Motorsport Knowledge Institute

A Division of the ATCUAE

Saving Lives in Cross-Country Rallies:

Evaluating Competitor Fatigue

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Credits

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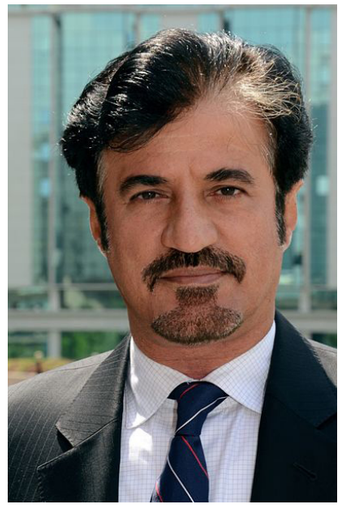
Improving saftey & standards

Introduction



As an ASN/FMN President we have a duty of care to all competitors and officials, local or visiting who take part in our events. We must work together with all our partners, including the FIA and FIM, to constantly elevate and improve safety standards.

The Abu Dhabi Desert Challenge POWERED BY NISSAN is a true motorsport classic, that was the first world level status event to be hosted in the Middle East region. Over the events 24 year history, we have worked hard to constantly improve safety and the competitor experience.

However, we can always do better and that is why I commissioned the experts to undertake this study during our 2014 event. The objective was to use science to examine the factors behind the high level of accidents and to use these findings to inform regulation change.

The findings are powerful and I hope will result in prompt changes to the regulations. More importantly they underline the value of research itself in helping us to improve motorsport safety.

Dr. Mohammed Ben Sulayem
President
ATCUAE / UAEMC

Executive Summary

The Abu Dhabi Desert Challenge (ADDC) is one of the early rounds of the FIA and FIM world cross-country rally series. In 2014, 45 riders competed in the bike category and a total of 46 cars commenced the event. Vladamir Vasilyev, who became the second Russian driver to win the Desert Challenge, said afterwards that "This is definitely the most difficult leg of the FIA Cross Country Rally series." Not surprisingly, "safety in the Desert Challenge is our number one priority" according to Dr. Mohammed Ben Sulayem, chairman of the organising committee. Although the FIA and FIM have an enviable track record in innovations to heighten competitor safety (e.g., Hans device), statistical comparisons with circuit racing in UAE (e.g., F1 & GP2) show that the rate of serious injury was 12 times higher in the cross-country discipline of motorsport.

Although the ADDC had not had a fatality in 23 previous years of competition, the 10 medevacs that occurred this year were typical for this event (approx. 10% of competitors). Serious incidents result from a complex matrix of factors but inattention or lack of vigilance is a commonly cited factor in the research literature. As a result, the goal of this research is to examine much closer than ever before how fatigue affects competitors alertness while contesting events of this nature. Fatigue typically reduces attention and vigilance which can impair decision-making, risk-management, aniticipatory abilities and reaction time (RT). Twenty-seven competitors (n = 7 bike category; n = 20 in car) from 10 countries participated in the study. Daily reaction time was measured prior to the commencement of each leg excluding the Super Special Stage at Yas Marina.

The measure employed was a psychomotor vigilance task performed on an ipad in the pre-start area. Self-reported sleep data, specifically the number of hours per night and ratings on the quality of sleep, were also recorded. In addition, critical incident de-briefing was conducted to assist with the psychological recovery of both competitors and SAR personnel. The main findings were that reaction times, on average, were increased by 9% across the desert stages of the event (days 2-5). Furthermore, when the latencies were categorised as high, medium and low, the results were even more compelling. On day one in the desert (leg 2) two-thirds of competitors responses had been categorised as high reaction times and by day four (leg 5), this had reduced to one-third.

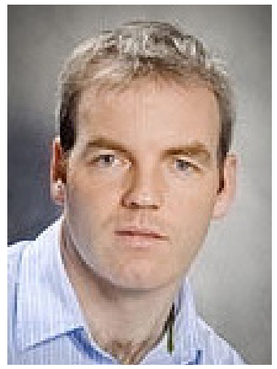
Sleeping in terms of hour per night varied but of greatest concern was the fact that the sleep quality halved across the four days of the desert stages. Other than lack of sleep, the inability of the competitors to maintain their rapid response time may be attributable to other factors including dehydration, concussion and fatigue. Consequently, among the recommendations of this study are specific amendments to existing FIA/FIM regulations, the development of new roles (e.g., Critical Incident Officer) with commensurate training and a call for a longitudinal study across two seasons seasons to investigate potential contributors to a loss of reaction time (e.g., dehydration, concussion and fatigue), all of which may help save lives and make cross-country rallies a safer sport for all.

Dedication:

This report is dedicated to Cameron Waugh (1963-2014) who loved motorsport.

