Diagnostic Accuracy of Insomnia Screening Tools: A Meta-Analysis

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Learner Objectives

- To learn the research procedure of diagnostic meta-analysis.
- To understand the diagnostic properties among the Insomnia Severity Index (ISI), Athens Insomnia Scale (AIS), and Pittsburg Sleep Quality Index (PSQI) in screening insomnia.

The authors declare no potential conflicts of interest with respect to the authorship and publication of this article.

Outline

- Research Background, Gap, & Purpose
- Methods
- Results
- Discussion
- Conclusion & Implication

Research Background

- Insomnia is a highly prevalent health complaint (6% to 34.5%) but remains underdiagnosed and undertreated.
- Insomnia diagnosis relies on clinical interviews with applying standard diagnostic insomnia criteria.
  - The Diagnostic and Statistical Manual of Mental Disorders (DSM), International Classification of Sleep Disorders (ICSD), International Classification of Diseases (ICD).
  - Time consuming and requires well-trained practitioners.

Research Background

- Using a brief, reliable, and easy-to-use questionnaire is essential for insomnia screening.
- 7-item ISI and 8-item AIS were developed according to standard insomnia diagnostic criteria.
- 19-item PSQI is recommended as a standard assessment tool of insomnia (Buysse et al., 2006).

Buysse DJ, Ancoli-Israel S, Edinger JD, Lichstein KL, Morin CM. Recommendations for a standard research assessment of insomnia. Sleep. 2006 Sep;29(9):1155-73.

Research Gap

- No study has estimated and compared the diagnostic properties among these three instruments in insomnia screening.

Research Purpose

- To estimate and to compare the diagnostic accuracy of the ISI, AIS, and PSQI for insomnia screening.

Data Source and Searches

- Following the PRISMA statement
- Searching EMBASE, PubMed, PsycINFO, CINAHL and Chinese Electronic Periodic Services (-May 2015)
- Search terms
  - (Insomnia Severity Index OR Athens Insomnia Scale OR Pittsburgh Sleep Quality Index) AND (sensitivity OR specificity OR validity OR reliability, OR validation OR cutoff value).

