

COVID Monkeys

HRV Analysis

September 28, 2020

Introduction

- ECG analysis of monkeys with COVID
- HRV performed of available signal
- Monkeys all have SARS-CoV2 infection, half were treated with anti-inflammatories

Quality of Signal Processing Efforts

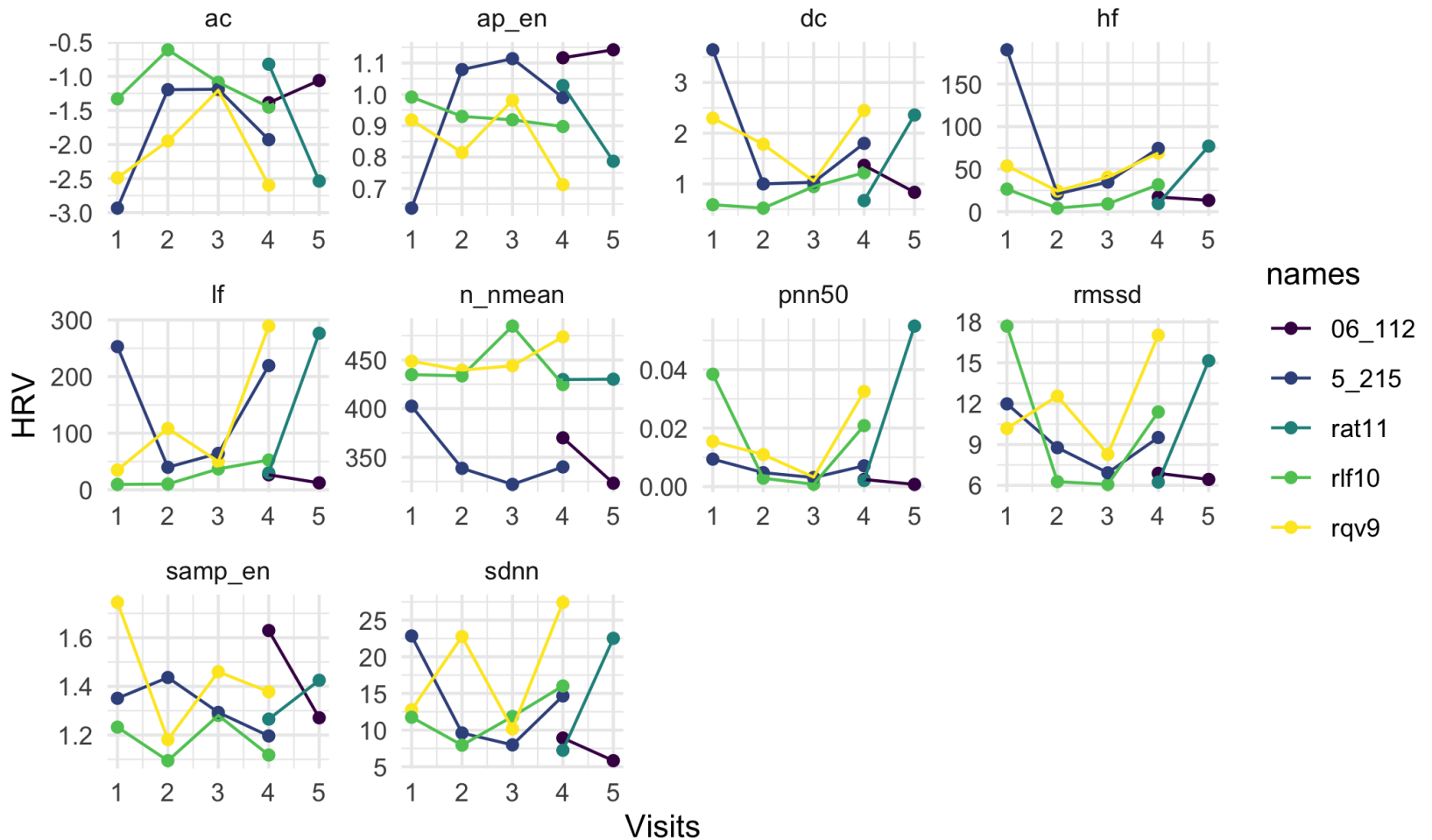
Best quality per session/lead

session	names	visit	lead	tot_wind	percent_not_analyzed
1	rat11	1	LII	58	0.0
2	06_112	1	NA	NA	NA
3	rat11	2	LII	58	19.0
4	06_112	2	LII	52	71.2
5	rat11	3	LII	58	27.6
6	06_112	3	LII	58	48.3
7	06_112	4	aVF	30	0.0
8	rat11	4	LI	70	24.3
9	5_215	1	aVF	18	0.0
10	rqv9	1	aVF	54	0.0
11	rlf10	1	aVF	37	2.7
12	06_112	5	aVF	127	0.0
13	rat11	5	aVF	135	0.0
14	5_215	2	aVL	72	0.0
15	rqv9	2	aVF	57	0.0
16	rlf10	2	aVF	121	0.0
17	rlf10	3	aVF	73	0.0
18	rqv9	3	aVF	42	0.0
19	rqv9	4	aVF	75	0.0
20	5_215	3	aVF	25	0.0
21	5_215	4	Vx	54	0.0

