Validation of the Healthy Sleep Scale - HSS

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ABSTRACT

Background: Research on healthy sleep remains relatively understudied in comparison to other areas of health promotion and sleep research (sleep problems or disorders). The aim of our study was to develop a short scale that could be easily used in primary health care and sleep research to evaluate healthy sleep. For this purpose, a cluster of healthy sleep items were studied and its psychometric properties were investigated.

Methods: Employees with standard working hours from a public Portuguese organization participated in the study (N=111; M= 44.3 ± 9.97 years, 72.1% female). After written consent, individuals filled out a set of questionnaires about sociodemographic characteristics, sleep timings (bedtime, sleep latency, wake up time, sleep inertia), healthy sleep (regular wake up time/bedtime; ease of falling asleep/waking up, recovered after sleep, slept throughout during the night, calm sleep, deep sleep, sleep quality and sleep satisfaction), sleep difficulties (ICSD-3/DSM-5-TR insomnia symptoms), mood (Profile of Mood States), Neuroticism/Extraversion (Eysenck Personality Inventory), arousability levels (Arousal Predisposition Scale) and well-being (WHO-5 Well Being Index). SPSS 28 was used for statistical analyses.

Results: Reliability analyses revealed that four healthy sleep items (calm sleep, deep sleep, sleep quality and sleep satisfaction) contributed to the overall Cronbach´s alpha (this value decreased when each item was removed). The 4-item Healthy Sleep Scale (HSS) reliability was high (α=.945). A single factor structure solution of the HSS was obtained explaining 86.15% of the total variance. There was a strong positive correlation (r= .919, p<.001) between HSS total score and the healthy sleep variable (Silva et al. 2022). Correlations with medium/large effects were equally observed between HSS and the following variables (in the expected direction): ICSD-3 insomnia symptoms (r= -.739, p <.001), DSM-5-TR insomnia symptoms(r= -.731, p <.001), depression-dejection (r= -.367, p <.001), tension-anxiety (r= -.390, p <.001), anger-hostility (r= -.300, p =.002), fatigue-inertia (r= -.429, p <.001), vigour-activity (r= .401, p <.001), neuroticism (r= -.555, p <.001), arousability (r= -.361, p <.001) and well-being (r= .640, p <.001).

Conclusion: Our HSS showed good psychometric properties and promises to be a valid tool to routinely evaluate healthy sleep in clinical practice and sleep research.

INTRODUCTION

Research on healthy sleep remains relatively understudied in comparison to other areas of health promotion and sleep research (sleep problems or disorders) (1).

AIM of our study was to develop a short scale that could be easily used in primary health care and sleep research to evaluate healthy sleep. For this purpose, a cluster of healthy sleep items were studied and its psychometric properties were investigated.

METHODS

SAMPLE
Employees from a public Portuguese organization with regular working hours participated in the study. (N=111; M= 44.3 ± 9.97 years, 72.1% female).

PROCEDURE
When attending their routine appointment at the Occupational Health Department, employees were invited to participate in the study. After written consent participants filled out a set of questionnaires about sociodemographic characteristics, sleep timings, healthy sleep, sleep difficulties, sleep hygiene, mood, neuroticism/extraversion, arousability levels and well-being.

STATISTICAL ANALYSES
1. Descriptive analysis of the sample sociodemographic characteristics and sleeping timings; 2. Reliability analyses were conducted with healthy sleep items; 3. Factor analysis with varimax rotation was used to investigate healthy sleep scale factors; 4. Correlations analyses (Spearman) between healthy sleep scale/variable were performed with other sleep variables (ICSD-3 symptoms; DSM-5-TR symptoms, sleep hygiene total score), psychological variables (mood states and personality traits) and well-being 5. Group comparisons were investigated between insomnia cases groups (ICSD-3 and DSM-5-TR criteria) and a group of individuals without insomnia (Mann Whitney U tests). Significant results were set at p<.05.

