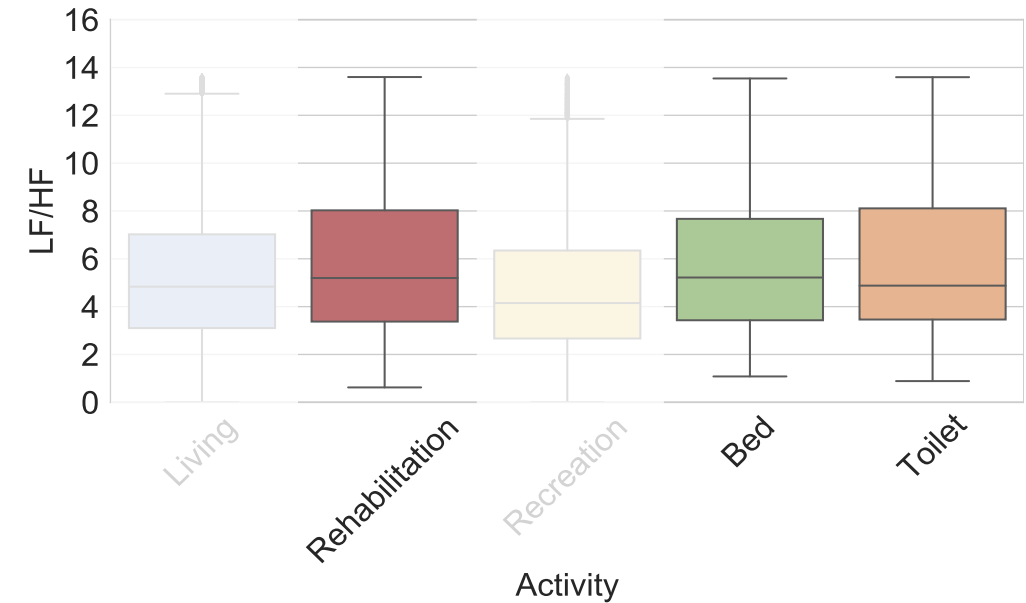
5 Result

LF/HF Ratio Boxplots

High LF/HF Ratio ► Stress



ID_01



ID_02

Higher values

ID_01

Bed Asst.

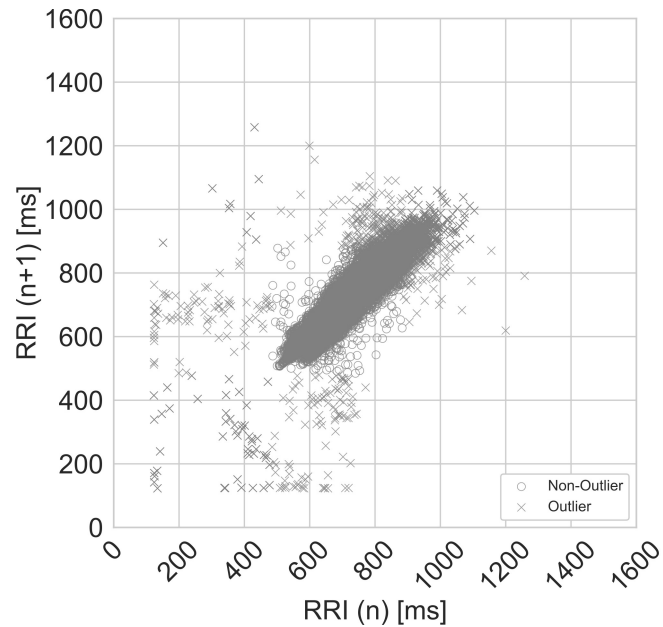
ID_02

Rehab. Instruction, Bed Asst. and Toilet Asst.