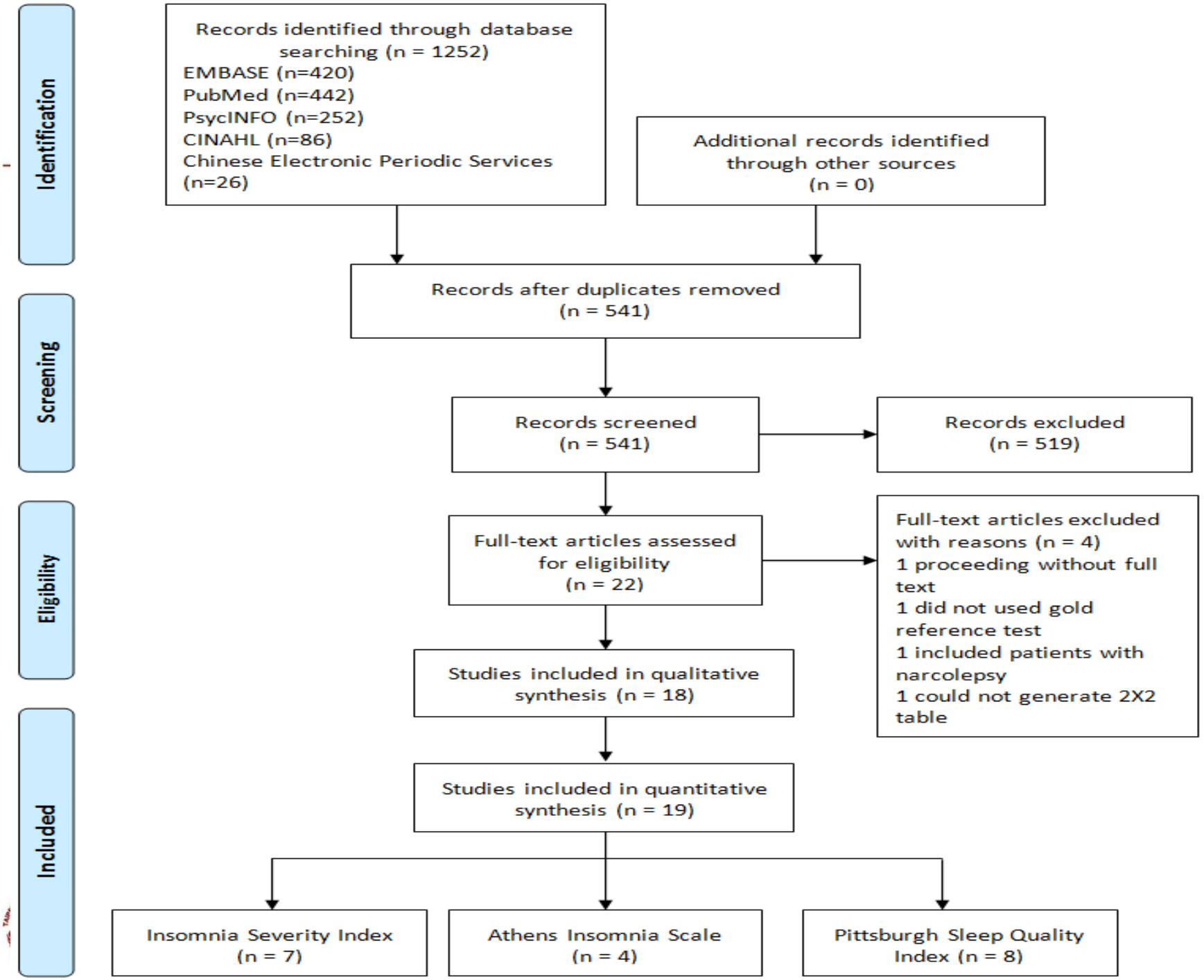
Study Selection- PIRS

- **Patients:** adults with suspected insomnia
- **Index:** ISI, AIS, and PSQI
- **References:** insomnia diagnostic criteria (ICD, DSM, and ICSD)
- **Study:** full-text original article with reporting sensitivity and specificity

Statistical Analysis

- Statistical software : STATA 14.0.
- Generalized linear mixed model
  - *Estimate pooled sensitivity, specificity, and diagnostic odds ratio (DOR).*
- Between-study heterogeneity
  - *Q* statistics and I^2 values.
- Publication bias
  - Deek's funnel plots.

$$\mathrm{DOR} = \frac{TP/FP}{FN/TN}$$


Identification
Screening
Eligibility
Included
Records identified through database searching (n = 1252)
EMBASE (n=420)
PubMed (n=442)
PsycINFO (n=252)
CINAHL (n=86)
Chinese Electronic Periodic Services (n=26)
Additional records identified through other sources (n = 0)
Records after duplicates removed (n = 541)
Records screened (n = 541)
Records excluded (n = 519)
Full-text articles assessed for eligibility (n = 22)
Full-text articles excluded with reasons (n = 4)
1 proceeding without full text
1 did not used gold reference test
1 included patients with narcolepsy
1 could not generate 2X2 table
Studies included in qualitative synthesis (n = 18)
Studies included in quantitative synthesis (n = 19)
Insomnia Severity Index (n = 7)
Athens Insomnia Scale (n = 4)
Pittsburgh Sleep Quality Index (n = 8)

Characteristics of Included Studies in ISI

First author, year	Country	Study design	Mean age	Female (%)	Sample size	Reference test
Alsaadi, 2013	Australia	Cross-sectional	43.9	51	79	ICSD-II
Cho, 2014	Korea	Case-control	53.9	62.6	302	DSM-IV-TR
Gagnon, 2013	Canada	Cross-sectional	49.0	65.3	101	IDI (DSM-IV+ DSM-V+ICSD2)
Morin, 2011	Canada	Case-control	50.7	61.2	245	DSM-IV
Savard, 2005	Canada	Cross-sectional	UK	100	210	IIS (DSM-IV+ ICSD-1)
Severson, 2013	Canada	Retrospective cohort	45.4	56.8	1207	ICSD-II
Yang, 2009	Taiwan	Case-control	40.4	57.1	329	ICSD-II

