



Review article

Is alexithymia associated with sleep problems? A systematic review and meta-analysis

Zainab Alimoradi^a, Nilofar Rajabi Majd^a, Anders Broström^{b,c}, Hector W.H. Tsang^d,
Parmveer Singh^e, Maurice M. Ohayon^f, Chung-Ying Lin^{g,h,i,j,**}, Amir H. Pakpour^{a,b,*}

^a Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin 3419759811, Iran

^b Department of Nursing, School of Health and Welfare, Jönköping University, 55111 Jönköping, Sweden

^c Department of Clinical Neurophysiology, Linköping University Hospital, Linköping, Sweden

^d Department of Rehabilitation Sciences, Faculty of Health and Social Sciences, Hong Kong Polytechnic University, Hung Hom, Hong Kong

^e P. G. Department of Agriculture, Khalsa College Amritsar, Punjab, India

^f Stanford Sleep Epidemiology Research Center (SSERC), School of Medicine, Stanford University, CA, USA

^g Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan

^h Department of Occupational Therapy, College of Medicine, National Cheng Kung University, Tainan, Taiwan

ⁱ Biostatistics Consulting Center, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

^j Department of Public Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan



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ABSTRACT

Alexithymia, a difficulty identifying and expressing emotions experienced by oneself or others, measurably harms quality of sleep. Research has observed the association between alexithymia and sleep problems; however, the cumulative effect of this association is still unknown. Therefore, this systematic review and meta-analysis was conducted to present scientific evidence regarding the relationship between alexithymia and sleep quality.

Adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline, and using relevant keywords, we searched six databases: Scopus, PubMed Central, ProQuest, ISI Web of Knowledge, EMBASE, and Science Direct. We selected observational studies on the association between alexithymia and sleep. We conducted meta-analysis using a random-effect model to calculate the effect size (ES) with Fisher's *z* transformation.

Eligible studies (*N* = 26) in 24 papers included 7546 participants from 12 countries. The entire ES for the association between alexithymia and sleep was 0.44 (95 % CI: 0.31, 0.56). Additionally, patient populations had a larger ES (ES = 0.55; 95 % CI: 0.30, 0.79) than healthy populations (ES = 0.30; 95 % CI: 0.20, 0.41).

The results of the present systematic review and meta-analysis revealed a significant association between alexithymia and sleep problems, especially among people with any medical condition.

1. Introduction

Alexithymia, a term coined by Peter Sifneos to describe patients who have difficulty engaging in insight-oriented psychotherapy (Sifneos, 1973), is currently conceptualized as a difficulty identifying and

expressing emotions experienced by oneself or others (Kooiman et al., 2002; Ricciardi et al., 2015). Alexithymia is considered both a cognitive and a personality trait, although it has not been classified as a mental disorder in the *Diagnostic and Statistical Manual of Mental Disorders, 5th edition* (DSM-5) (APA, 2013; De Gennaro et al., 2002). The characteristic

Abbreviations: DIE, Difficulty identifying emotions; DDE, Difficulty describing emotions; EOT, Externally oriented thinking; NOS, Newcastle Ottawa Scale; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; TAS-20, Toronto Alexithymia Scale.

* Corresponding author at: Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin 3419759811, Iran.

** Corresponding author at: Institute of Allied Health Sciences, Biostatistics Consulting Center and Departments of Public Health and Occupational Therapy, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan.

E-mail addresses: Zainabalimoradi@yahoo.com (Z. Alimoradi), anders.brostrom@ju.se (A. Broström), hector.tsang@polyu.edu.hk (H.W.H. Tsang), parmveersingh@khalsacollege.edu.in (P. Singh), mohayon@stanford.edu (M.M. Ohayon), cylin36933@gmail.com (C.-Y. Lin), amir.pakpour@ju.se (A.H. Pakpour).

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problems caused by alexithymia include (i) difficulty identifying and describing feelings; (ii) difficulty distinguishing feelings from somatic symptoms; (iii) limited emotional imagination; and (iv) an externally-oriented cognitive style (Kooiman et al., 2002). The 20-item Toronto Alexithymia Scale (TAS-20) is a well-recognized and widely used tool for diagnosing alexithymia (Bagby et al., 1994b; Taylor et al., 1999). It includes three subscales: “difficulty identifying emotions (DIE),” “difficulty describing emotions (DDE),” and “externally oriented thinking (EOT).”

In the scientific literature, the prevalence of alexithymia is reported across a number of different populations. A recent review indicates that approximately 10 % of the general population has alexithymia (Ricciardi et al., 2015). However, some evidence indicates that people have a potentially higher risk of developing alexithymia if they are older, male, poorly educated, or have a low socioeconomic status (Franz et al., 2008). A high prevalence of alexithymia has been observed among populations with psychosomatic disorders and autism spectrum disorders (40–60 %), eating disorders (24–77 %), addictive disorders (30–50 %), obsessive-compulsive disorder (11–36 %), and mental disorders such as anxiety (13–58 %) (Ricciardi et al., 2015). In addition to these neurological disorders, prior research shows that alexithymia is associated with several medical conditions including allergies, asthma, cancer, hypertension, angina pectoris with coronary spasm, myocardial infarction, inflammatory bowel disease, and diabetes (Taylor et al., 1999). Because of its association with these other maladies, it is extremely important to begin treatment of alexithymia as early as possible.