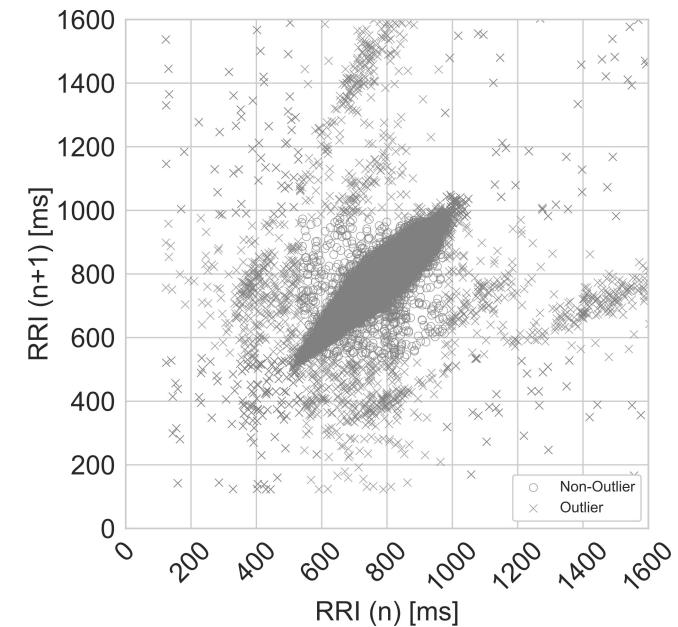
► High Possibility of being in stress state

5 Result

Lorenz Plots



ID_01



ID_02

Outliers are **widely distributed**

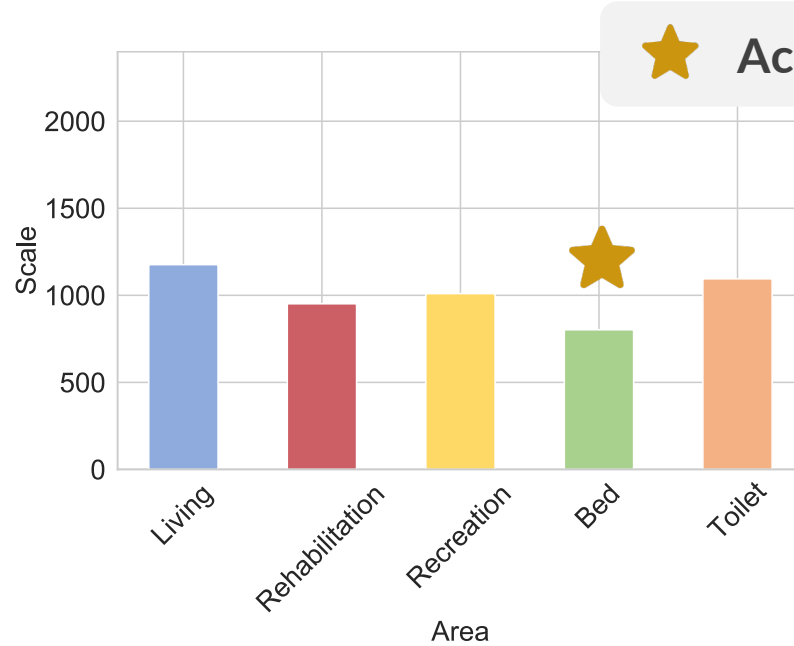


Could the caregiver's behavior have prevented the collection of sufficient sensor data?

