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The AASM Scoring Manual Four Years Later

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Purpose of Review: Review published studies and critiques which evaluate the impact and effects of the American Academy of Sleep Medicine (AASM) Sleep Scoring Manual in the four years since its publication.

Findings: Using the AASM Manual rules to score sleep and events in a polysomnogram (PSG) results in: (1) very large differences in apnea-hypopnea indexes (AHI) when using the recommended and alternative rule for scoring hypopneas in adults; (2) increases in NREM 1 and sleep stage shifts with compensatory decreases in NREM 2 in children and adults when following rule 5.C.b. for ending NREM 2 sleep; (3) increases in NREM 3 in adults scoring slow wave activity in the frontal EEG derivations; (4) improved interscorer reliability; and (5) successfully identified fragmented sleep in children with obstructive sleep apnea (OSA) from primary snorers or normal controls because

they had more NREM 1 and stage shifts using rule 5.C.b. Criticism of the Manual most often cited: (1) two rules for scoring hypopneas; (2) alternative EEG montage cancellation effects; (3) scoring stages 3 and 4 as NREM 3; and (4) too few rules for scoring arousals and REM sleep without atonia.

Summary: Four years have passed since the AASM Scoring Manual was published with far less criticism than those who developed it feared. The AASM Manual provides a foundation upon which we all can build rules and methods which identify the complexity of sleep and its disorders.

Keywords: Sleep scoring parameters, AASM standard, polysomnography/classification/standards, practice guidelines as topic sleep apnea, practice guidelines as topic sleep scoring
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Four years have passed since the American Academy of Sleep Medicine (AASM) published *The AASM Manual for the Scoring of Sleep and Associated Events*.¹ The Manual represents a brave effort to standardize how a comprehensive in-laboratory polysomnogram (PSG) performed in the United States should be recorded, scored, analyzed, and reported.² Before it, we were never certain that sleep study data across city, state, country, or sea were comparable. Based on digital video-PSG recording techniques, the Manual incorporates the effects of age and disease on sleep and provides rules for visual scoring of sleep stages, arousals, movements, respiratory and cardiac events during sleep.³ Driving goals in developing it were: simplicity, ease of implementation, likelihood of improving interscorer reliability, and avoiding radical changes unless sufficient evidence existed to do so. Every effort was made to make the Manual evidence-based, but when insufficient, the committee used the UCLA Appropriateness Method to develop consensus recommendations.⁴ This paper reviews studies and critiques which evaluate the impact and effects of the AASM Manual Sleep Scoring Manual in the four years since its publication.

Two Definitions for Scoring Hypopneas in Adults

The greatest criticism has been directed at the AASM's decision to permit two different ways for scoring hypopneas in a PSG in adults.⁵ Why two? The Respiratory Scoring Task Force detailed in its review paper¹ convincing level I and II evidence that apnea-hypopnea indexes (AHI) which define hypopneas as only a discernible amplitude reduction but were associated with a $\geq 4\%$ desaturation correlated significantly with: (1) preva-

lent and incident blood pressure;^{6,7} (2) lower neurocognitive test scores;⁸ and (3) automobile crashes due to sleepiness.⁹ The respiratory review paper also provided sufficient evidence for scoring hypopneas which caused as little as $\geq 20\%$ to 30% fall in airflow and/or $\geq 2\%$ or $\geq 3\%$ desaturations.^{10,11}

However, the AASM wanted rules for scoring hypopneas which had substantial or excellent interscorer reliability. Interrater reliability (IRR) as it relates to scoring sleep in a PSG measures how closely individuals score the same sleep study. IRR when scoring a PSG depends upon the: (1) skill, experience, and training of scorer; (2) technical quality of study; (3) clarity and simplicity of scoring rules; (4) diligence with which scoring rules are applied; and (5) degree of physiological ambiguity of the sleep/wake patterns.¹² When two or more individuals score a stage of sleep or an event in a PSG differently, it can introduce enough variability to lead to a false positive or false negative for a particular diagnosis.