Its association with sleep problems is another critical reason for the study of alexithymia. Evidence of the association between alexithymia and poor sleep has been documented using both objective and subjective measures of sleep quality (Bazydlo et al., 2001; Bauermann et al., 2008; Murphy et al., 2018). Moreover, alexithymia is closely associated with other effects of poor sleep including chronic pain, depression, and posttraumatic stress disorder (Lumley et al., 1996; Taylor et al., 1999). Some have argued that anxiety and depression are a cause of the connection between alexithymia and poor sleep, and the literature has already noted the association between alexithymia, depression, anxiety, and sleep disturbances (Hendryx et al., 1991; Honkalampi et al., 2000). However, a recent study revealed that alexithymia is associated with poor sleep whether or not depression and anxiety are present (Murphy et al., 2018). From this, it can tentatively be concluded that alexithymia is closely connected to an individual's quality of sleep, and therefore that healthcare providers should develop appropriate interventions to help improve sleep quality for individuals suffering from alexithymia.

Considering the significance and relatively high prevalence of alexithymia, the current literature lacks an adequate summary of the evidence of alexithymia's association with sleep disorders. It is crucial for healthcare providers to obtain this information so that they can provide early and essential interventions for alexithymia patients. Sleep problems within the general population may be minimized with early intervention, and patients can thereby avoid high costs of treatment later on. Despite the growing number of studies assessing alexithymia and sleep disorders, there has been no recent systematic review and meta-analysis exclusively assessing the relationship between the two. To the best of the present authors' awareness, the evidence on the association between alexithymia and sleep is scarce and scattered in the literature, and till date, there is no summarized evidence on this topic. Therefore, to summarize the available findings, we used the substantial body of evidence reported in the current literature, and conducted a systematic review and meta-analysis to gain an insight on this relationship.

2. Methods

This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (Moher et al., 2009). It was conducted across six academic databases; relevant

studies were abstracted, and their methodological quality was assessed using Newcastle Ottawa Scale (NOS). Findings were synthesized using a meta-analysis approach. The protocol was registered in the PROSPERO International Prospective Register of Systematic Reviews under the ID code CRD42020146851 (Pakpour et al., 2020).

2.1. Search strategy

We systematically searched six academic databases—Scopus, PubMed Central, ProQuest, ISI Web of Knowledge, EMBASE, and Science Direct—for literature published between July 15th 1990 to May 7th 2021. As our full text access to these databases began with literature published in 1990, we chose that year as the starting date for our search. Search terms were extracted from published reviews and primary studies as well as PubMed Medical Subject Headings (MeSH), and the systematic review was conducted for all eligible studies published between 1990 and May 2021. To organize the search syntax, we used the PECO framework. Based on PECO, queries were comprised of four aspects: Patient-Problem (P), Exposure (E), Comparison (C) and Outcome (O). To formulate the search query, we set “alexithymia” as the Exposure and “sleep disorder” as an Outcome. The Boolean search method (AND/OR/NOT) was used to develop the search query. Search syntax was customized based on the advanced search options of each database. The search strategy is provided in [Additional File 1](#). Additionally, reference lists of selected studies were also consulted to increase the likelihood of retrieving relevant empirical studies.

2.2. Eligibility criteria

2.2.1. Type of studies

For inclusion, studies had to be: a) observational (case-control and cross-sectional); b) published in a peer-reviewed journal; c) published in English; d) using the Toronto Alexithymia scale (TAS-20) for assessing alexithymia; and e) assessing sleep problems via robust psychological methods. Studies conducted by self-devised measures were excluded.

2.2.2. Type of participants

No limitation was imposed on participants' characteristics.

2.2.3. Exposure

Alexithymia was chosen as the exposure and measured using the Toronto Alexithymia scale (TAS-20), a globally recognized and reliable scale for assessing alexithymia. Developed in 1986, the TAS-20 is a measure of a subject's difficulty understanding, processing, or describing emotions (Mayer et al., 1990). It was later revised, and the current version contains twenty statements rated on a five-point Likert scale. The reliability and validity of the TAS-20 was established (Bagby et al., 1994a; Taylor et al., 1988).

2.3. Outcomes

2.3.1. Primary outcome

The primary outcome named in this study (i.e., sleep problems) refers to a broad category of sleep disorders characterized by either hypersomnolence or insomnia. More specifically, our primary outcomes were measures used to assess any type of sleep problem (including insomnia, nightmares, poor sleep quality, poor sleep efficiency, or sleep disorders such as sleep apnea). These diagnoses were measured with a reliable scale or confirmed by a clinician. For example, we considered as part of the primary outcome patients with a clinical diagnosis of insomnia, and standardized instruments such as the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS).

2.3.2. Secondary outcomes

- 1 To assess heterogeneity and its possible sources.

