Resting Heart Rate Deviation Model Results

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Outline

Strong-D Study Recap

Strength Training Regimen for Normal Weight Diabetics

- ▶ Goal: determine the best exercise regimen for normal weight participants with Type 2 Diabetes
  - ▶ Manipulated variables: strength vs aerobic vs combined exercises
  - ▶ Response variable: indirect measures of blood sugar levels
- ▶ Data:
  - ▶ Fitbit: frequent measurements, e.g. per second raw heart rate
  - ▶ iPad sign-in data, e.g. study arm data
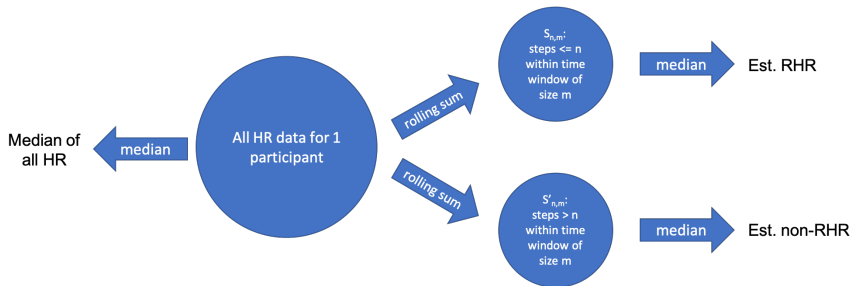 - ▶ Clinical + demographics data, e.g. weight, race

Model: Design

Figure 1: RHR Estimation Model.

Model: Optimization

Motivation: HR *variability* is positively correlated with exercise intensity. $\Rightarrow$ RHR has *lower* variability.

$$n^*, m^* = \arg\min_{n,m} SD(S_{n,m})$$

$$n \in \{x \in \mathbb{Z} : 0 \leq x \leq 1000 \text{ and } x \bmod 10 = 0\}$$

$$m \in \{x \in \mathbb{Z} : 1 \leq x \leq 120\}$$
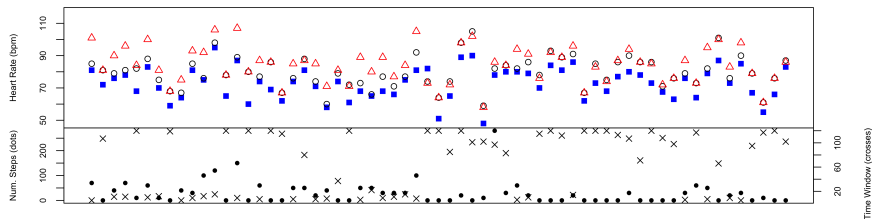
Results: Optimal Parameters and Median Comparison

Figure 2: Metrics related to estimated RHR. For each participant, the bottom plot shows the optimal number of steps (n^*) and time window size (m^*). The top plot compares corresponding RHR estimates (blue squares) to the estimated non-RHR values (red triangles) and the median of all sampled HR measurements (black circles).
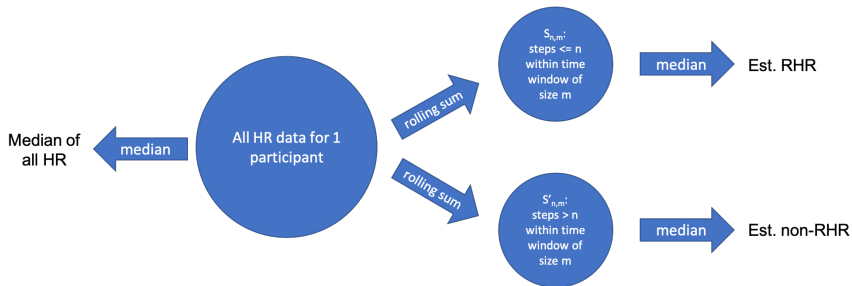
Model: Design

Figure 3: RHR Estimation Model.
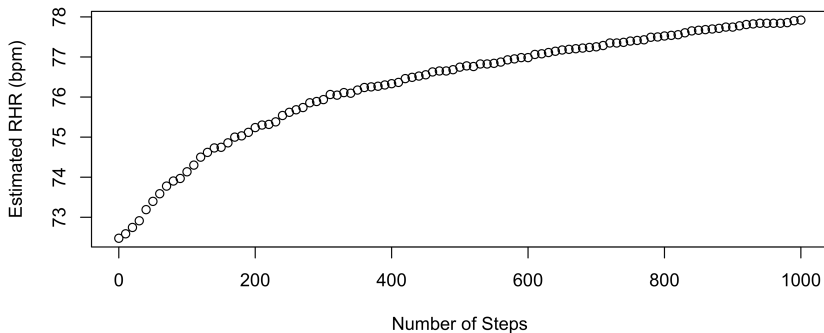
Results: Sensitivity Analysis for Steps

Figure 4: Sensitivity analysis of the mean RHR estimates over all participants for each step value while holding the optimum window size constant.

