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Ultra-short term heart rate variability and combat-related traumatic injury- is there an association? Findings from the ADVANCE study, UK

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Background

-Combat-related traumatic injury (CRTI) has been associated with increased systemic inflammation, arterial stiffness, metabolic syndrome[1], hypertension[2] and coronary artery disease [3,4].

-Limited evidence on the relationship between non-acute traumatic injuries[5] and Heart Rate Variability (HRV) i.e. the variation in time interval between two consecutive heart beats[6]

Aims

-Explore the association between CRTI and HRV among a contemporary population of military personnel and veterans.

-Examine the impact of injury severity and mechanism on HRV.

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Methodology

ArmeD serVices trAuma rehabilitatioN outComE (ADVANCE) study[7]

	Variables
Sample Size	n=862 servicemen -baseline data from the ADVANCE study[8]
Exposure variable	CRTI (Yes/no) Injury Severity (NISS*≥25 and NISS*<25) (2008) *New Injury Severity Score Injury Mechanism (Blast vs others)
Outcome variable	Ultra-short term HRV (HRV_{UST})[9] Root Mean Square of Successive Differences (RMSSD)- a time domain measure of HRV
Confounders	Age at assessment, rank, time from injury, ethnicity
Statistical analysis	Multivariate regression analysis 3 models (CRTI, Injury severity, Mechanism)

7. The ADVANCE study. Available at: https://www.advancestudydmrc.org.uk/
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Results

Table 1 Baseline demographics and anthropometric data among uninjured and injured (CRTI)

	Uninjured	CRTI	P value*
n (%)	434 (50.35)	428 (49.65)	–
Age at assessment (years)	33.97±5.46	33.87±5.41	0.80
Rank (%)			
Junior	265 (61.06)	295 (68.93)	0.04
Middle	108 (24.88)	82 (19.16)	
Senior	61 (14.06)	51 (11.92)	
Still serving in military (%)	381 (87.79)	122 (28.50)	<0.001
Time from deployment/injury to assessment (years)	7.87±2.02	7.95±2.08	0.54
Injury mechanism (%)			
Blast	–	328 (76.81)	
Others		99 (23.19)	–
NISS 2008 (IQR)	–	12 (6–27)	–
NISS 2008 (IQR) and injury mechanism			
Blast	–	14 (6–27)	–
Others		9 (5–17)	
Ethnicity (%)			
White	399 (91.94)	385 (89.95)	0.31
Other	35 (8.06)	43 (10.05)	
Smoking (%)			
Current smoker	99 (22.81)	89 (20.79)	
Ex/non-smoker	335 (77.19)	339 (79.21)	0.47
Family history of CVD† (%)	81 (18.66)	76 (17.76)	0.73
Height (cm)	178.93±6.22	179.25±7.32	0.48
Weight (kg)	87.71±12.20	86.64±14.75	0.24
BMI adjusted for amputation (kg/m^2)	27.37±3.37	28.05±4.04	<0.01

Data presented as mean±SD or number (%) or median (IQR) for highly skewed data
*Based on the comparison of CRTI versus uninjured groups.
†Defined as a history of stroke or transient ischaemic attack or confirmed coronary heart disease in one or more first-degree relatives.
BMI, body mass index; CRTI, combat-related traumatic injury; CVD, cardiovascular disease; NISS, New Injury Severity Score.

Table 2 Comparison of haemodynamic and ultrashort term HRV (HRV_{UST}) between uninjured and injured (CRTI)

	Uninjured	CRTI	P value*
HR (BPM)	51.85±7.46	54.85±8.91	<0.001
Brachial systolic BP (mm Hg)	131.27±11.49	130.24±11.21	0.18
Brachial diastolic BP (mm Hg)	72.72±8.11	72.63±8.65	0.87
Brachial end systolic pressure (mm Hg)	113.9±11.72	113.2±11.93	0.36
RMSSD (ms) (median, IQR)	46.22 (31.14–67.84)	39.47 (27.77–59.77)	<0.001

Data presented as mean±SD or median (IQR) for highly skewed data.
*Appropriate equality test based on normality.
BP, Blood pressure; BPM, beats per minute; CRTI, combat-related traumatic injury; HR, Heart rate; HRV, HR variability; RMSSD, root mean square of successive differences.