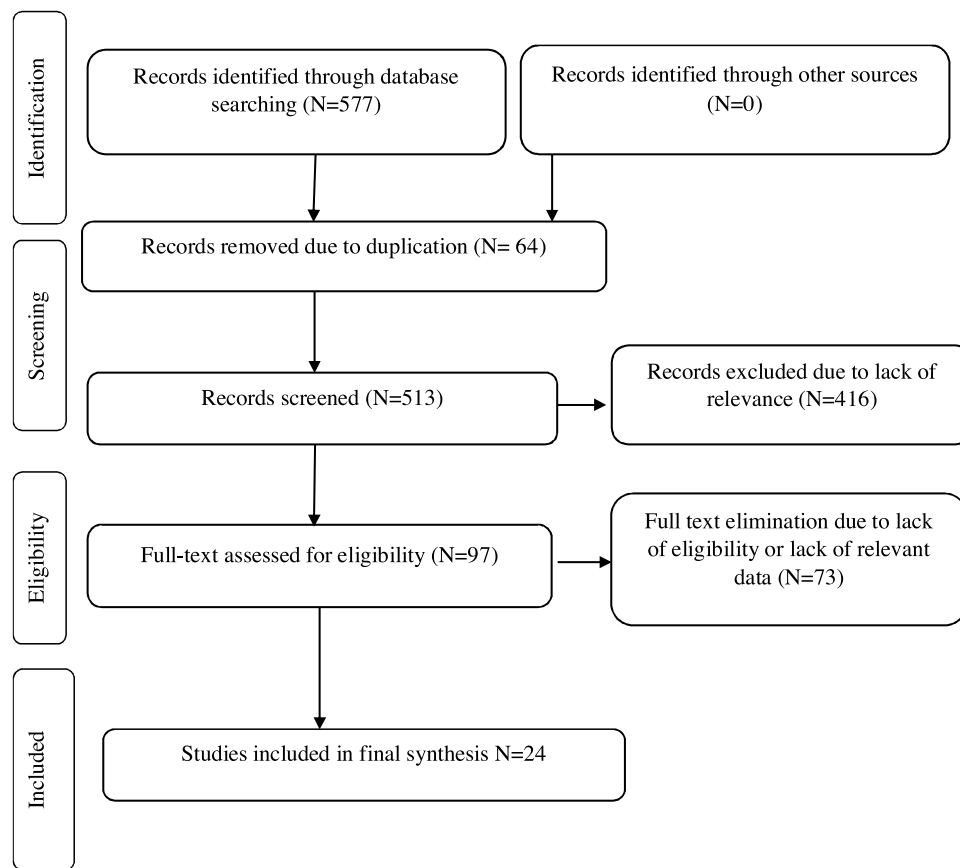


Fig. 1. PRISMA Flowchart of selected studies.

2 To assess moderator variables in the association of alexithymia with sleep problems.

2.4. Study selection

The title and abstract of all retrieved papers were screened based on the inclusion criteria. We then more closely examined full texts of potentially relevant studies based on the criteria mentioned above, and thereby selected the relevant studies.

2.5. Quality assessment

NOS was used to evaluate the methodological quality of these studies. The three characteristics of selection, comparability, and outcome were examined with the NOS checklist. There are three versions of the checklist for evaluating cross-sectional studies (7 items), case-control (8 items), and cohort (8 items). Despite a slight difference in the number and content of these items, each item is rated with a point (except for comparability, which can have two points) for a maximum possible score of 9. Studies with less than 5 points were classified as having a high risk of bias (Luchini et al., 2017). No studies were excluded based on quality; however, we did conduct subgroup analysis to assess the impact of quality on pooled effect size (ES).

2.6. Data extraction

We extracted data from the included studies using a pre-designed form containing critical information—name of the first author, year, study design, country of the study, number of participants, gender, mean age, scale used to assess psychological distress and sleep problems, and numerical results (e.g., Pearson correlation coefficient and standardized mean difference).

Two reviewers independently performed the study selection, quality assessment, and data extraction. Disagreements were resolved by consensus.

2.7. Data synthesis

For the quantitative analysis, a random-effect model meta-analysis was conducted using STATA software version 14 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP). It was proposed that included studies be taken from diverse populations to account for both within-study and between-study variances (Hox and Leeuw, 2003). The Q Cochrane statistic was used to ascertain heterogeneity, and the degree of heterogeneity was estimated using the I^2 index. Numerical values of I^2 were classified as mild ($I^2 < 25\%$), moderate ($25 < I^2 < 50\%$), severe ($50 < I^2 < 75\%$) and highly severe heterogeneity ($I^2 > 75\%$) (Savović et al., 2014).

The included studies reported the association of alexithymia and sleep problems differently. Therefore, the ES of standardized mean difference (SMD) was transformed into Pearson's correlation coefficients (Cohen, 2013; Rosenthal et al., 1994) at www.psychometrica.de, where the ES was defined as small at 0.1, moderate at 0.3, and large at 0.5 (Lenhard and Lenhard, 2016). The potential instability of variance in correlation coefficients, (i.e., Pearson's r correlation coefficient), was converted to Fisher's z score. All analyses were performed using Fisher's z values as ES (Alimoradi et al., 2019; Lipsey and Wilson, 2001). Fisher's z -transformation was applied using a formula of $z = 0.5 \times [\ln(1+r) - \ln(1-r)]$. The standard error of z was calculated based on $SEz = 1/\sqrt{(n-3)}$ (Borenstein et al., 2009). Therefore, the selected measure of effect for the current meta-analysis is expressed as Fisher's z score, 95 % CI.

Moderator analysis was conducted using subgroup analysis. Publication bias was evaluated using funnel plot and Begg's test, and probable publication bias was corrected using the Fill and Trim method

Table 1
Summary of Included Studies' Characteristics.

