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Impact of climate change on mental health: a systematic review

ABSTRACT

The World Health Organization (WHO) defines mental health not merely as the absence of disorder, but as a state of well-being that enables individuals to cope with life's stresses, work productively, and contribute to their community. Climate change threatens this capacity in ways that the empirical literature has increasingly documented, although often through small and geographically biased samples. This systematic review aimed to synthesize the evidence on the impact of climate change on mental health. The review was conducted in accordance with the PRISMA 2020 guidelines. The search was conducted in September 2024 across five databases – Web of Science (WoS), Scopus, PubMed, SciELO, and Google Scholar – using nine search queries combined with AND/OR operators. Of 436 records identified, 213 met the inclusion criteria. The direction of evidence was classified into four categories. The methodological quality of the 42 eligible secondary studies was assessed using AMSTAR-2. 59.2% of studies reported positive associations. Positive convergence was highest for suicidal behavior (80%), post-traumatic stress disorder (PTSD) (75.7%), and cognitive outcomes (71.9%). 40.5% of secondary studies reached high or moderate confidence on AMSTAR-2. The association exists but is not uniform. Suicidal behavior, PTSD, and cognitive deterioration show high convergence and identifiable mechanisms; eco-anxiety and well-being show moderate convergence and a conceptual complexity that is not adequately captured. Radical behaviorism provides a functional framework for understanding how climate-related mental health deterioration may occur through the extinction or suppression of adaptive behavioral repertoires and chronic negative reinforcement, while also informing potential intervention targets beyond symptom-focused treatment.

KEY WORDS

climate change; mental health; radical behaviorism; psychology; AMSTAR-2

ORGANIZATION – Universidad Católica Luis Amigó, Manizales, Colombia

AUTHORS' CONTRIBUTIONS – A: Study design · B: Data collection · C: Statistical analysis · D: Data interpretation · E: Manuscript preparation · F: Literature search · G: Funds collection

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BACKGROUND

Climate change is understood as the alteration of the climate attributed directly or indirectly to human activity that modifies the global atmospheric composition (United Nations, 1992). This alteration has ceased to be an abstract threat and has become an everyday reality on the planet. In 2019, CO_2 concentration reached its highest level in two million years; 79% of these emissions came from the industrial, energy, and transportation sectors (IPCC, 2023). The consequences are concrete: between 3.3 and 3.6 billion people live in contexts highly vulnerable to climate change, especially in regions such as Southeast Asia, Africa, and Latin America, where floods, droughts, hurricanes, and forced displacement intensify existing social and environmental pressures (IPCC, 2023; UNHCR, 2023). What is less evident is the imprint these transformations leave on mental health, which is defined by the World Health Organization (WHO, 2022) as a state of well-being in which the person realizes their abilities, can cope with the normal stresses of life, works productively, and contributes to their community. This definition places mental health on a positive plane – not as the absence of disorder, but as active functional capacity – and recognizes that it is conditioned by individual, social, and structural factors. From this perspective, environmental determinants have a direct impact; when the physical and social environment deteriorates, mental health is affected. Climate change, by destroying communities, disrupting livelihoods, and generating chronic uncertainty, acts precisely as an adverse structural determinant (WHO, 2022; Hayes et al., 2018).

Radical behaviorism offers a reformulation of mental health that complements and refines the WHO perspective. Developed by Skinner (1953/1972) and extended by the tradition of applied behavior analysis, this framework locates the explanation of behavior in the functional relationships between the organism and environmental reinforcement contingencies. From this standpoint, mental health is not an internal state or a diagnostic entity – it is the adaptive behavioral repertoire of public and private responses that allow an organism to regularly contact sources of positive reinforcement, sustain behavioral patterns oriented toward valuable outcomes, and reorganize when contingencies change (Kanter et al., 2010). Well-being is something the organism does under specific environmental conditions, not something it has in a stable manner; therefore, its deterioration does not emerge from within: it is the expected response when the environment ceases to provide the contingencies that sustained the adaptive behavioral repertoire.

