

Final Scientific Report: A-29204 Grant 26/20

Anticipation and Experience of Stressful Situations and their Psychobiological Impact on Providing Pre-hospital Emergency Medicine Care

Background & Aims

In response to situations that are perceived as challenging, threatening, or stressful, biological mechanisms are activated, principally the Sympathetic Adrenal Medullary (SAM) and Hypothalamic-Pituitary-Adrenal (HPA) axes, which through the secretion of hormones (e.g., adrenaline and cortisol respectively), facilitate the liberation and mobilisation of energy resources. These physiological responses are our attempts to maintain allostasis and our ability to respond is entirely adaptive. Acute activation of these responses is therefore observed immediately prior to and during challenging events as evidenced by increases in psychobiological responses to acute laboratory stressors (Wetherell et al 2017) and in individuals experiencing real-life stressors, for example, skydiving (Hare et al 2013) and firefighting (Young et al 2014). In addition to acute responding, cortisol is responsible for a number of regulatory functions that are maintained through a marked profile of diurnal secretion characterised by a rapid increase in the 30-45 minutes after awakening (Cortisol Awakening Response: CAR) followed by a decline across the day reaching nadir around midnight (Saxbe 2008). This profile is also associated with a range of psychosocial factors. Given the energising role of cortisol in response to acute challenges, it is suggested that the CAR has an adaptive function in preparing for demands and providing an energetic boost to maximise functioning (Clow et al 2010). In support, increased CARs have been observed in situations requiring greater perceived demand such as in newly qualified doctors (Brant et al., 2009), workdays compared to non-workdays (Kunz-Ebrecht et al 2004, Liberzon et al 2008), and on days of competitive dancing, motorcycling, and tennis events (Rohleder et al 2007; Filaire et al 2007, 2009). Further, work from our lab demonstrates CARs of greater magnitudes on the day of social and cognitively demanding stressors in ambulatory (Wetherell et al 2015) and controlled sleep laboratory conditions (Elder et al 2018). This evidence suggests that acute biological responding and the diurnal secretion of cortisol play an adaptive role in response to stress.

Whilst there is an adaptive role of higher levels of cortisol following awakening, elevated levels of cortisol when not experiencing stress, or at times of the day where cortisol levels should be low, for example before bed, is not functional. For example, higher levels of evening cortisol are observed in individuals with greater anxiety, depression, and perceived stress (Van den Bergh et al 2008; Lovell et al 2011); in police officers reporting the risk of physical danger (Allison et al 2019); and in PTSD (Miller et al 2007).

Individuals who provide emergency services frequently mount physiological responses in anticipation of and during critical events, however, the opportunity for full recovery can be limited (Young et al 2014). These responses are adaptive and provide the resources required to maintain the required level of functioning during a critical event; however, frequent and sustained physiological responding increases wear and tear and places individuals at increased risk of stress-related illness (McEwan, 1998). The observation and monitoring of individuals while they are engaging in emergency situations in real time would provide an understanding of the stress responses of these individuals in a critical care scenario. However, this presents significant logistical challenges and could compromise the delivery of care. A viable alternative is to assess individuals during realistic training scenarios. The 'Pre-Hospital Emergency Medicine Crew Course' (PHEMCC) is a world-leading training experience run by the Great North Air Ambulance Service (GNAAS) which provides this opportunity.

The PHEMCC provides high-fidelity, scenario-based training for medics to develop skills and knowledge in complex, high-stress pre-hospital emergency environments and comprises life-saving medical care alongside leadership, communication strategy, stress management, and decision making. The PHEMCC

runs consecutively for 2 weeks with different activities each day, apart from Days 6 and 7 (weekend). The activities include immersive experiences and high-fidelity simulations in a range of environments with contributions from other emergency services (e.g., police, fire service, mountain rescue), and actors. Week 1 largely comprises the learning and acquisition of skills, while the second week involves the application of those skills in complex scenarios. The requirements of each day therefore vary depending on their planned activities which differ in terms of their anticipated learning, cognitive, and physical loads. Daily activities and anticipated loads are summarised in Table 1. Preliminary work, prior to this funded project, showed that levels of self-reported anxiety were greatest on days when the training scenarios were more complex and challenging. This was evident following awakening, representing anticipation of forthcoming demand, but on some days, anxiety levels were still high at bedtime and were associated with participants worrying about the day's events. It is therefore important to assess whether these patterns of psychological responding relate to biological functioning, as it is the repeated and sustained activation of biological responses that can lead to the negative effects of stress on psychological and physical wellbeing. Through simultaneous psychological and biological assessment, it will be possible to see which training days are characterised by the greatest psychobiological responding and therefore identify those activities that may have implications for health and wellbeing in pre-hospital emergency medicine roles.