Authors	Years	Country	Type Of Study	Population	% Female	Sample Size	Mean Age (Years)	Measure Of Sleep	NOS Score
(Youssef et al., 2020)	2020	Lebanon	Cross-Sectional	Adults	62	456	27.29	Lebanese Insomnia Scale (LIS-18)	7
(Bileviciute-Ljungar and Friberg, 2020)	2020	Sweden	Case-Control	Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome And Healthy Control	72	54	44	Epworth Sleepiness Scale (ESS)	5
(Chiricozzi et al., 2020)	2020	Italy	Cross-Sectional	Atopic Dermatitis (AD) Patients And Healthy Control	47.96	442	40.3	NRS Sleep	6
(Ma et al., 2020)	2020	China	Cross-Sectional	College Students	60.96	2,626	18.34	ISI	7
(Horta-Baas et al., 2020)	2020	Mexico	Cross-Sectional	Women With Fibromyalgia	100	102	48.76	ISI	7
(Nielsen et al., 2019)	2019	Canada	Case-Control	Adult	69.28	140	24.19	Sleep Disorders Questionnaire-Abbreviated Version (SDQ-A)	5
(Basta et al., 2019)	2018	Italy	Cross-Sectional	Patients With Systemic Sclerosis	100	40	62	PSQI	6
(Merckelbach et al., 2018)	2018	Netherlands	Cross-Sectional	Psychiatric Outpatients	18.5	80	51.65	SLEEP-50	6
(Murphy et al., 2018)	2018	Study1: United Kingdom	Cross-Sectional	Adults	62.85	70	42.93	PSQI	5
		Study2: United Kingdom	Cross-Sectional	Adults	64.38	108	38.84	PSQI	
(Rehman et al., 2018)	2017	Study1: USA	Cross-Sectional	University Students	76.8	401	24.08	PSQI	6
		Study2: USA	Cross-Sectional	University Students	71.64	402	24.75	PSQI	
(Vinai et al., 2015)	2015	Italy	Case-Control	Patients And Healthy Control	71.32	143	54.23	Patients with diagnosed insomnia Dream Questionnaire: Only Nightmare Distress	4
(Godin et al., 2013)	2013	Canada	Case-Control	Idiopathic REM Sleep Behavior Disorder Patients And Healthy Control	0	62	60.95	PSQI	6
(Özyürek et al., 2013)	2013	USA	Cross-Sectional	Patients With Knee Osteoarthritis (OA)	60	305	69.68	PSQI	4
(Aydin et al., 2013)	2011	Turkey	Cross-Sectional	Patients With Depression	62.35	85	37.45	PSQI	5
(De Santo et al., 2010)	2010	Italy	Case-Control	Patients On Maintenance Hemodialysis	37.5	40	54.25	PSQI	4
(Engin et al., 2010)	2010	Turkey	Cross-Sectional	Patients And Healthy Control	40.62	192	30.76	Patients with diagnosed insomnia Sleep Problems Inventory (SPI)	5
(Bauermann et al., 2008)	2008	Canada	Cross-Sectional	Young Adults	73.24	456	19.74	Patients with diagnosed insomnia	6
(Lundh and Broman, 2006)	2006	Sweden	Cross-Sectional	Patients And Healthy Control	55.30	396	39.66	PSQI	6
(De Gennaro et al., 2004)	2004	Italy	Cross-Sectional	University Students	80	600	23.17	Sleep And Dream Diary	7
(De Gennaro et al., 2003)	2003	Italy	Cross-Sectional	University Students	100	20	22.06	Sleep Impairment Index (SIM)	5
(Pallesen et al., 2002)	2002	Norway	Case-Control	Insomniacs & Good Sleepers	80.19	101	70.4	Sleep Latency	6
(De Gennaro et al., 2002)	2002	Italy	Cross-Sectional	University Students	0	27	23.07	The Symptom Check List-90 (SCL-90)	4
(Valkamo et al., 2001)	2001	Finland	Cross-Sectional	Patients With Coronary Heart Disease (CHD)	0	157	59.75	Latency To Persistent Sleep	5
(Bazydlo et al., 2001)	1999	USA	Cross-Sectional	Healthy Adults	52	40	27.9		6

(Rothstein et al., 2005). Moreover, we used subgroup analyses that examine the different measurements of sleep to understand whether different measurements functioned differently. To determine the effect of individual studies on the outcome, we performed sensitivity analysis using the Jackknife method (Miller, 1974). The Jackknife Method is also known as the “one-out method,” was used to evaluate the quality and consistency of the results. That is, significant changes were evaluated by removing each study individually.

3. Results

3.1. Study screening & selection process

The initial search retrieved 577 studies in five databases—Scopus (86), PubMed (79), WOS (15), Embase (16), ProQuest (236) and Science Direct (145), from which we removed 64 duplicated articles. Screening based on title and abstract removed a further 416 articles. We reviewed the full texts of the remaining 97 articles. In this process, 24 articles met the eligibility criteria. Fig. 1 shows the search process based on the PRISMA flowchart.

