Review paper

Archives of Psychiatry Research 2025;61:5-24

DOI:10.20471/jan.2025.61.01.01
Received Jan 19, 2024
Accepted after revision Feb 29, 2024

Understanding the Mechanisms And Benefits of Autonomous Sensory Meridian Response (ASMR) Consumption: a Systematic Review.

Jessica Alejandra Ortega-Balderas[1], César Alessandro Ramos-Delgado[2], Neri Alejandro Alvarez-Villalobos[2,3], Oscar de la Garza-Pineda[4], Jorge Gutierrez-de-la-O[1], Oscar de la Garza-Castro[1], Xavier Gerardo Quiroz-Perales[1], Santos Guzman-Lopez[1], Rodrigo Enrique Elizondo-Omaña[1*], Alejandro Quiroga-Garza[1,3]

[1]Human Anatomy Department, School of Medicine, Universidad Autónoma de Nuevo León, Monterrey, Mexico, [2]Centro de Desarrollo de Investigación 360, School of Medicine, Universidad Autónoma de Nuevo León, Monterrey, Mexico, [3]Delegación de Nuevo León, Instituto Mexicano del Seguro Social, Monterrey, Mexico, [4]Neurology Division, Hospital Universitario "Dr. José E. González", Universidad Autónoma de Nuevo León, Monterrey, Mexico

Authors Jessica Alejandra Ortega-Balderas and César Alessandro Ramos-Delgado contributed equally to this manuscript.

Keywords

Autonomous Sensory Meridian Response; ASMR; magnetic resonance imaging; clinicial trial; auditory perception.

Abstract

Aim: To summarize the ASMR intervention studies and the approaches to examine objective parameters and potential benefits. **Materials and Methods:** A search strategy was performed in Scopus, Web of Science, MEDLINE, EMBASE, and Google Scholar following the PRISMA statements and was registered in PROSPERO (CRD42021228070). Studies in which ASMR intervention was included or compared with controls were selected. **Results:** twenty-eight studies (27 healthy and 1 depression participants) were included. Many studies have incomplete data. Specific patterns of MRI and EEG components were found. Specifically, nucleus accumbens, dorsal anterior cingulate gyrus, insula, and inferior frontal gyrus, decreased functional connectivity between the dorsolateral prefrontal cortex (dlPFC) and posterior cingulate cortex (PCC), diminished connectivity in the left precuneus, default mode network (DMN) with reduced functional connectivity. In EEG the results vary among increased alpha power in the left frontal, left parietal, and right parietal, and near the precuneus; an increase in gamma power in sensorimotor regions, a declined delta band power in the right frontal region, a decreased alpha power in occipital, while alpha and gamma power increased in the central areas. **Conclusion:** This review attempts to understand the designs and future implications of a novel therapeutic tool. The inconsistency of the ASMR intervention and control design, the various questionnaires assessing the condition, the contrasting risk of bias among studies, the lack of ethnic diversity of the participants, and the mostly subjective self-reported

Correspondence to:
Alejandro Quiroga-Garza, MD. PhD.
Departamento de Anatomia Humana, Facultad de Medicina, UANL
Ave. Francisco I. Madero esq y Aguirre Pequeño, Col. Mitras Centro
S/N, Monterrey, N.L. México. C.P. 64460
Phone: +52 81 8329 4171

sensations, made this systematic review highly heterogeneous. This, in turn, impacts the generalization of the benefits and neurological components.

Introduction

The Autonomous Sensory Meridian Response (ASMR) is a relatively recent unscientific term defined by Jennifer Allen [1]. The online community has increased since 2007, and currently, there are plenty of ASMR social network sites [2,3]. It describes a characteristic and atypical multisensory condition in response to "sensory triggers" (specific auditory, visual stimuli (virtual or real), tactile, or olfactory) [1]. The most common response is a pleasant tingling sensation (frisson) which causes positive feelings and relaxation, and may last minutes after the stimuli (1,4-6). Another kind of synesthesia associated with this response is an involuntary sensation beginning from the head and neck region and spreading downwards to the back, arms, and legs. Common triggers include whispers, soft speaking, tapping, scratching, slow hand movements, and personal attention [7]. They share standard features such as low voice volume, cyclic sounds, or actions and may include layered sounds or visuals [6,8,9]. The response may be self-modulated according to the triggers' intensity, the stimuli type, and individual preferences and is influenced mainly by the environment [1,4,7,8]. Although studies have shown ASMR may be induced in a laboratory setting [10]. However, a notable remark about ASMR is that not everyone can experience it [7,10-12].

Several studies describe ASMR as a complex event with a distinct physiological profile and psychosocial component. Authors have devotedly attempted to link this subjective sensory phenomenon based on theoretical data and its potential therapeutic benefits [8,13]. The attempts have included correlating ASMR and personality types or moods and indicating personality differences between ASMR experiencers and controls [1,3,7,14]. The physiological approaches have studied the effects of blood pressure, heart rate, pupil diameter and skin conductance [7,11,15-19]. Neuroimaging studies have associated assumed regions of interest, indicating increased or decreased activity in different brain areas with ASMR stimuli and between controls and ASMR subjects [12,20,21] or ASMR subjects only [5,12,20-22]. However, a significant limitation has been developing a measurement instrument to assess the stimuli and the response [23]. The ambiguous definition and the physiological and psychological approaches of the parameters are heterogeneous and have not been thoroughly described [18]. Thus the inaccurate interpretation of its underlying objective physiological mechanisms [8]. Similarly, the prevalence and inducing/ending settings of the sensations among the general population remain unspecified [8,12,18].

Despite the skepticism, even about the existence of ASMR, its closeness to a placebo effect has encouraged its practice as a stress-reduction technique [24,25]. While ASMR is linked to placebo and expectancy effects, other articles offer evidence of the opposite, increasing the interest among patients with severe physical and affective disorders [26,27]. The previous studies showed that many participants report frisson sensations and a calming, emotionally positive feeling [7]. ASMR experiencers frequently engage with ASMR media for relaxation, stress, depression and anxiety reduction, pain management, and sleep induction [3,8,9]. Offering temporary aid to individuals with those disorders [8].

This systematic review aims to revise the intervention in ASMR studies focusing on objective measurements such as vital signs, MRI assessment, electroencephalography (EEG), or benefits for the individuals who engage in ASMR compared to controls.

Materials and Methods

The study was reviewed and approved by the University's Ethics and Research Committees with the registration number RV21-005. The study was also registered in the International Prospective Register of Systematic Reviews (PROSPERO) with the registration number CRD42021228070. The study is reported in accordance with the Preferred Reporting Items for Reviews and Meta-Analysis (PRISMA) [28].

Data sources and search strategy

An experienced librarian helped us design and conduct the search strategy. We searched the following electronic databases from their inception to December 2022: Scopus, Web of Science, MEDLINE, and EMBASE. We also searched for grey literature on Google Scholar. We complemented the initial strategy by screening the reference lists from the selected studies to identify any potentially relevant studies that may have been missed and contacting experts in the field to determine any unpublished or in-progress eligible studies.

Study selection process

Study selection took place in two phases (title/abstract and full-text screening). Studies that met all the following criteria were included in this review: (1) observational studies (cohorts and case reports) contemplating ASMR intervention for experiencers and/or controls; (2) reported psychological, physiological, imaging examinations, or EEG (3) reported in English. Through each phase of the review, two reviewers worked independently and in duplicate to assess the eligibility of the studies. Chance-adjusted inter-rater agreement was assessed at each phase using the Kappa statistic. Before each screening phase, a pilot test with a random sample of studies from the search strategy results was performed to standardize the reviewers' criterion. All disagreements between reviewers at each screening phase were solved by consensus and if needed, by a discussion with an independent reviewer. The disagreements were discussed, and criteria were adapted as necessary. The pilot test was repeated until a Kappa index of (> 0.70) was reached. In the first phase, the title and abstract of all the studies obtained from the search strategy were screened, and reviewers selected the eligible articles based on the inclusion criteria. Discordant decisions passed to the full-text phase during this phase to achieve a highly sensitive selection. Eligibility was then assessed through a full-text screening. Disagreements between the reviewers during this second phase were resolved by consensus, and if it was not achieved, a third reviewer arbitrated the evaluation. During the process, we documented the number of included and excluded articles and the reasons for the exclusion (Figure 1).