Acknowledgements: The study could not have occurred without the cooperation of the competitors and their teams, who gave their time freely over the four days of the study. Furthermore, I wish to express my gratitute to Dr. Mohammed Ben Sulayem for his leadership on this project and the team at ATCUAE for funding this initiative. Other contributors that require acknowledgement inlcude Prof. Craig Mahoney (University of the West of Scotland) Dr. Mark Lyons (University of Limerick), Tara O'Connor (Dublin Business School), Dr. Caren Diehl (Up & Running Consultants, Dubai) and Dr. Sarah Wickenden.

Biographies:



TADHG MACINTYRE

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SEAN PETHERBRIDGE

Dr. Petherbridge is a specialist in family medicine in Dubai for the last 10 years. In addition, he has been the CMO at F1, rally and ADCC events in UAE in recent years.

The Abu Dhabi Desert Challenge

The Abu Dhabi Desert Challenge (ADDC) is one of the most challenging events on the cross-country rally series. It is distinguished by the spectacular venue, the Empty Quarter in UAE, which is full of beauty. In common with other events in FIA/FIM calendar, it is held in hot environmental conditions, which present unique challenges for the competitors. In this the 24th staging of the event, the competitors show a deep respect for the conditions and prepare accordingly. As articulated by Dr. Mohammed Ben Sulayem, chairman of the organising committee "our objective is to make the sport safer for all competitors by reducing the risk of accidents." Nevertheless the challenge of the ADCC is unsurpassed and we have measured 67°C inside a closed cockpit. Some racers have installed air conditioning, just so they can survive a desert event.

Both the FIA and FIM have an enviable track record in safety. Together with the initiatives by CMO and the organisers of the ADDC, competitors have made strides in improving their safety by heeding concerns about dehyration and the use of sentinel systems. Table 1 summarises the main medical interventions at ADCC 2014. Despite the success of prior interventions, it is apparent that both spinal compression and concussion are critical issues for competitors. Critical incident de-briefing was conducted by the first author (a psychologist) with the specific SAR personnel and two of the competitors.

Concussion can even result from collision with assistive technology

Table 1: Summary of Medical Interventions at ADCC 2014
(Source: ADDC CMO)

Number of Instances	Status
10	Medivacs to Madinat Zayed Hospital.
1	Fatality.
3	Diagnosed concussions.
7	Diagnosed spinal compression and severe injury (3 cars & 4 bikes).

The rationale for the current study was to assess the role of fatigue across the different days and desert stages (i.e., legs 2-5). The key issue is whether competitors could recover sufficiently from one day to the next to perform at a similar level in terms of reaction time and alertness. Furthermore, the influence of sleep pattern and sleep quality was investigated as a primary contributor to recovery state. It was hoped that the report of the research team would be invaluable to the stakeholder organisations, the FIA and the FIM, future competitors and support personnel.

Hypotheses:

1. The number of participants scoring high on the "alertness test" would reduce across the days of the event.
2. The mean response times would increase from leg 2 to leg 5.
3. The number of hours of self-reported sleep would reduce as the event progressed.
4. The quality of the sleep would diminish as the event progressed.

Note: In total, the number of competitors that started the event were: 45 riders; 46 drivers and 45 co-drivers.

Improving measurability & results through advancement in science

Methodology

Participants: Twenty-seven competitors, comprising 7 riders, 17 drivers and 3 co-drivers (1 female), consented to participate in the study. The inclusion criteria were primarily that they could comprehend the "English" instructions or that their co-driver could interpret for them.

Apparatus: The Psychomotor Vigilance Task (PVT) has been used for more than 40 years by sleep and alertness researchers. It is proven sensitive to the major components of alertness. In this study an app version (Mind Metrics PVT), a valid objective measures, was employed on an Apple iPad Air ®. The test records the average reaction time, each individual trial, and provides an alertness score which is also categorised as being "low," "medium," or "high."

Materials: A brief sleep survey was presented to the participants. Items focused on the following issues: 1. "What time you went to bed at?" 2. "What time you awoke at?" 3. "Estimate the numbers of hours. sleep you had?" and 4. "Please rate your sleep quality on the following 1-5 scale with anchor points as follows: 1 = "Very Good Sleep." 5 = "Very Poor Sleep." Note that for the purposes of communicating the findings, the ratings were converted into proportions on a 2-10 scale where 10 was the highest quality sleep and 2 was the lowest quality.

Procedure: On days 1-4 of the desert stages of the event (i.e., rally legs 2-5) participants were approached in the pre-start area. Here they were asked to provide information on their sleep pattern and sleep quality from the preceding night. Subsequently, they completed a series of 10 practice trials on the PVT and then 20 recorded test trials.

Additional Data Collection: Three high level competitors and three team staff were interviewed about the challenges of the event with regard to driver and rider safety. This data is used to provide some background commentary for this report and it will be analysed and reported separately.