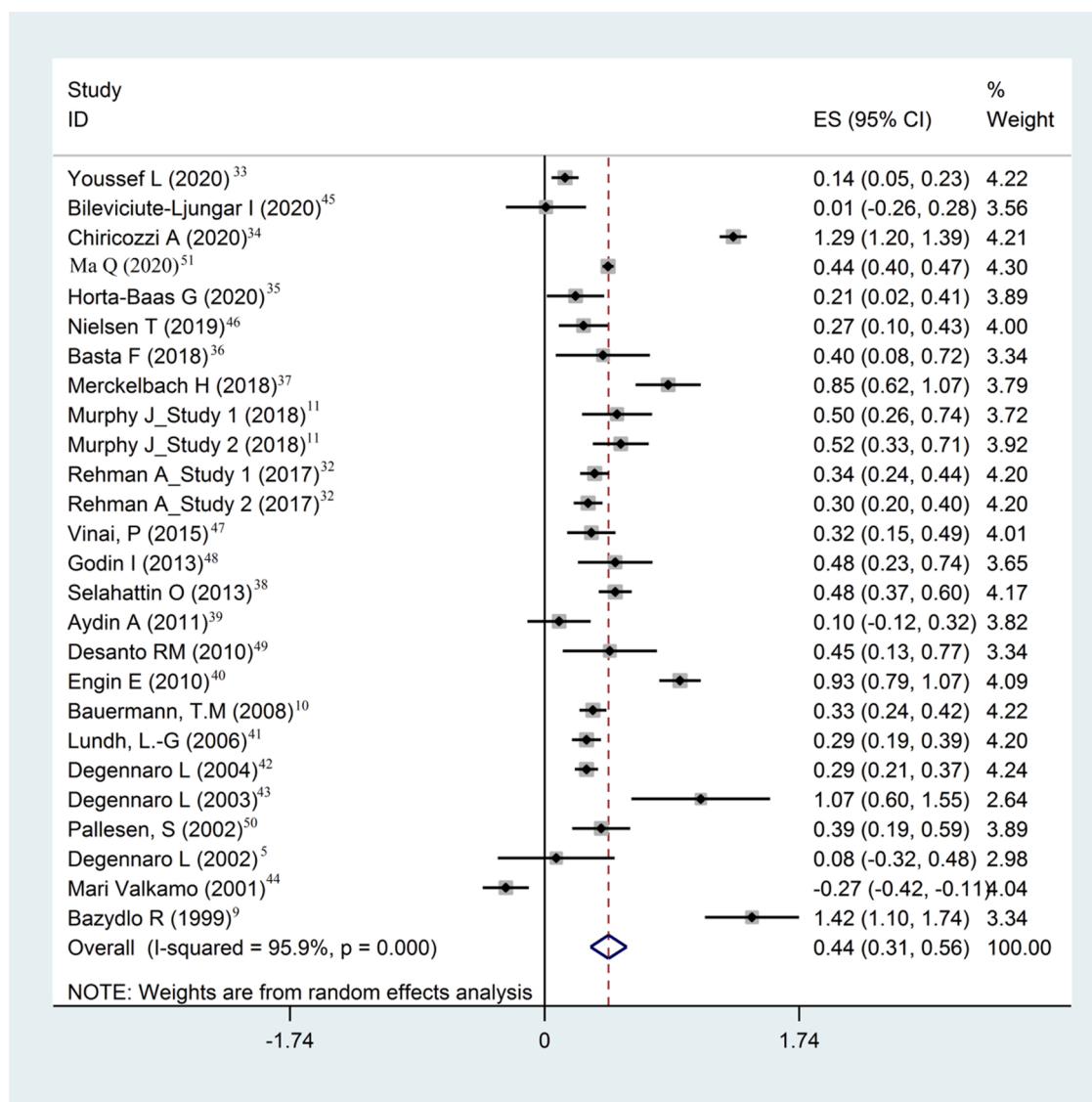


Fig. 2. Forest plot displaying the estimated pooled effect size (Fisher's z score) regarding the association of alexithymia with sleep problems.

3.2. Study description

The study included a total of 24 papers with 7547 participants from 12 countries (Lebanon, Sweden, Italy, China, Mexico, Canada, Netherlands, United Kingdom, USA, Turkey, Norway, and Finland). Two of the included papers reported the results of two studies in each paper (Murphy et al., 2018; Rehman et al., 2018); thus, a total of 26 studies were analyzed in the present systematic review and meta-analysis (Table 2). The mean age of participants varied from 18.34 years to 70.40 years. Females constituted approximately 58.42 % of all participants. The most frequently used study design was cross-sectional (20 studies) (Aydin et al., 2013; Basta et al., 2019; Bauermann et al., 2008; Bazydlo et al., 2001; Chiricozzi et al., 2020; De Gennaro et al., 2003, 2002; De Gennaro et al., 2004; Engin et al., 2010; Horta-Baas et al., 2020; Lundh and Broman, 2006; Merckelbach et al., 2018; Murphy et al., 2018; Özyürek et al., 2013; Rehman et al., 2018; Valkamo et al., 2001; Youssef et al., 2020). The six remaining studies had a case-control design (Bileviciute-Ljungar and Friberg, 2020; De Santo et al., 2010; Godin et al., 2013; Nielsen et al., 2019; Pallesen et al., 2002; Vinai et al., 2015). Studies were conducted in various geographical areas including the continents of Europe (N = 14) (Basta et al., 2019; Bileviciute-Ljungar and Friberg, 2020; Chiricozzi et al., 2020; De Gennaro et al., 2003, 2002;