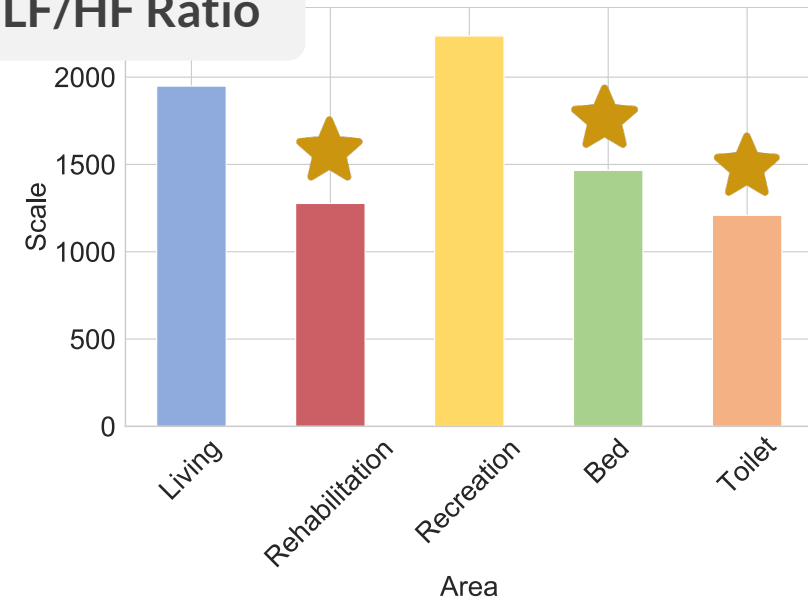
5 Result

Lorenz Plot Area

Small Area ► Stress



ID_01

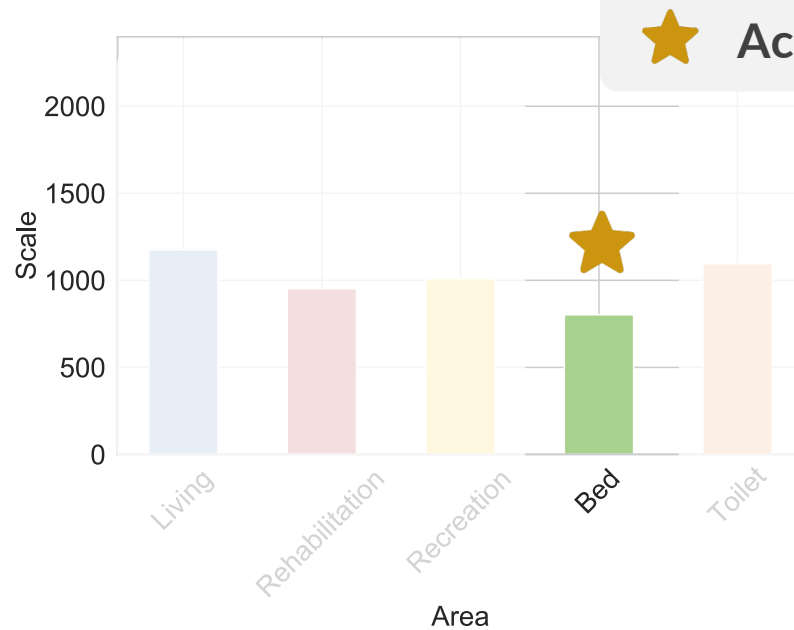


ID_02

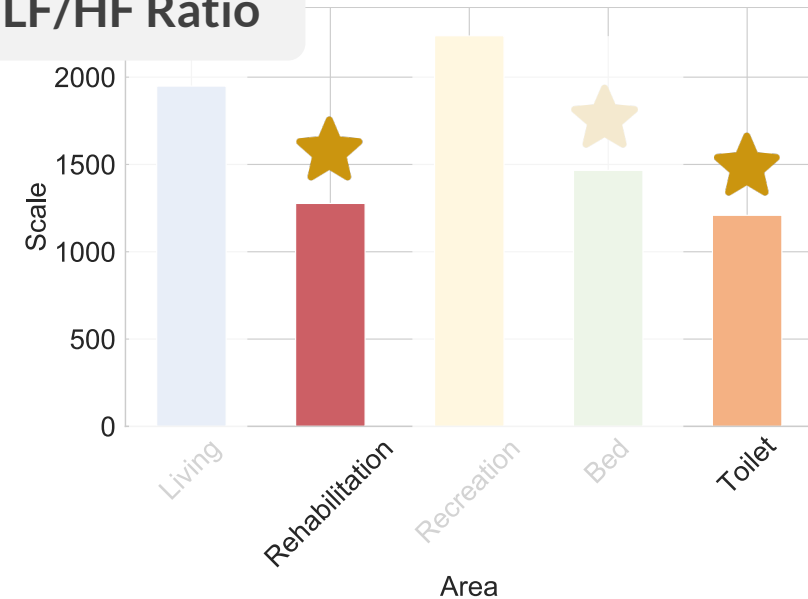
5 Result

Lorenz Plot Area

Small Area ► Stress



ID_01



ID_02

Small Area

ID_01

Bed Asst.

ID_02

Rehab. Instruction and Toilet Asst.