Data management

All search results were uploaded to EndNote X8 for de-duplication. The resulting studies were uploaded to Distiller Systematic Review (DSR) software for both titles/abstract and full-text screening. All results from the search strategy were documented per database before and after de-duplication.

Data collection process

Two independent reviewers working in duplicate collected data for all eligible articles using standardized data extraction forms in Microsoft Excel (Version 16, Microsoft Corporation, Redmon, WA, USA). We gathered information regarding the authors' information, year of publication, types of interventions, either ASMR condition or ASMR intervention, control condition or intervention, baseline characteristics of patients, inclusion criteria, exclusion criteria, lost patients, conclusion, and the operational ASMR definition. Disagreements were resolved by consensus, and if an agreement was not reached, an additional reviewer reviewed data extraction and resolved conflicts. Before this process, the two reviewers conducted a pilot test working independently and in duplicate. Disagreements were resolved by consensus, and if an agreement was not reached, a third reviewer made the final decision. Feedback about any suggested adjustments was given by the reviewers, and if necessary, they were applied to the preliminary extraction form.

Missing data

If important data for our outcomes was missing or unclear, the corresponding author was contacted via e-mail to clarify the situation. If they did not respond in a 10-day lapse, a second e-mail was sent with the same 10-day lapse for a response. If nonrespondent the data or article were excluded from the statistical analysis.

Risk of bias in individual studies

Two reviewers working independently and in duplicate evaluated the risk of bias (ROB) from the studies using Cochrane's ROBINS-I tool for the quasi-RCTs and observational studies and the tool by Murad and associates [29]. Methodological quality and synthesis of case series and case reports, and the Anatomical Quality Assurance (AQUA) checklist to assess the RMI studies [30]. The AQUA tool was not designed to evaluate the quality of anatomical studies. However, the authors decided it was helpful to evaluate each MRI study. Any disagreement during this process was resolved by consensus or, if not achieved, by a third reviewer's arbitration.

Data Synthesis

The studies included were described as a narrative synthesis in a table including setting, sample size, population characteristics, description of the intervention, study groups, type of outcomes, and the level of risk of bias.

We extracted the included studies' data and organized it in tables. The heterogeneity of the included studies used different estimates, definitions, settings, psychological tests, MRI techniques, physiological evaluation, and statistical analyses to report their results. Therefore, it was impractical to transform the data into a single effect measure or perform a meta-analysis.

Outcome measures

Because of the nature of the study, the primary outcome was a qualitative synthesis of the information, performing a description of the study design, year, country, operational definition of ASMR, participants' demographical characteristics, inclusion and exclusion criteria, percentage of loss subjects and conclusions (Table 1). Tables 5 and 6 describe the MRI technique, coordinates, studied regions of interest, the moment of the MRI, Hemisphere, Region, Structure, Brodmann area, axis (x, y, z), cluster size, T, and p-value. Tables 2 and 3 show these MRI studies' methods and coordinate templates. The physiological studies are described with blood pressure and pulse for the ASMR and control individuals (before and after the ASMR stimuli). The studies regarding electroencephalogram (EEG) approaches were summarized in power, the pupil diameter studies in millimeters for ASMR and controls (control vs ASMR videos), skin conductance in micro siemens (mS) for ASMR and controls (baseline and stimuli), and tingles frequency, location, and duration for ASMR and controls.

Results

Study selection

The literature search yielded 28 studies. Finally, 28 non-randomized studies of interventions reported the effects of ASMR (auditory, visual, or audiovisual interventions) for ASMR or non-ASMR-aware subjects (Figure 1). One case report and six magnetic resonance imaging studies were included in this systematic review. Details of the interventions, participants' characteristics and criteria admission, conclusions, and ASMR definition are reported for each study and can be found in Table 1. Meta-analysis was not possible due to the substantial heterogeneity among the included studies, particularly in terms of the unclear ASMR status and definition, type of interventions, and characteristics of patients.