De Gennaro et al., 2004; De Santo et al., 2010; Lundh and Broman, 2006; Merckelbach et al., 2018; Murphy et al., 2018; Pallesen et al., 2002; Valkamo et al., 2001; Vinai et al., 2015), North America (N = 8) (Bauermann et al., 2008; Bazydlo et al., 2001; Godin et al., 2013; Horta-Baas et al., 2020; Nielsen et al., 2019; Özyürek et al., 2013; Rehman et al., 2018), and Asia (N = 4) (Aydin et al., 2013; Engin et al., 2010; Ma et al., 2020; Youssef et al., 2020). Italy was the country with the highest number of eligible studies (N = 7) (Basta et al., 2019; Chiricozzi et al., 2020; De Gennaro et al., 2003, 2002; De Gennaro et al., 2004; De Santo et al., 2010; Vinai et al., 2015). The smallest sample size was 20 (De Gennaro et al., 2003), and the largest was 2,626 (Ma et al., 2020). Various measures were used to assess sleep problems; the PSQI was used the most frequently (9 studies). Three studies had only female participants, and three had only male participants. Other studies involved both genders. Fourteen studies focused on people with certain diseases. Table 1 provides a summary of the included studies' characteristics.

3.3. Quality assessment

The results of the quality assessment using the NOS checklist are presented in Additional File 2. The maximum score on NOS is 9; a score lower than 5 indicates a high risk of bias (Luchini et al., 2017). Based on

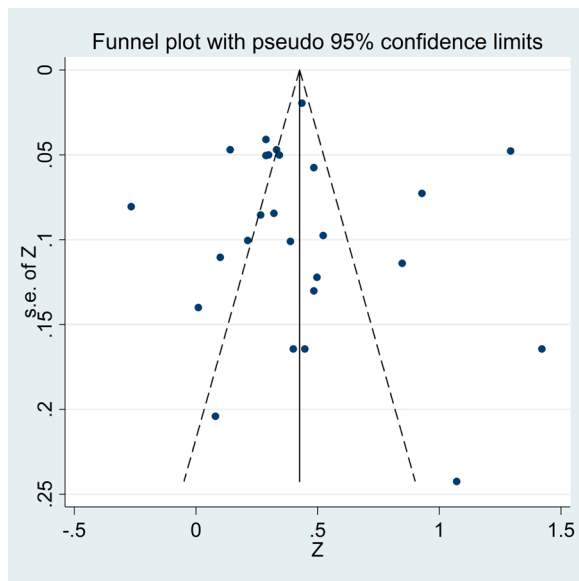


Fig. 3. Funnel plot assessing publication bias in studies regarding the association of alexithymia and sleep problems.

this criterion, 84.6 % of studies were categorized as high quality (i.e., having a low risk of bias). The impacts of study quality were further assessed and reported in subgroup analysis.

3.4. Outcome measures

The pooled estimated ES showed small to moderate correlation between alexithymia and sleep with a corrected Fisher's z score of 0.44 (95 % CI: 0.31; 0.56 $I^2 = 96$ % $\text{Tau}^2 = 0.09$). The forest plot is shown in Fig. 2.

3.5. Publication bias

This was evaluated using the Begg's test and funnel plot (Fig. 3). This assessment showed no probability of publication bias within the included studies ($p = 0.23$).

3.6. Sensitivity analysis

Sensitivity analysis was conducted using the Jackknife method, and showed that pooled ES is not affected by any single study effect (Fig. 4).

3.7. Moderator analysis

We conducted subgroup analysis to identify possible sources of heterogeneity and moderator variables on the association of alexithymia and sleep problems. Table 2 presents the results of the subgroup analysis. Another subgroup analysis was carried out to examine whether different types of sleep have different associations with alexithymia: the two subgroups were PSQI and other measurements of sleep (which were combined due to the small sample size of each measurement). The results indicated that there were no significant differences between PSQI and other measurements of sleep. The nonsignificant finding was also supported by the metaregression, which showed no significant difference between the methods of assessing sleep problems (coefficient = 0.10; SE = 0.16; $p = 0.52$; $\text{tau}^2 = 0.13$; $I^2 = 95.96$ %).

Potential sources of heterogeneity were study quality (low quality with $I^2 = 45$ % vs. high quality studies with $I^2 = 96.5$ %), study design (case-control studies with $I^2 = 37.1$ % vs. cross-sectional studies with $I^2 = 96.8$ %), and measure of sleep problems (PSQI with $I^2 = 57.9$ % vs. other measures with $I^2 = 97.2$ %).

The pooled point estimate of ES was influenced by study quality (low quality with ES = 0.39 vs. high-quality studies with ES = 0.46), study design (case-control studies with ES = 0.32 vs. cross-sectional studies with ES = 0.47), target population (healthy population with ES = 0.30 vs. patient population with ES = 0.55), participants' gender distribution (female-only studies with ES = 0.51 as the highest vs. male-only studies with ES = 0.09 as the lowest), participants' age category (youth