Research Findings

The objective of the study was to investigate if competitors could recover sufficiently from one day to the next to perform at a similar level in terms of reaction time and alertness. Our preliminary findings suggest that this was not the case and the tentative explanation may be related to the lack of sleep quality over the duration of the event. Our initial hypothesis that the number of participants scoring high on the "alertness test" would reduce across the days of the race was supported (see Figure 1). The magnitude of these scores was somewhat surprising as familiarity with the test across several trials may have a slight practice effect. This was only recorded with one outlier who improved daily.

Conversely, the trend of the data showed a reduction in the "high" alertness scores from two-thirds of the sample to one-third, with approximately 20% of the sample recording "low alertness" levels by day 4 in the desert. Furthermore, the average response times increased by up to 9% at this time point. The delay in reaction time could lead to driver error, an increased lag time in the response to attentional cues and reductions in anticipatory abilities.

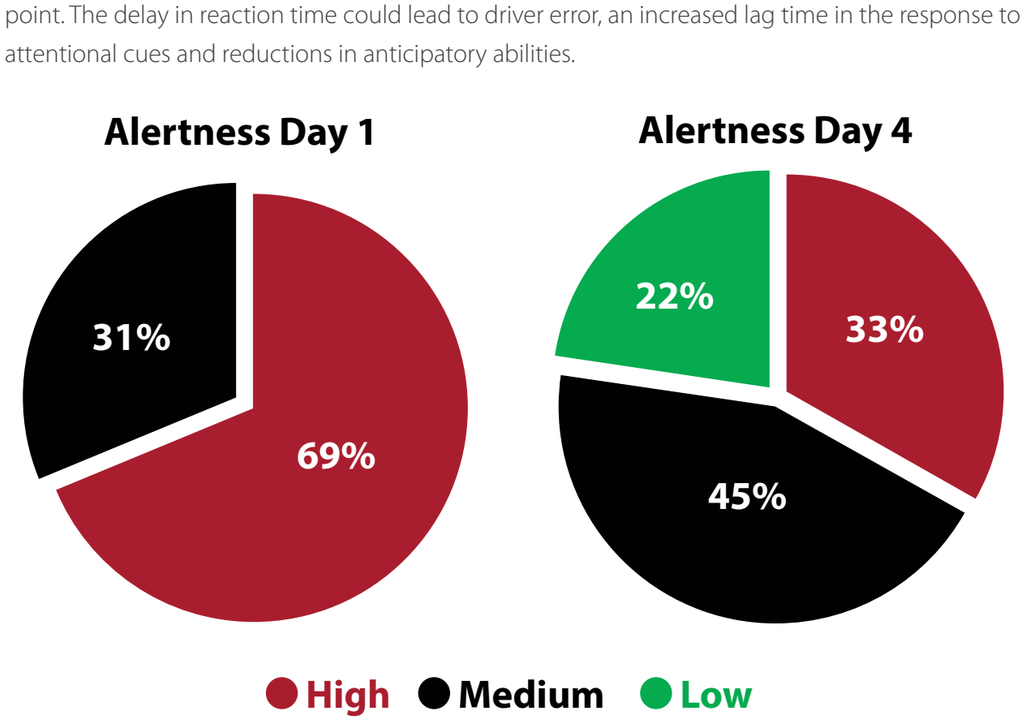

Figure 1: Average alertness score on Psychomotor Vigilance Test Days 1-4 (Legs 2-5).

An array of factors may lead to reduced alertness but fatigue is the primary factor. Our findings indicated that the number of hours of self-reported sleep would reduce as the event progresses. As predicted, the quality of reported sleep reduced as the event progressed, despite an increase in sleep hours (see Figure 2). This warrants further scrutiny as our methodology was based on self-report which is subject to biases and memory distortions.

Objective measures including sleep monitoring technologies could be applied coupled with other measures (e.g., dehydration) to establish the factors that both inhibit and promote sleep quality and effective recovery.