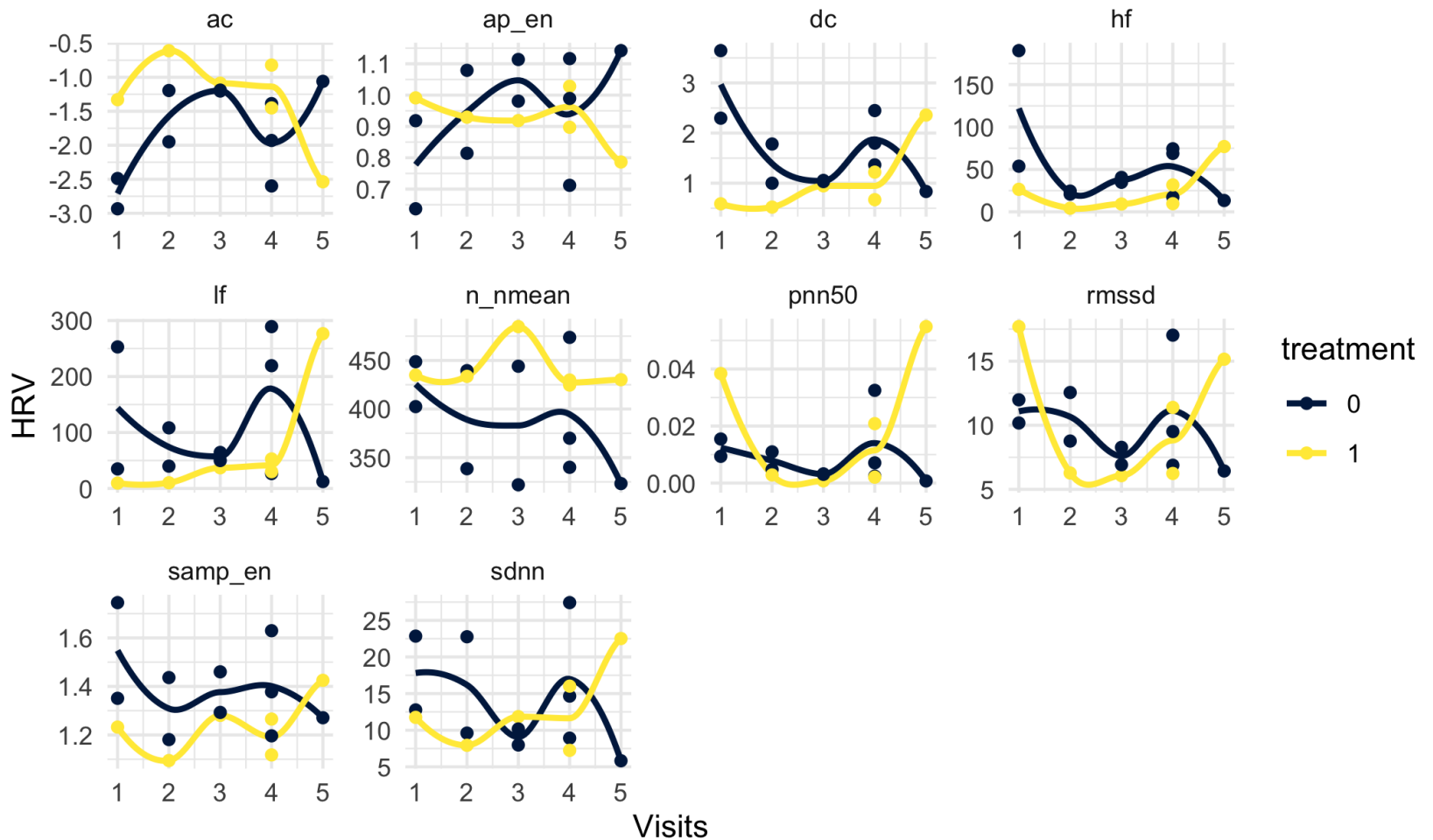
HRV Findings

session	NN	SDNN	RMSSD	PNN50	HF	LF	APEN	AC	DC
7	370	8.91	6.88	0.243	17.30	26.60	1.117	-1.388	1.366
8	430	7.25	6.24	0.208	9.60	30.01	1.028	-0.821	0.671
9	402	22.85	11.99	0.938	190.18	252.91	0.637	-2.934	3.645
10	449	12.77	10.18	1.546	53.81	35.00	0.918	-2.489	2.297
11	435	11.75	17.69	3.841	26.56	9.63	0.991	-1.330	0.589
12	323	5.83	6.43	0.075	13.36	12.36	1.142	-1.061	0.835
13	430	22.52	15.15	5.486	77.02	276.56	0.787	-2.537	2.359
14	339	9.61	8.77	0.477	20.89	39.87	1.079	-1.195	1.000
15	440	22.76	12.55	1.094	24.47	108.38	0.814	-1.949	1.782
16	434	7.94	6.28	0.285	4.25	10.21	0.930	-0.610	0.522
17	485	11.86	6.07	0.079	9.21	36.98	0.919	-1.088	0.947
18	444	10.17	8.28	0.323	40.60	49.93	0.981	-1.203	1.055
19	474	27.42	17.03	3.251	68.92	289.17	0.712	-2.598	2.449
20	322	7.98	6.92	0.307	34.85	64.39	1.114	-1.189	1.032
21	340	14.66	9.51	0.710	74.40	219.41	0.989	-1.929	1.800
22	425	16.02	11.39	2.084	31.75	52.75	0.897	-1.451	1.221

