

Cycling Analytics

Meeting 19 April 2021



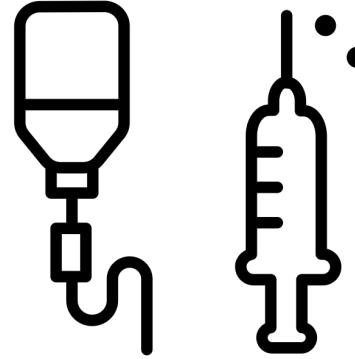
Recap

Overview

Cycling



Glucose



Devices

Cycling



heart rate

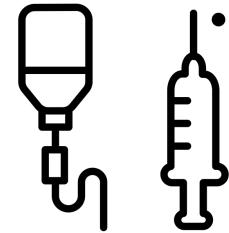


power



bike computer

Glucose



dexcom



----- june 2020



libre

Platforms

Cycling



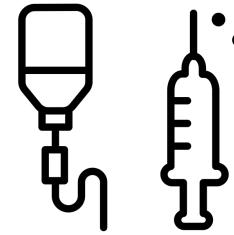
heart rate

power

bike computer

TrainingPeaks (sec)

Glucose



dexcom



libre

Dexcom (min)

Objective

Support patients with Type 1 Diabetes (TNN
riders) in glucose management during exercise

1. General insights in glucose levels in-,
during- and after training sessions through
descriptives
2. Association of **training sessions** with time
spent in glucose levels
3. **Predict future glucose levels** based on
current and past glucose and current and
past exercise.

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Today

- **Update:** changes w.r.t. previous meeting
- Insights in data through **descriptives**

Update

Update: Changes in data

Use **2019 data** instead of 2020 data because:

- Has been used before in research projects
- Patient consent forms
- No covid
- Easier platform (dexcom instead of libre)

⇒ 11 athletes for season 2019 (1 dec 2018 - 30 nov 2019)

Data completeness: TrainingPeaks

11 riders for season 2019 (1 dec 2018 - 30 nov 2019)

Which training sessions do we **exclude** (so far)?

- If there is **no file** in TrainingPeaks or the file is broken
- No data about **timezone** available (not in file or from location)
- **Device selection:** ELEMNT (BOLT/ROAM), Zwift
- Files that are recorded **simultaneously** (duplicate timestamps)

Data completeness: TrainingPeaks

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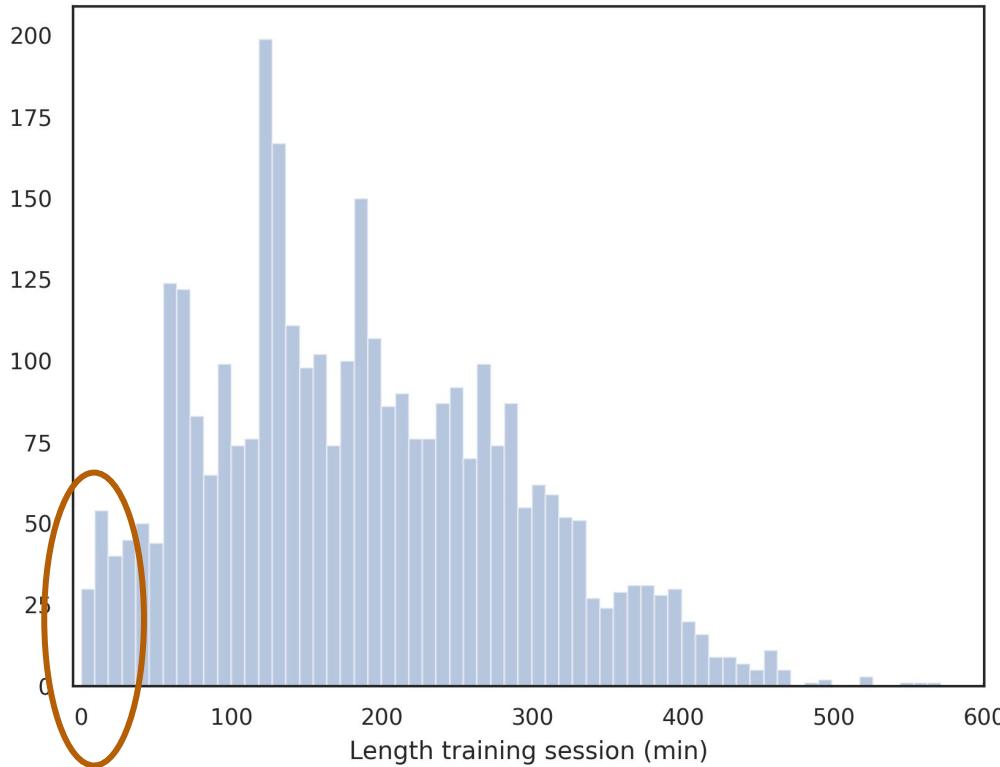
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Current issues

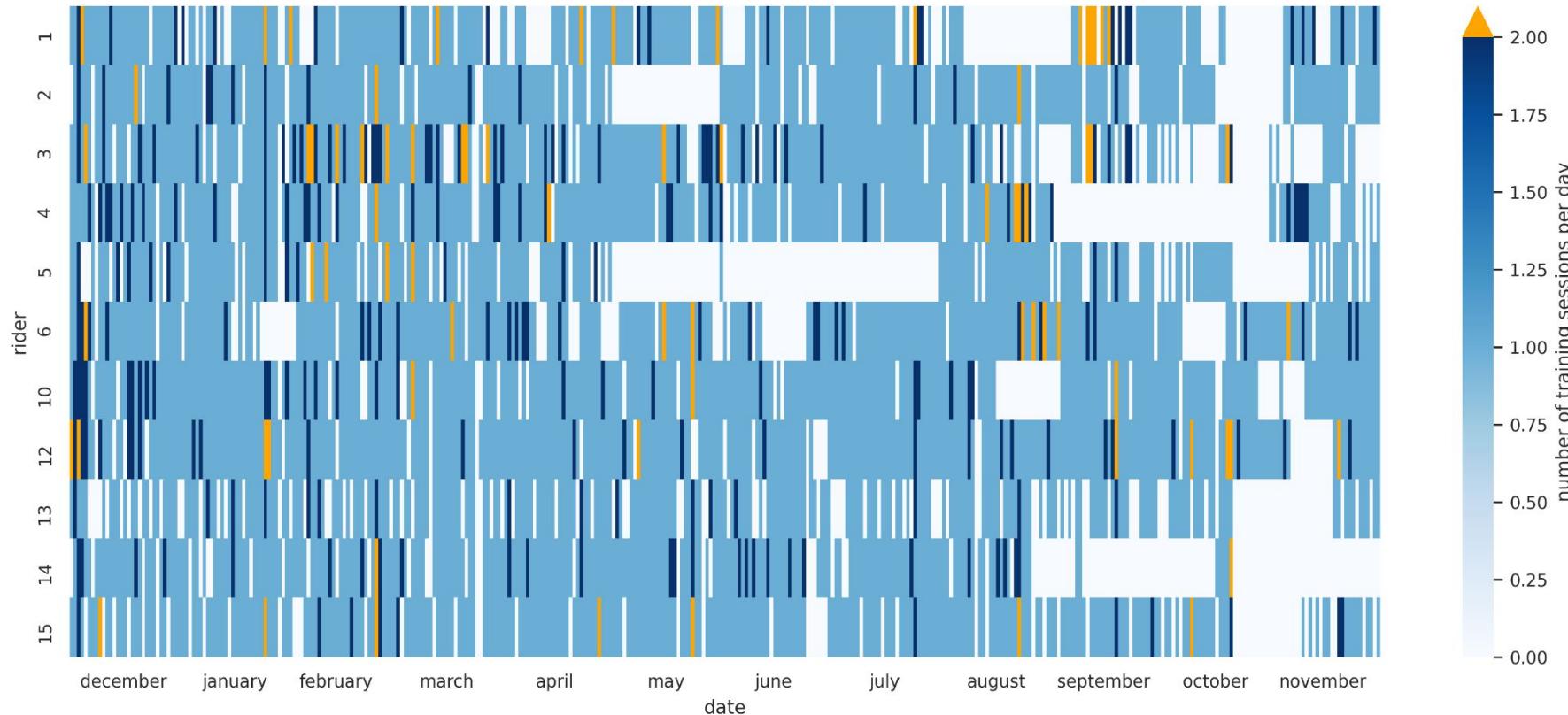
- **Timezone** from file and timezone from location differ in ~10 training sessions per rider
- A few training sessions are **copied** from one rider to the other
- Match data with **training calendar** file, to check if all training sessions overlap
 - Training sessions under 20 min