This project therefore assesses psychobiological functioning during a 2-week, high-fidelity training course, including rest days. Specifically, we assessed the SAM (heart rate, HRV-derived stress index) and HPA (diurnal cortisol and Cortisol Awakening Response) axes, self-reported anxiety, and anticipated and experienced demands.

Table 1. PHEMCC Daily Activities and Proposed Load (H – High, M – Medium, L – Low)

Day	Activities	Anticipated Load		
		Learning	Cognitive	Physical
Day 1	Human Factors & Pre-Hospital Emergency Assessments	H	H	L
Day 2	Surgical Skills	H	H	L
Day 3	Obstetrics, Paediatrics, Ultrasound	M-H	L	M
Day 4	Patient Transfer	M-H	M-H	L
Day 5	Water Rescue, Extreme Environments	M	M-H	H
Day 6	Weekend	-	-	-
Day 7	Weekend	-	-	-
Day 8	Road Traffic Collisions and Extrication	M	M-H	M
Day 9	Confined Spaces, Working at Height, Burns and Fire	M	H	H
Day 10	Road Traffic Collision (day-night simulation)	H	H	H
Day 11	Ballistics & Major Incidents (mass shooting simulation)	M	H	M-H
Day 12	Final Assessments	M	H	H

MATERIALS & METHODS

The study protocol was pre-registered on the Open Science Framework (<https://osf.io/m7k2q>) and study materials and analyses are available at <https://osf.io/r4cep/>

Recruitment & Participants

Participants were recruited from the Pre-Hospital Emergency Medicine Crew Course (PHEMCC). The PHEMCC is aimed at 1) Doctors at senior registrar or consultant level with a background in Emergency Medicine, Anaesthesia or Intensive Care and experience of delivering general anaesthesia and critical care in hospital settings and pre-existing knowledge of the management of major trauma and critically unwell patients, and 2) qualified paramedics with experience of working on the road and looking to further their critical care skills and knowledge. The course is run once per year and has a maximum

cohort size of 15. To maximise samples size, delegates from the PHEMCC were recruited across two successive years (2021 & 2022). In 2021, 14 of the cohort consented and in 2022 all 15 of the cohort consented to participate. Participants were given information about the study when they were accepted onto the course and given the opportunity to contact the research team to address any questions. It was made clear that their participation was voluntary and would have no impact on their status on the course. Informed consent was obtained on day 1 of the course.

Participants

A total of 29 delegates gave informed consent; however, full data are available for N=27 following withdrawal of 2 delegates from the course in 2022. The sample comprised 9 females and 18 males (Mage = 36.22, SD = 6.91) of which 13 were doctors and 14 were paramedics.

Materials

Questionnaires

Background distress was measured using the Perceived Stress Scale (PSS, Cohen et al., 1983) and Depression Anxiety and Stress Scale (DASS-21, Lovibond & Lovibond 1995). The Competitive State Anxiety Inventory (CSAI-2, Martens et al., 1990) was used to record self-reported levels of cognitive and somatic anxiety and self-confidence. The CSAI-2 comprises 27 items rated on a 4-point Likert scale with higher scores indicating higher levels of each state. It is a well-established tool for the assessment of competition anxiety across a wide variety of sporting contexts and has been previously used, alongside the measurement of cortisol, to differentiate training and competition in sport (MacDonald & Wetherell, 2019). Although developed for sporting contexts, the items are relevant to stressful and challenging situations such as those experienced in emergency medicine. Only one item in the scale specifically refers to 'competition'; in this instance the competition was substituted for 'activities'. State anxiety was measured using a version the short-form State-Trait Anxiety Inventory (SF-SA, Marteau & Bekker, 1992). The scale is comprised of three negative items (tense, upset, worried) and three reverse-scored positive items (calm, relaxed, content). Responses are made on a 4-point Likert scale (not at all, somewhat, moderately, very much). All item responses are summed to give a total score, with higher scores indicating greater levels of state anxiety. The Daily Anticipated and Experienced Demands Scale was developed for this study to assess thoughts about the forthcoming day shortly after waking, and reflection on the day's events before bed. The scale comprises 5 items assessing clarity, stress, control, confidence in coping, and worry and the tense is altered to reflect thoughts before and after the day's events. Prior to use in the current study, the items were piloted for feasibility in a sample of 7 participants taking part in the PHEMCC. The items successfully differentiated training days from non-training (weekend days), and levels of stress and worry were greater on days when clarity and confidence in coping were lower.