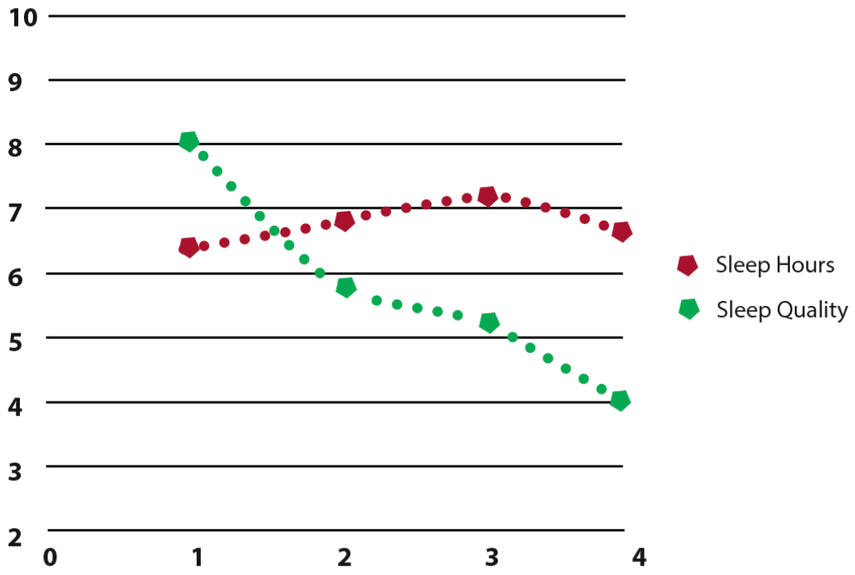

Figure 2: No. of Hours Sleep and Self-Reported Sleep Quality for Days 1-4 of ADCC: legs 2-5 of event (10 = High Quality; 1 = Low Quality).

Other than lack of sleep, the inability of the competitors to maintain their response time may be attributable to other factors which include dehydration, concussion and peripheral fatigue. Originally, this study had planned to evaluate peripheral fatigue by evaluating metabolic load (i.e., heart rate) and by measuring alertness at the end of each leg, but due to logistical challenges this was not possible in 2014. It is imperative that this be included in follow-up research. The testament of the competitors supports the fact that fatigue was a major challenge. One rider stated that "I fell just at the end. It always happens like this at the end of the stage when you feel exhausted and make mistakes." Another competitor explained that while the stage was beautiful "its hard once you are out of energy."

While the number of competitors presenting with clinical dehydration issues was low, many more may have suffered from excessive fluid loss which may have impaired their performance. As little as a 3% loss of fluid may significantly compromise performance. Both the FIA and FIM have well developed regulations on the need to carry fluids. In light of the potential performance decrements and potential consequences this issue requires further empirical scrutiny using objective measures of dehydration. Furthermore, the role of concussion has yet to be explored comprehensively among this sample. Anecdotal evidence emerged that concussion may be an issue. One participant, due to a concussion on the previous day, could not recall the subsequent day that he had participated in testing that morning.

Conclusion

The findings of this study indicate that competitors were unable to maintain their response time across the days of the ADCC. Fatigue and poor sleep quality as indicated by self-report may be linked to the slower response times observed here. Other factors including the role of dehydration, concussion and peripheral fatigue warrant futher investigation among these world class competitors. A series of practical, logistical and technical recommendations are now summarised which may help save lives and make cross-country rallies a safer sport for all.

Findings prove loss of response time is evident

Key Recommendations

1. Simple and quick methods of measuring dehydration to be employed (e.g., daily weigh-in & weigh-out for competitors coupled with monitoring of fluid intake) at all international cross country rally events.

2. Augment the existing medical resources under the management of the CMO to include a "Critical Incident Officer." The role would include the development of a standardized protocol for the management of serious incidents on event, to provide de-briefing for those engaged in rescue and medical interventions and any competitors involved on scene, conducting research on the risk factors in cross-country rally events and finally, to develop and disseminate preventative strategies for the competitors.

3. FIA and FIM relevant commissions to consider division of the Bivouac into four distinct areas:

    a. HQ/Media/Hospitality in one part with no traffic and parking for media and officials.

    b. Teams and service where only competitors and service cars have access.

    c. Refuelling zone, and,

    d. Accommodation area with significant separation from service and refuelling to optimise sleep and reduce risks from hazards (e.g., refueling and engine noise).

4. Neurocognitive assessment of competitors on computerized tests to provide baseline data for accurate diagnosis of concussion should it occur.

5. Pooling of data across the FIA/FIM events on an annual basis by the CMOs, complemented by the new FIA Accident Database. Reporting to include the development of a database on the medical interventions, competitor weightloss and other relevant psychophysiological data (e.g., cognitive test forconcussion). Annual review by FIA/FIM with reporting to the competitor community and ASN/FMN's.

Areas for Further Research

1. Considering this work as the pilot study, funding should be made available to conduct a championship-wide longitudinal study across three events per annum in the 2015 and 2016 seasons (e.g, Bajas, cross-country, and marathon events) to evaluate the risk factors for competitors including sleep (& recovery strategies), hydration, concussion and fatigue.

2. A second study, involving both technical and medical personnel should be conducted on the preventative strategies to deal with both spinal compression, concussion and dehydration among competitors.

Separation of Biviouac into four zones may increase sleep quality and reduce risks from hazards


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The Motorsport Knowledge Institute (MKI) was founded in 2011 as the Research, Training and Education division of the ATCUAE. It is a global leader in developing and sustaining motorsport through academic methods, as well as improving safety standards by both reducing the risk of incidents and increasing the standard of post incident care.

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