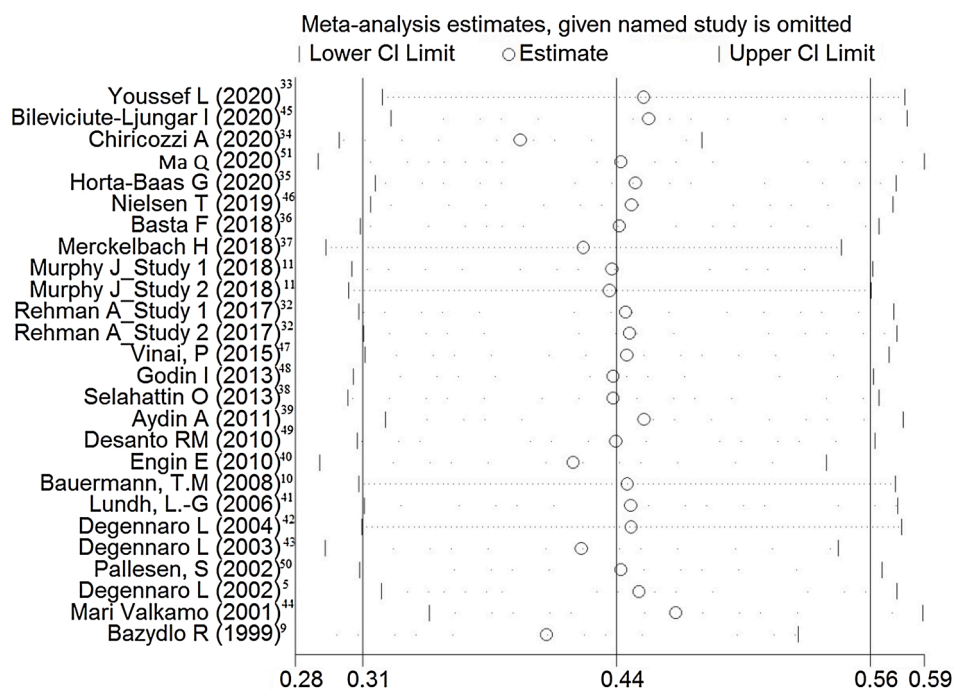


Fig. 4. Sensitivity analysis plot based on the Jack-knife Method, displaying the estimated pooled effect size (Fisher's z score) regarding the association of alexithymia with sleep problems.

Table 2

Results of subgroup analysis with effect size.

Variable		No. studies	Based on Fisher's Z score		Based on Pearson correlation coefficient*		I ² (%)	Tau ²	p
			ES	CI 95 %	ES	CI 95 %			
Quality	Low risk of bias	22	0.46	0.32; 0.60	0.43	0.31; 0.54	96.5	0.1	<0.001
	High risk of bias	4	0.39	0.24; 0.53	0.37	0.24; 0.49	44.9	0.009	<0.001
Geography based on continent	Asia	4	0.41	0.13; 0.68	0.39	0.13; 0.59	96.8	0.07	0.004
	Europe	14	0.44	0.18; 0.70	0.41	0.18; 0.60	97.1	0.23	0.001
Study design	North America	8	0.43	0.30; 0.57	0.405	0.29; 0.52	86.7	0.03	<0.001
	Cross Sectional	20	0.47	0.33; 0.62	0.44	0.32; 0.55	96.8	0.1	<0.001
	Case-control	6	0.32	0.21; 0.43	0.31	0.21; 0.41	37.1	0.007	<0.001
Measure of sleep problem	PSQI	9	0.36	0.29; 0.44	0.35	0.28; 0.41	57.9	0.007	<0.001
	other	17	0.48	0.29; 0.66	0.45	0.28; 0.58	97.2	0.14	<0.001
Target population	Healthy	12	0.3	0.20; 0.41	0.29	0.20; 0.39	90.6	0.03	<0.001
	Patient	14	0.55	0.30; 0.79	0.5	0.29; 0.66	96.5	0.2	<0.001
Participants' gender distribution	Female only	3	0.51	0.09; 0.94	0.47	0.09; 0.74	81.5	0.11	<0.001
	Male only	3	0.09	−0.42; 0.61	0.09	−0.40; 0.54	91.8	0.19	0.005
Participants' age category	Both	20	0.48	0.34; 0.61	0.45	0.33; 0.54	96.4	0.09	<0.001
	Youth (<24 years)	5	0.37	0.26; 0.49	0.35	0.25; 0.45	82.7	0.01	<0.001
	Adult (24–60 years)	19	0.45	0.25; 0.65	0.42	0.24; 0.57	96.9	0.19	<0.001
	Elder (> 60 years)	2	0.46	0.36; 0.56	0.43	0.34; 0.51	0	0	<0.001
	Overall ES	26	0.44	0.31; 0.56	0.41	0.30; 0.51	95.9	0.09	<0.001

* The transformation from Fisher's z score to Pearson correlation coefficient was conducted using <https://www.psychometrica.de/correlation.html#fisher>.

population had the lowest of all age groups with ES = 0.37), and measure of sleep problems (PSQI with ES = 0.36 vs. other measures with ES = 0.48).

4. Discussion

The pioneer studies in assessing the association between alexithymia and sleep were published in the 1990s (Hyppä et al., 1990). This systematic review and meta-analysis thus cumulated the data regarding alexithymia and sleep from 1990 to 2021 to ensure that we have included all evidence in this field to quantify the association between alexithymia and sleep problems. More specifically, we retained and analyzed a total of 26 studies reported by 24 papers. The overall analysis revealed a moderate ES (ES = 0.44) between alexithymia and sleep problems. The findings highlighted that the symptoms of alexithymia (i. e., an inability to identify, describe, and orient emotions and feelings) are related to sleep issues. Moreover, results also indicated that individuals with sleep-related problems experience greater difficulty identifying and describing their emotions than those who do not have sleep problems. This could also be caused by the subjects' inability to describe their emotions via a self-reporting measure (Thorberg et al., 2011).

