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**Title:** Sleep diversity index for fragmentation analysis

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**Body:** Introduction: Sleep fragmentation is one of the main problems of sleep disorders especially in respiratory failure. During this last decade, several indicators of sleep fragmentation were introduced but none of them seems to take into account the succession of sleep stages. To tackle with this problem, we used the Shannon entropy index for modelling sleep stages diversity from an hypnogram and for assessing more accurately sleep quality by quantifying its fragmentation. Methods: This study was conducted at the sleep laboratory of the Centre Hospitalier Intercommunal de Toulon la Seyne. 100 polysomnographies under spontaneous breathing were analysed: 55 from normal subjects and 45 from patients with obstructive sleep apnea who came for a diagnosis. The hypnogram was sampled every 15 epochs. The Shannon entropy index (Sh) was then calculated for each sample. We noticed that entropy varies between two extrema: a minimum value (zero) corresponding to an absence of changing in sleep stages and a maximum value corresponding to the equiprobability of occurrence of sleep stages (ShMax). We define the Sleep Diversity Index (SDI) as being equal to the proportion of time spent at an entropy  $Sh > 1/2 ShMax$  for the total duration of the recording. Results: First, a statistical test of linear correlation has highlighted a very strong anti-correlation ( $r = -0.88$ ,  $p < 0.01$ ) between the SDI and the sleep efficiency index defined by the ratio between total sleep time and time spent in bed. Then, using the receiver operating characteristic (ROC) curves, the IDS threshold of fragmentation was determined at 17.57%. Conclusion: If IDS is lower than 17.57%, then sleep is considered as non-fragmented and otherwise, sleep is considered as fragmented.