TrainingPeaks: length of training sessions



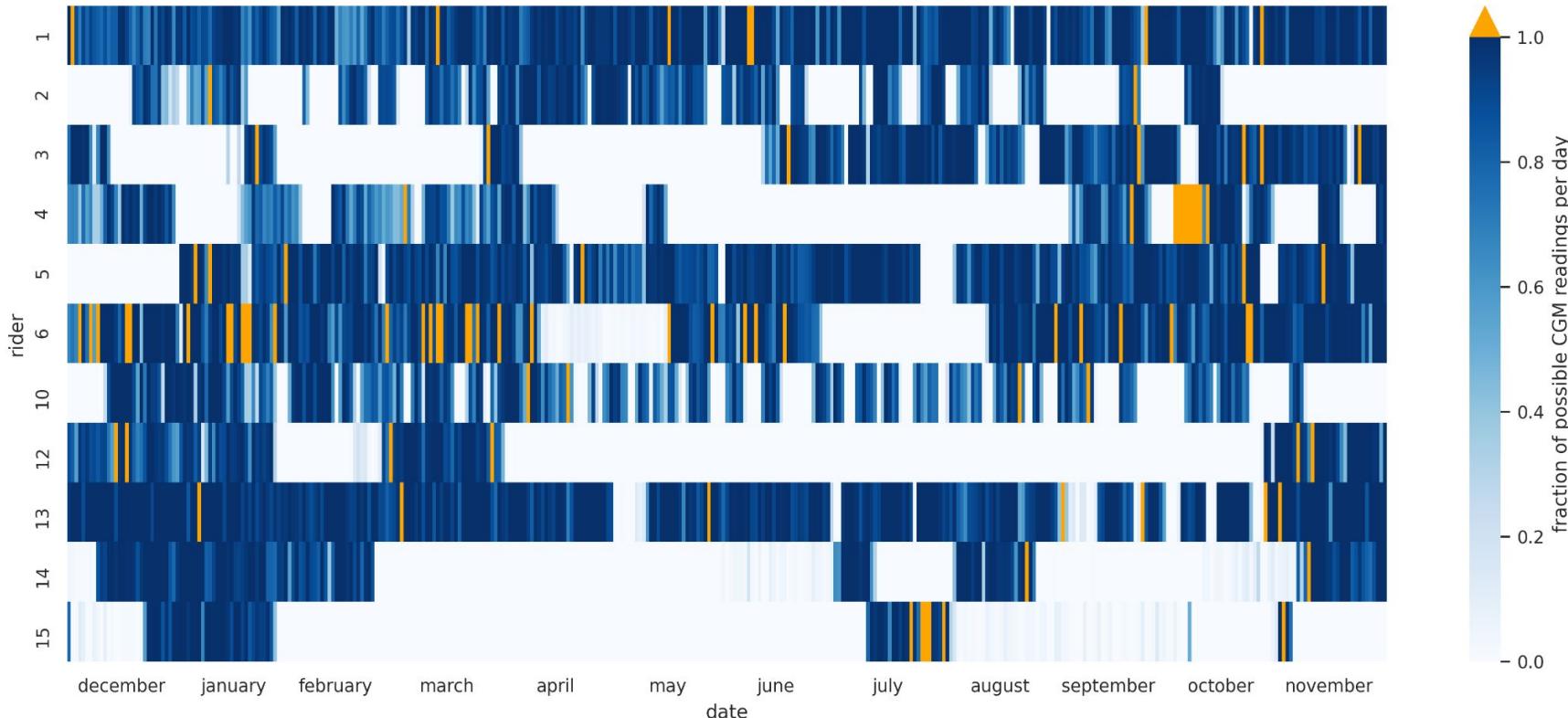
Data completeness: TrainingPeaks

For each rider, number of training sessions per day



Data completeness: Dexcom

For each rider, fraction of possible CGM readings per day

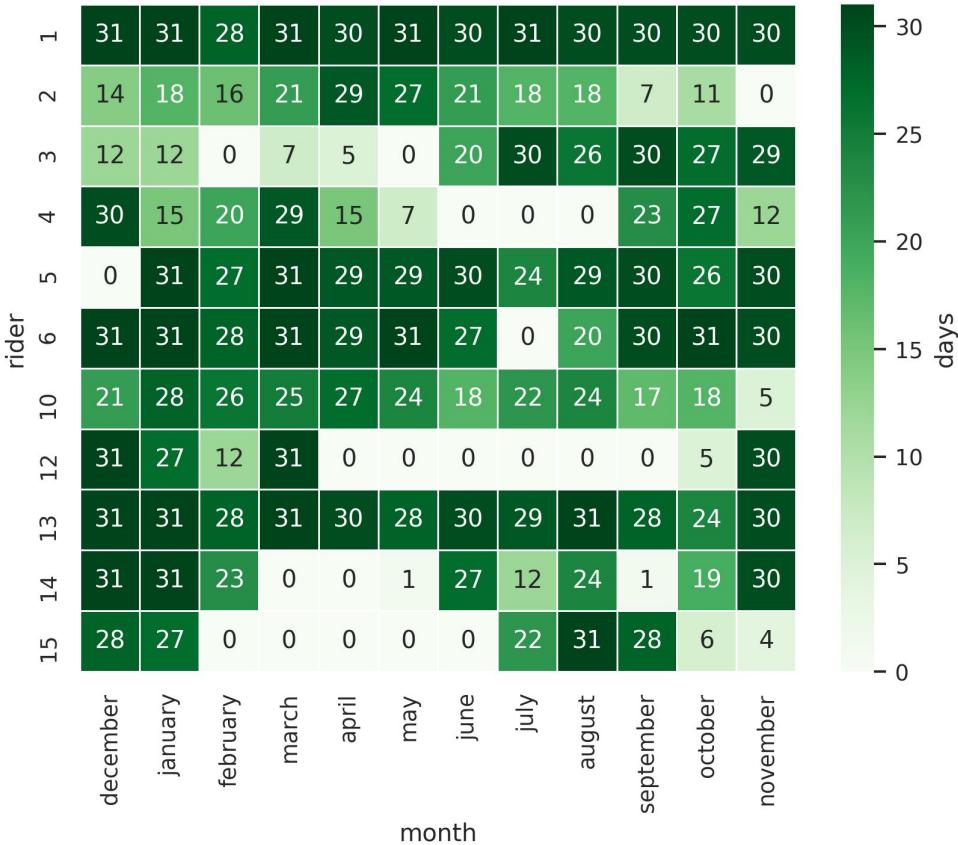


Data completeness: Dexcom

For each rider, number of days per month for which there is glucose data

Open issues:

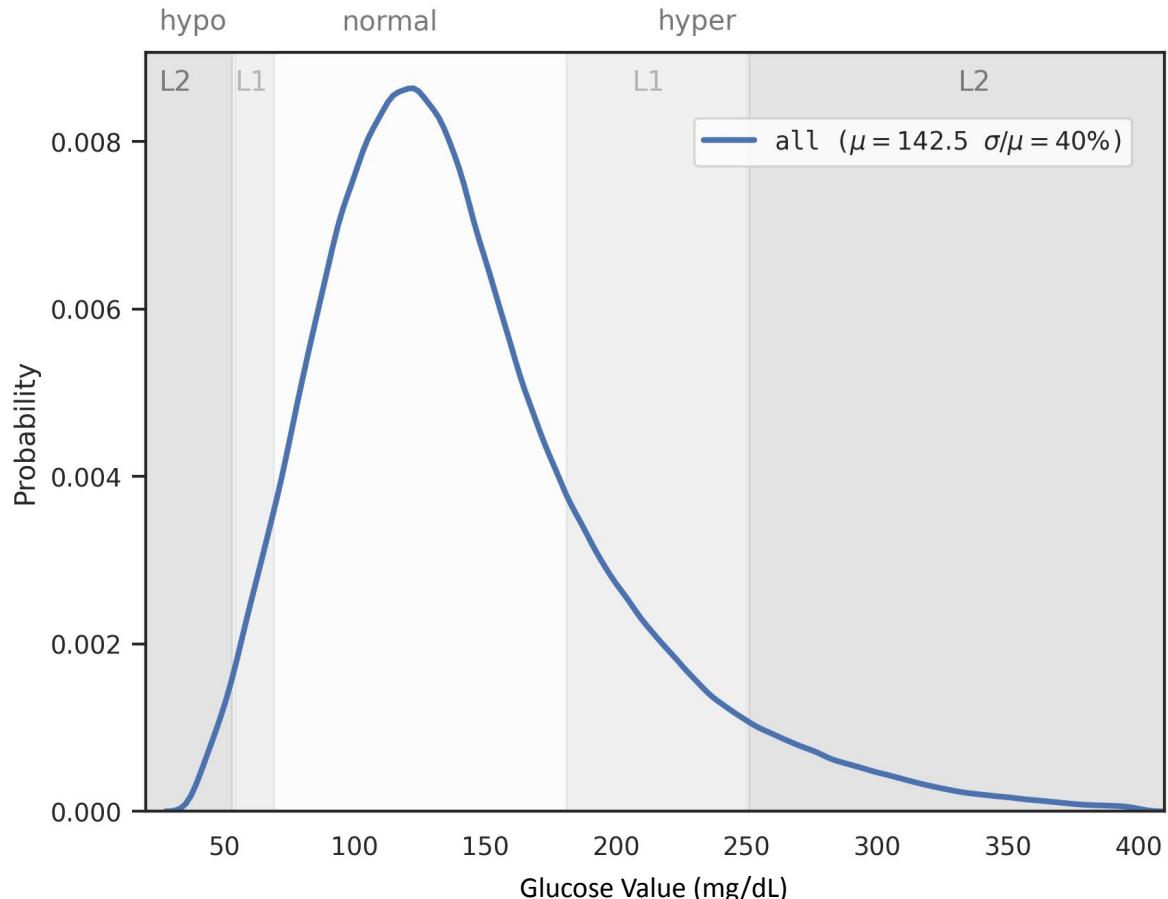
- Select days with >70% of possible glucose readings over two week period?
- Why can there be more glucose readings than 288?
- Readings: “High” and “Low”
- Exclude calibration measurements?
- Why are there glucose values in TrainingPeaks that are not in Dexcom