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(included 2473 participants with a mean age of 47.2 years)

Characteristics of Included Studies in AIS

First author, year	Country	Study design	Mean age	Female (%)	Sample size	Reference test
Jeong, 2015	Korea	Cross-sectional	40.3	6.3	221	ICD-10
Okajima, 2013	Japan	Case-control	48.8	58	640	DSM-IV
Soldatos, 2003	Greece	Cross-sectional	42.9	58	299	ICD-10
Sun, 2011	Taiwan	Cross-sectional	56.7	59.5	195	DSM-IV

(included 779 participants with a mean age of 47.2 years)

Characteristics of Included Studies in PSQI

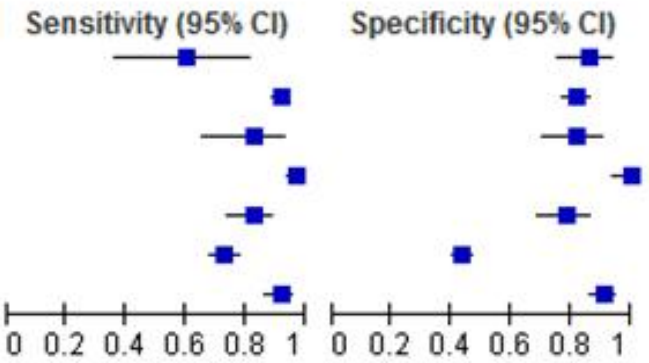
First author, year	Country	Study design	Mean age	Female (%)	Sample size	Reference test
Aloba, 2007	Nigeria	Cross-sectional	23.2	38.8	520	DSM-IV and ICSD-R
Alsaadi, 2013	Australia	Cross-sectional	43.9	51	79	ICSD-II
Backhaus, 2002	Germany	Case-control	44.8	54.9	125	DSM-IV
Doi, 2000	Japan	Case-control	50.4	47.9	96	DSM-IV
Farrahi Moghaddam, 2012	Iran	Case-control	35.5	55.0	258	DSM-IV
Fictenberg, 2001	USA	Cross-sectional	33.8	41	50	DSM-IV
Tsai, 2005	Taiwan	Case-control	39	63.9	208	DSM-IV
Tzeng, 2012	Taiwan	Cross-sectional	58.3	34.1	205	DSM-IV

(included 1441 participants with a mean age of 41.1 years)

Forest Plots

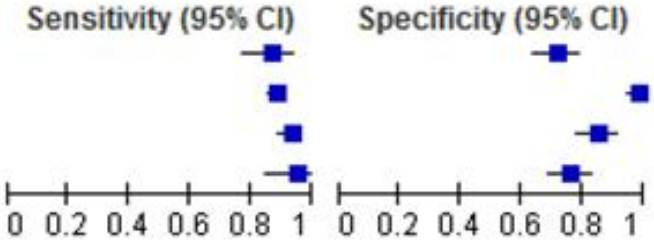
(A) Insomnia Severity Index

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Alsaadi, 2013	12	8	8	51	0.60 [0.36, 0.81]	0.86 [0.75, 0.94]
Cho, 2014	278	56	24	256	0.92 [0.88, 0.95]	0.82 [0.77, 0.86]
Gagnon, 2013	28	12	6	55	0.82 [0.65, 0.93]	0.82 [0.71, 0.90]
Morin, 2011	173	0	5	61	0.97 [0.94, 0.99]	1.00 [0.94, 1.00]
Savard, 2005	93	21	20	76	0.82 [0.74, 0.89]	0.78 [0.69, 0.86]
Severson, 2013	247	489	92	379	0.73 [0.68, 0.78]	0.44 [0.40, 0.47]
Yang, 2009	135	16	12	166	0.92 [0.86, 0.96]	0.91 [0.86, 0.95]