This reformulation has direct implications for understanding problem behaviors. From the viewpoint of radical behaviorism, what the diagnostic literature labels as anxiety, depression, or post-traumatic stress are not diseases the organism "has," but functional patterns of behavior that the organism "does" in response to specific contingencies (Cooper et al., 2020; Hayes et al., 1999). The deterioration of behavioral well-being occurs when the environment drastically reduces available positive reinforcers, establishes sustained aversive stimulation, or makes the relationship between behavior and consequences unpredictable. Under those conditions, the organism tends to increase avoidance and escape behaviors maintained by negative reinforcement – which transiently alleviates distress but narrows the adaptive behavioral repertoire and reduces access to sources of well-being (Kanter et al., 2010).

Climate change operates exactly as this type of environmental disruptor and does so through several simultaneous pathways. When a disaster destroys a community or an agricultural practice sustained for generations, it eliminates the contexts that maintained broad classes of adaptive behavior which, in operant terms, may be understood as a large-scale extinction process with its documented effects: behavioral variability, response bursts, and, if extinction is sufficiently generalized, progressive suppression of the adaptive behavioral repertoire (Cooper et al., 2020). Extreme events such as floods, fires, and hurricanes establish avoidance and escape behaviors through high-magnitude aversive conditioning; these persist long after the event due to intermittent negative reinforcement, producing persistent private responses (what other traditions call rumination) maintained by their function of transiently reducing uncertainty (Hayes et al., 1999). Added to this are forced displacement, which interrupts behavioral chains tied to specific territories, and sustained heat, which physiologically degrades the rate of operant response and discriminative precision (Lohmus, 2018; López-Sánchez & Hancock, 2018).

Despite the growing recognition of these consequences, the available empirical research remains fragmented. Most published reviews have been built on small bases – between five and seven primary studies (Charlson et al., 2021; Hayes et al., 2018; Kelman et al., 2021; Liu et al., 2021; Martin et al., 2022) – which limits the ability to distinguish real effects from methodological noise and to identify which behavioral variables are most consistently affected. The present review was therefore guided by the following research question: What is the impact of climate change on mental health, and how consistently is this association supported by the available evidence?

OBJECTIVES

General objective: To conduct a systematic review in order to analyze the impact of climate change on mental health.

Specific objectives:

- Describe temporal, geographical, and design-type trends in the reviewed corpus.
- Analyze the frequency and direction of evidence for each behavioral variable.
- Determine the associations between specific types of climate exposure and specific mental-health outcomes, given that the literature has often treated climate change as a unitary factor.
- Identify populations with the greatest documented vulnerability, with particular attention to geographical biases in scientific production.
- Evaluate the methodological quality of secondary studies using AMSTAR-2.

METHODOLOGY

This work is a systematic review with a mixed-evidence design, conducted under the PRISMA 2020 guidelines (Page et al., 2021), which allows for reproducibility and analysis of a field with the methodological heterogeneity documented here. Given that a substantial proportion of the included studies are secondary reviews, including systematic reviews, scoping reviews, narrative reviews, and meta-analyses, the design of the present study approximates an umbrella review or overview of reviews (Aromataris et al., 2015; Munn et al., 2018) while also incorporating primary empirical evidence – a design specifically recommended when the body of evidence is extensive and methodologically heterogeneous (McKenzie & Brennan, 2017).

The search was conducted in September 2024 through Web of Science, Scopus, PubMed, SciELO, and Google Scholar. Nine English-language search queries were used with Boolean AND/OR operators: "climate change" AND "mental health"; "hot weather" AND "mental health"; "climate change" AND "psychological problems"; "climate change" AND "psychology"; "hot weather" AND "psychological problems"; "ambient air pollution" AND "mental health"; "heat extremes" AND "mental health"; "heat extremes" AND "psychological problems"; "Heat wave" AND "mental health" AND "cognition". It is worth clarifying that although all queries were in English, some database searches yielded documents in Spanish that were used for the present work. The title screening process yielded 436 records (Table 1).