Smartwatches

Commercially available smartwatches (Garmin Vivosport or Vivosmart 5) were used for continual assessment. In terms of requirements for this project, the devices differed only in the presence of GPS mode on the Vivosport; however, this was not required and deactivated. The devices record a range of fitness-related indices via accelerometry and the optical sensor on the back of the device. We used the devices to monitor heart rate (HR) in beats per minute (bpm), and to record stress using the Garmin Stress Index™. Using Firstbeat analytics, the Garmin Stress Index™ uses a combination of HR and HRV data, whilst controlling for variation caused by movement. HRV, changes in the interval between consecutive heart beats, can be used to determine the relative activity of the sympathetic and parasympathetic branches of the autonomic nervous system and can therefore be used as a marker of psychological stress (Peek et al., 2022). The stress index is scored from 0-100 where scores less than 25 indicate parasympathetic dominance, and scores greater than 25 indicate sympathetic dominance. Higher scores therefore indicate increasing activation of the sympathetic nervous system and therefore

provide a measure of stress that is not influenced by physical movement. Smartwatch data were sampled every 60 seconds and averaged across 15-minute measurement periods.

Salivary cortisol

Participants provided four saliva samples each day at awakening, awakening +30 minutes, awakening +45 minutes, and before bed using Salivettes (Sarstedt, Germany). Samples were refrigerated by participants until collection by the researcher and were frozen (−80°C) until time of assay. Samples were assayed in duplicate, using the enzyme-linked immunosorbent assay method (Salimetrics Europe, Cambridge UK) at the ARU Biomarker Laboratory, Cambridge (all intra and inter assay coefficients <10%). Samples were obtained, stored, and transported in line with the Human Tissue Act (2004).

To maximise integrity of samples and adherence to protocol, saliva collection followed expert guidelines (Stalder et al., 2022). Participants were given a face-to-face demonstration of saliva provision, their first samples were supervised, and any questions addressed before they provided further samples unsupervised. Furthermore, self-reported waking times were verified using smartwatches.

Procedure

This study was granted ethical approval by Northumbria University Ethics College. Following informed consent, participants were administered a smartwatch and asked to wear the device continuously (as tolerable) for the duration of the training course. Questionnaires for demographic information and background distress (PSS, DASS-21) were then completed and the researcher gave a demonstration of the saliva collection technique, followed by the provision of three supervised saliva sample during the training course briefing (these samples are not included in analyses as they do not align with any aspect of the proposed diurnal assessment). To minimise any impact on the training experience, with the exception of continuous measures obtained through smartwatches, all measurements were completed outside of the scheduled training activities. On each day, including the non-training (middle weekend) days, participants followed the same collection protocol. Every morning, immediately following waking, participants provided a saliva sample, followed by two more samples taken 30 minutes and 45 minutes following waking and noted their waking time and the times that samples were provided. During this sampling period participants also completed a morning questionnaire comprising CSAI-2, SF-SA, and the anticipation of forthcoming demands questions. Before bed on each day, participants completed the CSAI-2, SF-SA, and the experience of the day's demands questions. Participants then provide a final saliva sample before sleep and recorded the sample time. Every day, the researcher collected all study materials from the previous day, distributed the following day's materials, and carried out a data-synch for smartwatches. At the end of the training course, participants completed the PSS and DASS-21, and were given a study debrief.

Treatment of data and analysis

Smartwatch data were processed by Fitrockr Health Solutions (Berlin, Germany). Data collected on smartwatches were transferred at regular intervals via a Bluetooth connection to the Fitrockr Hub App on a tablet (Samsung Galaxy). Collated data were sent daily from the hub to Fitrockr and processed data for all smartwatch variables were made available via the Fitrockr Web App. Heart rate and stress data were aggregated to give a single value for each day (day 1: 09:00h–00:00h; Day 2 – Day 11: 00:01h–00.00h; Day 12: 00:01h–1500h). Salivary samples were used to derive the following indices of cortisol secretion: levels at awakening, CAR magnitude (individual peak response: +30 / +45 minus awakening), and levels at bed.

Linear mixed effects models were used to analyse all outcomes. These were fitted using the lme4R-package (Bates et al., 2015). All models used a Gaussian likelihood with sum-coded (-1, 1) fixed effects. For psychological variables this included fixed effects of day, time (AM vs PM), and their interaction. For

physiological variables, this included a fixed effect of day only. All models contained random intercepts by participants. As there was one measurement per cell for participants this constituted the maximal random effects structure. Mixed effects models were chosen over traditional ANOVA methods as they can make accurate estimates with missing data without the need for case-wise deletion or multiple imputation. Main effects and interactions were evaluated after model fitting using ANOVA with type-III sums of squares using the Satterthwaite method for calculating degrees of freedom. After model fitting, estimated marginal means were calculated using the emmeans R-package (Lenth 2023) Plots of estimated marginal means include arrows indicating significant differences with p-values adjusted using Tukey contrasts (i.e., from the Studentised range distribution). Significant differences between conditions are indicated where arrows do not overlap.