The IRR for scoring respiratory events in a PSG is particularly affected by the: (1) duration of the event; (2) degree of reduction in the amplitude of the measured signal(s); (3) level of the oxyhemoglobin desaturation associated with it; and (4) presence and duration of arousal which accompanies it.³

Ayappa et al. found the percent scoring agreement for scoring apneas using a nasal pressure sensor was excellent (0.91) but only moderate for hypopneas (0.69) or flow limitation events (0.64).¹⁴ The more subtle the reduction in airflow, the more difficult to achieve good interscorer agreement: one scorer identified 35% more flow limitation events than the other. Whitney et al. found a hypopnea associated with 2% to 5% desaturations could be scored with IRR of 0.90, but scoring agreement in-

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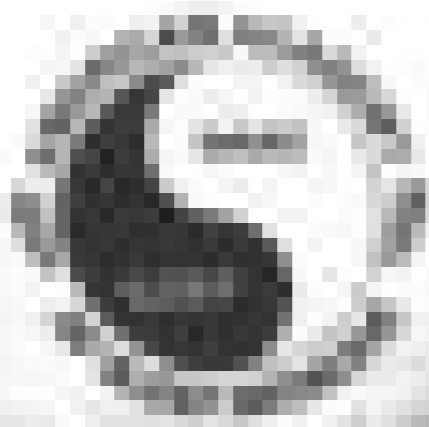
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కేటగి	6 సం.ల స్కేలు	12 సం.ల స్కేలు	18 సం.ల	24 సం.ల స్కేలు
SGT	-	Inter + TTC	NA	B.A/B.Sc +B.Ed + EO & GO.
LP	-	10+5+P.T./B.Ed.	NA	10+5+P.T./B.Ed + EO & GO
PET	-	B.A/B.Sc + B.Ped	NA	B.A/B.Sc + B.Ped + EO & GO
SA	-	B.A/B.Sc +B.Ed + EO & GO.	NA	B.A/B.Sc +B.Ed + EO & GO.
HM	-	Not Necessary	NA	NA

PDF

The AASM Manual for the Scoring of Sleep and Associated Events

Rules, Terminology and Technical Specifications



The AASM scoring manual: a critical appraisal

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Conflict of interest statement: None.

Purpose of review

Surrogate recently published studies and critiques evaluating the effects of the American Academy of Sleep Medicine (AASM) Sleep Scoring Manual.

Recent findings

Only a few retrospective studies have been published evaluating the new AASM Scoring Manual. These have shown that when scoring polysomnograms (PSGs) using the AASM rules compared to previous standards and guidelines increased amount and percentage of sleep time in Non-Rapid Eye Movement Sleep (NREM 1 (N1) and N2 sleep), and decreased NREM 3 (N3) sleep; improved inter-scorer reliability when scoring sleep stages in adults; large differences in apnea-hypopnea indexes (AHI) using different hypopnea scoring definitions; and PSGs scored using the 'recommended' hypopnea definition in the new manual identified no significant sleep disordered breathing in 40% of lean individuals with symptomatic OSA (AHI >5h by 1999 'Chicago' criteria) and a favorable response to treatment.

Summary

Two years have passed since the AASM Scoring Manual was published, generating less criticism than was feared by those who developed it. The improvement in inter-scorer reliability using the Manual is heartening since this goal shaped many of the choices made. The alternative hypopnea rule should be endorsed as a recommended option. The AASM Scoring Manual provides a foundation upon which we all can build rules and methods that quantify the complexity of sleep and its disorders. Multicenter validation and refinement of the Manual is encouraged.

Keywords

AASM standard, polysomnography/classification/standards, practice guidelines as topic sleep apnea, practice guidelines as topic sleep scoring, sleep scoring parameters

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Introduction

In May 2007, the American Academy of Sleep Medicine (AASM) published the *AASM Manual for the Scoring of Sleep and Associated Events* (Manual) [1*]. This Manual was sorely needed; previously, sleep practitioners scored sleep stages using the Rechtschaffen and Kales sleep scoring manual (R & K) first published in 1968 [2], manually using a 1992 AASM guideline [3], periodic limb movements using another 1992 AASM guideline [4], and REM sleep without atonia using methods published by Muzlin's group in 1999 [5], and respiratory events using pieces and parts from AASM position papers written in 1999 [6] and 2001 [7]. Later on, we in the United States added scoring rules to comply with Centers for Medicare and Medicaid Services (CMS) requirements governing funding for OSA treatment [8]. Given this hodgepodge of criteria, sleep practitioners were never quite certain that sleep study data across city, state, country, or sex were comparable.