Glucose descriptives

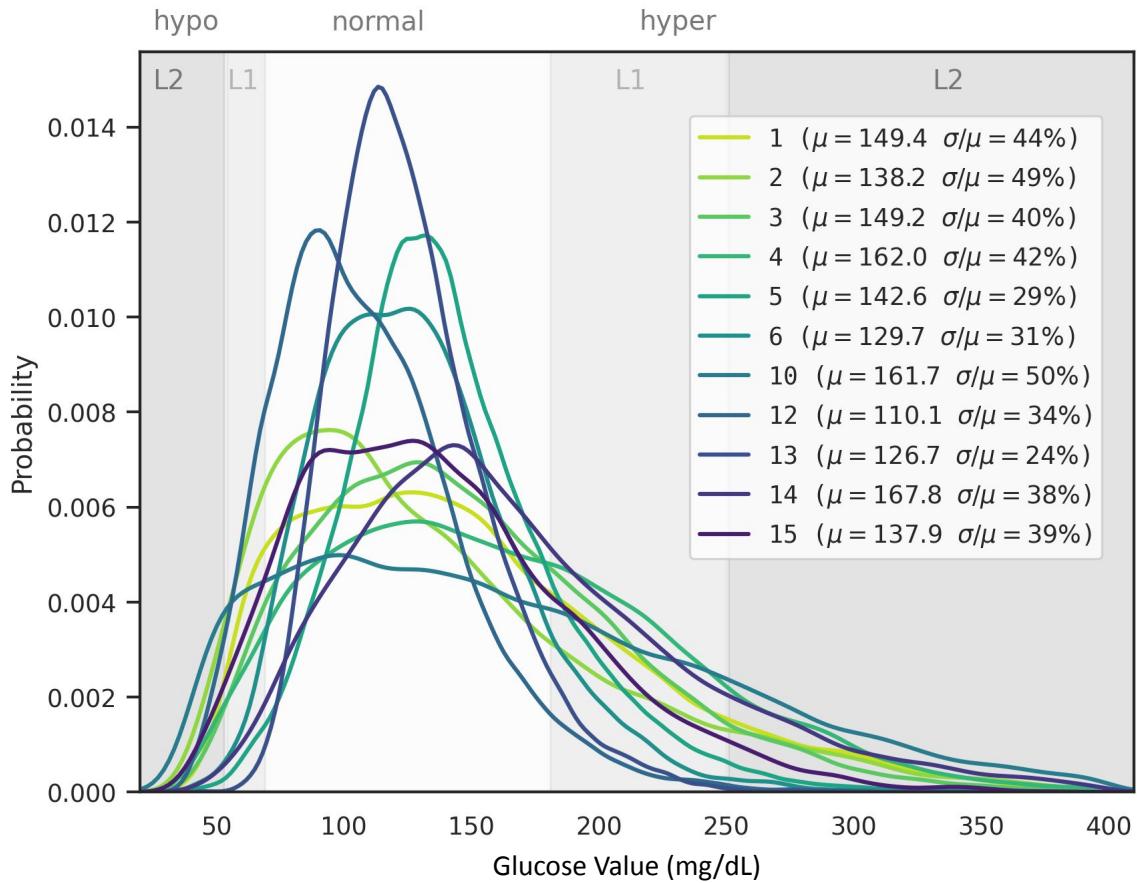
Glucose distributions

For all riders
Entire day
⇒ **stratify**



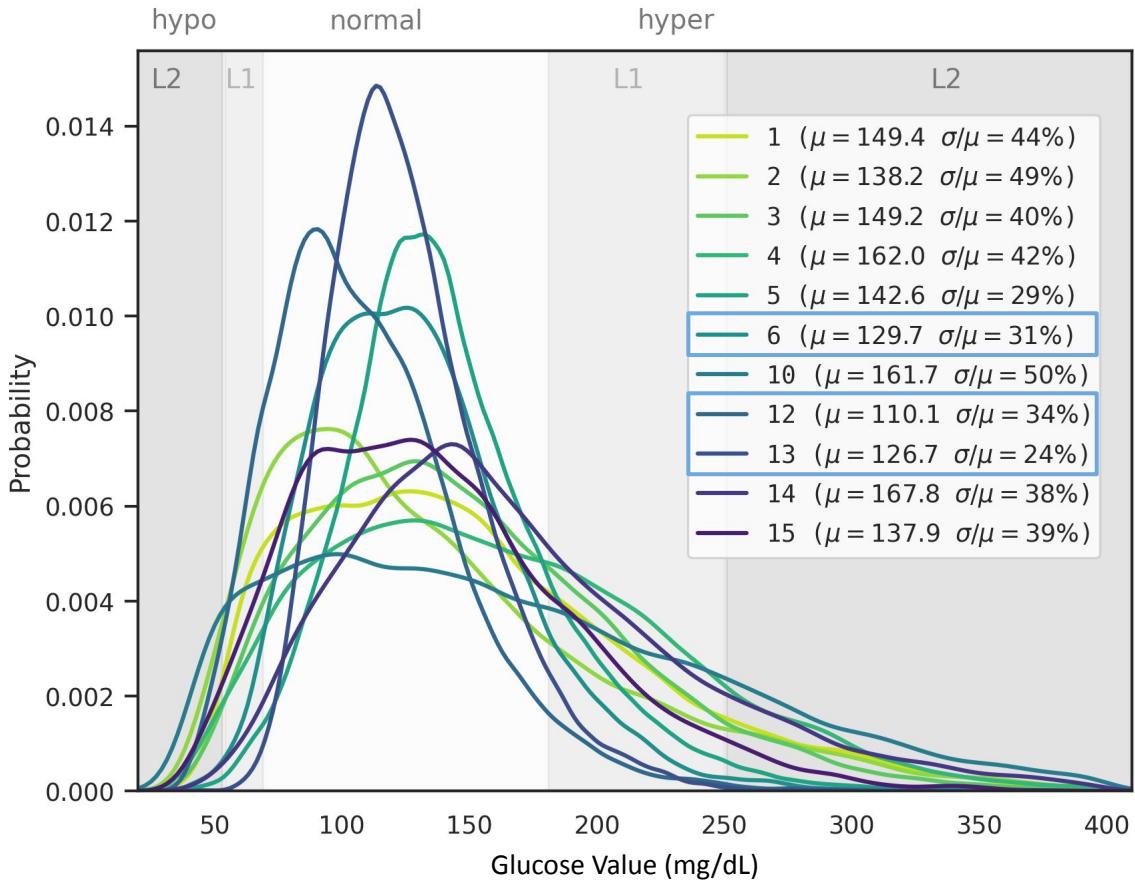
Glucose distributions

By rider



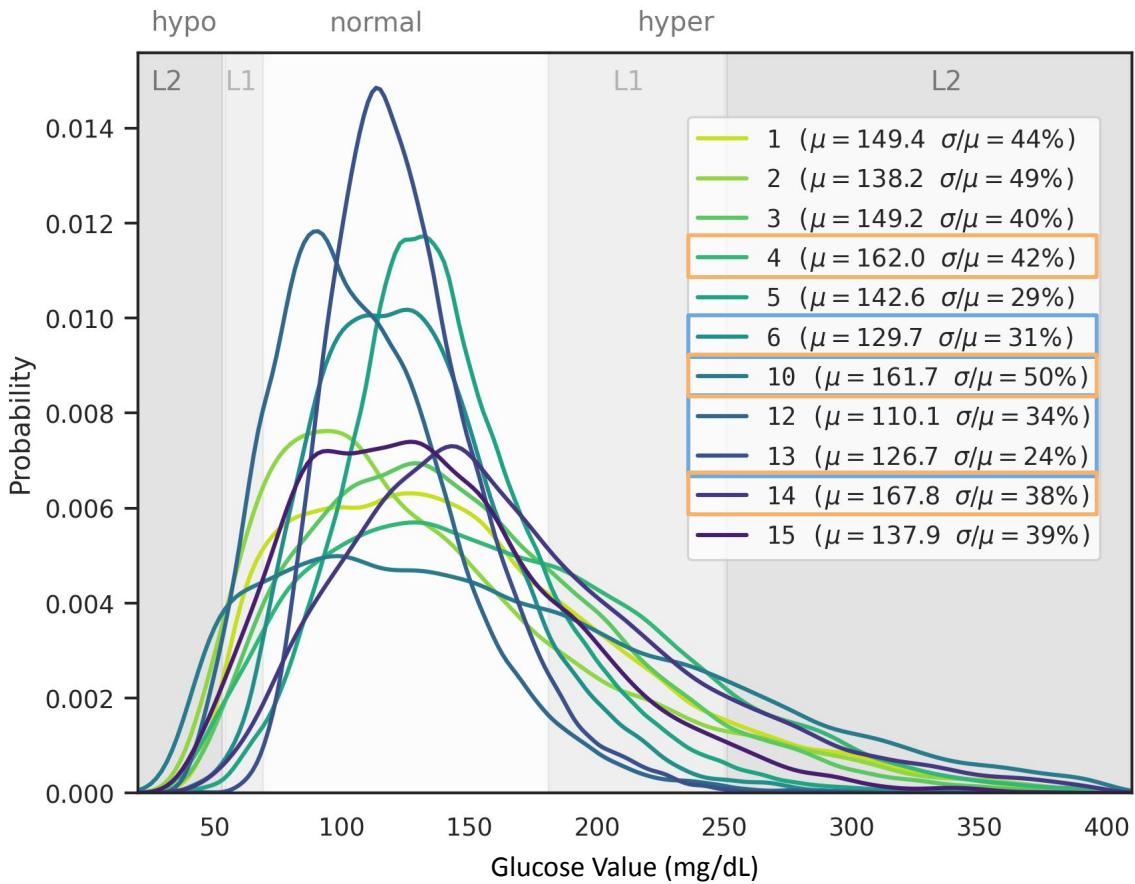
Glucose distributions

By rider



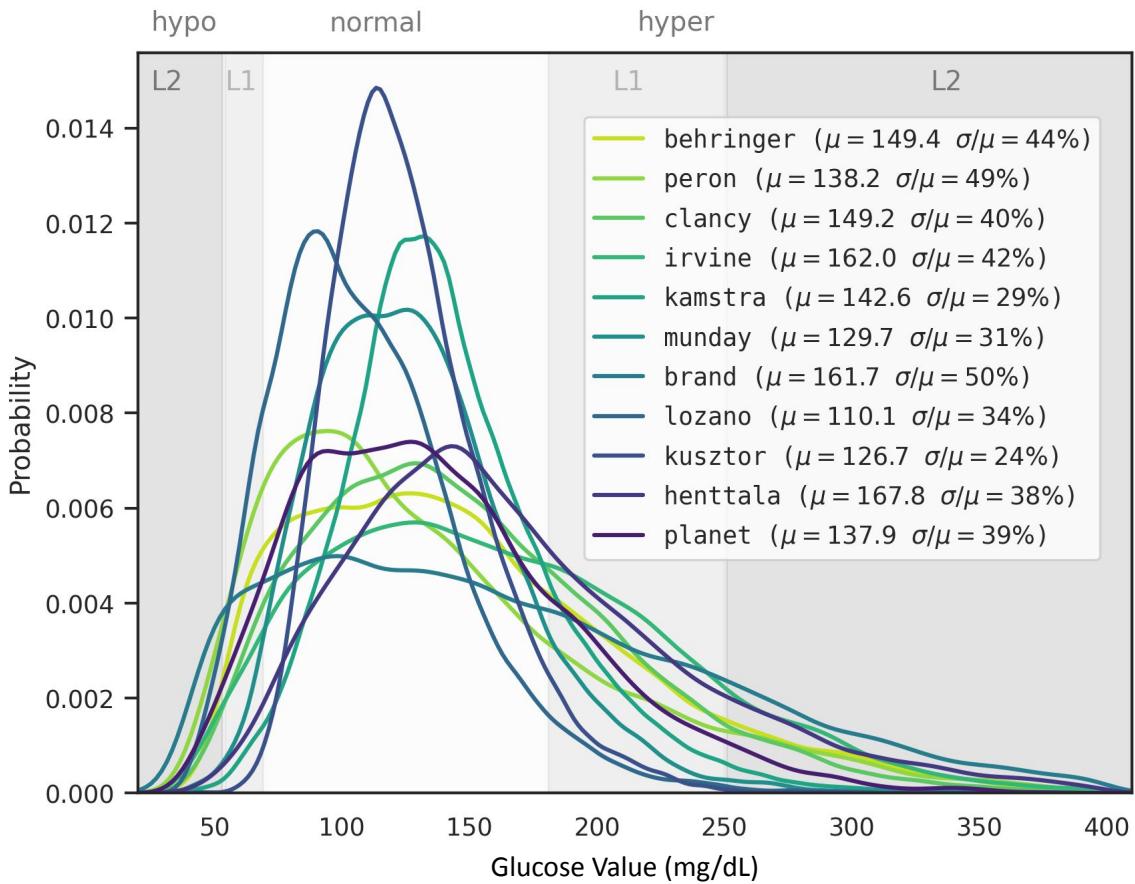
Glucose distributions

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Glucose distributions

By rider



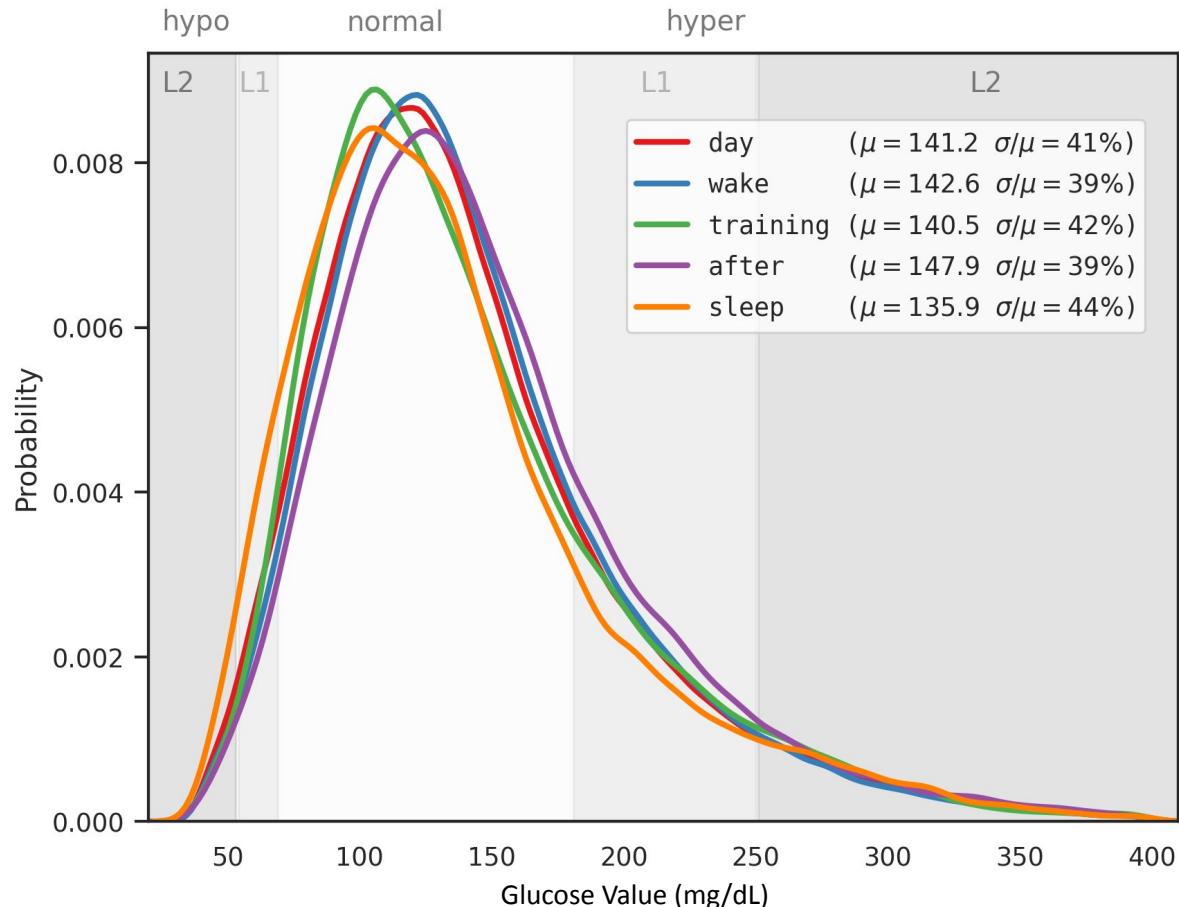
Glucose distributions

Stage	Glucose reading selection
day	0:00-24:00h on days of training sessions
wake	6:00-24:00h on days of training sessions
training	time of training sessions
after	4h after training sessions (exclude time second training session)
sleep	0:00-6:00h on night after training sessions