RESULTS

Psychological Responding

There were significant main effects of day and time for State Anxiety (Day: $F(11, 564.39) = 5.97, p < 0.001$; Time: $F(1,564.38) = 18.93, p < 0.001$), Cognitive Anxiety (Day: $F(11,565.32) = 24.09, p < 0.001$; Time: $F(1,565.27) = 21.27, p < 0.001$), Somatic Anxiety (Day: $F(11, 565.70) = 9.38, p < 0.001$; Time $F(1,565.61) = 30.96, p < 0.001$), and Self-confidence (Day: $F(11,565.14) = 12.15, p < 0.001$; Time: $F(1, 565.08) = 13.60, p < 0.001$). Additionally, there were significant Day x Time interactions for Cognitive Anxiety, $F(11,565.19) = 2.73, p = 0.002$, and Somatic Anxiety, $F(11,565.46) = 1.82, p = 0.048$. Estimated marginal means for State Anxiety, Cognitive and Somatic Anxiety, and Self-confidence are presented in Figure 1.

For measures of Anticipated and Experienced Demand there were significant main effects of day and time for Stress (Day: $F(11,563.57) = 38.08, p < 0.001$; Time: $F(1,563.48) = 12.22, p < 0.001$), Worry (Day: $F(11,563.14) = 15.17, p < 0.001$; Time: $F(1, 563.03) = 60.26, p < 0.001$), Coping (Day: $F(11, 562.43) = 11.38, p < 0.001$; Time $F(1,562.33) = 7.36, p < 0.007$), and Control (Day: $F(11,562.50) = 15.91, p < 0.001$; Time $F(1,562.41) = 10.73, p = 0.001$). Estimated marginal means for measures of Anticipated and Experienced Demands are presented in Figure 2.

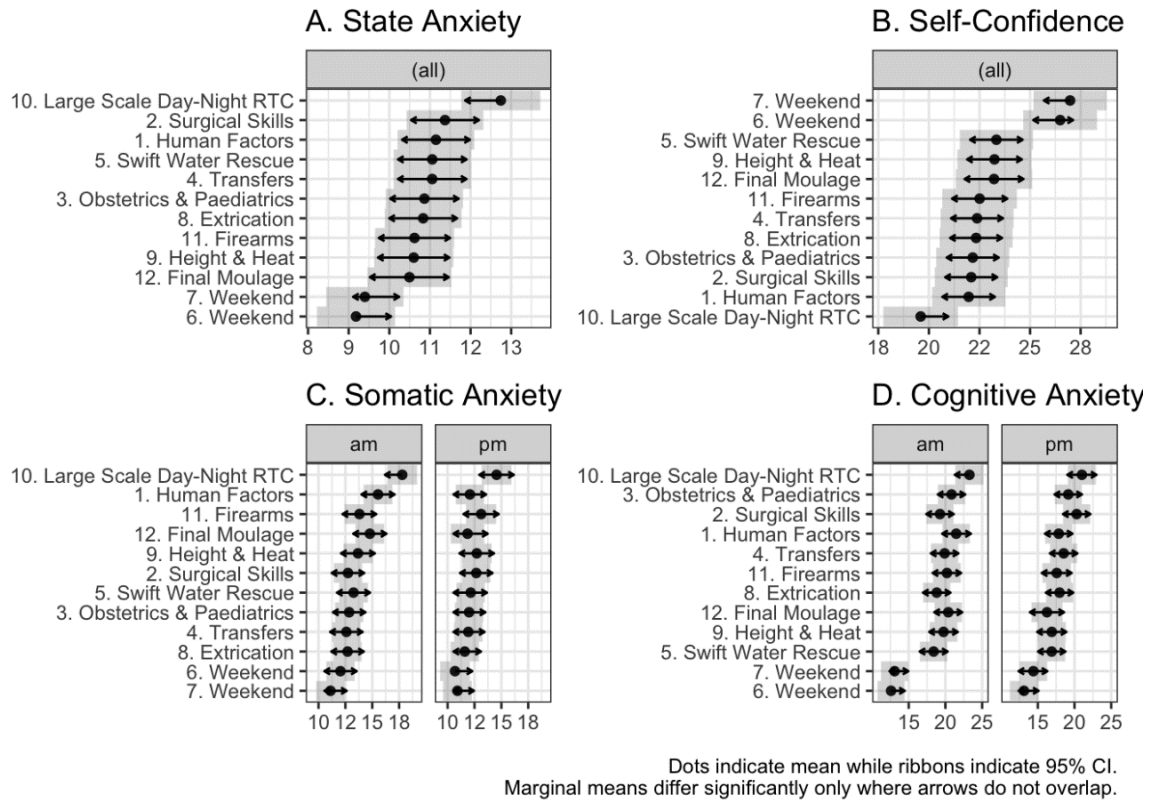


Figure 1. Daily estimated marginal means for State Anxiety (A), Self-confidence (B), Somatic (C) and Cognitive Anxiety (D)