Summary HRV over repeat visits by Monkey



Summary HRV by treatment status



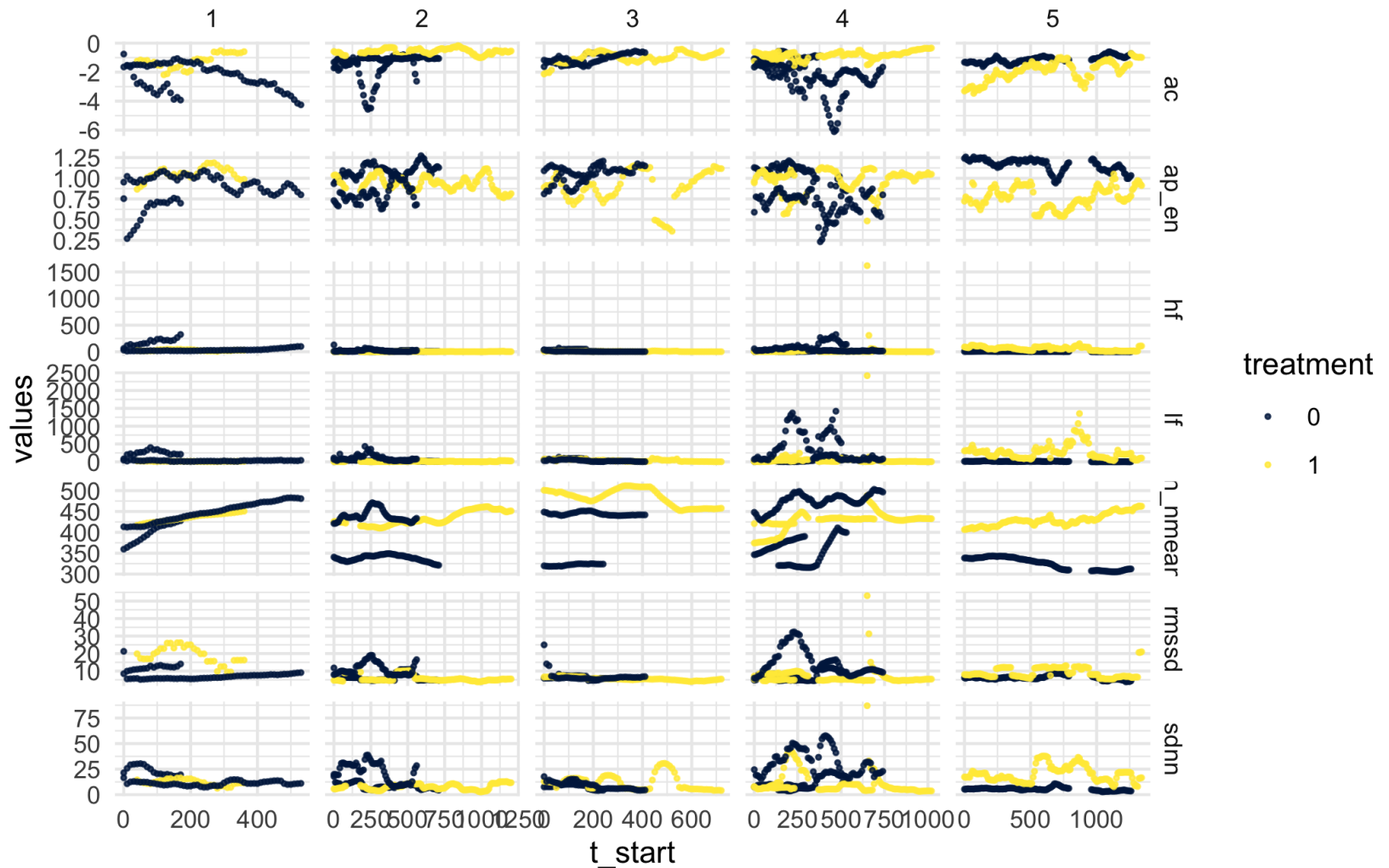
Summary by Treatment

HRV Changes by Treatment Groups										
Treated	HRV Measurements									
	n_nmean	sdnn	rmssd	pnn50	hf	lf	ap_en	samp_en	ac	dc
0										
1	425.6	17.8	11.1	0.0	122.0	144.0	0.8	1.5	-2.7	3.0
2	389.0	16.2	10.7	0.0	22.7	74.1	0.9	1.3	-1.6	1.4
3	383.0	9.1	7.6	0.0	37.7	57.2	1.0	1.4	-1.2	1.0
4	394.6	17.0	11.1	0.0	53.5	178.4	0.9	1.4	-2.0	1.9
5	323.3	5.8	6.4	0.0	13.4	12.4	1.1	1.3	-1.1	0.8
1										
1	434.9	11.8	17.7	0.0	26.6	9.6	1.0	1.2	-1.3	0.6
2	433.6	7.9	6.3	0.0	4.3	10.2	0.9	1.1	-0.6	0.5
3	484.8	11.9	6.1	0.0	9.2	37.0	0.9	1.3	-1.1	0.9
4	427.3	11.6	8.8	0.0	20.7	41.4	1.0	1.2	-1.1	0.9