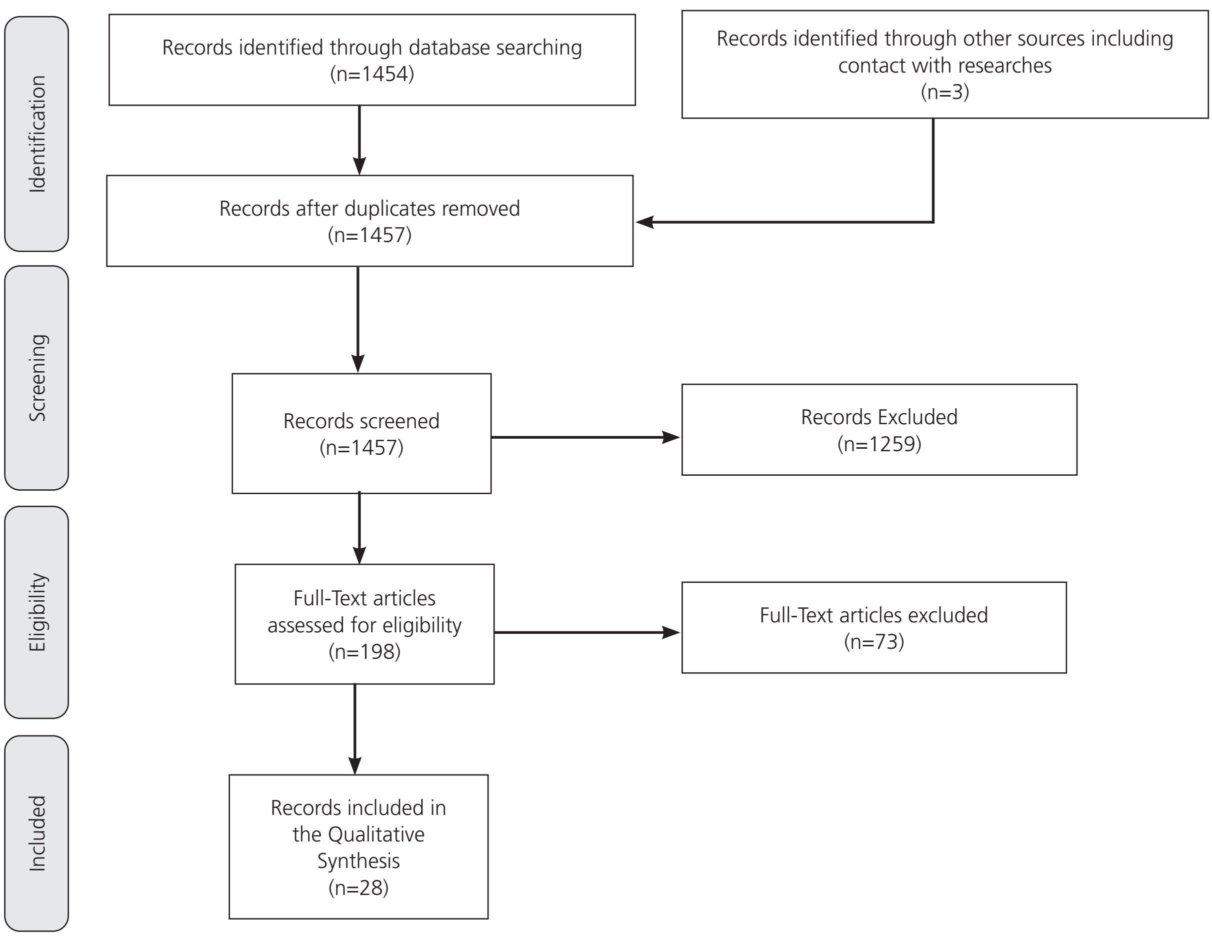

Figure 1. PRISMA flow diagram

Table 1. Non-randomized studies of interventions

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Lohaus 2023 Germany	Online demographic questionnaire. Then in both groups subjects watched 10 different three-minutes videos (diverse ASMR and walking tours) in the same order. A modified ASMR-15	ASMR watching n 205 Age: 25.1 ± 7.2 154 females 50 males 1 nonbinary	Walking tour videos n 96 Age: 24.8 ± 5.3 68 females 28 males	German Universities students IC: self-reported with no neurological or psychological diseases, ≥ 18 yrs, fluent in German EC: NR LP: NR	Participants who considered themselves ASMR responders had higher scores on the ASMR 15 scale. ASMR videos were more likely to trigger ASMR sensations compared to walking tour videos. The intensity of ASMR experiences varied among different videos.
Fredborg 2021 Canada	ASMR audiovisual stimuli. Control audiovisual stimuli. ASMR audio-only stimuli. Control audio-only stimuli ASMR Checklist EEG evaluation on resting state Evaluation for tingling sensation	n 14 Age: 24 ± 4.9	n 14 Age NR	Community volunteers Mostly female Caucasian Canadians IC: participants recruited EC: history of psychiatric or neurological illness LP: 2 ASMR participants and their matched controls	ASMR audio caused significant increased alpha power in left frontal electrodes, left parietal electrodes, right parietal electrodes, frontal electrodes, and near the precuneus.
Ahn 2020 South Korea	ASMR: the sound of stepping on fallen leaves Means Opinion Score Test	50 NR	NR	NR IC: NR EC: NR LP: NR	ASMR lowered BP and pulse in individuals with high levels and helped normalize it in those with low levels
Wang 2020 China	ASMR: 15-minute audio clip. ASMR Checklist Corsi blocks task Number-letter task Simplified version of the manual Stroop task	n: 109 Age: 21 ± 1.9 60 females	n: 103 Age: 20 ± 1.9 54 females	NR IC: NR EC: NR LP: NR	ASMR audio could decrease performances of set shifting and inhibitory control. ASMR individuals should keep away from ASMR-audios or videos when engaged on executive attention.
Paszkiel 2020 Poland	Silence. Relaxing rap music. ASMR-music. EEG examination.	n: 9 Age: 22	NR	Participants without musical education. IC: 22 year old right-handed EC: neurological or psychiatric disorders LP: NR	ASMR-triggering music could reduce stress levels similar to relaxing sounds.
Lee 2020 South Korea	Resting state MRI (5 min). ASMR with MRI scanner (5 min) Behavioral data collection Multi-Affect Indicator	n: 28 26.4 ± 3.8 13 females 15 males	NR	NC IC: NR EC: history of neurological disorders LP: NR	PCC-superior temporal gyrus, pACC-mPFC, and Ig2- cuneus connections were greater during ASMR. Integration of visual and auditory information followed by self-referential processing was associated to ASMR.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Valtakari 2019 Netherlands	Two videos (ASMR and control). Questionnaire. Pupil diameter Number of tingling sensations Duration of tingling.	n: 30 NR	n: 33 NR	Total of 91 subjects; 63 females, 28 male. Participant distribution NC Age: 25, range 18-60 IC: NR EC: NR LP: NC	ASMR was associated with changes in physiology. Pupil diameter was greater during ASMR.
Smith 2019 Canada	fMRI scanning while watching six 4-minute videos (3 ASMR and 3 control videos) ASMR Checklist	n: 17 Age: 22.7 ± 4.7 8 males 9 females	n: 17 Age: 22.8 ± 5.4 8 males 9 females	Student population. IC: NR EC: History of neurological injury or psychiatric illness LP: 0	ASMR was associated with increased activity in sensorimotor cortex regions (medial prefrontal, precentral gyrus, left superior temporal gyrus, and left cuneus) as well as other areas (thalamus, left precuneus, cingulate gyrus, and medial sensorimotor regions). Also a decrease in activity in the right cuneus.
Ahn 2019 South Korea	Reed wind sound. MOS test	NC	NC	NR IC: NR EC: NR LP: NR	ASMR acoustics can be clinically useful to normalize blood pressure and pulse as well as to treat or cure minor illnesses and complications.
Poerio 2019 United Kingdom	Study 1 Videos: 3min (a) six soft-spoken ASMR videos (b) six ASMR videos with sound only. (c) six control videos Self-reported changes. Multi-affect Indicator.	n: 813 NR	NR	1002 participants. 48 % female Age: 29.4 ± 10.8 IC: NR EC: NR LP: 1071 (n: 2073 started the study)	ASMR caused tingling, increased excitement and calmness, and decreased levels of stress and sadness, compared to controls. No significant differences with controls in regards to affective responses. None of the videos induced sexual arousal
	Study 2 Videos: 3min Control video vs. ASMR standard video vs. ASMR self-selected video. Self-reported changes. Multi-affect Indicator. Heart rate Skin conductance level.	n: 55 NR	n: 55 NR	110 participants. 58 % female. Age: 26.1±8.6 IC: NR EC: NR LP: 2 (equipment malfunction)	ASMR was a pleasant, calm feeling with a distinct physiological profile. It reduced heart rate and increased skin conductance