The assessments of alexithymia (using the TAS-20 scale) were consistent across the 26 eligible studies presented in the systematic review and meta-analysis. However, a higher score on the TAS-20 was not sufficient to assure an accurate measurement of alexithymia or other sub-constructs (Marchesi et al., 2014; Suslow et al., 2000; Tull et al., 2005). The TAS-20 depends on a patient's accuracy in self-reporting; a reflection of co-morbid conditions is difficult and this is likely to influence the results.⁵ Some possible biases in the results of self-reporting measures include a patient's memory errors and responses to perceived social pressure, which are beyond the control of the researchers. Nevertheless, the TAS-20 is extremely reliable as a psychometric test and above reproach as a tool for diagnosing alexithymia (Westwood et al., 2017).

In addition to this, our results showed a significant difference between the diagnostic groups. The heterogeneity between healthy participants and patient-participants was from 90.6 %–96.5 %, which is a highly severe heterogeneity between studies. Studies involving patient-participants revealed a higher ES (ES = 0.47) than healthy participants (ES = 0.32). This is possibly because patients better understand the symptomatology of sleep problems. Additionally, the high prevalence of alexithymia in patient-participants emphasizes a need for greater

medical attention on this subject. The prevalence of alexithymia was much higher within the patient population (than the general population (13–77 % vs. ~10 %; Ricciardi et al., 2015). Therefore, healthcare providers are in a particularly good position for assessing the potential risk of alexithymia and the subsequent likelihood for a patient to develop sleep problems.

The meta-analysis found that age and gender have a significant effect on the prevalence of alexithymia and sleep problems. Results showed that younger participants have a lower ES than other age groups (i. e., adults and older people). A similar effect was reported between adults and older people. As for the effect of gender within the studies (k = 3), a negligible ES was observed in studies comprised of only male participants, whereas a medium ES was observed in studies with some female participants. It can be inferred that age and gender have an impact on the ability of patients to identify and describe their own emotions and feelings and those of others.

It was found that a larger ES was observed among cross-sectional studies than in case-control groups. A plausible reason is that case-control studies usually control some characteristics of participants (e. g., age and gender) between the case and control groups, so the heterogeneity between these groups is not substantial. Therefore, with demographic characteristics accounted for, differences in rates of alexithymia between case and control groups are not influenced by demographic differences. However, the nature of cross-sectional designs cannot altogether eliminate the effect of such characteristics. Therefore, heterogeneity in cross-sectional designs can be large, and the differences in levels of alexithymia reported in the cross-sectional studies are still likely to be influenced by participants' demographics. As a result, a smaller ES was found in case-control studies than in cross-sectional studies.

Apart from the comprehensive literature search, the present systematic review and meta-analysis used rigorous methodology. The search was completed using major databases, and keywords were identified according to the PECO framework. We conducted quality assurance according to the NOS checklist and sensitivity testing. Moreover, the entire procedure followed the PRISMA guideline. Therefore, we are confident in the findings of the systematic review and meta-analysis. However, there are some limitations in our review and analysis. First, as mentioned earlier, alexithymia was assessed using the TAS-20, which relies on the accuracy of a patient's self-assessment—therefore, its precision is somewhat questionable. Second, the majority of the analyzed studies (20 of 26) adopted a cross-sectional design, which only provides weak evidence of causality. Nevertheless, the six studies

using case-control design showed similar levels of ES in their results. Thus, the impacts of alexithymia on sleep are supported even by the cross-sectional studies. Third, similar to the drawbacks of the TAS-20, most studies examined here assessed quality of sleep via the self-reported PSQI. Fourth, except for the PSQI, other measurements of sleep were not widely used to examine the association between sleep and alexithymia. Therefore, we could only examine whether PSQI performed differently than all the other measurements of sleep putting together in the association with alexithymia. However, sleep is complex and involves different phases and properties. Therefore, when sufficient evidence is accumulated, future meta-analyses are needed to further clarify whether alexithymia affects different phases and properties of sleep differently. Finally, the patient populations included in these studies are affected by a variety of diseases. Given that the effects and symptoms of these diseases can vary greatly between patients, heterogeneity in patient populations is high. Therefore, results stemming from studies of patient populations in general may not be applicable to patients with a specific disease.

5. Conclusion

In conclusion, we used rigorous methodology to review the topic of alexithymia and sleep in several major databases. We performed meta-analysis to analyze the strength of the connection between alexithymia and sleep, and our findings here indicated a moderate ES. The moderate and positive association between alexithymia and sleep indicates that when individuals suffer from a difficulty with emotional regulation such as alexithymia, they are likely also to suffer from poor sleep. Most of the studies reviewed employed a cross-sectional design; some adopted a case-control design. Therefore, the link of causality between alexithymia and sleep (i.e., the impact of alexithymia on sleep) is somewhat supported even with different study designs. Healthcare providers should thus be aware of this issue's importance for their patients: if providers are able to improve their patients' emotional regulation, they may simultaneously improve their quality of sleep. However, additional evidence is still needed to illuminate the causal relationship between alexithymia and sleep. Moreover, future studies should be conducted to examine whether clinical interventions for alexithymia can help individuals improve their quality of sleep.

Declaration of Competing Interest

None to declare.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.neubiorev.2021.12.036>.

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