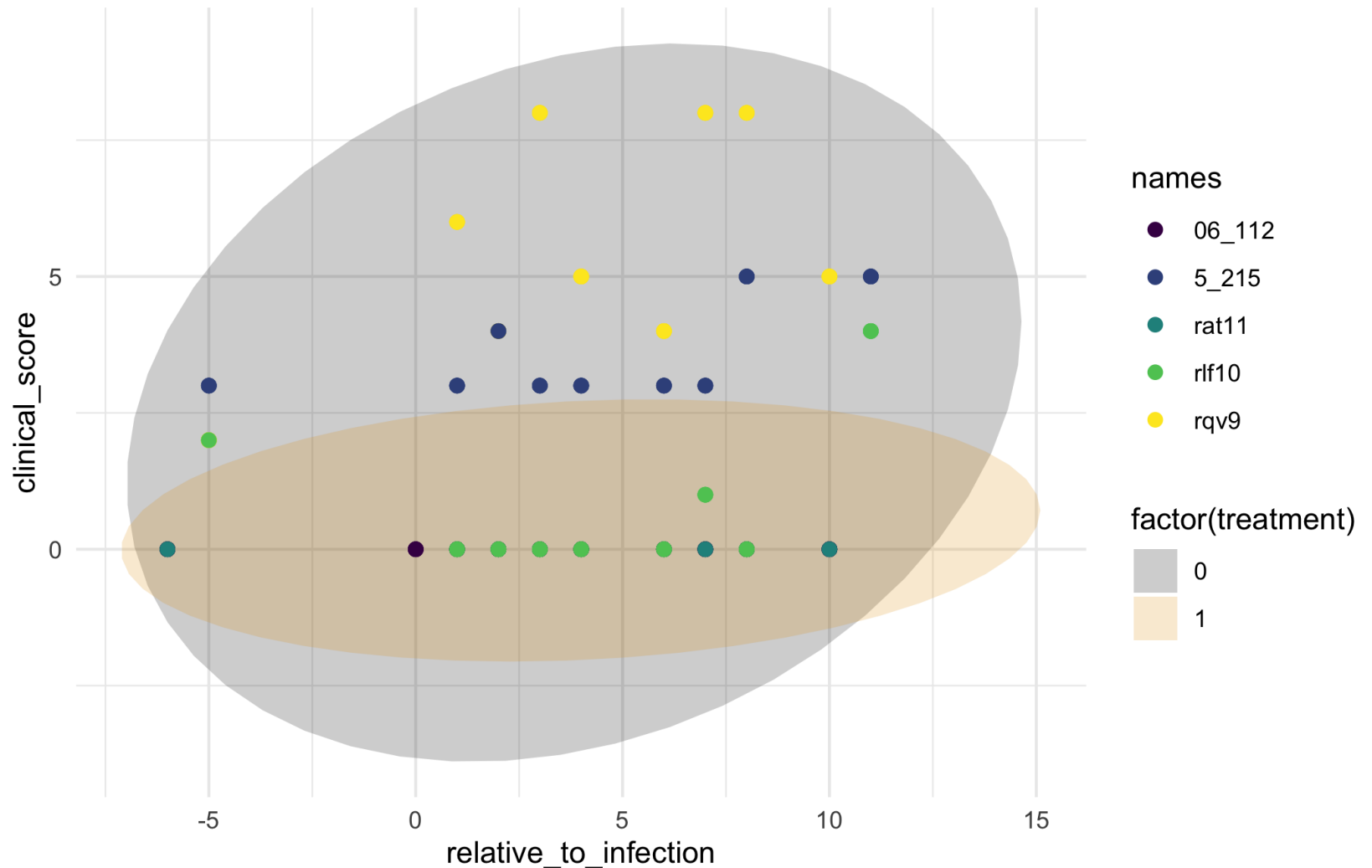
Repeat Measures Analysis

hrv	stratum	term	df	sumsq	meansq	statistic	p.value
n_nmean	names	visit	1	2.23e+03	2.23e+03	0.208	0.680
n_nmean	Within	visit	1	3.52e+02	3.52e+02	0.474	0.507
sdnn	names	visit	1	3.72e+01	3.72e+01	0.782	0.442
sdnn	Within	visit	1	1.81e+01	1.81e+01	0.386	0.548
rmssd	names	visit	1	1.06e+01	1.06e+01	1.015	0.388
rmssd	Within	visit	1	2.08e-01	2.08e-01	0.011	0.918
pnn50	names	visit	1	0.00e+00	0.00e+00	0.062	0.819
pnn50	Within	visit	1	0.00e+00	0.00e+00	0.055	0.820
hf	names	visit	1	1.08e+03	1.08e+03	0.382	0.580
hf	Within	visit	1	5.52e+02	5.52e+02	0.262	0.620
lf	names	visit	1	3.63e+02	3.63e+02	0.023	0.890
lf	Within	visit	1	1.61e+04	1.61e+04	1.768	0.213
ap_en	names	visit	1	3.20e-02	3.20e-02	1.353	0.329
ap_en	Within	visit	1	0.00e+00	0.00e+00	0.012	0.915
samp_en	names	visit	1	2.10e-02	2.10e-02	0.434	0.557

Continuous HRV Throughout Study



Clinical severity of illness



Mixed Models

outcomes	term	estimate	std.error	statistic	conf.low	conf.high
clinical_score	n_nmean	0.034	0.011	3.091	0.012	0.056
clinical_score	sdnn	0.185	0.079	2.343	0.030	0.339
clinical_score	rmssd	0.247	0.174	1.420	-0.094	0.588
clinical_score	pnn50	73.587	71.278	1.032	-66.115	213.288
clinical_score	hf	0.003	0.016	0.224	-0.027	0.034
clinical_score	lf	0.008	0.006	1.360	-0.003	0.018
clinical_score	ap_en	-6.855	3.650	-1.878	-14.009	0.299
clinical_score	samp_en	0.686	3.350	0.205	-5.880	7.253
clinical_score	ac	-1.993	0.985	-2.024	-3.924	-0.063
clinical_score	dc	1.398	0.814	1.718	-0.197	2.992