Note: training sessions are **not** excluded from day, wake and sleep

For all riders combined

⇒ stratify



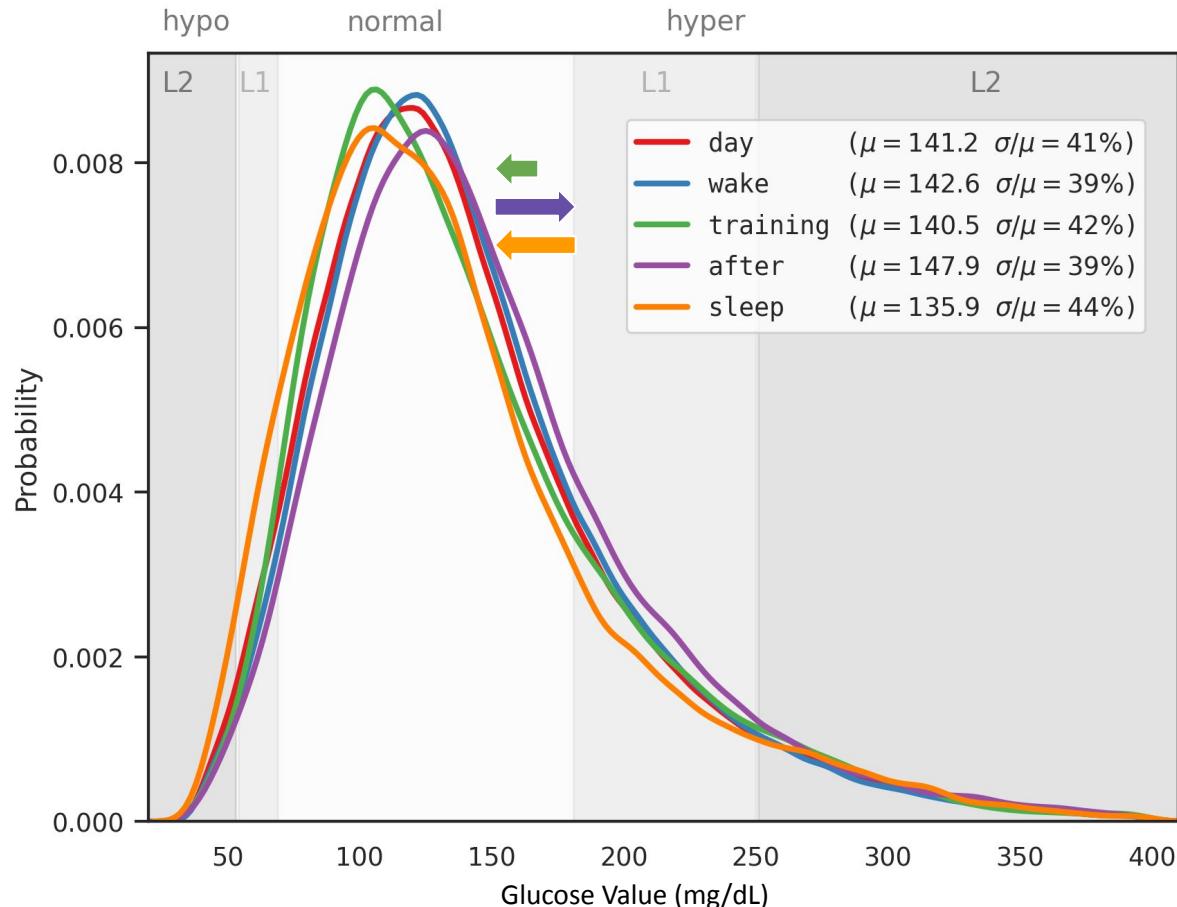
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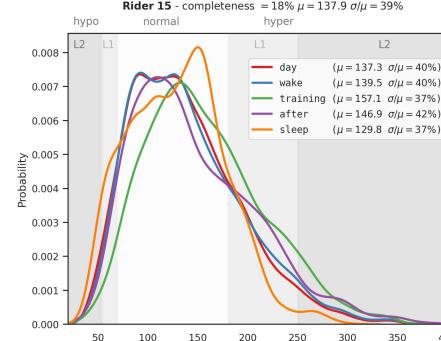
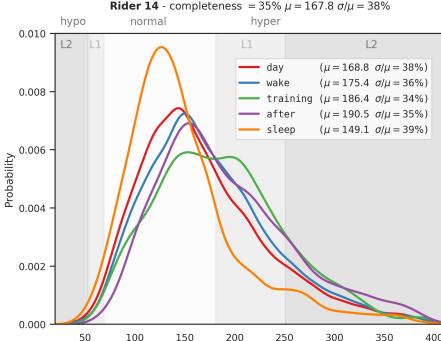
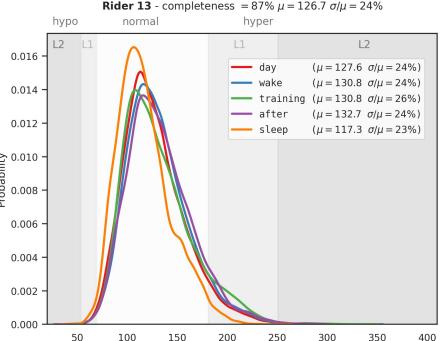
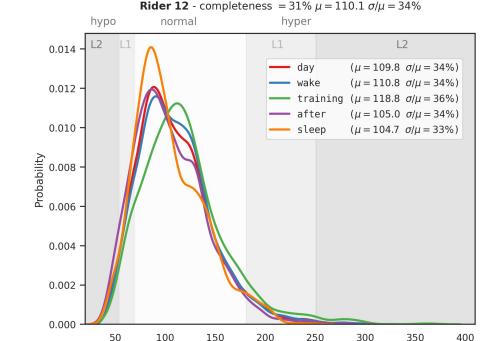
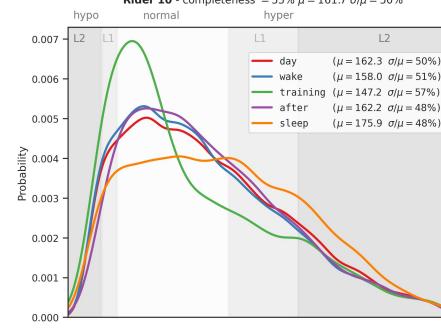
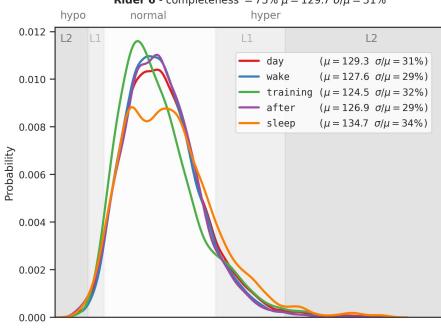
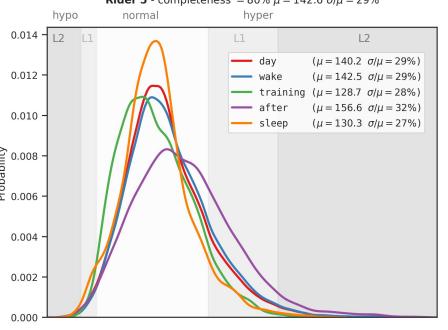
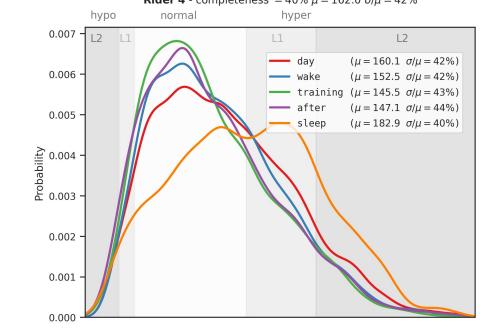
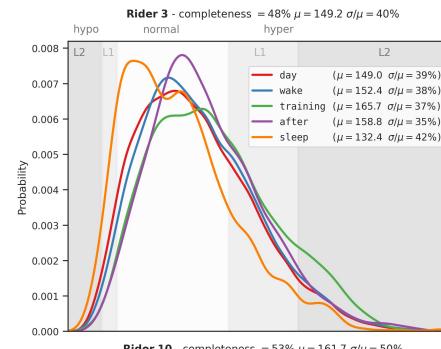
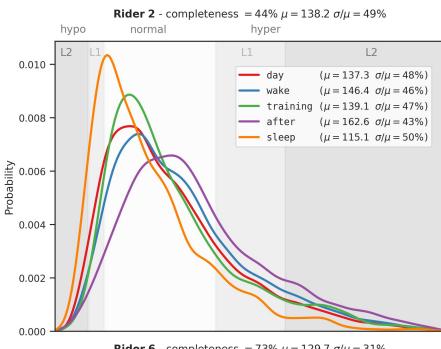
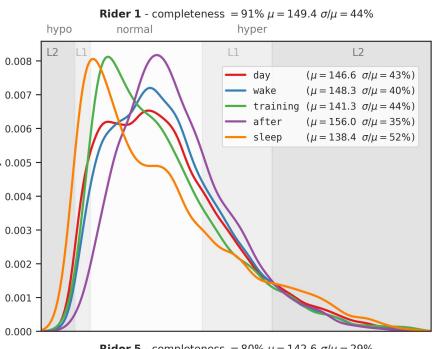
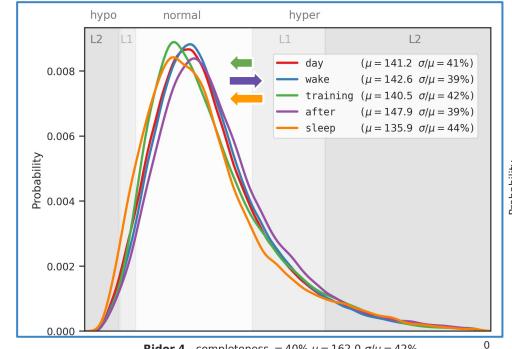
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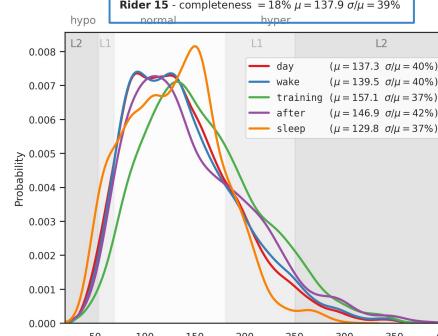
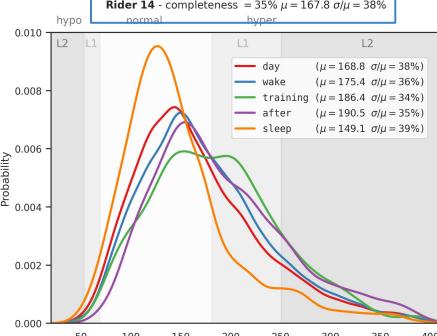
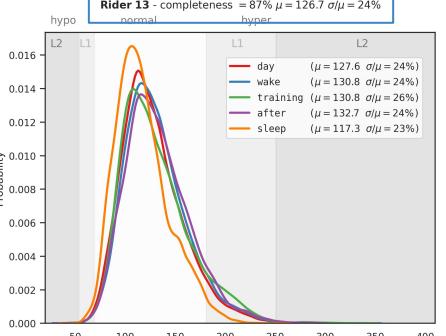
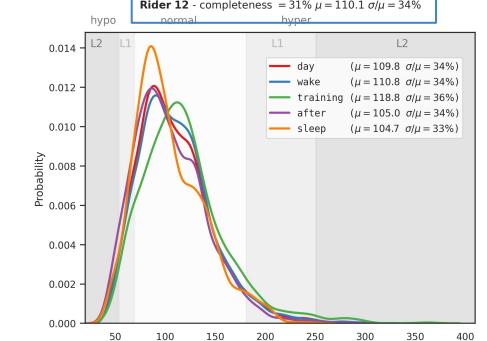
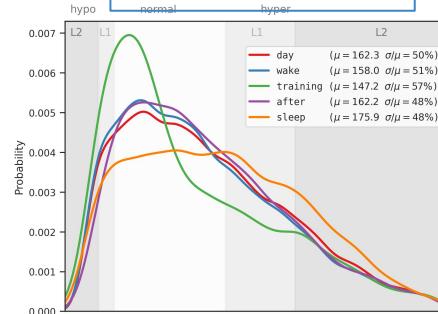
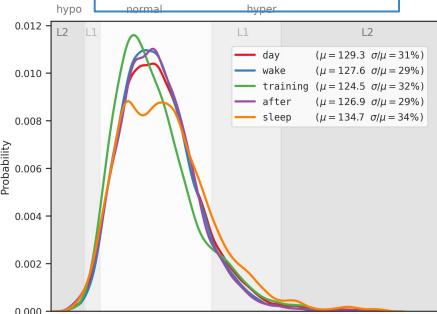
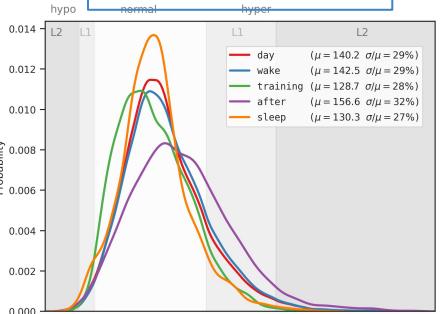
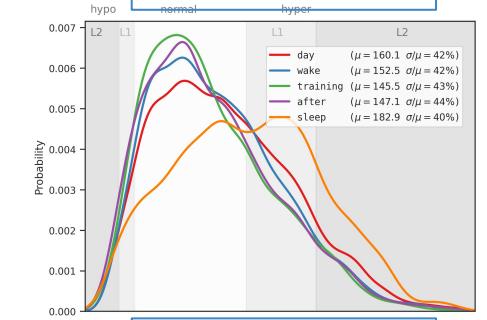
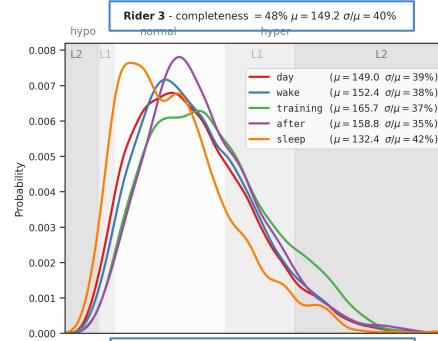
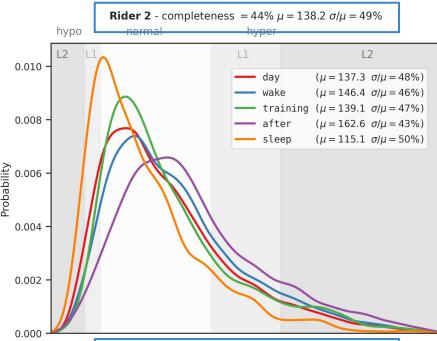