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Cash 2018 USA	Audio: 5min with ASMR (triggers) and without (instrumental technological music) and suggestive instructions.	n: 102 Age: 26.8 ± 8.1 32 female	n: 107 Age: 19.6 ± 1.4 80 females	Psychology students. IC: NR EC: NR LP: NA	ASMR results from expectancy effects and may be a placebo effect. Controls reported ASMR sensations when audio clips were accompanied by leading instructions, while ASMR users reported ASMR only with intended ASMR audio clips
Lochte 2018 USA	Video: 5min ASMR Each participant then selected 5 (7min) clips, which strongly stimulated their ASMR Evaluation: baseline, relaxing, or tingling sensations.	n: 10 Age: 23.6 (18-33) 3 female 7 male	NR	ASMR-sensitive right-handed volunteers IC: fMRI-compatible EC: failed prior-ASMR exposure LP: NC	ASMR can happen during a fMRI procedure. Stimulated brain regions include the nucleus accumbens, mPFC, insula, and secondary somatosensory cortex.
Pedrini 2021 Italy	Video: 5min (ASMR, Control, High-Arousal, Low-Arousal and Rest video) PupilCore; Interpersonal Reactivity Index (IRI); Telepresence Scale ASMR Experience; ASMR-15; ASMR POST Environmental factors.	n: 76 Age: 25.0 ± 0.9 53 females 23 males	NR	Italian young adults IC: Ability to watch a computer display at 54 cm without glasses EC: any psychiatric diagnosis LP: NR	ASMR associated with greater pupil diameter. Lower delta values during the high-arousal, and control. Lower theta, and high alpha delta values during the low-arousal and control. Lower alpha values during low-arousal. Lower during the low-arousal and control videos. Higher scores in empathic concern determined higher tingles perception. ASMR-15 subscale "sensations" was related to almost all the frequency bands.
Sakurai 2021 Japan	Audio: 5min self-selected auditory stimuli Resting state task for comparison with the stimulus task was white noise. fMRI Questionnaire on somatosensation and mood.	n: 30 Age: 20.3 ± 0.7 18 males 12 females	0 NR	Healthy, ASMR-naive IC: MRI compatible EC: Psychiatrically impaired LP: 6 (temporal lobe activation not confirmed)	None of the subjects experienced musical frisson. No correlation between comfort and/or tingling with brain activity. Significant activation in the left thalamus proper, left anterior insula, right triangular part of the inferior frontal gyrus, right cerebellum exterior, left accumbens, right amygdala, left medial superior frontal gyrus (MSFG), left planum polare, left calcarine cortex, right superior frontal gyrus medial segment, and right lingual gyrus.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Seifzadeh 2021 Iran	Popular ASMR videos on YouTube (20min) EEG	n: 1 Age: 30 1 female	NR	30-year-old, Graduate, righthanded, ASMR experience (4yr) No history of neurologic or psychiatric disorders, substance abuse, or hearing problems	Frontal region: decrease delta, gamma-2, delta/theta power ratio, theta/beta power ratio Central regio: increase alpha, gamma-1, gamma-2 Occipital region: decrease alpha, theta/beta power ratio
Ohta 2021 Japan	Audio: ASMR during mental tasks EEG	n: 8 Age: 20-23 8 males	NR	Healthy subjects IC: Normal EEG EC: history of neurological disorders LP: NR	Mental task: lowest alpha-band activity, and highest beta-band activity. Mental task + ASMR alpha-band activity similar resting condition.
Koo 2021 South Korea	Videos: 10 ASMR and 10 entertainment EEG Arousal using a 10-point Likert scale	n: 8 Age: 29.1 ± 1.9 6 males 2 females	NR	NR IC: NR EC: NR LP: NR	Entertainment videos increased delta waves in the frontal and central region and decreased gamma waves in occipital region ASMR decreased delta waves in the frontal and central region and increased gamma waves in occipital region. It also lowered arousal
Maniago 2021 Saudi Arabia	Three groups (whispering, auditory, personal attention) ASMR videos for experimental groups, and vocal expression for the comparison group. Adapted MAAS	Whispering n: 18 Age: 19.6 ± 7.2 13 females/5 males Auditory n: 18 Age: 19.2 ± 7.6 11 females/7 males Personal attention n: 18 Age: 20 ± 6.6 10 females/8 males	NR	54 Saudi Arabia nursing students IC: 18–25 years EC: History of hearing impairment conditions, sleep disturbances (narcolepsy or insomnia), signs and symptoms of dizziness and lethargy LP: NR	Participants exposed to whispering and auditory sounds obtained significantly higher MAAS post-test scores. No significant differences in the personal attention triggers.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Hardian 2020 Indonesia	Videos: 14 ASMR clips from YouTube for 14 days. Control: non-ASMR videos from YouTube. PSQI questionnaire	n: 15 Age: 18.3 ± 0.6 13 females	n: 15 Age: 18.4 ± 0.8 12 females	Medical students. Javanese, Chinese, and Indonesian IC: Perform basic medical science module exams, EC: Subjects who received medication that can influence sleep quality, drink coffee or chocolate or perform heavy exercise LP: NR	ASMR stimulation improved sleep quality (reduction of PSQI score) after 14 consecutive days..
Tada 2021 Tokyo	Experiment 1 Audiovisual, Audio-only, or visual-only stimuli 4-point Likert ASMR scale (no, weak, moderate, or strong ASMR) visual analog scale for tingling and tickling sensations. POMS 2	n: 30 Age: 20.5 ± 0.1 12 males 18 females	NR	Japanese right-handed students IC: Normal hearing and vision EC: NR LP: 2 (excluded for not perceiving tingling or tickling sensations)	The tingling and tickling intensity was greater under audiovisual conditions than under audio-only. The ASMR estimate was positively correlated with the intensity of tingling and tickling sensations.
	Experiment 2 Audiovisual stimuli PPG POMS 2	n: 42 Age: 21.9 ± 2.3 14 males 28 females	NR	Japanese right-handed students IC: Normal hearing and vision EC: NR LP: 2 (technical problems)	The pulse wave amplitude increased while the pulse rate decreased during stimuli. The Total Mood Disturbance score decreased after the experiment. ASMR activates the parasympathetic nervous system.
Yusaira 2021 India	Video: two 16min (ASMR vs. Neutral) SRSI SRPI GHQ	n: 30 Age: 18-25 15 males 15 females	n: 30 Age: 18-25 15 males 15 females	60 college students from Kerala and Karnataka, India IC: College students EC: History of psychiatric, neurological, or trauma. LP: NR	ASMR increases the relaxation state of sleepiness and decreases joy, love, and thankfulness, as well as the stress state of worry.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Idayati 2021 Indonesia	Double blind Rest for 30 minutes before treatment. ASMR video (3 minutes long with triggers in the form of special treatment roleplay is shown via a 6.3-inch smartphone with a resolution of 2280 × 1080 megapixels) sitting in a room installed with air conditioning measuring 3x3 meters. Blood pressure measurements using a mercury sphygmomanometer, heart rate using a fingertip pulse oximeter, and respiratory rate calculated in units of bpm by observing volunteers in one minute, were taken before and after treatment.	30 students (15 male and 15 female) range 18-21 This refers to the intervention type.	No	Students of the Faculty of Architectural Engineering, Syiah Kuala University aged 18-21 years, who were not currently taking medicine (cardiovascular or, psychotropic drugs, analgesics, antipyretics, antibiotics, and diuretics) in the last 48 hours and were not active smokers. The majority are watching ASMR videos for the first time IC: Currently not taking (cardiovascular or psychotropic drugs, analgesics, antipyretics, antibiotics, and diuretics) in the last 48 hours and were not active smokers EC: No LP: No	After watching the ASMR video, it was found that all vital signs except for the respiratory rate decreased. And it is also in accordance with statistical analysis with the Wilcoxon test where heart rate, systolic blood pressure, and diastolic blood pressure have a value of $p < 0.05$.
Lindfors 2021 United Kingdom	Video: 2 clips (person-centric triggers vs. various triggers) MAI – modified ASMR checklist Four open-ended questions.	n: 106 Age: NR	n: 37 Age: NR Unsure group c: 79 Age: NR	Undergraduate students and volunteers from online communities n: 222 (68 males, 1 prefer not to say). Age: 25 ± 8.6 IC: NR EC: NR LP: 9 were excluded due to incomplete consent forms	Non-ASMR-experiencers showed significantly higher stress. Clear variability in participants' descriptions of both the intensity and the pleasurability of ASMR. Their multi-dimensional model represents the individual variability in perceived pleasurability and intensity of ASMR.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Smejka 2021 United Kingdom	Video: 2min from YouTube includes an assortment of auditory triggers. ISI - modified PHQ-9 SDHS – modified PSAS - modified ASMR experience. Open response Rate of enjoyment (scale of 1–10). Description of sensations	n: 724 538 females, 176 males 8 other Insomnia group: Age: 31.1 ± 11.0 Depression group: age: 25.3 ± 7.3 Combined group: age: 27.1 ± 7.9 Control group: Age: 28.6 ± 9.0	n: 111 81 females 30 males Insomnia group: age: 25.5 ± 6.4 Depression group: Age: 26.6 ± 10.9 Combined group: Age: 32.4 ±15.5 Control group: Age: 29.5 ± 11.7 1	Participants with depression, insomnia, or both, as well as healthy IC: ≥ 18 years age, with corrected, or uncorrected sight and hearing. EC: NR LP: Participants who had not been able to access the video (n = 16) or had significant amounts of missing data (n = 1199) Ambiguousgroup: n: 202 (137 females, 61 males, 4 other) Insomnia group: 33.3 ± 6.1 Depression group: 27.1 ± 11.4 Combined group: 29.17 ± 9.6 Control group: 29.7 ± 12	'Experienced ASMR' group rated their enjoyment of the video and positivity towards the ASMRtist significantly higher than the 'No ASMR' group. All ASMR experiencers had a significant increase in mood and a decrease in arousal. ASMR Participants in the Combined group (insomnia and depression) showed an increase in positive mood compared to all other groups and a decrease in arousal compared to the Insomnia and Control groups. The Depression group had a significant increase in mood and decrease in arousal when compared to the Insomnia and Control groups. The ASMR experience may be linked to mechanisms involved in depression than insomnia.
Engelbregt 2022 Amsterdam	Control video vs. ASMR standard video vs. ASMR self-selected video. HEXACO-SPI Heart rate POMS -short version ASMR Checklist -modified Eriksen Flanker task. Electrodermal activity	n: 38 Age: 20.4 ± 2.9 33 female 5 male	NR	Dutch undergraduate Psychology students IC: Healthy and between 17 and 35 years. No selection was made based on self-described ASMR experiencer EC: NR LP: EEG analyses data from 6 participants were excluded from data analysis due to noise in the recordings	ASMR improved depression scores, reduced heart rate, decreased in theta power in the left frontal and right temporal areas, and in alpha power in the right temporal and parietal area; beta power increased in the left temporal The EEG results suggest that ASMR is characterized by focused attention and immersion. No significant effects of ASMR were found for the skin conductance nor a relationship between tingles and personality traits. ASMR videos may be relaxing even in not ASMR-experiencers.

Table 1. (continued)

Study Year Country	Interventions Evaluation Tools	ASMR participants (n)/ mean age ± SD in years	Control participants (n)/ mean age ± SD in years	Characteristics of participants/ Inclusion criteria (IC), exclusion criteria (EC) and lost patients (LP)	Conclusions
Swart 2022 United Kingdom	Video: 10min ASMR Four subjective self-reported states: Baseline, relaxed state with no tingling (Relaxed), weak tingling sensation (WeakASMR), and strong tingling sensations (StrongASMR). EEG Heart rate	n: 26 Age: 27.0 ± 1.4 15 female 11 males	NR	NR IC: 18-45 years; Normal auditory, visual acuity, and no neurological or psychiatric problems EC: NR LP: Resting state data from one participant could not be Recorded	All participants were classified as either weak or strong ASMR-Responders ASMR, compared to baseline, was associated with decreases in delta power in prefrontal regions, decreases in high beta power in parietal and occipital regions, and decreases in gamma power in occipital regions. Also increases in alpha power in parietal, frontal, and temporal regions; increases in low beta power in parietal and temporal regions. There is electrophysiological evidence for prolonged ASMR-induced relaxation. There is a decay effect of ASMR in the absence of self-reported ASMR. Modulations by ASMR in high-frequency power shifts to lower frequencies, except for enhanced alpha. Temporal continuity of the ASMR video is not vital for ASMR induction
Eid 2022 United Kingdom	Video: 5min ASMR YouTube Video engagement questionnaire Neuroticism scale from BFI STAI	n: 36 Age: 30.4 ± 11.1 26 females 9 males 1 other	n: 28 Age: 28.4 ± 12.2 20 females 8 males	NR IC: 18-58 years EC: NR LP: NR	ASMR-experiencers have significantly greater neuroticism, state anxiety, and trait anxiety scores. ASMR-experiencers reported decreased state anxiety after the ASMR video. There was no difference in pre-and post-video state anxiety in the non-experiencers group.

