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Circadian Rhythms, Sleep And Cognitive Performance In Simulated Lunar Isolation

Trastornos Circadianos e Insomnio

Josu Egea Carro[1], Javier Puertas Cuesta[2], Lourdes Guerra Martin[3], Christopher Gordon [4], Svetlana Postnova [5], Jorge Ullate Mora[6], Maria Mercedes Hernández Hernández[6], Carlos Egea Santaolalla[6], **Maria Comas Soberats**[6,7]

1. Universitat de Valencia, Valencia, España
2. Universidad Católica de Valencia, Valencia, España
3. Araba University Hospital, Vitoria-Gasteiz, España
4. Macquarie University, Sydney, Australia
5. University of Sydney, Sydney, Australia
6. Bioaraba Health Research Institute, Vitoria-Gasteiz, España
7. IKERBASQUE Basque Foundation for Science, Bilbao, España

Introducción
Future lunar and Martian habitats are likely to disrupt circadian timing and sleep through atypical light, workload and isolation. Misalignment is linked to degraded alertness, mood and cognitive performance, which threatens mission readiness. We investigated how circadian–sleep systems and performance adapt during lunar-like isolation without natural light.

Objetivos
To describe and quantify changes in sleep timing, continuity, efficiency and day-to-day stability across Stages (Pre, During, Post) using wrist actigraphy.

To characterize subjective sleepiness, fatigue, alertness, sustained attention with the Psychomotor Vigilance Task (PVT) and mood on prespecified study days.

To relate mission-schedule elements (sleep opportunity, work blocks, meals, caffeine after 16:00, exercise, EVA timing) to sleep and performance outcomes.

Material y Método
Eight healthy adults lived for two weeks in an underground analogue habitat in Switzerland with no sunlight. Observations covered three Stages: Pre (−14 to −1), During (days 1 to 14) and Post (+1 to +14). Continuous wrist actigraphy (Kronowise) recorded activity, posture, distal skin temperature and light, with nightly sleep diaries. Subjective sleepiness and fatigue were measured every ~3 hours on days −3, 4, 12 and +4 using the Karolinska Sleepiness Scale, the Samn-Perelli fatigue rating and visual analogue ratings of fatigue and alertness. Mood was assessed once daily on days −14, −3, 4, 12 and +4 with DASS-21 and POMS. Sustained attention was measured with a Psychomotor Vigilance Task on the same three-hour schedule and days. A mission schedule log captured sleep-opportunities, work blocks, meal times, caffeine after 16:00, exercise and EVA timing.

Resultados y conclusiones
Data acquisition was completed for eight participants with high compliance to actigraphy and the three-hour assessments. Mixed-effects analyses of Stage, time of day and their interaction are in progress. This lunar-analog protocol is feasible and supports robust within-subject comparisons that will inform scheduling guidelines and fatigue-risk mitigation for future lunar operations and other

extreme environments.