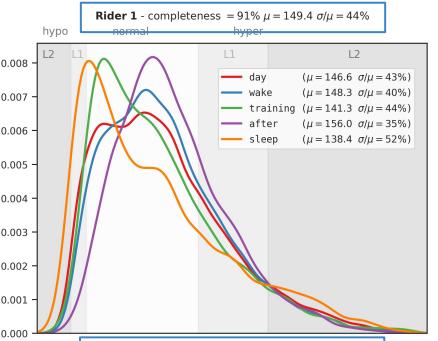
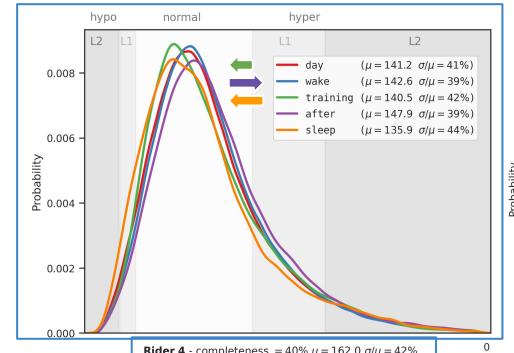
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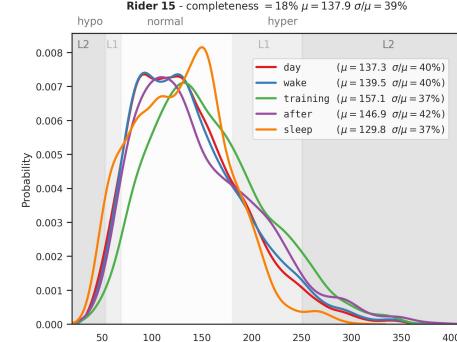
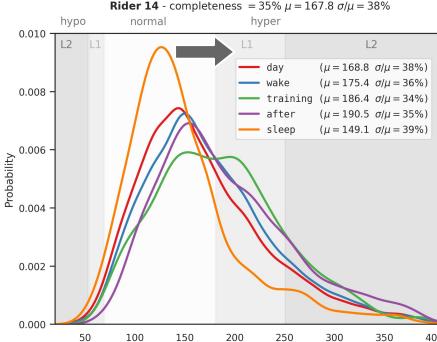
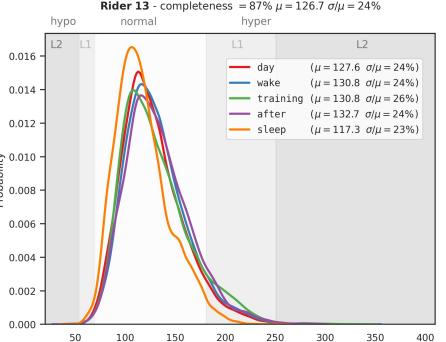
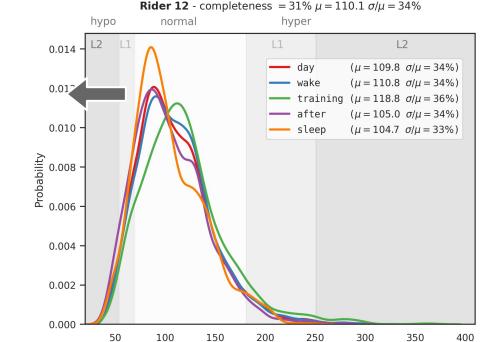
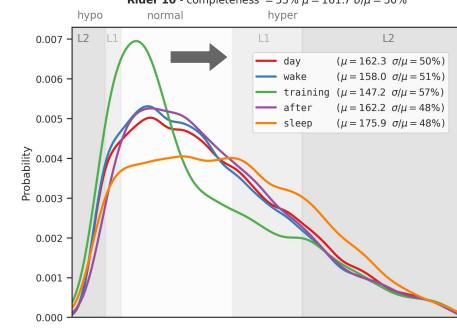
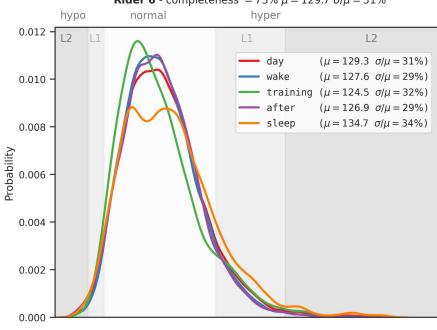
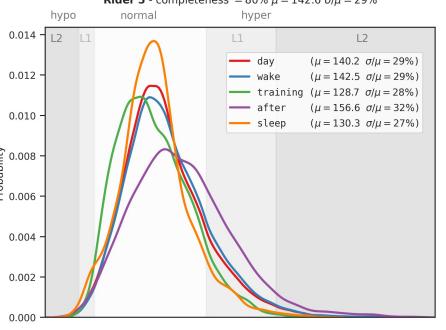
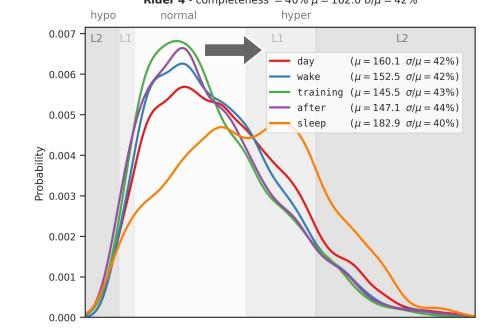
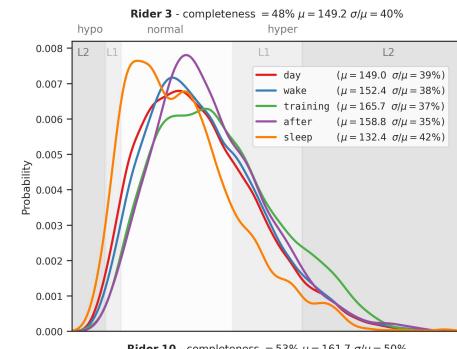
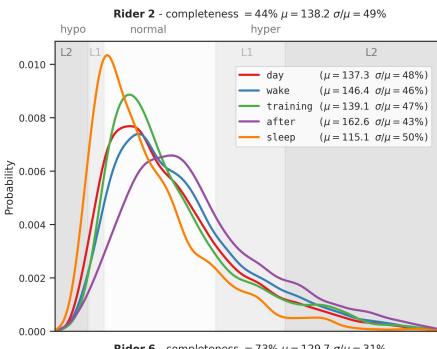
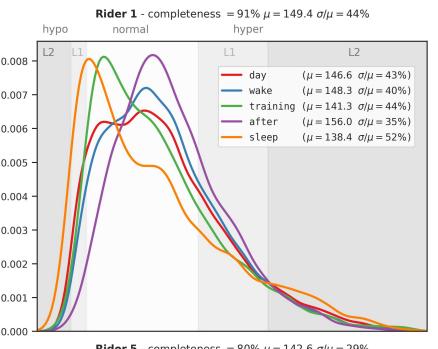
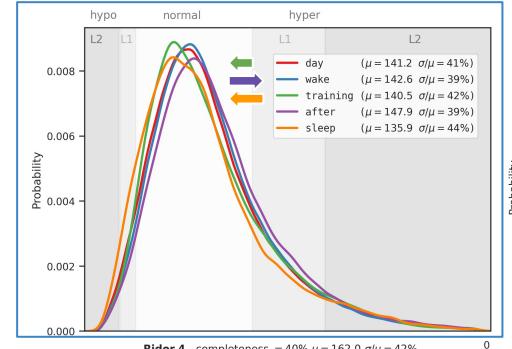
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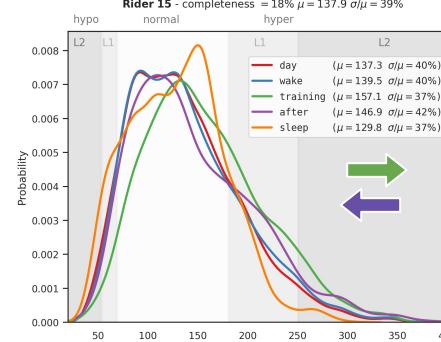
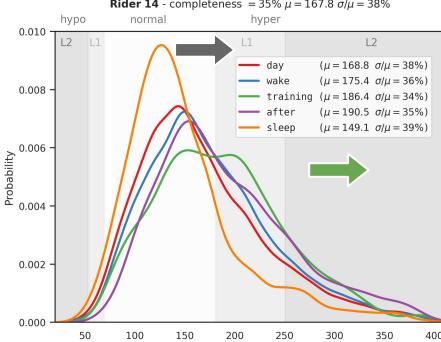
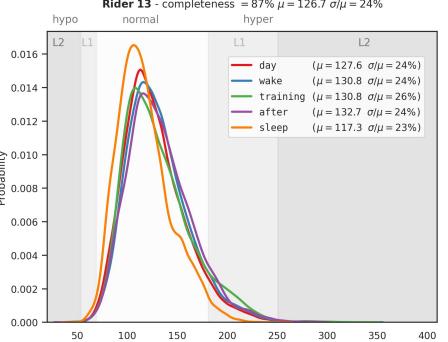
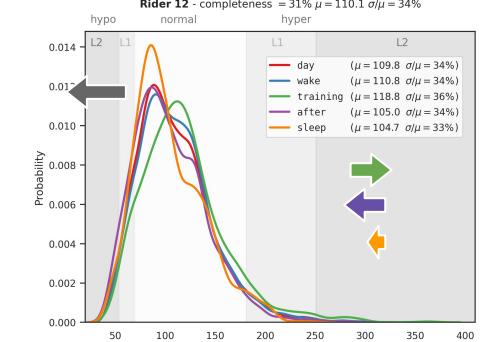
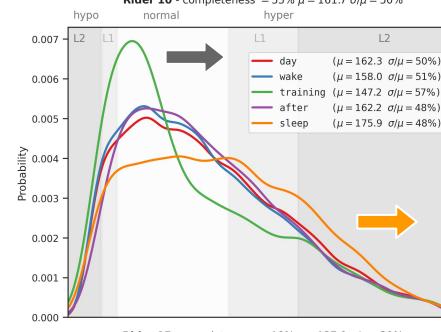
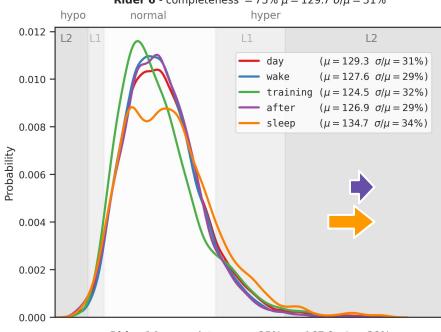
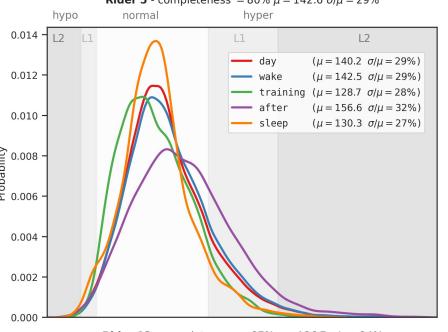
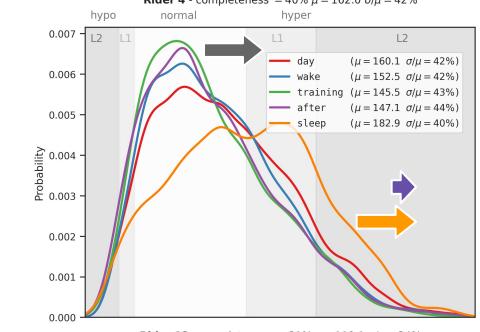
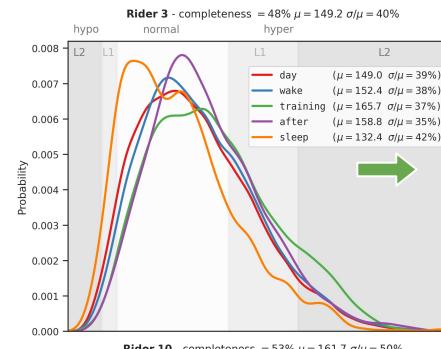
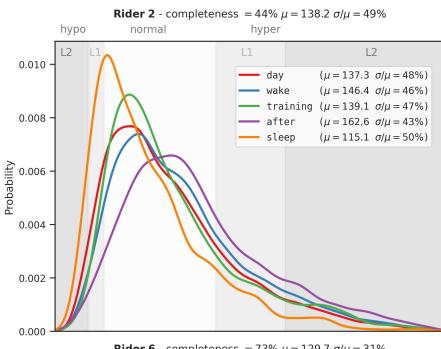
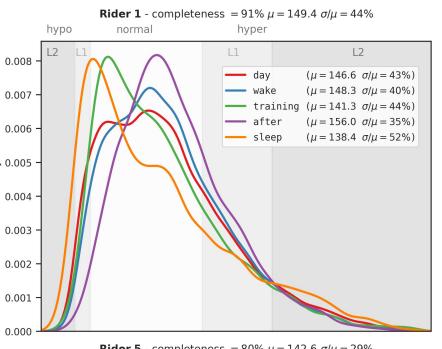
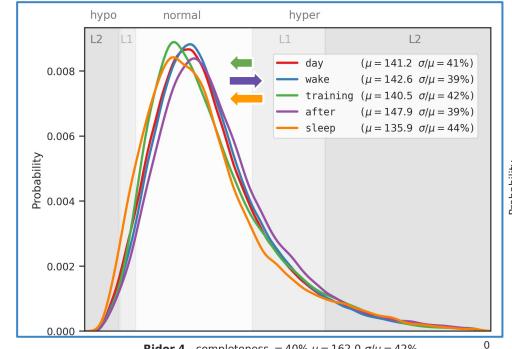
⇒ stratify