INSTRUMENTS
Sleep timings: habitual bedtime, average time to fall asleep (after bedtime), habitual wake up time, average time to rise (after waking up) (2,3).

Healthy sleep: a set of questions were used to evaluate regularity of bedtimes and wake up times, feeling recovered after waking up, sleep continuously (without waking up) during the night, calm/peaceful sleep, deep sleep, good sleep quality and sleep satisfaction. Response option included the following option: 1=never/almost never; 2=rarely; 3=sometimes, 4=often (3 or more times per week) and 5=almost always/always. Higher scores indicated healthier sleep (4–6)

Insomnia symptoms: ICSD-3/DSM-5-TR insomnia symptoms: a questionnaire was used to define individuals with chronic insomnia which was derived from a pre-existing questionnaire (7). Based on answers obtained to this sleep questionnaire it was possible to define a chronic insomnia episode according to diagnostic criteria of the International Classification of Sleep Disorders third edition, ICSD-3(8), and to identify a case of persistent insomnia according to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition, Text Revised, DSM-5-TR (9) (2,3). To define ICSD-3 and DSM-5-TR insomnia cases participants who reported sleep disorders (sleep apnea, restless leg syndrome or narcolepsy) were not studied (n=11) (Criterion F, DSM-5-TR and ICSD-3)

Sleep Hygiene Index: evaluates inadequate sleep behaviours and attitudes with 13 items. To each item corresponds a response scale with 5 options that can vary from 5=always to 1=never. A total score can vary between 63 (indicating less adequate sleep hygiene practices) to 13 values (more appropriate). (3,10)

Profile of Mood States: scale with 65 mood adjectives and 6 sub-scales: tension-anxiety, depression-dejection, anger-hostility, confusion-bewilderment, fatigue-inertia and vigour-activity. Response scale varies from 0=not at all to 4=extremely. Higher values suggest higher values on the mood dimension evaluated.(11,12)

Eysenck Personality Inventory: evaluates neuroticism and extraversion/introversion personality traits. The EPI short version of 12 items was used: 6 items measure neuroticism and 6 items evaluate extraversion/introversion. Individuals are asked to report how they normally feel on a response scale with 4 options (ranging from 1=almost never to 4= almost always). Higher values in both subscales indicate greater neuroticism and extraversion. (13,14)

Arousal Predisposition Scale: includes 12 items that assess individual predisposition for cognitive activation. To each item corresponds a response scale that varies from 1 (never) to 5 (almost always) with higher scores indicating greater predisposition to arousal (1 item is recoded inversely). (2,15)

WHO-5 Well Being Index: includes 5 items that evaluate general well-being. To each item corresponds a response scale that varies from 0=at no time to 5=all the time. The total score, that varies from 0 to 25, is multiplied by 4 (range 0-100), and higher scores represent better well-being(16,17).

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RESULTS

1. Reliability analyses
Reliability analyses revealed that 4 healthy sleep items contributed to the total Cronbach alpha of **.945** and formed the Healthy Sleep Scale (HSS). When each item was deleted the HSS total Cronbach alpha decreased suggesting that these items made a contribution to the HSS internal consistency (table 1).

Table 1: Reliability of 4 healthy sleep items (Cronbach alpha= **.945**)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Calm sleep	10.22	10.753	.872	.771	.928
Deep Sleep	10.33	10.242	.851	.763	.933
Sleep quality	10.40	9.987	.909	.837	.915
Sleep satisfaction	10.49	9.743	.849	.772	.935

