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Title: Additive Effects Of The Number Of Completed Flights And Time Awake On Fatigue In Short-Haul Airline Pilots

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Introduction: Time awake more so than the duration of the flight duty period affects airline pilots' fatigue, consistent with current models of sleep-wake regulation. It is less clear, however, whether the quality of the time awake impacts fatigue. Although current flight time limitations take the number of flights within a duty period as a measure of workload into account, quantitative evidence for its fatiguing effect is scarce.

Methods: Fatigue (Samn-Perelli 20-point scale) and workload ratings (NASA-Task-Load-Index) were obtained at the end of each of 553 short-haul flights from 37 pilots operating regular rosters. Pilots also checked off from a predefined list the hassles (e.g. critical fuel status, unforeseen aircraft change, bad weather, no break between flights etc.) experienced during each flight. A linear mixed-model with fatigue as dependent variable was adjusted for time awake, number of completed flights, number of hassles, and pilot's responsibility (flying/monitoring). In addition, we tested (linear mixed-model) the influence of number of hassles, number of flights, time awake, and pilot's responsibility on subjective workload. Linearity of the predictors, and absence of multicollinearity were verified.

Results: Fatigue was influenced by time awake, number of flights and pilot's responsibility ($p < 0.05$), whereas no effect was found for number of hassles. Fatigue increased by 0.4 points with every hour awake, and by 0.3 points with every completed flight (other variables kept constant). Fatigue was lower by 0.4 points when the pilot was flying instead of monitoring. Assuming one completed flight fatigue exceeded the critical threshold of 12 points (flying duty not recommended) after 17.1h awake, whereas with four completed flights this threshold was crossed already after 14.7h. Subjective workload increased with number of hassles, but not with number of flights or time awake.

Conclusion: Objective workload measured by the number of completed flights contributes to fatigue, adding to the time-awake effect. Subjective workload assessed by the NASA-Task-Load-Index increases with the number of hassles, but not with the number of flights, indicating that this instrument is not sensitive to this type of objective workload.

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