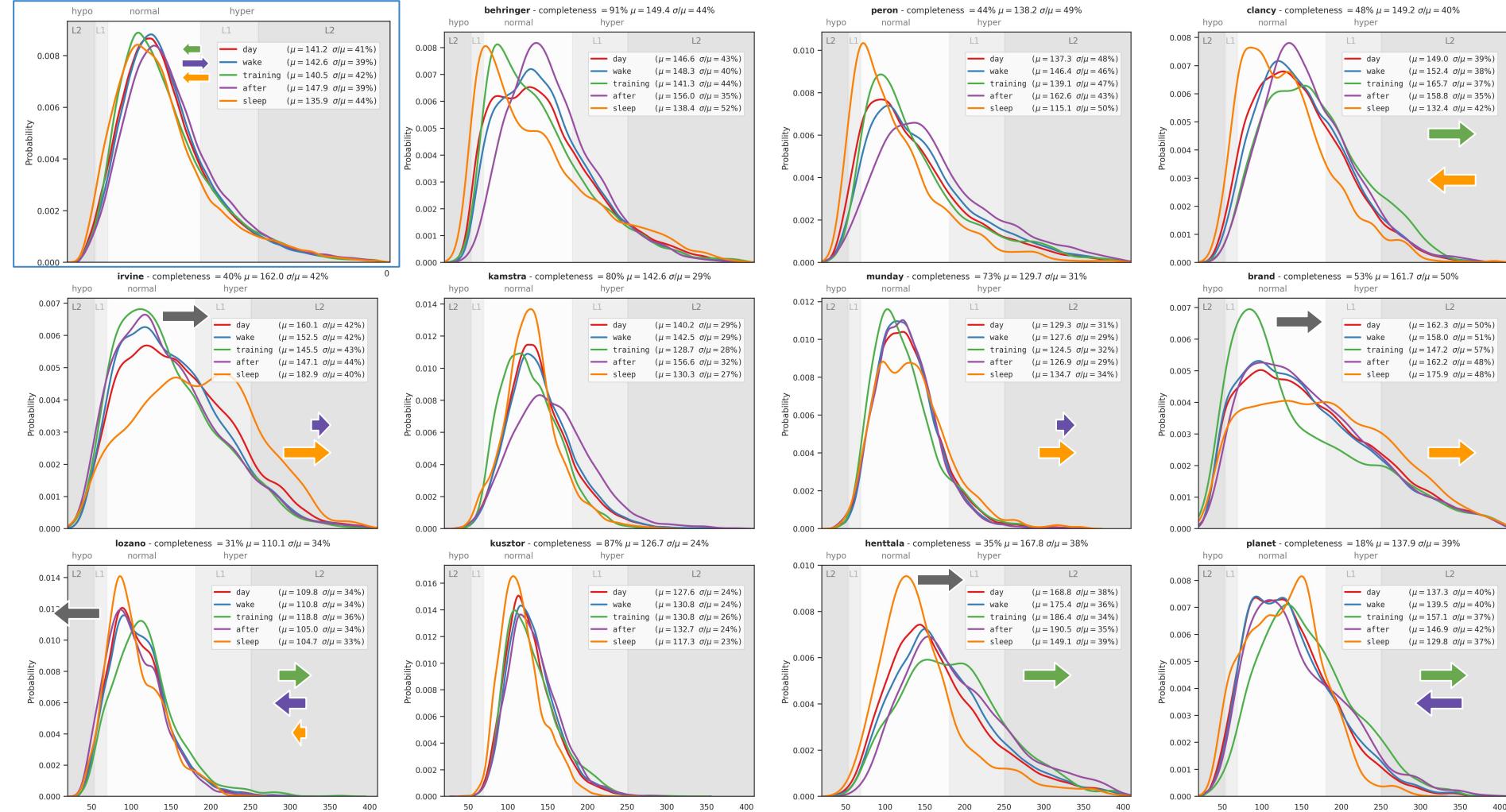


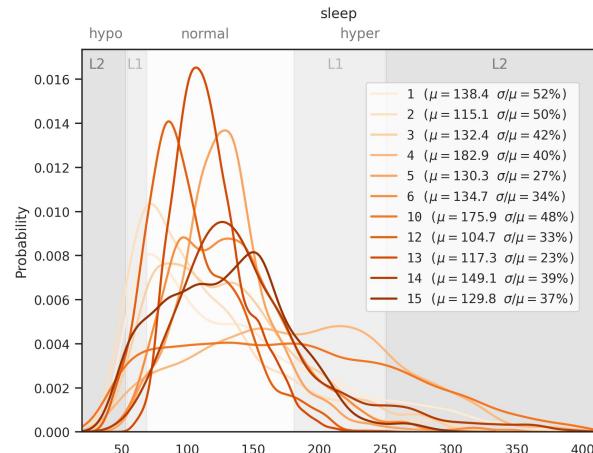
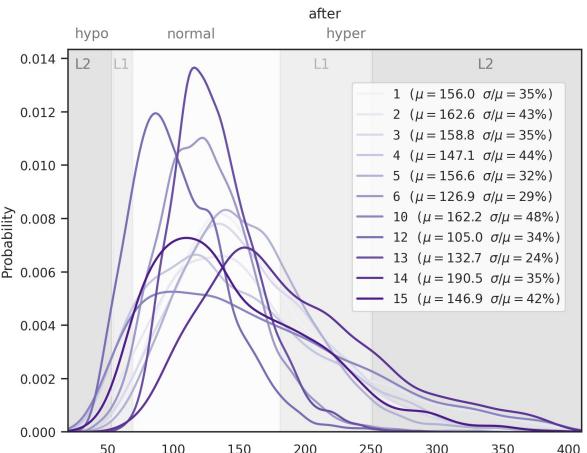
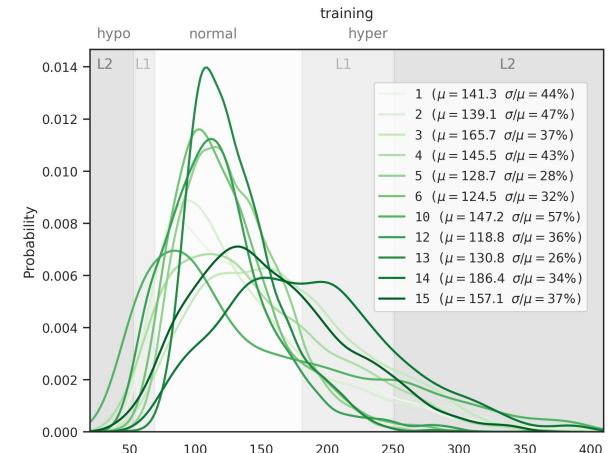
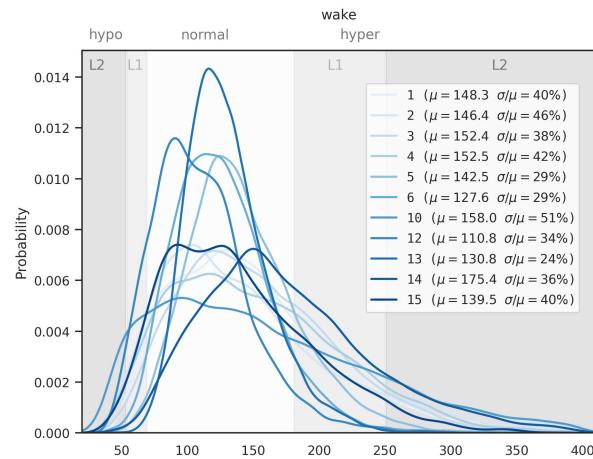
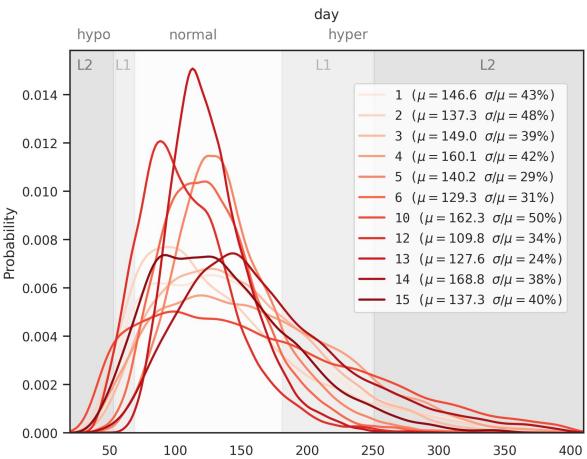
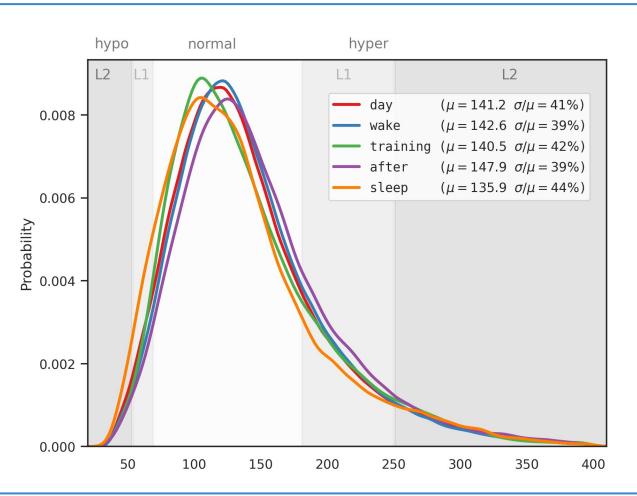