IC - Inclusion criteria; EC - exclusion criteria; LP - lost patients; NR - not reported; NC - not clear; BP - blood pressure; fMRI - functional Magnetic Resonance Imaging; BFI - Big Five Inventory; STAI - The State Trait Anxiety Inventory; EEG – electroencephalogram; POMS - Profile of Mood States; PPG – photoplethysmography; BPM - breaths per minute; BMI - body mass index; MFG - right middle frontal gyrus; PCC - posterior cingulate cortex; pACC - pregenual anterior cingulate cortex; Ig2 – insula; POMS 2 - Profile of Mood States, 2nd Edition; PSQI - Pittsburgh Sleep Quality Index; MAAS - Mindful Attention Awareness Scale; SRSI - Smith Relaxation States Inventory; SRPI - Smith Relaxation Posttest Inventory; GHQ - General Health Questionnaire; MAI - Multi-Affect Indicator; ISI - Insomnia Severity Index; PHQ-9 - Patient Health Questionnaire; SDHS - Short Depression-Happiness Scale; PSAS - Pre-Sleep Arousal Scale; HEXACO- SPI - HEXACO-Simplified Personality Inventory

Table 2. Non-intervention MRI studies

Authors, year	MRI Technique and Field strength scanner	Coordinates template
Smith, 2016	3-T BrainVoyager QX 2.8.4	Tailarach
Smith, 2019	3-T anatomical scan: magnetization-prepared rapid-gradient-echo (MP-RAGE) sequence	Tailarach
Smith, 2020	3-T TRIO. 7-minute resting-state functional Structural MRI scan	MNI
Smith, 2022	Functional MRI. Six 5-min fMRI runs (60-s fixation cross followed by a 4-min video)	NR

NR - not reported

Study characteristics

There was a sustainable level of agreement between reviewers in the title & abstract screening phase (k = 0.72) and full-text phase (k = 0.86). A total of (n = 1457) studies were identified and screened in the initial search strategy; whereas (n = 198) were screened for full-text screening. After both screening phases, (n = 28) studies were included for the qualitative and quantitative synthesis. The summarized data from these studies are provided in Table 1 and Table 2. Exclusion reasons are documented in Table 1, considering extreme scores on study variables, participants did not report tingles during the interventions and technical malfunctions (6,7,16,18,31-34). Across all studies, no conflicts of interest were observed.

Description of the participants

All the studies evaluated ASMR as an intervention in healthy participants (either students or community volunteers), except for one in which subjects with depression and/or insomnia were studied [34]. Sixteen studies did not provide stated inclusion and exclusion criteria. Five studies did not clearly state the operational ASMR definition to group participants, but most of them utilized the description by Barratt and associtaes 2015 [8].

Functional Magnetic Resonance Imaging (fMRI) studies

Seven studies evaluated MRI in healthy participants. We separated the described tables into interventional and non-intervention studies. Three of them did not assess the intervention of ASMR stimuli before the scan (two utilized the Tailarach coordinates system, and the other utilized MNI) (Table 3). The remaining four imaging studies evaluated the MRI during ASMR stimuli, two with low ROB and two with moderate ROB (3 utilized MNI and only one utilized Tailarach coordinates) (Table 4).

Table 3. Intervention MRI studies

Authors, year	MRI Technique and Field strength scanner	Coordinates template
Smithe et al., 2019	3-Tesla Siemens TRIO MRI scanner T1-weighted gradient-echo images using a magnetization-prepared rapid-gradient-echo sequence	Tailarach
Lee et al., 2020	3T, T1-weighted sequence. CONN toolbox. Head movements were corrected. ART. 5-min resting-state fMRI scan AND participants underwent ASMR task in the MRI scanner	Montreal Neurological Institute. (Gaussian kernel was applied to the normalized images.)
Lochte et al., 2020	3 T, T1-weighted imaging, functional images T2	Montreal Neurological Institute
Sakurai et al., 2021	3 Tesla MRI system (Canon Vantage Galan. Statistical Parametric Mapping 12)	Montreal Neurological Institute

R – Right; L – left; NR - not reported.

Table 4. Physiological Assessment Studies

Authors, Country, Year	Sample (n)	Blood pressure before	Blood pressure after	Control group pulse before	Control group pulse after
Ahn et al., South Korea, 2019	1	HPB: 163/117 NBP: 130/79 LBP 102/69	HBP: 157/99 NBP: 129/82 LBP: 117/75	HBP: 91 NBP: 78 LBP: 57	HBP: 83 NBP: 71 LBP: 62
Poerio et al., United Kingdom, 2019	55	NR	NR	75.91 ± 13.27	71.74 ± 12.58
Ahn et al., South Korea, 2020	1	HBP: 147/110 NBP: 135/93 LBP: 83/58	HBP: 132/92 NBP 128/85 LBP 115/75	HBP: 118 NBP: 93 LBP: 42	HBP: 105 NBP: 78 LBP: 62
Paszkiel et al., Poland, 2020	9	111.78 ± 1.79/69.11 ± 5.6	111.00 ± 1.50/ 67.33 ±6.12	64.22 ± 5.09	61.33 ± 3.71
Idayati et al., Indonesia, 2021	30	115.33/ 75.63	113.57/ 66.90	78.03 ± 10.549	74.27 ± 12.230

Measurements described in systolic/diastolic blood pressure in mmHg and pulse in beats per minute with mean ± standard deviation. HBP - high blood pressure subject; NBP - normal blood pressure subject; LBP - low blood pressure subject; NR - not reported

The studies' brain activity was measured using fMRI. Although fMRI may measure individual differences, best suited to detect dynamic states. It can detect specific brain states when the subject is engaged in attention tasks or experiencing painv [35]. Lochte and associates 2018 found that the experience of ASMR is associated with activity in the nucleus accumbens, dorsal anterior cingulate gyrus, insula, and inferior frontal gyrus [5]. Lee and associates 2020 utilized the Multi-Affect Indicator (MAI) and performed a correlation analysis between the functional connectivity and individual scores for the affective state [22]. They also corrected confounding factors (subject movement, pulse, breathing, and parameters related to task effects). They evaluated clusters and found that the connectivity strength involved in visual information was negatively correlated with the behavior score. Also, ASMR can be associated with decreased functional connectivity between the dorsolateral prefrontal cortex (dlPFC) and posterior cingulate cortex (PCC) compared to the resting state. Smith and associates 2019 determined that control participants showed greater connectivity than ASMR participants in the left precuneus, while the medial prefrontal cortex, posterior inferior parietal lobule, angular gyrus, posterior cingulate cortex, and precuneus (default mode network, DMN) of ASMR individuals appeared to have reduced functional connectivity [21].

Physiological parameters

Three studies have undergone acoustic analysis (two have high ROB, and one was omitted in the analysis) [11,15,36]. Ahn and associatesstudied acoustic analysis of two different sounds, fallen leaves and reed wind, and their effects on vital human signs [11]. They included time-domain analysis, spectrogram analysis, and spectrum analysis, determining ASMR is commonly elicited by low-frequency, repetitive, stimulating, complex sounds, and detail-focused, slow-paced visual stimuli [11,15]. Koumura and associates 2020 examined the amplitude, spectral centroid, spectral bandwidth, and instantaneous roughness of ASMR stimuli. They determined auditory stimuli with more significant sound-pressure levels, soft sounds, and dark timbre were frisson triggers. Even though they utilized ASMR stimuli in a naïve population, they named the response frisson, defining it as tingling sensations related to sounds and positive or negative emotions [36]. The frisson estimate also correlated with the Profile of Mood States (POMS) Tension-Anxiety, implying subjects with anxiety-prone to frisson.