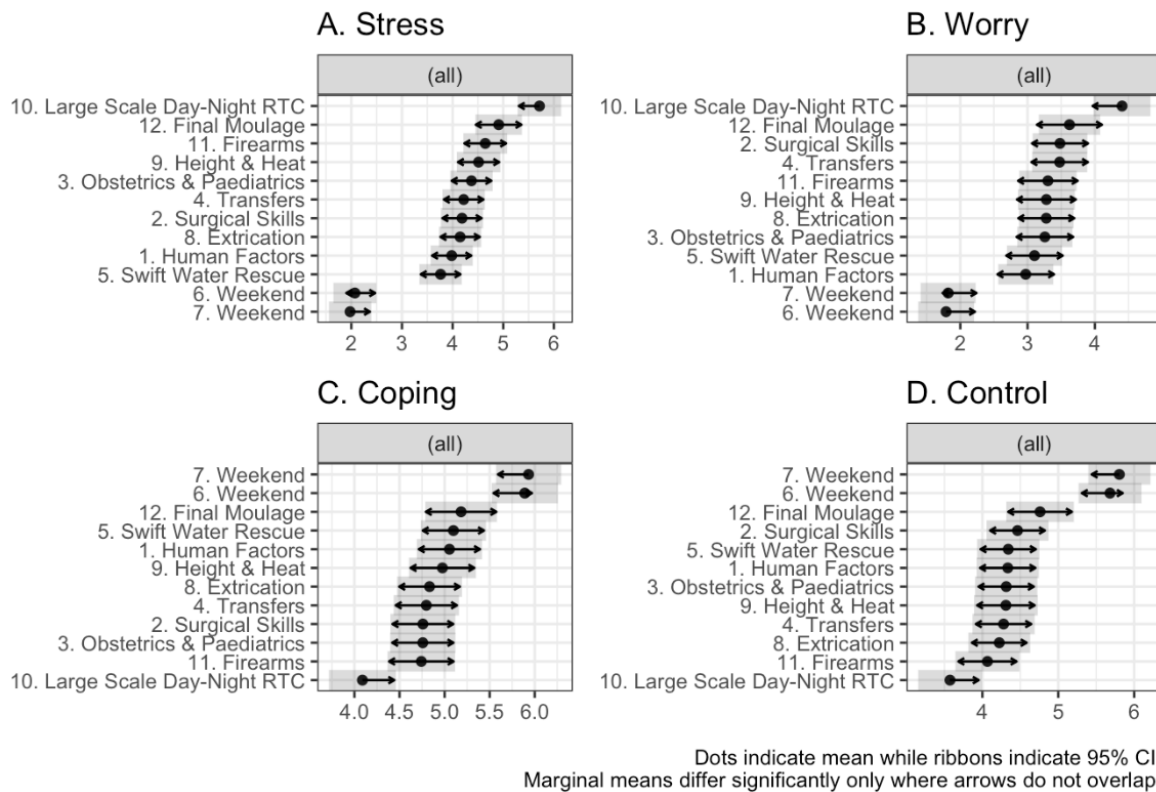


Figure 2. Daily estimated marginal means for Stress (A), Worry (B), Coping (C), and Control (D)

Biological Responding

There were significant differences across days for aggregated measures of Heart Rate $F(11, 256.91 = 10.50, p < 0.001$, and Stress $F(11, 255.59 = 12.00, p < 0.001$). Estimated marginal means for aggregated Heart Rate and Stress across days are presented in Figure 3.