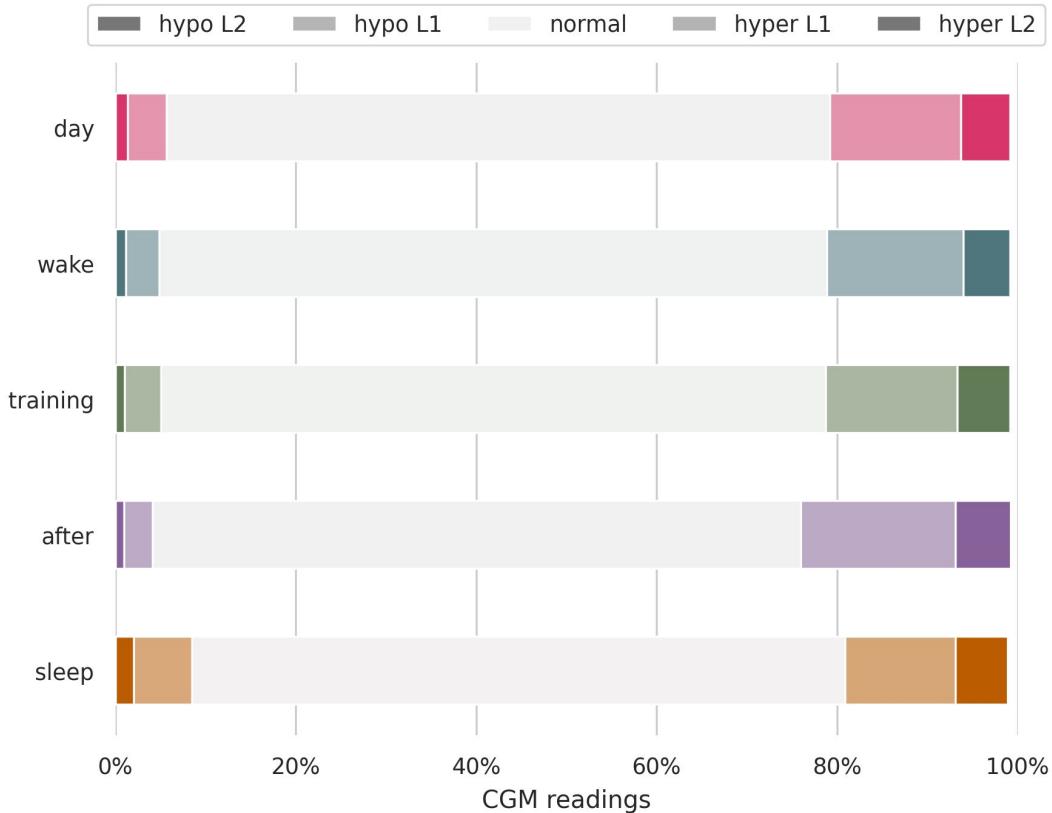


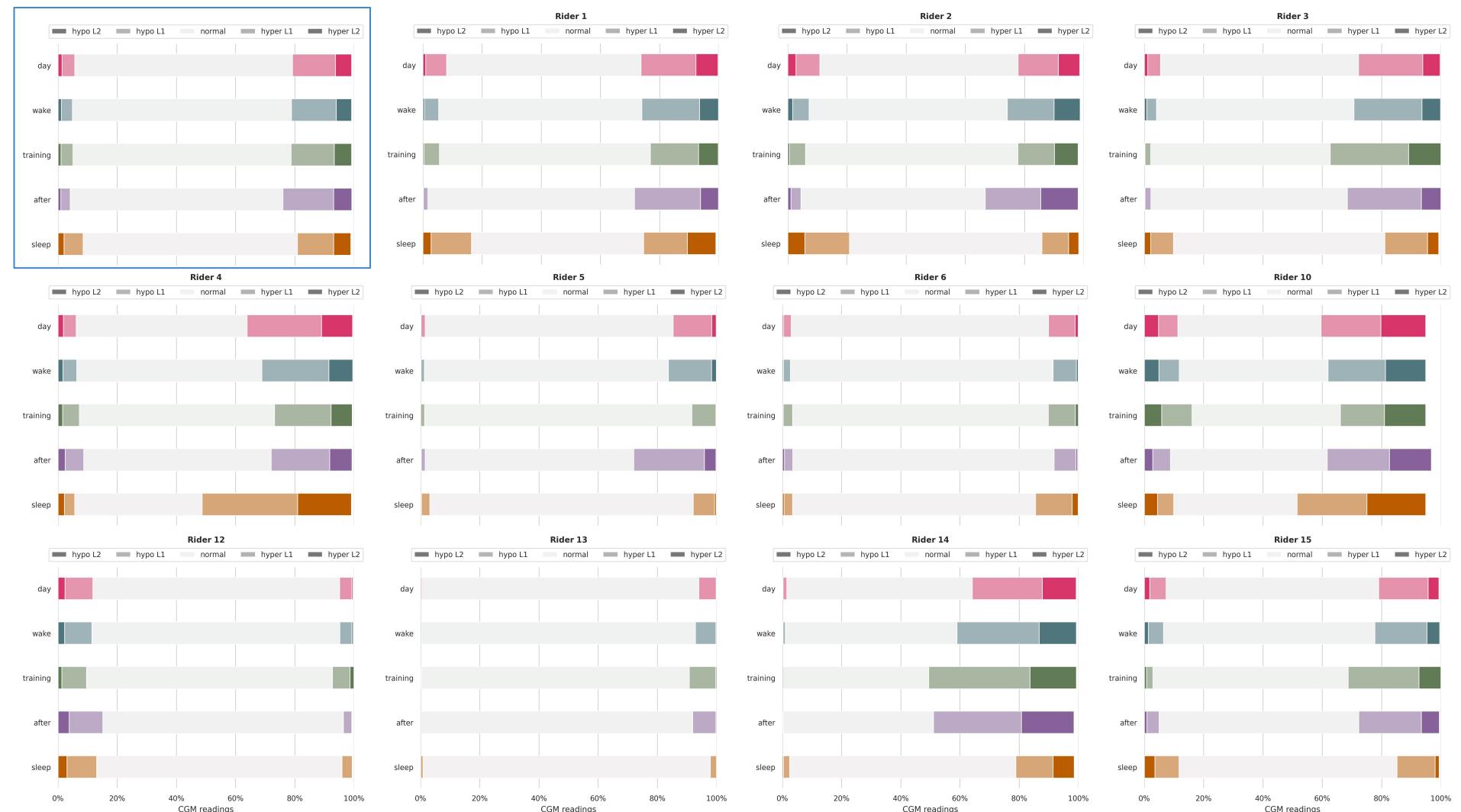


Percentage of CGM readings in glucose level

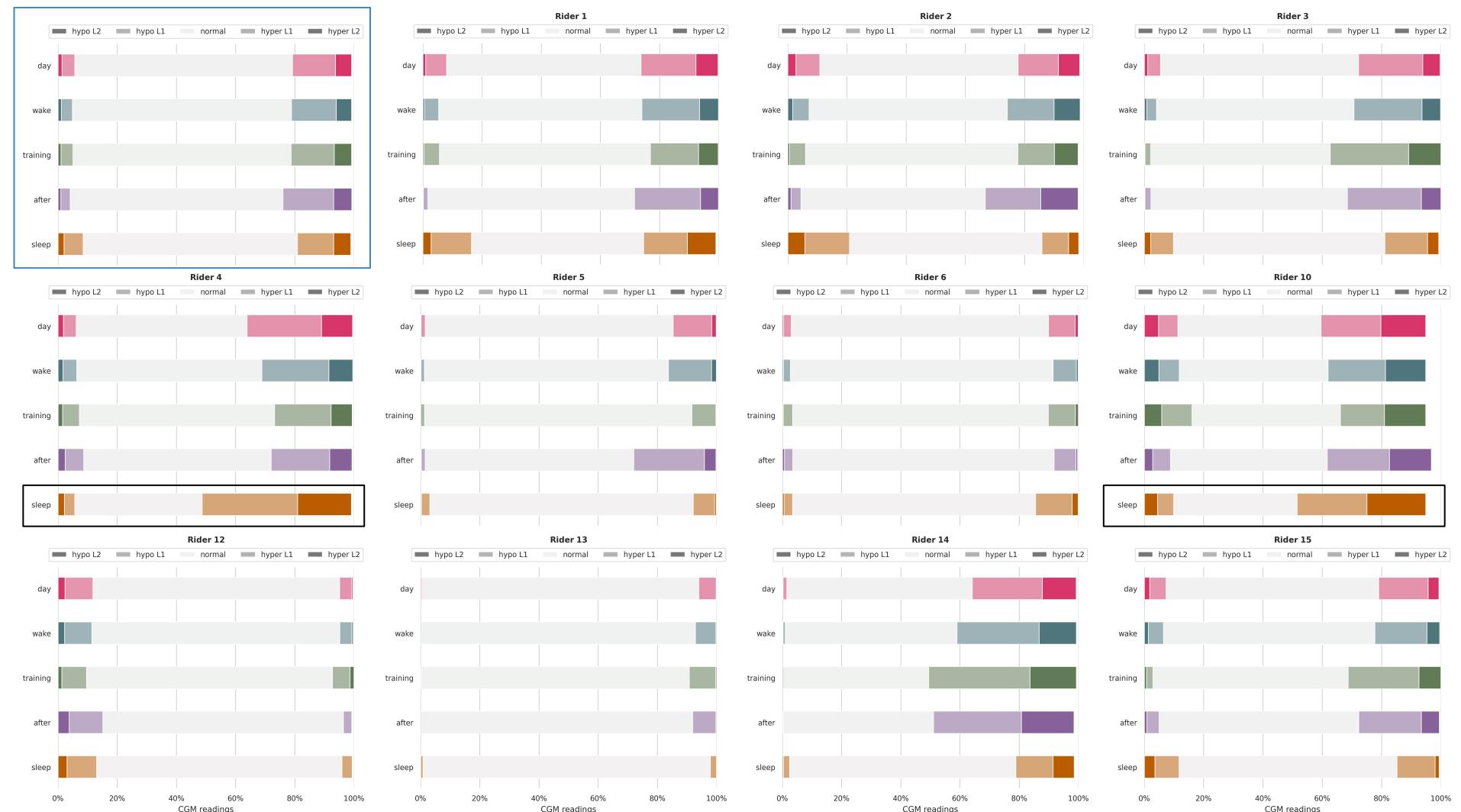
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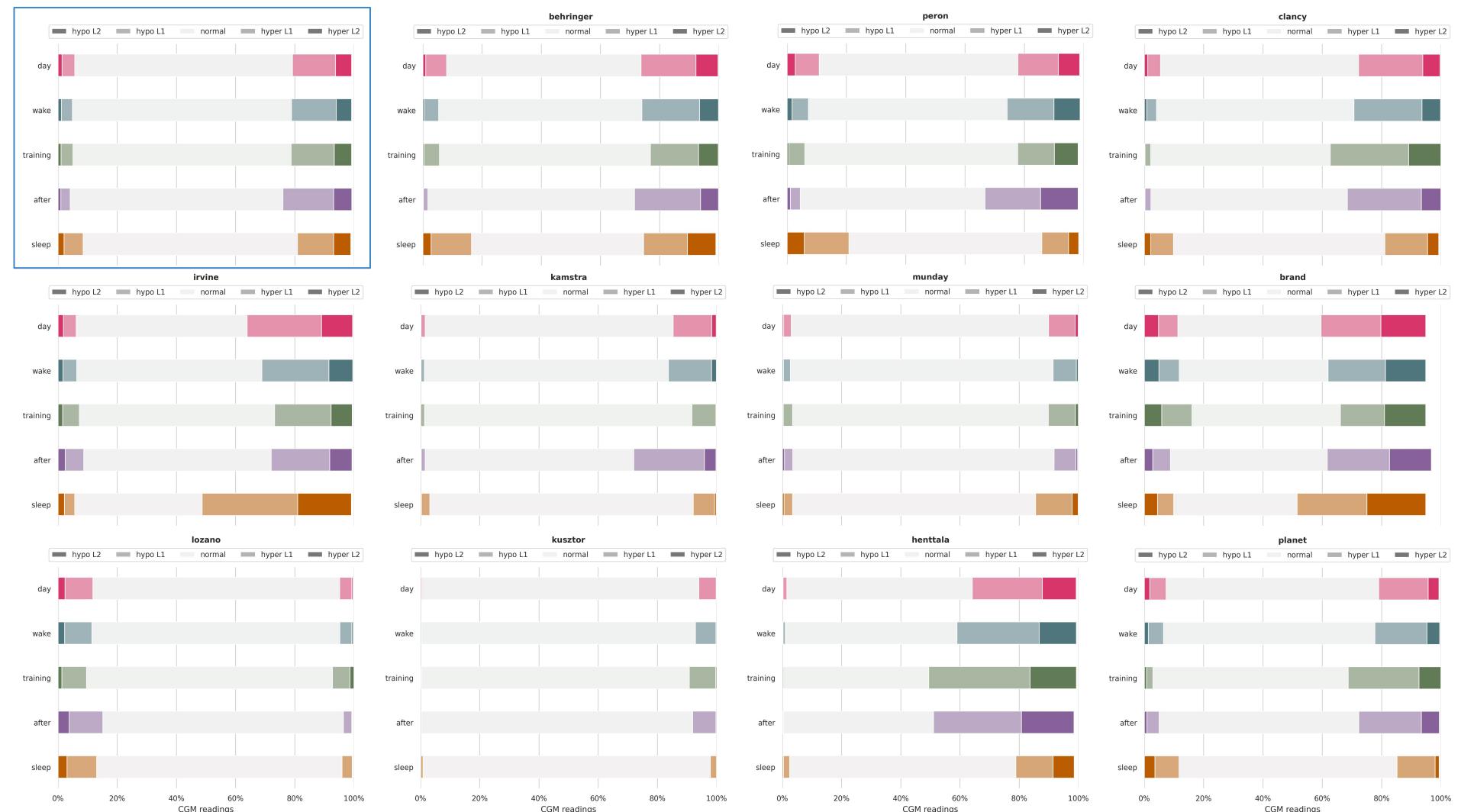
⇒ stratify











Any further glucose descriptives or ideas?

- Area under the curve
- Risk of hypoglycemia and hyperglycemia (?)

Training sessions

Correlations on a training session level

See if there are correlations between glucose (variability) and exercise variables

Exercise variables:

- Data from trainingpeaks (i.e. from GPS, heart-rate meter and power meter)
- Training session statistics (TSS, CTL, ATL, etc.)
- [TODO] Rider statistics (VO2%max, HbA1c)

Current issues

- Why is there sometimes zero output from the power meter, and how to treat this data