Five studies have assessed vital signs during the stimulus (3 with moderate ROB and 2 with serious ROB). Ahn and associates (2020) measured blood pressure and pulse using EX's EASY X 800 equipment at baseline and ten minutes later while listening to the audio stimuli of stepping on fallen leaves and in another study using reed sounds with headphones [11,15]. These studies did not measure these parameters at different times. Both agreed that these sounds lower the blood pressure and pulse levels in hypertensive and normal subjects and normalize low blood pressure subjects. However, they did not perform a comparative test to show these figures' significance. They affirmed this could be used as a treatment therapy and did not focus on long-term effects nor describe the hypertensive stages according to the guidelines. And low blood pressure is not included in the blood pressure categories of the American Heart Association [37]. The authors suggest these sounds may aid people in normalizing blood pressure levels. Emerging meta-analyses evaluating alternative interventions have shown positive effects of proposal therapeutic music on mood disorders and postoperative recovery. This could represent a low-cost intervention without significant side effects and favorable blood pressure results [26]. Paszkiel and associates tested different stimuli [17]. They measure how fast one can relax given the baseline state and call these measurements the "CBA ratio." According to their study, the magnitude of the alpha waves shows ASMR sounds and relaxing music are better for the subjects' relaxation. Also, the most significant influence on the individual ability to relax can be attributed to ASMR sounds and relaxing sounds. A different situation happened with the heart frequency, as soothing sounds or no stimulation were able to lower the heart rate. All studies appeared to show lower blood pressure after the ASMR stimuli were used. Poerio and associates 2018 performed two experiments [7]. They observed more significant reductions in heart rate and an increase in skin conductance of ASMR participants after watching ASMR videos compared to non-experiencers.

Two studies have experimentally assessed pupillometry [18,19]. Valtakari and associates used an ASMR and a control video (ASMR video with removed audio) in counterbalanced order. They measured pupil diameter, the number of tingling sensations, and the total duration. They controlled for light exposure sensations. They obtained that ASMR subjects, controls, and the unsure group showed significantly greater pupil diameter during the ASMR video, probably accounting for those stimuli increasing pupil diameter. Pupil diameter was also significantly greater during reported tingling sensations. However, ASMR and unsure participants reported significantly longer tingle duration for the ASMR video than the control video, but this did not happen with control subjects.

EEG Studies

Five studies assessed EEG with participants while listening to ASMR or other non-ASMR stimuli. Three of them with low ROB, and two with moderate ROB. The data demonstrates the self-reported sensory and emotional changes during ASMR are associated with measurable changes in neural activity [38].

Paszkiel and associates determined the CBA ratio for the alpha waves' magnitude, suggesting that the most considerable influence on the subject's ability to relax can be attributed to ASMR sounds and relaxing music [17]. Fredborg and associates determined EEG time-frequency power during ASMR stimuli and non-ASMR experiencers [38]. Their EEG results found significantly increased alpha power in the left frontal, left parietal, right parietal, and near the precuneus regions during audio-only ASMR stimuli. At the same time, for control participants, there was a decrease in alpha power in the broad frontal ($p = 0.036$), right medial frontal ($p = 0.013$), left medial frontal, and precuneus. There was a significant increase near the precuneus in ASMR experiencers for ASMR video trials, while there were no differences in control participants. There were no significant increases in ASMR audio or video for any group for gamma power. But when comparing ASMR audio versus non-ASMR audio, ASMR experiencers showed a significant increase in gamma power in sensorimotor regions. The case report by Seifzadeh and associates 2021 found a declined delta band power in the right frontal region. It also decreased alpha power in occipital post-ASMR stimuli, while alpha and gamma power increased in the central areas.

Ohta and associates 2021 assessed EEGs during resting and performing mental tasks with and without applying ASMR. All subjects showed the lowest alpha-band activity during the cognitive functions and significantly the highest beta-band activity. When using ASMR sounds during the mental task, the level of alpha-band activity returned to the resting condition. While when applying ASMR in the resting state, there was a significantly higher alpha-band activity than without ASMR. Koo and associates 2021 assessed EEG during resting and a video-watching section of ASMR versus Korean show videos. They determined that ASMR is a low-arousal stimulus. In the non-ASMR videos, delta waves increased in the frontal and central regions, and gamma waves decreased in the occipital region. In ASMR, delta waves fell in the frontal and central areas, and gamma in the occipital regions increased. The alpha power was not measured.

Risk of Bias Assessments

The ROBINS-I tool was used to determine ROB. Overall there was serious ROB in 3 studies, moderate in 13 studies, and low in 6 studies (Table 5).

We used the Methodological quality and synthesis of case series and case report results, obtaining a low risk

Table 5. Risk of bias assessment: ROBINS-I

Author Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported results	Overall
Cash, 2018	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Lochte, 2018	Low	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Poerio, 2018	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Ahn, 2019	Serious	Low	Moderate	Low	Critical	Critical	Low	Serious
Smith, 2019	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Valtakari, 2019	Low	Serious	Moderate	Low	Moderate	Moderate	Low	Moderate
Ahn, 2020	Serious	Low	Moderate	Low	Critical	Critical	Low	Serious
Hardian, 2020	Moderate	Low	Low	Low	Low	Moderate	Low	Low
Lee, 2020	Low	Low	Low	Low	Low	Low	Moderate	Low
Paszkiel, 2020	Moderate	Low	Moderate	Low	Low	Low	Low	Moderate
Wang, 2020	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Fredborg, 2021	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate	Moderate
Idayati, 2021	Serious	Low	Low	Low	Low	Low	Low	Moderate
Koo, 2021	Moderate	Low	Low	Low	Low	Low	Low	Low
Lindfors, 2021	Serious	Serious	Moderate	Low	Moderate	Moderate	Serious	Serious
Maniago, 2021	Moderate	Moderate	Low	Low	Low	Low	Low	Low
Ohta, 2021	Moderate	Low	Low	Low	Low	Low	Low	Low
Pedrini, 2021	Moderate	Serious	Moderate	Low	Low	Moderate	Moderate	Moderate
Sakurai, 2021	Low	Low	Moderate	Low	Low	Low	Low	Low
Tada, 2021	Low	Serious	Moderate	Low	Moderate	Moderate	Low	Moderate
Wiggs, 2021	Low	Moderate	Moderate	Low	Moderate	Moderate	Low	Moderate
Yusaira, 2021	Serious	Low	Low	Low	Low	Moderate	Low	Moderate
Eid, 2022	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate
Engelbregt, 2022	Low	Low	Low	Low	Low	Low	Low	Low
Swart, 2022	Moderate	Serious	Moderate	Low	Low	Moderate	Low	Moderate

Table 6. Risk of bias assessment: AQUA Checklist for MRI studies

Author, year	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5
Smith et al., 2016	Unclear	Low	Unclear	Low	Low
Lochte et al., 2018	Unclear	Low	Unclear	Low	High
Smith et al., 2019	Unclear	Low	Unclear	Low	High
Smith et al. , 2019	Unclear	Low	Unclear	Low	High
Lee et al., 2020	Unclear	Low	Unclear	Low	Low
Smith et al., 2020	Unclear	Low	Unclear	Low	High
Sakurai et al., 2021	Unclear	Low	Unclear	Low	High
Smith et al. , 2022	Unclear	Low	Unclear	Low	Low

Domain 1 - Objectives and subject characteristics; Domain 2 - Study design; Domain 3 - Methodology characterization; Domain 4 - Descriptive anatomy; Domain 5 - Reporting of results

of bias for the only case report study. However, there are remaining challenges when describing the ROB for questions such as the dose-response effect or the duration of follow-up.

The Anatomical Quality Assurance (AQUA) checklist was used to assess ROB in MRI studies (Table 6) [39]. The use of "unclear risk of bias" was used mainly for the question of Domain 1: Was (Were) the chosen subject sample(s) and sample size appropriate for the objective(s) of the study? This is because, currently, there is no standardized way of measuring ASMR experience, and there might be inaccuracies within the categorization of the subjects [34]. Also, it was used when there was insufficient data to classify it and when there were concerns regarding reporting data, and it could not be agreed whether it was a high or low risk of bias. The risk of bias was unclear in all studies' domain 3 (methodology), as no study included appropriate measures taken to reduce inter-and intra-observer variability. Only three studies explicitly indicated the experience of the individual(s) performing each part of the study. This section is considered one of the most important to validate an anatomical study [40]. The risk of bias in Domain 5 of reporting the results was low in two studies, as they stated the confounding factors of the study.