2. Factor analysis
Assumptions to perform factor analysis were verified. Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .877 and Bartlett's Test of Sphericity was significant p <.001. Factor analysis with varimax rotation revealed a single component (Scree Plot of Cattell, Figure 1) explaining 86, 15% of the total variance.
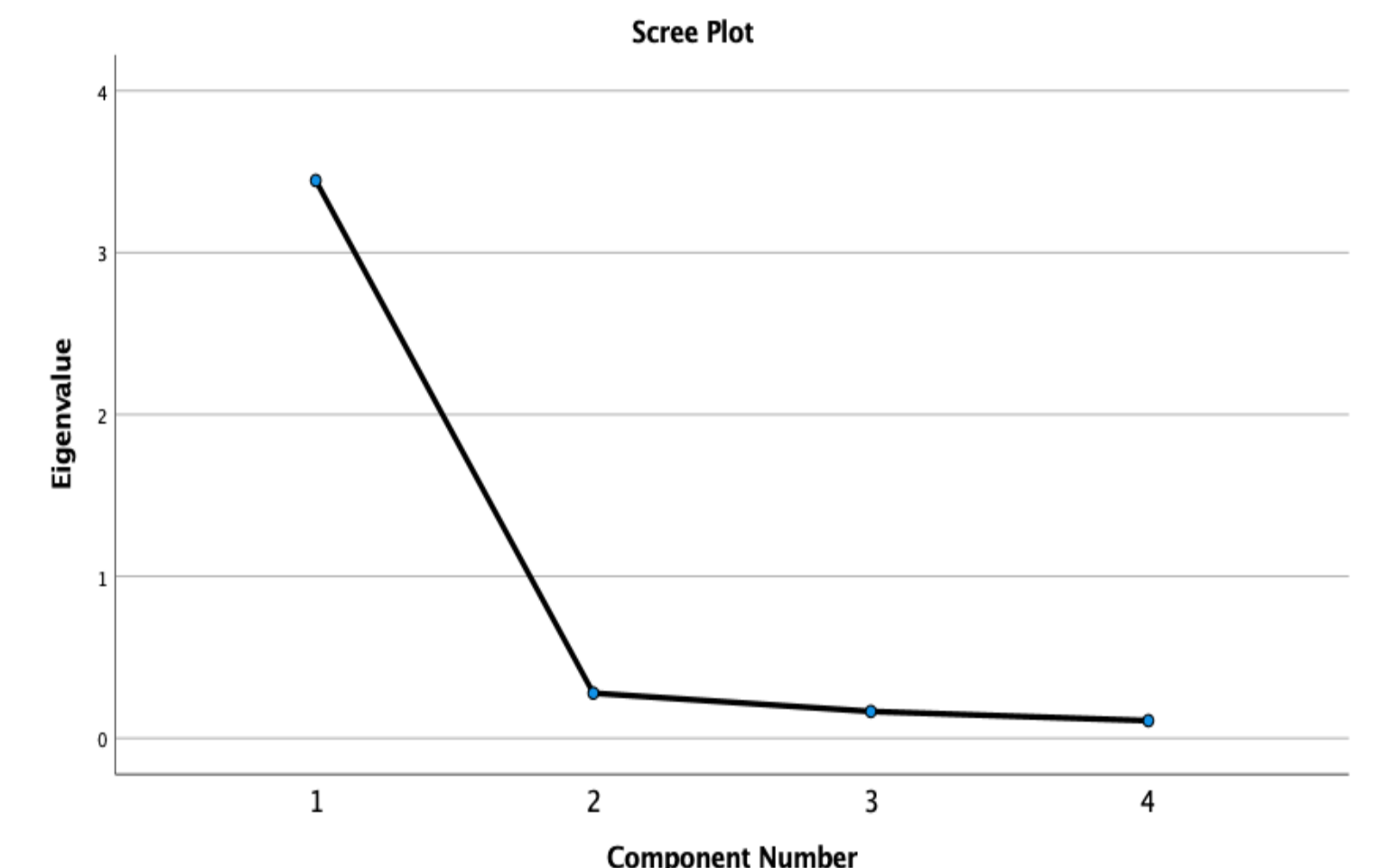

Figure 1: Scree plot Cattell

3. Correlations and comparisons between insomnia groups
✓ Strong positive correlation between HSS total score and the healthy sleep variable (r= .919, p<.001);

✓ Correlations with medium/large effects (in the expected direction between HSS and ICSD-3 insomnia symptoms, DSM-5-TR insomnia symptoms, depression-dejection, tension-anxiety, anger-hostility, fatigue-inertia, vigour-activity, neuroticism, arousability and well-being (Table 2).