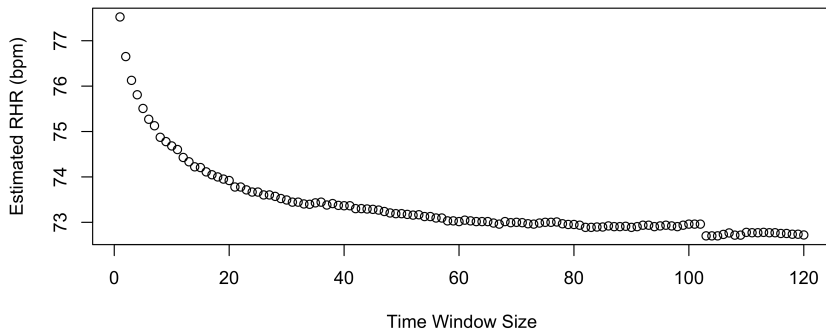# Results: Sensitivity Analysis for Window Size

Figure 5: Sensitivity analysis of the mean RHR estimates over all participants for each time window size while holding the optimum step value constant.

Results: Comparisons

$RHR_{clinic} = mean(\text{supine/sitting/standing RHRs})$

Table 1: Comparison of metrics averaged over all participants.

	Est. RHR	Est. non-RHR	Clinic RHR
Mean Value (bpm)	73.02	84.33	76.09
Mean SD (bpm)	7.80	14.33	N/A
Mean Num. Measurements	18257.76	41206.76	N/A

Literature:

▶ HR is positively correlated with exercise intensity. $\Rightarrow$ RHR has *lower* values.
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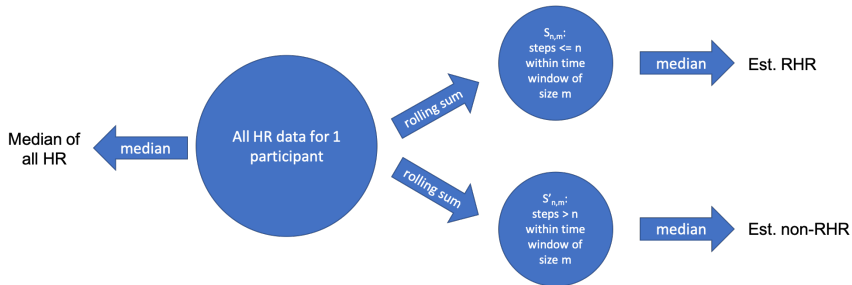
Model: Design

Figure 6: RHR Estimation Model.
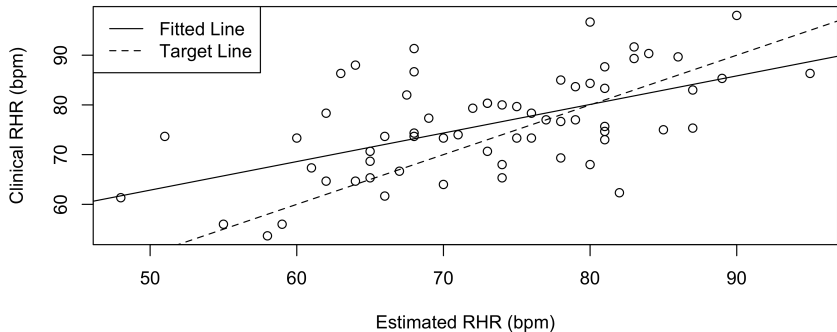
Results: Comparison with Clinical RHR

Figure 7: Linear regression of RHR_{est} versus RHR_{clinic} values for the deviation penalty. Each data point represents a participant. The solid line compares the clinical RHR with the estimated RHR ($R^2 = 0.32$, $P = 1.32 \times 10^6$). The dashed line represents the target scenario, where RHR_{est} perfectly recapitulates RHR_{clinic}.

$$MAE = \frac{1}{N} \sum |y - \hat{y}| = 7.53 \text{bpm}$$