- Impute glucose to calculate *time in glucose levels*. Use linear imputation?

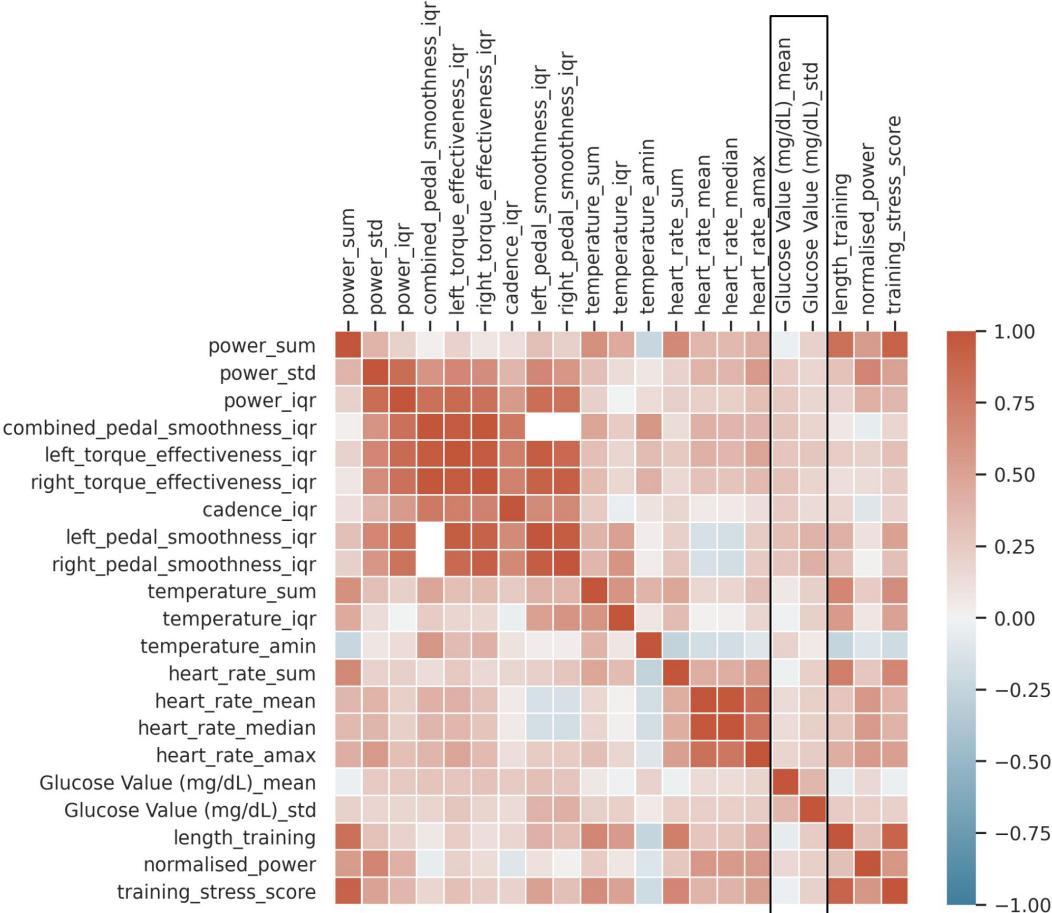
TrainingPeaks: correlations

Features that are most correlated with mean and std of glucose values over a training session

TODO:

- Include rider statistics
- Impute glucose values so we can obtain *time in glucose levels*
- Many other things (also mentioned before)

⇒ Figure is preliminary



Predict future glucose

Next steps

Model to predict future glucose

$$\text{glucose}(t + 30\text{min}) = f(\text{agg}_{s \in [t-30,t]} \text{glucose}(s), \text{agg}_{s \in [t-30,t]} \text{exercise}(s))$$

Sliding window approach to get historic information of features

- *Aggregation functions*: sum, mean, median, std, iqr, min, max

How often should there be a new prediction?
(every 1 min, every 5 min?)

- If every 1 min, linearly interpolate glucose values?