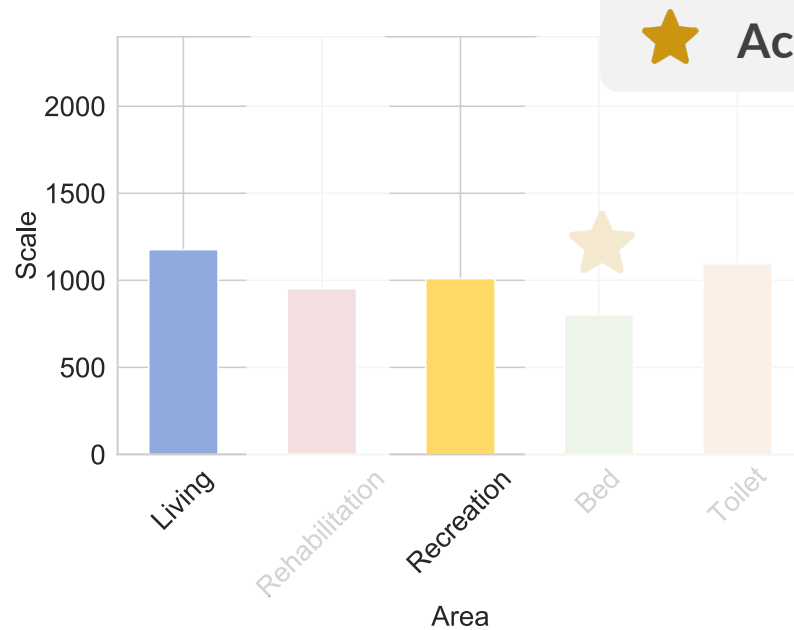
► **High Possibility** of being in stress state

Similar Trend in LF/HF Ratio

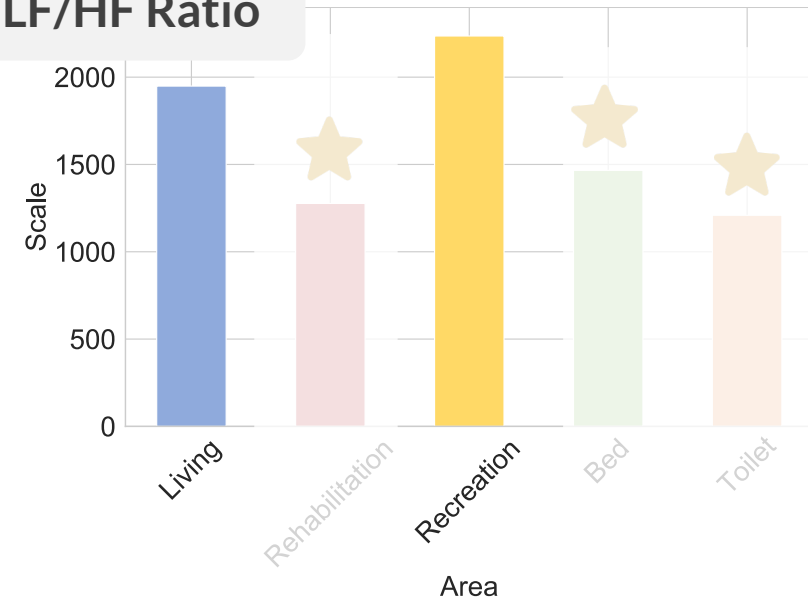
5 Result

Lorenz Plot Area

Small Area ► Stress



ID_01



ID_02

Relatively large for **Work in the Living room** and **Recreation Instruction**



Mental load was small for **one-to-many activities**

6 Future Issues

- **The amount of data was not sufficient**

- ❑ Nearly half of the subjects did not wear the sensor
- ❑ The questionnaire was not answered



It is difficult to collect data while actually performing cursing care tasks

Some ingenuity is needed

(Use of devices that do not affect the work, Reviewing the questionnaire)

6 Future Issues



- **Differences among facilities and services**

- ☐ We received the opinion that the mental state changes depending on the person (e.g., dementia patient) being treated

- **Differences in personalities**

- ☐ By incorporating questionnaires such as the **Big Five** in our experiments, we may be able to observe differences in personality and stress changes

Currently, we are continuing the experiment in another nursing home

7 Conclusion

● Overall

- ❑ Visualization and analysis of changes in caregiving activity and psychological state
- ❑ From the objective stress index, we were able to confirm that the caregivers were under stress in certain caregiving activity

● Future Work

- ❑ Review the devices and survey indicators used
- ❑ Ongoing data collection
- ❑ Building a stress estimation model based on the obtained data