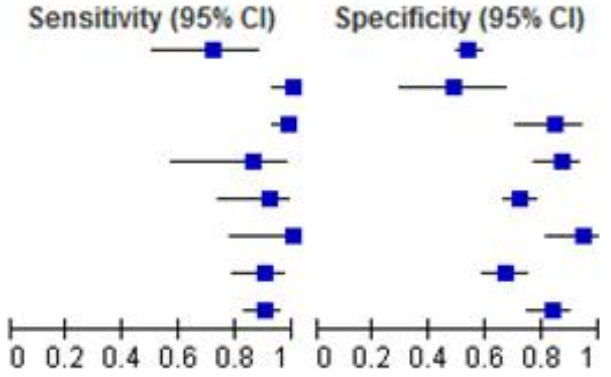
(B) Athens Insomnia Scale

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Jeong, 2015	66	39	10	99	0.87 [0.77, 0.94]	0.72 [0.63, 0.79]
Okajima, 2013	423	3	54	160	0.89 [0.85, 0.91]	0.98 [0.95, 1.00]
Soldatos, 2003	164	18	12	105	0.93 [0.88, 0.96]	0.85 [0.78, 0.91]
Sun, 2011	42	36	2	115	0.95 [0.85, 0.99]	0.76 [0.69, 0.83]



(C) Pittsburgh Sleep Quality Index

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Aloba, 2007	18	228	7	267	0.72 [0.51, 0.88]	0.54 [0.49, 0.58]
Alsaadi, 2013	50	15	0	14	1.00 [0.93, 1.00]	0.48 [0.29, 0.67]
Backhaus, 2002	79	7	1	38	0.99 [0.93, 1.00]	0.84 [0.71, 0.94]
Doi, 2000	12	11	2	71	0.86 [0.57, 0.98]	0.87 [0.77, 0.93]
Farrahi Moghaddm, 2012	23	65	2	168	0.92 [0.74, 0.99]	0.72 [0.66, 0.78]
Fichtenberg, 2001	15	2	0	33	1.00 [0.78, 1.00]	0.94 [0.81, 0.99]
Tsai, 2005	46	52	5	105	0.90 [0.79, 0.97]	0.67 [0.59, 0.74]
Tzeng, 2012	94	17	10	84	0.90 [0.83, 0.95]	0.83 [0.74, 0.90]



Summary Estimates of Sensitivity, Specificity, and DOR

Scales	Pooled Sensitivity (95% CI)	Pooled Specificity (95% CI)	Pooled DOR (95% CI)
ISI	0.88 (0.79 to 0.93)	0.85 (0.68 to 0.94)	41.9 (8.77 to 200.3)
AIS	0.91 (0.87 to 0.93)	0.87 (0.68 to 0.95)	67.7 (23.4 to 196.1)
PSQI	0.93 (0.86 to 0.96)	0.75 (0.64 to 0.84)	39.4 (14.5 to 106.9)
ISI vs. AIS (p)	0.40	0.77	0.54
ISI vs. PSQI (p)	0.31	0.31	0.98
AIS vs. PSQI (p)	0.92	0.92	0.55

No difference among three scales

Heterogeneity and Publication Bias

	ISI	AIS	PSQI
***Q* statistics (p value)**	182.1 (<0.001)	7.59 (0.06)	30.7 (<0.001)
	Between-study heterogeneity		
I^2 value	97%	60.5%	77.2%
Deek's funnel plots p value	0.25	0.19	0.66
	No publication bias		

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Discussion

	7-item ISI	8-item AIS	19-item PSQI
Diagnostic properties	V	V	V
Insomnia symptoms evaluation			Focusing on sleep quality
Feasibility			More questions requiring longer administration time

Conclusion & Implication

- The ISI, AIS and PSQI have comparable diagnostic properties.
- Clinicians and researchers should apply the ISI and AIS to screen insomnia in advance and thus increase insomnia treatments.