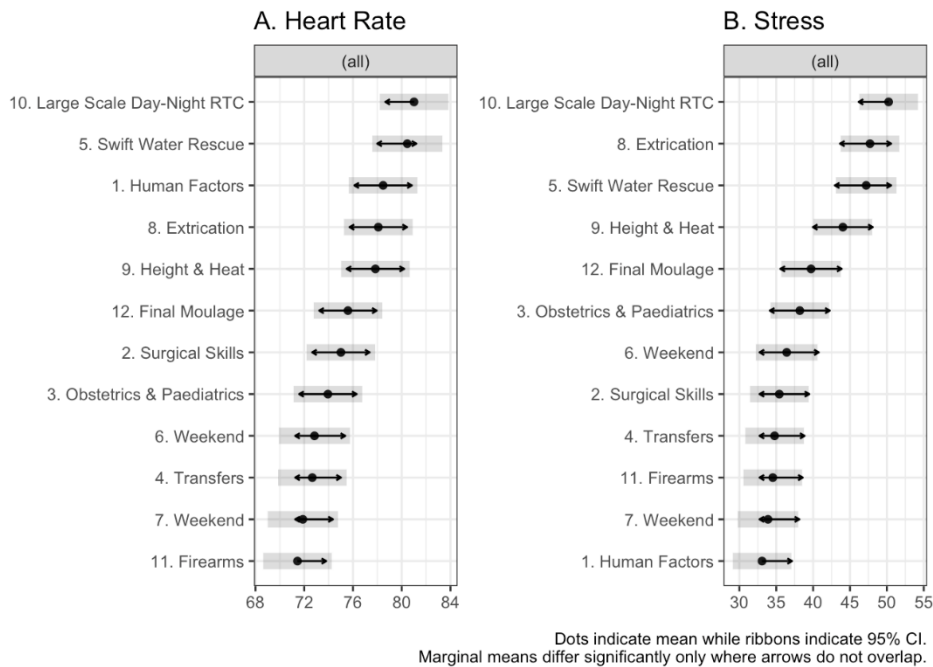


Figure 3. Daily estimated marginal means for heart rate (A), and Stress (B)

For cortisol indices, there were significant differences across days for aggregated measures of Waking Cortisol, $F(10, 252.01) = 2.90, p = 0.002$, and for the CAR, $F(10, 248.58) = 3.8, p < 0.001$, but not for levels at bed, $F(10, 245.96) = 1.30, p = 0.231$. Estimated marginal means cortisol indices are presented in Figure 4.

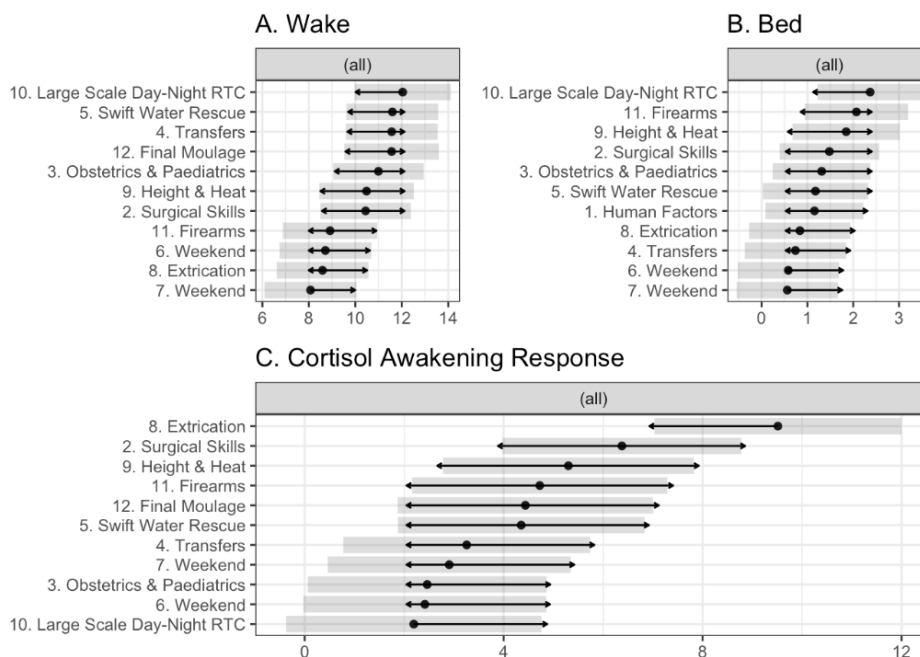


Figure 4. Daily estimated marginal means for cortisol indices, Wake (A), Bed (B), and CAR (C)

DISCUSSION

Summary & Interpretation of Findings

This project assessed psychobiological functioning during a 2-week, high-fidelity training course in pre-hospital emergency medicine. Each day differed in terms of activities and associated demands of learning, cognitive, and physical load, and indices of psychobiological functioning were assessed throughout. The analyses allowed for a comparison across all days, including non-training days, for all psychobiological indices. Specifically, psychological factors associated with distress, demand (state, somatic, and cognitive anxiety; stress; worry), and perceived resource (self-confidence; coping; control) were assessed. Additionally, biological markers of the Sympathetic Adrenal Medullary (heart rate; HRV-derived Stress) and Hypothalamic-Pituitary-Adrenal (waking and bedtime cortisol levels; Cortisol Awakening Response) axes, were measured. To allow for consistency in analyses across all variables, continuous data (heart rate and HRV-derived stress) were aggregated to produce single values for cross-day comparisons. These analyses were represented in Figures 1-4, where differences across days can be identified.