✓ ICSD-3 and DSM-5-TR insomnia cases referred lower values in the HSS in comparison with individual without insomnia (Table 3).

Table 2: Correlations between healthy sleep variable, HSS, HSS items with other sleep and psychological variables

	Healthy sleep variable	Healthy sleep scale	Calm sleep	Deep sleep	Sleep quality	Sleep satisfaction
ICSD-3 insomnia sx	-.739**	-.756**	-.742**	-.680**	-.668**	-.690**
DSM-5-TR insomnia sx	-.731**	-.717**	-.692**	-.675**	-.657**	-.708**
Sleep Hygiene Index	-.132	-.138	-.129	-.164	-.140	-.073
POMS						
Tension-anxiety	-.390**	-.364**	-.395**	-.338**	-.379**	-.339**
Depression-dejection	-.367**	-.305**	-.365**	-.320**	-.325**	-.318**
Anger-hostility	-.300**	-.265**	-.312**	-.261**	-.258**	-.251*
Confusion- bewilderment	-.213*	-.218*	-.259*	-.206*	-.180	-.127
Fatigue-inertia	-.429**	-.375**	-.442**	-.393**	-.362**	-.387**
Vigour-activity	.401**	.403**	.340**	.380**	.348**	.370**
Eysenck Personality Inventory						
Neuroticism	-.555**	-.532**	-.480**	-.525**	-.494**	-.523**
Extraversion	.269**	.288**	.202*	.227*	.297**	.288**
Arousal Predisposition Scale	-.361**	-.263**	-.309**	-.299**	-.352**	-.332**
Well Being Index	.640**	.554**	.555**	.591**	.579**	.605**
Happy	.506**	.460**	.480**	.410**	.467**	.488**
Calm	.506**	.444**	.500**	.416**	.438**	.495**
Active	.479**	.444**	.453**	.386**	.417**	.470**
Woke up feeling refreshed	.746**	.631**	.646**	.656**	.690**	.740**
Life with interesting things	.336**	.280**	.305**	.308**	.281**	.313**

** Correlation significant at .01 level; * Correlation significant at .05 level, sx=symptoms

Table 3: Comparison between ICSD-3 groups and DSM-5-TR-5 groups relatively to healthy sleep levels

	Insomnia group ICSD-3 N=90	No insomnia group, ICSD-3 N=10		Insomnia group DSM-5-TR N=92	No insomnia group DSM-5-TR N=8	
	M ±	M ±	p	M ±	M ±	p
Healthy sleep scale	14.7 ± 3.85	8.8 ± 3.73	< .001	14.7 ± 3.81	7.6 ± 3.07	< .001
Healthy sleep variable	14.8 ± 3.50	9.9 ± 3.34	< .001	14.8 ± 3.47	8.9 ± 2.30	< .001

CONCLUSION

➢ Our HSS showed good psychometric properties and promises to be a valid tool to routinely evaluate healthy sleep in sleep research.

➢ Limitations: (i) test-retest is missing to investigate HSS temporal stability; (ii) objective sleep assessments were not performed to validate HSS; (iii) small sample size which jeopardizes generalization of results; iv) It is not clear if HSS the scale be used in clinical samples or within individuals with irregular working schedules as shift-workers or who frequently experience transmeridian flights as pilots or flight attendants as the HSS was developed based on a sample of employees with regular daytime schedules;

➢ Future research: use objective assessments of sleep (e.g. actigraphy or portable Polysomnography) to validate HSS and explore HSS psychometric properties in clinical samples with sleep disorders as insomnia.

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