Discussion

This systematic review demonstrated the high heterogeneity in the ASMR intervention methodology with associated improvements in participants' well-being, with varying strengths of evidence to support their use. In particular, the use of ASMR stimuli was associated with the normalization of blood pressure and pulse, activation and deactivation of specific brain areas, and improved well-being in the ASMR experiencers or ASMR interventions. In contrast, the evidence for ASMR non-experiencers was not robust.

The ASMR is a complex emotional phenomenon with a statistically significant biological profile that is still relatively ambiguous and without defined criteria [7]. In 2010, the ASMR term was coined, describing a component of sensations. The autonomous feeling assumes that individuals have no control over feeling it, the sensory response, and the "meridian" because it occurs in the center of the body [34]. While the definition of ASMR is nuanced, certain qualities appear to be universal to the phenomenon. The sensation has been repeatedly reported to present a calmness or sleepiness, involving pleasurable tingling sensations, often radiating down the midline to the rest of the body [7,8,41,42]. Calmness itself would not be appropriately considered ASMR. However, this could be a typical description of ASMR, which could be further refined as there are no objective criteria to define a "real" response [34]. As a result, stress management approaches have become essential for preventing stress-related health problems and accomplishing psychological well-being [22]. Another problem could arise from synesthesia and frisson, examples of atypical multimodal experiences [2,43]. However, some characteristics make ASMR distinct from these two. First, the stimuli often referred to as "ASMR triggers" typically consist of socially intimate acts (e.g., watching someone apply make-up), whispering, and/or repetitive sounds [1,8,21]. People new to it will have a hard time distinguishing whether they have experienced it. Another reason could be the inherent indecisiveness of participants who are prone to categorize themselves as unsure when there is an option. To avoid such ambivalent attitudes towards the ASMR experience, future research needs to find ways to define the criteria for ASMR more clearly [18].

The definition used by most of the authors originated by Barratt and associates 2015. However, the authors used different meanings throughout the included studies to explain ASMR. Some studies defined the presence of ASMR as confirmed by having participants view videos created to elicit ASMR responses in the presence of the investigators. They confirmed the responses with tingling sensations [8]. Other studies included participants who were recruited via ASMR network groups. Therefore, the subjects would be aware of how this phenomenon is described [9]. Websites and YouTube channels are dedicated to ASMR, which exposes more people to it. There could also be a misunderstanding of the name as other authors refer to ASMR for allocation of scarce medical resources, age-standardized mortality rate, age-specific mortality rates, or Amélioration du service medical rendu. But without a universal definition, it would be complicated to contribute to this topic's further research significantly.

Limitation include the lack of ethnic diversity in studies. Major depressive disorder (MDD) prevalence slightly varies among ethnic groups, eliminating health inequality by ethnicity, sexual orientation, and gender is a priority [44,45]. It would be also relevant to study whether this is helpful in participants with diseases such as insomnia or depression [34,46]. As for the gender, most studies recruited women, and took this gap as a possible gender effect for further evaluation [47]. However, studies have found that age and gender seem not to influence depression biomarkers [48,49]. Another concern is the need for validity and homogeneity of the methods, participants' characteristics, and interventions. By utilizing the same environmental conditions, video and audio resolution, volume, use of headphones, and dividing the interventions into audio, audiovisual and visual only. Another challenge is advancing racial justice in mental health research while addressing the prevalent issue of limited access to evidence-based treatments for patients with mental health disorders [50,51]. Insufficient data exists to determine the effects or efficacy of evidence-based ASMR programs for minority populations.

Resting-state functional magnetic resonance imaging (rs-fMRI) is a tool widely used in brain function assessment [52]. Functional neuroimaging studies showed abnormal functional connectivity in patients with MDD [52]. Other studies showed current depression severity to be strongly predicted by greater activity and greater positive functional connectivity among the central executive network (CEN), DMN, and salience network (SN) while performing working memory and emotional regulation tasks [53]. However, the results of the included studies were inconsistent. The inconsistencies may be due to small samples or different data analysis methods used in fMRI. Future studies could include more resting state networks, similar to Liu and associates comparing subjects with MDD and controls [52].

The eye-tracking-based methods reliably evaluate psychometric properties. However, using eye tracking minimized the confounding motor element, as no motor responses are needed to assess attention [52]. MRI studies have also shown activation in motor areas. Does this mean that it has to do with sensory and motor nerves?

While we consider the previous research studies remarkable, trying to unveil this potential therapeutic tool cannot be obtain until more evidence is gathered in a strict, well planned, methodological process that is standardized for ASMR. This would better understand individual and complex differences in the ability to experience emotional phenomena and the potential positive effects [7]. This new knowledge could reap valuable rewards regarding mental health when maintaining a thorough assessment with a multidisciplinary team to study the core properties. And it could also lead to practical, reachable, and cost-effective interventions to improve mental health.

In conclusion, several studies have important ROB. The heterogeneity of their ASMR definition, participants, methods, and outcomes measurements make it difficult to compare. However, possible benefits include relaxation and stress reduction, promoting calmness and emotional well-being. Improved sleep quality, pain management, mindfulness aid, and enhanced cognitive functions. Thus, it can be a tool for regulating emotions and stress responses. While the mentioned benefits have been reported in the research papers, it is important to note that individual experiences of ASMR can vary significantly. More research is still needed to understand the underlying mechanisms and to explore the potential therapeutic applications of ASMR in specific populations. There is a need to establish international guidelines and recommendations for the performing and reporting ASMR studies.

Acknowledgements

None.

Conflict of interest

None to declare.

Funding Sources

None.