Analyses revealed significant differences in all variables across days, and the figures show consistent patterns with regards to the impact of different days upon psychobiological indices. The most consistent observation was a difference between training and non-training (weekend) days. The lowest levels of state, somatic, and cognitive anxiety, stress, and worry were reported at weekends. In contrast, the highest levels of self-confidence, coping, and control, were reported at the weekend compared with all training days. Moreover, for all variables of distress and demand, and perceived resource, reported levels at the weekend were clearly distinguishable from all training days, and this is supported in the follow-up analyses (presented as non-overlapping arrows in figures). Similar patterns were observed for biological measures, albeit with less consistency and distinction. Weekend days were among the lowest for heart rate, and although one weekend day was relatively higher for HRV-derived stress, it should be noted that levels were also similar across multiple days for this variable. The same pattern emerged for indices of cortisol where weekend values were among the lowest at Wake and Bed, and the CAR suggested a reduced magnitude in responding.

While the identification of weekend, non-training days, does not speak directly to the aim of assessing the impact of high-fidelity training on psychobiological functioning, the consistent pattern of lower distress and biological responding, and higher perceived resources on non-training days, clearly demonstrates the capacity for recovery and provides further evidence of the adaptive nature of stress responding. That is, in preparation for, and during demanding, threatening, or stressful events, energy resources are mobilised via activation of the SAM and HPA axis. In contrast, in situations where perceived demand, threat, and stress are lower, the same level of resources are not required and responding can therefore be reduced. This pattern is evident during this course where the training days elicit higher levels of stress and demand and are accompanied by concomitant levels of biological responding compared with the weekend. This up and down-regulation of resources to match demand is adaptive (McEwan, 1998), and demonstrates that the proposed learning, cognitive, and physical loads of each of the training days function as intended.

Although the mounting of physiological responses when required is adaptive, it is typically the case that individuals who provide emergency services have limited opportunity for recovery (Young, et al., 2014). To these ends, the overall structure of the training course, with two blocks of five training days separated by a weekend, is less representative of the on-the-job experiences of those that deliver emergency care. For these individuals, long hours, shift work including nightshifts, and atypical working weeks are commonplace (Klinefelter et al., 2023), and the frequency and sustained physiological activation within these work patterns will increase vulnerability to negative consequences for health and wellbeing. This is evidenced by the increasing levels of burnout reported in those that deliver emergency care (e.g., NHS Staff Survey 2022). Within the context of this training course, however, the lower levels of responding observed at the weekend represent adaptive responding and demonstrate

that these participants, when afforded the opportunity, experience a lowering of biological responding that matches a reduction in their perceived distress and demand. The extent to which this opportunity exists in their lived experience, however, remains unclear and warrants further investigation.

While the weekend days could be clearly differentiated for every variable, the majority of training days were characterised by similar patterns of distress and demand, and perceived resources. There were similar patterns across days for heart rate and HRV-derived stress, although with a tendency towards greater levels of heart rate and HRV-derived stress in the second week of training. That is, for each of these variables, 4 of the top 6 highest values were recorded on days in the second week of training. The main exception was for Day 5 (Swift Water Rescue). This pattern of responding corresponds with the proposed cognitive and physical loads (Figure 1), where Day 5, and each day of the second training week, are categorised as medium to high load. The second week of the course involves the application of the skills developed in week 1 in complex scenarios. That the perceived demands correspond with the proposed cognitive and physical loads demonstrates the face validity of the course and emphasises the association between high-fidelity training and the consequent psychobiological demands.

One day specifically however, emerged as distinct from all other training days. Day 10 (Road Traffic Collision: Day-Night) was characterised by the highest levels of state, somatic, and cognitive anxiety, stress, and worry, the lowest levels of self-confidence, coping, and control, and the highest levels of heart rate, HRV-derived stress, and cortisol levels at waking and bed. This day is split into two clinical scenarios which are designed to expose candidates to the demands of major incidents and mimic situations where demands exceed perceived resources. The day begins at midday rather than 9am to mimic a change in shift pattern and to facilitate a scenario that runs from dusk through to darkness. Both scenarios comprise a variation of road traffic collisions alongside other ensuing emergencies, and involve complex decision making, multiple patients, and cross-working with additional emergency services. By this stage of the course candidates are expected to be fully immersed in the experience and care is taken to ensure that these scenarios feel as real as possible. Specific factors facilitating this realism include the use of actors, other emergency services, lighting, and simulated blood. Having a break between the two scenarios represents a gap between callouts such as would be experienced in real emergency care, and starting the second of the two scenarios at dusk adds an extra layer of cognitive load and realism. As such, this day is truly high-fidelity and is characterised by the highest learning, cognitive, and physical loads across the entire course. It is perhaps, therefore, not surprising that this day elicits the greatest levels of psychobiological responding and the lowest levels of perceived resources. Given the high-fidelity nature of the activities and timing, Day 10 represents a typical, albeit exceptionally challenging, day that is in line with the daily requirements of front-line emergency medicine. That this day is characterised by the highest levels of psychobiological responding is cause for concern and emphasises the importance of the opportunity for recovery to avoid the negative consequences of repeated and sustained physiological activation on health and wellbeing through the manifestation of burnout.