No significant differences in:

Demographic, anthropometric and haemodynamic data *except* heart rate and RMSSD[9]

9. Maqsood, R., Schofield, S., Bennett, A.N., Bull, A.M., Fear, N.T., Cullinan, P., Khattab, A. and Boos, C.J., 2023. Relationship between combat-related traumatic injury and ultrashort term heart rate variability in a UK military cohort: findings from the ADVANCE study. *BMJ Mil Health*.

-**CRTI** was associated with a 13% lower geometric mean ratio (GMR) RMSSD versus the uninjured group (GMR 0.87, 95%CI 0.89-0.94, p<0.001)[9].

-A **higher injury severity** (NISS≥25) was significantly associated with a 22% lower GMR RMSSD (GMR 0.78, 95%CI 0.69-0.89, p<0.001)[9].

-**Blast** injuries (GMR: 0.86, 95%CI 0.79-0.93, p<0.001) were also independently associated with a 14% lower GMR RMSSD[9].

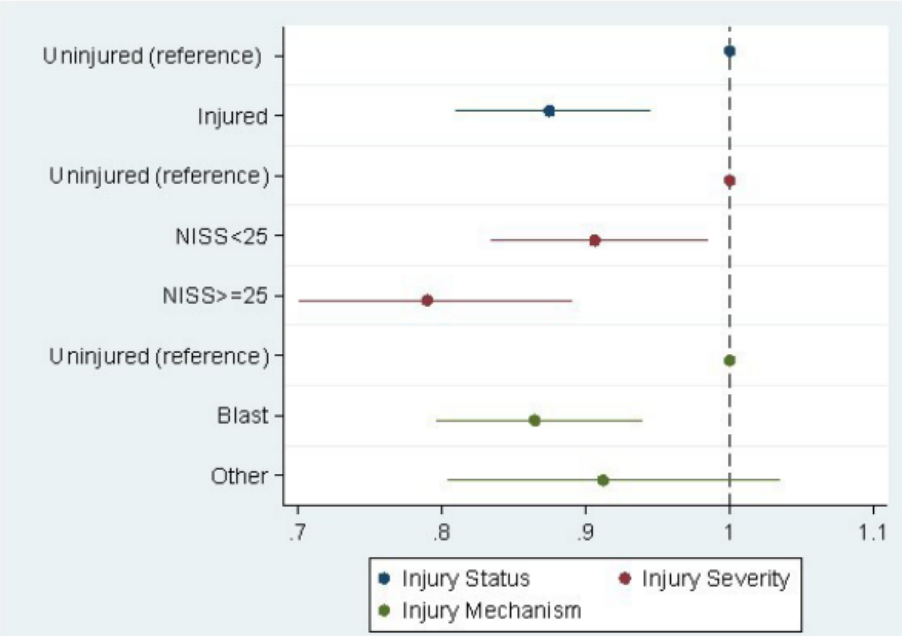

Figure 1 Geometric mean ratio (GMR) of the associations between root mean square of successive differences (RMSSD) and injury status, injury severity and injury mechanism. NISS, New Injury Severity Score.

Conclusion

-CRTI, higher injury severity and blast are independent predictors of lower HRV$_{UST}$.

-In the injured group, indicative of autonomic imbalance, lower para-sympathetic tone and elevated sympathetic tone.

9. Maqsood, R., Schofield, S., Bennett, A.N., Bull, A.M., Fear, N.T., Cullinan, P., Khattab, A. and Boos, C.J., 2023. Relationship between combat-related traumatic injury and ultrashort term heart rate variability in a UK military cohort: findings from the ADVANCE study. *BMJ Mil Health*.