The Manual represents a brave first effort to standardize how polysomnogram (PSG) performed in the United States should be recorded, scored, analyzed, and reported [1*]. The Manual is based upon digital PSG recording techniques, incorporates the effects of age and disease on sleep, provides technical specifications, and addresses not only visual sleep stage scoring, but also rules for scoring arousals, movements, and respiratory and cardiac events during sleep [9]. As a participant in many task force sessions, I perceived during these years in the principles of simplicity, ease of implementation, likelihood of improving inter-scorer reliability, and avoidance of radical changes unless there was sufficient evidence to proceed otherwise, whereas at the same time emphasizing that the rules contained in the Manual were subject to revision and evolutionary improvements with debate, the passage of time, and accumulation of further evidence.

The paper reviews recently published studies and critiques that evaluate the impact and effects (good, bad, or neutral) of the Manual.

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Competent (2 points)	Approaching Competent (1 point)	More Practice Needed (0 points)
The dancer skill was performed correctly.	You demonstrated the skill correctly, but used a little more practice before you are ready to teach this skill. You either you did not perform the lead correctly, did not follow the lead correctly, or were somewhat out of sync.	You need more practice to be deemed acceptable for this skill.
Message	Timing	Style
1	2	3

Dancer: Miroslava		Dancer: Irving	
Song: "Just a Christian Centre" (Dancer Partner)		Song: "Just Got That by Cheryl Pepper" (Dancer Partner)	
Pr	Perform each skill 1 (competent) times	Pr	Perform each skill 1 (competent) times
1	Lady's neck turn	1	Lady's neck turn
2	Lady's outside turn	2	Lady's outside turn
3	Gentleman's turn	3	Gentleman's turn
4	Stomach turn	4	Stomach turn
5	Shoulder turn	5	Shoulder turn
6	Fancy arm	6	Take the hat
7	Spin the Cat	7	Footwork
8	Buildlight		
9	Eventhumb to hand out		
10	Beats (4 points)	10	Beats (4 points)
11	On beat (4 points)	11	On beat (4 points)
12	To Rate the entire time (2 points)	12	To Rate the entire time (2 points)
13	Good lighting and film quality (2 points)	13	Good lighting and film quality (2 points)
14	Correct music used (2 points)	14	Correct music used (2 points)
15	Chaoslike sections were edited out (2 points)	15	Chaoslike sections were edited out (2 points)
16	Title for dance included (1 point)	16	Title for dance included (1 point)
17	Follow the order of skills provided (2 points)	17	Follow the order of skills provided (2 points)
18	Submits the each skill (2-point extra credit)	18	Submits the each skill (2-point extra credit)

Dancer: Sabu		Dancer: Wally	
Song: "Bossa Nova" (Area: Mass) (Dancer Partner)		Song: "Bossa Nova" (Dancer Partner)	
Pr	Perform each skill 1 (competent) times	Pr	Perform each skill 1 (competent) times
1	Lady's neck turn	1	Wally's leg
2	Full pivot turn	2	Lady's turn
3	Lady's outside turn	3	Box step
4	Gentleman's turn	4	Gentleman's pass by
5	Cross over	5	Gentleman's turn
6	Circle turn	6	Lady's pass by
7	Beats (4 points)	7	Turning Beat of Box Step
8	On beat (4 points)	8	Beats (4 points)
9	To Rate the entire time (2 points)	9	On beat (4 points)
10	Good lighting and film quality (2 points)	10	To Rate the entire time (2 points)
11	Correct music used (2 points)	11	Good lighting and film quality (2 points)
12	Chaoslike sections were edited out (2 points)	12	Correct music used (2 points)
13	Title for dance included (1 point)	13	Chaoslike sections were edited out (2 points)
14	Follow the order of skills provided (2 points)	14	Title for dance included (1 point)
15	Submits the each skill (2-point extra credit)	15	Follow the order of skills provided (2 points)
		16	Submits the each skill (2-point extra credit)

HMC sleep staging dataset was collected as part of a study that assesses the generalization performance of an automatic sleep score algorithm through multiple heterogeneous data sets. In general, an updated list of EDF(+) compatible software is usually available on the EDF Plus website [12]. The automatic algorithm described in [2] used as input two EEG (C4/M1, C3/M2), EMG chin and an ECG horizontal channel. C., Mark... A., ... MS WORD files will be automatically rejected by the online application system. The recordings were acquired during the common clinical practice. Coimbra, "Deep convolutional neural networks for heart sound segmentation," IEEE Journal of Biomedical and Health Informatics, vol. [Online] Further details can be found in: Penzel et al. If you use a previous version of this database, you might consider excluding these recordings from Ethics analysis Authors do not declare ethical concerns. You need JavaScript enabled to view it. E. Please see table 2 in this article, map the approximate distribution of king credits.

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