Conclusions & Future Work

This is the first assessment of this training course and represents the longest continual assessment of the impact of high-fidelity training scenarios in emergency care. Moreover, with the inclusion of a range of measures, this study is the most comprehensive assessment of psychobiological functioning in emergency medicine to date. The analyses have allowed for an objective assessment of the psychobiological demands of the course in relation to the proposed learning, cognitive, and physical loads, and as such, the study confirms the face validity of the course. It is suggested that in addition to the simulation of environment and equipment to simulate real world scenarios, high-fidelity simulations should create realistic environments to the extent that they also elicit the emotional responses that would typically be experienced in real emergency situations (Kharasch et al., 2011). This study clearly demonstrates these emotional responses, and additionally corresponding biological responding.

Through assessing psychobiological responding we have identified patterns of adaptive responding and recovery as evidenced by differences in responding between training days and weekends. Moreover, we have been able to link increases in cognitive and physical workloads to concomitant increases in distress, demand, and biological responding, and reductions in perceived resources, as evidenced by greater responding on training days with the highest loads and greatest fidelity. Given that frequent and sustained psychobiological responding, with limited opportunity for recovery, can increase the risk of burnout, and burnout is pervasive in emergency medicine, these patterns warrant further investigation.

To investigate this in more detail, we will conduct further analyses of the continuous data captured via smartwatches, specifically measures of heart rate and HRV-derived stress. These data were captured at 15-minute intervals throughout the course and can therefore be used in fine-tuned analyses of within day variations including periods before, during, and after specific activities. These analyses would allow for the assessment of acute responding but can also detail those activities that may be associated with psychobiological activation prior to (i.e., at waking) and following (i.e., bedtime) events. Overactivation at these periods, particular at bedtime where the focus should be on recovery, may be indicative of excessive worry and rumination and this could have implications for health and wellbeing.

Expected & Achieved Output Indicators

Expected Outcomes	Status	Commentary
UK conference	✓	Study presented as part of invited Keynote address to British Psychological Society, Psychobiology Section (Newcastle, September 2023)
International Conference	✓	Study presented at Stress, Trauma, Anxiety & Resilience (STAR) conference (Faro, July 2023) *
Stakeholder Event	✓	Findings presented to GNAAS (CEO, Director of Operations, Head of Training) A further event is being organised for wider dissemination to others in the organisation
Submitted manuscript		Paper addressing the primary aim: a psychobiological assessment of high-fidelity training in emergency medicine - this paper is the final stages of preparation and will be submitted to the Journal of Stress, Trauma, Anxiety & Resilience (Q1 2024)
Additional Outcomes (not in project proposal)		
International Conference		American Psychosomatic Society (APS). APS is the leading society for research integrating mind and body. Abstract accepted for Conference (March 2024) **
Garmin Blog entry		Invited to contribute a blog detailing the study for the Garmin website (Q2/Q3 2024)
Manuscript submission		This paper will detail a more fine-grained assessment of the data derived from smartwatches using time-series analyses (estimated submission Q3 2024)
Dissemination		I have received Invites from other UK universities to share the study findings at research seminars and these visits will be organised during 2024
* Assessing the psychobiological impact of high-fidelity training in pre-hospital emergency medicine		
** Assessing psychobiological responding and recovery during high-fidelity training in pre-hospital emergency medicine		

Covid19 Impact Statement

In the original project scheduling, this study was due to commence on 1st February 2021. At the proposed time of project start, the Covid19 pandemic and associated restrictions meant that all face-to-face-research was prohibited, and it was not possible to obtain ethical approval for forthcoming projects due to uncertainty over restrictions and their time course. Ethical approval was granted towards the end of May 2021 and a new start date (August 2021) was agreed. Unfortunately, there were additional delays to the completion of the Grant Agreement, in part due to issues of remote working during Covid19, and continued uncertainty regarding the ongoing impact of Covid19 on the proposed research plans. The project had to be re-evaluated considering changes to Health and Safety and Ethical policies and was passed in July 2021 and the Grant Agreement was finalised in September 2021 immediately prior to the first data collection phase.

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