References

1. Fredborg B, Clark J, Smith SD. An examination of personality traits associated with Autonomous Sensory Meridian Response (ASMR). Front Psychol. 2017;8:247.
2. del Campo MA, Kehle TJ. Autonomous sensory meridian response (ASMR) and frisson: Mindfully induced sensory phenomena that promote happiness. Int J Sch Educ Psychol. 2016;4:99-105.
3. McErlean ABJ, Banissy MJ. Assessing individual variation in personality and empathy traits in self-reported autonomous sensory meridian response. Multisens Res. 2017;30:601-13.
4. Smith SD, Katherine Fredborg B, Kornelsen J. An examination of the default mode network in individuals with autonomous sensory meridian response (ASMR). Soc Neurosci. 2016;12:361-5.
5. Lochte BC, Guillory SA, Richard CAH, Kelley WM. An fMRI investigation of the neural correlates underlying the autonomous sensory meridian response (ASMR). Bioimpacts. 2018;8:295-304.
6. Swart TR, Banissy MJ, Hein TP, Bruña R, Pereda E, Bhattacharya J. ASMR amplifies low frequency and reduces high frequency oscillations. Cortex. 2022;149:85-100.
7. Poerio GL, Blakey E, Hostler TJ, Veltri T. More than a feeling: Autonomous sensory meridian response (ASMR) is characterized by reliable changes in affect and physiology. PLoS One. 2018;13;e0196645.
8. Barratt EL, Davis NJ. Autonomous Sensory Meridian Response (ASMR): A flow-like mental state. PeerJ. 2015:3;e851.
9. Barratt EL, Spence C, Davis NJ. Sensory determinants of the autonomous sensory meridian response (ASMR): Understanding the triggers. PeerJ. 2017:5;e3846.
10. Roberts N, Beath A, Boag S. A mixed-methods examination of autonomous sensory meridian response: comparison to frisson. Conscious Cogn. 2020;86:103046.
11. Ahn IS. A Study on the human body response to the sound of stepping on fallen leaves in ASMR. Int J Eng Trends Technol. 2020;68:173-8.
12. Smith SD, Fredborg BK, Kornelsen J. Functional connectivity associated with five different categories of Autonomous Sensory Meridian Response (ASMR) triggers. Conscious Cogn. 2020;85:103021.
13. Ahuja NK. "It feels good to be measured": Clinical role-play, walker percy, and the tingles. Perspect Biol Med. 2013;56:442-51.
14. McErlean ABJ, Osborne-Ford EJ. Increased absorption in autonomous sensory meridian response. PeerJ. 2020:8;e8588.
15. Ahn IS, Kim BY, Bae MJ. A study on the human sensation of the reed wind sound in ASMR. IJERT. 2019;12:1494-9.
16. Engelbregt HJ, Brinkman K, van Geest CCE, Irrmischer M, Deijen JB. The effects of autonomous sensory meridian response (ASMR) on mood, attention, heart rate, skin conductance and EEG in healthy young adults. Exp Brain Res. 2022;240:1727-42.
17. Paszkiel S, Dobrakowski P, Łysiak A. The impact of different sounds on stress level in the context of EEG, cardiac measures and subjective stress level: a pilot Study. Brain Sci. 2020;10:728.
18. Valtakari NV, Hooge ITC, Benjamins JS, Keizer A. An eye-tracking approach to Autonomous sensory meridian response (ASMR): The physiology and nature of tingles in relation to the pupil. PLoS One. 2019;14:e0226692.
19. Pedrini C, Marotta L, Guazzini A. ASMR as idiosyncratic experience: experimental evidence. Int J Environ Res Public Health. 2021;18:11459.
20. Smith SD, Fredborg BK, Kornelsen J. A functional magnetic resonance imaging investigation of the autonomous sensory meridian response. PeerJ. 2019;7:e7122.
21. Smith SD, Fredborg BK, Kornelsen J. Atypical functional connectivity associated with Autonomous Sensory Meridian Response: an examination of five resting-state networks. Brain Connect. 2019;9:508-18.
22. Lee S, Kim J, Tak S. Effects of Autonomous Sensory Meridian Response on the functional connectivity as Measured by Functional Magnetic Resonance Imaging. Front Behav Neurosci. 2020;14:154.
23. Roberts N, Beath A, Boag S. Autonomous sensory meridian response: Scale development and personality correlates. Psychol Conscious. 2019;6:22-39.
24. Cash DK, Heisick LL, Papesh MH. Expectancy effects in the Autonomous Sensory Meridian Response. PeerJ. 2018;6:e5229.
25. Ahuja A, Ahuja NK. Clinical role-play in Autonomous Sensory Meridian Response (ASMR) videos: performance and placebo in the digital era. JAMA. 2019;321:1336-7.
26. Hostler TJ, Poerio GL, Blakey E. Still more than a feeling: Commentary on Cash et al., "expectancy effects in the autonomous sensory meridian response" and recommendations for measurement in future ASMR research. Multisens Res. 2019;32:521-31.
27. Haller H, Anheyer D, Cramer H, Dobos G. Complementary therapies for clinical depression: an overview of systematic reviews. BMJ Open. 2019;9:e028527.
28. Moher D, Liberati A, Tetzlaff J, Altman DG, The Prisma group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Ann Int Med. 2009;151:264-9.
29. Sterne JAC, Hernán MA, Reeves BC, Savović J, Berkman ND, Viswanathan M, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016;355;i4919.
30. Murad MH, Sultan S, Haffar S, Bazerbachi F. Methodological quality and synthesis of case series and case reports. BMJ Evid Base Med. 2018;23;60-3.
31. Janik McErlean AB, Ellis L, Walsh J. "No pain, no gain": The impact of autonomous sensory meridian response on pain perception. Perception. 2022;51:565-77.
32. Sakurai N, Ohno K, Kasai S, Nagasaka K, Onishi H, Kodama N. Induction of relaxation by Autonomous Sensory Meridian Response. Front Behav Neurosci. 2021;15:761621.
33. Tada K, Takahiro E, Kondo HM. The Autonomous Sensory Meridian Response activates the parasympathetic nervous system [Internet]. Research square [Preprint]. 2021 [cited 2023 Nov 27]. Available from: https://www.researchsquare.com/article/rs-1026254/v1
34. Smejka T, Wiggs L. The effects of Autonomous Sensory Meridian Response (ASMR) videos on arousal and mood in adults with and without depression and insomnia. J Affect Disord. 2022;301:60-7.
35. Kragel PA, Han X, Kraynak TE, Gianaros PJ, Wager TD. fMRI can be highly reliable, but it depends on what you measure [Internet]. PsyArXiv Preprints [Preprint]. 2020 [cited 2023 Nov 27]. Available from: https://osf.io/preprints/psyarxiv/9eaxk
36. Koumura T, Nakatani M, Liao HI, Kondo HM. Dark, loud, and compact sounds induce frisson. Q J Exp Psychol. 2020;74:1140-52.
37. Goetsch MR, Tumarkin E, Blumenthal RS, Whelton SP. New guidance on blood pressure management in low-risk adults with stage 1 hypertension. J Am Coll Cardiol. 2021;21:20-1
38. Fredborg BK, Champagne-Jorgensen K, Desroches AS, Smith SD. An electroencephalographic examination of the autonomous sensory meridian response (ASMR). Conscious Cogn. 2021;87:103053.
39. Henry BM, Tomaszewski KA, Ramakrishnan PK, Roy J, Vikse J, Loukas M, et al. Development of the Anatomical Quality Assessment (AQUA) Tool for the quality assessment of anatomical studies included in meta-analyses and systematic reviews. Clin Anat. 2017;30:6-13.
40. Vazquez-Zorrilla D, Millan-Alanis JM, Alvarez-Villalobos NA, Elizondo-Omaña RE, Guzman-Lopez S, Vilchez-Cavazos JF, et al. Anatomy of foot Compartments: a systematic review. Ann Anat. 2020;1;229:151465.
41. Kovacevich A, Huron D. Two Studies of Autonomous Sensory Meridian Response

(ASMR): The relationship between ASMR and music-induced frisson. Empir Musicol Rev. 2019;13:39-63.
42. Swart TR, Bowling NC, Banissy MJ. ASMR-Experience Questionnaire (AEQ): A data-driven step towards accurately classifying ASMR responders. Br J Psychol. 2022;113:68-83.
43. Reddy NV, Mohabbat AB. Autonomous sensory meridian response: Your patients already know, do you? Cleve Clin J Med. 2020;87:751-4.
44. Vargas SM, Wennerstrom A, Alfaro N, Belin T, Griffith K, Haywood C, et al. Resilience Against Depression Disparities (RADD): a protocol for a randomised comparative effectiveness trial for depression among predominantly low-income, racial/ethnic, sexual and gender minorities. BMJ Open. 2019;9:e31099.
45. Quiroga-Garza A, Garza-Cisneros AN, Elizondo-Omaña RE, Vilchez-Cavazos JF, Montes-de-Oca-Luna R, Villarreal-Silva E, et al. Research barriers in the Global South: Mexico. J Glob Health. 2022;12:03032.
46. Hu MQ, Li HL, Huang SQ, Jin YT, Wang SS, Ying L, et al. Reduction of psychological cravings and anxiety in women compulsorily isolated for detoxification using autonomous sensory meridian response (ASMR). Brain Behav. 2022;12:e2636.
47. Lohaus T, Yüksekdag S, Bellingrath S, Thoma P. The effects of Autonomous Sensory Meridian Response (ASMR) videos versus walking tour videos on ASMR experience, positive affect and state relaxation. PLoS One. 2023;18:e0277990.
48. Enneking V, Leehr EJ, Dannlowski U, Redlich R. Brain structural effects of treatments for depression and biomarkers of response: a systematic review of neuroimaging studies. Psychol Med. 2020;50:187-209.
49. Zarate-Garza PP, Ortega-Balderas JA, Ontiveros-Sanchez de la Barquera JA, Lugo-Guillen RA, Marfil-Rivera A, Quiroga-Garza A, et al. Hippocampal volume as treatment predictor in antidepressant naïve patients with major depressive disorder. J Psychiatr Res. 2021;140:323-8.
50. Chibanda D, Jack HE, Langhaug L, Alem A, Abas M, Mangezi W, et al. Towards racial equity in global mental health research. lancet Psychiatry. 2021;8:553-5.
51. Jonassaint CR, Belnap BH, Huang Y, Karp JF, Abebe KZ, Rollman BL. Racial differences in the effectiveness of internet-delivered mental health care. J Gen Intern Med. 2020;35:490-7.
52. Liu J, Zhu Q, Zhu L, Yang Y, Zhang Y, Liu X, et al. Altered brain network in first-episode, drug-naive patients with major depressive disorder. J Affect Disord. 2022;15;297:1-7.
53. Bertocci MA, Afriyie-Agyemang Y, Rozovsky R, Iyengar S, Stiffler R, Aslam HA, et al. Altered patterns of central executive, default mode and salience network activity and connectivity are associated with current and future depression risk in two independent young adult samples. Mol Psychiatry. 2023;28:1046-56.