The eligibility criteria were defined *a priori* in accordance with the PICO principles adapted for observational evidence reviews (Munn et al., 2018). Included were primary empirical studies, systematic reviews, scoping reviews, meta-analyses, and theoretically oriented reviews that synthesized empirical evidence, published in English or Spanish between

Table 1

Records identified by search term and database

Search term	WoS	Scopus	PubMed	Google Scholar	SciELO	Selected by title
Climate change and mental health	2,108 (63)	2,342 (76)	1,029 (41)	5,017 (6)	15 (0)	186
Hot weather and mental health	46 (2)	109 (0)	151 (1)	3,580 (0)	1 (0)	3
Climate change and psychological problems	211 (3)	144 (2)	84 (5)	1,730 (3)	0 (0)	13
Climate change and psychology	1,682 (25)	350 (23)	1,255 (30)	3,020 (60)	29 (1)	139
Hot weather and psychological problems	0 (0)	4 (0)	11 (3)	2,200 (4)	0 (0)	7
Ambient air pollution and mental health	6 (1)	263 (0)	226 (13)	1,800 (2)	0 (0)	16
Heat extremes and mental health	199 (26)	249 (8)	139 (6)	2,700 (5)	0 (0)	45
Heat extremes and psychological problems	10 (2)	6 (1)	5 (1)	1,500 (15)	0 (0)	19
Heat wave and mental health and cognition	1 (0)	6 (1)	4 (2)	7,240 (5)	0 (0)	8
Total (maximums per criterion)	**2,108**	**2,342**	**1,255**	**7,240**	**29**	**436**

Note. Numbers in parentheses indicate the records selected by title from each database.

2015 and 2024. Studies were eligible if they involved human participants of any age, sex, or origin, or synthesized evidence concerning such populations, and if they examined direct or indirect associations between climate-related exposures and mental health outcomes or cognitive functioning. Cognitive functioning was treated as a general category and was not subdivided into specific cognitive processes. We excluded single-case studies, books, book chapters, editorials without original data or systematic synthesis, and studies not accessible through any of the five databases consulted.

Selection proceeded through the four PRISMA 2020 phases: identification, duplicate removal, title and abstract screening, and full-text assessment. Data were extracted into a structured matrix recording title, authors, year, country, study type, methodological design, population, instruments, variables, and main conclusions. Each included article was then categorized according to the reported association between climate exposure and mental health into four categories: positive (confirmed association in the direction of deterioration), mixed (inconsistent results within the study or across subgroups), null (no association), and insufficient (inconclusive evidence according to the authors themselves). Classification was based on systematic analysis of the conclusions, objectives, and variable sections of 213 studies. This made it possible to distinguish between how many works address a variable and what proportion reach the same conclusion.

METHODOLOGICAL QUALITY ASSESSMENT

Formal quality assessment was concentrated on the 42 eligible secondary studies using AMSTAR-2 (Shea et al., 2017). This decision follows the procedure described in the Cochrane Handbook (Higgins et al., 2022) as methodologically appropriate when the size and heterogeneity of the corpus make exhaustive evaluation of all included designs unfeasible (Moher et al., 2007; Page et al., 2021; Pollock et al., 2016). AMSTAR-2 comprises 16 items with seven critical domains and generates four confidence levels: high, moderate, low, and critically low.

SYNTHESIS AND COMPARATIVE QUANTITATIVE ANALYSIS

Results were synthesized through structured narrative synthesis (McKenzie & Brennan, 2017; Popay et al., 2006) complemented by a comparative quantitative analysis that included: frequency and convergence percentage tables by variable; contingency tables between behavioral variables and types of climate exposure; distribution of vulnerable populations by geographic region; publication temporal trends; and a summary of AMSTAR-2 compliance by item.

RESULTS

The search across five databases identified 436 records. Upon beginning the screening process, it was evident that a significant proportion were duplicates across databases – 214 in total – reducing the corpus to 222 records assessed by title and abstract. Of these, 9 were excluded (reasons for exclusion presented in Figure 1). The final corpus consisted of 213 studies. The PRISMA 2020 flow diagram is presented in Figure 1.

Of the 110 secondary evidence syntheses, 42 met the criteria for AMSTAR-2 assessment because they were systematic, scoping, or meta-analytic reviews;

Figure 1

Flow diagram of the selection process according to PRISMA 2020 (Page et al., 2021)

<table>
<tr><td colspan="5">Identification</td></tr>
<tr><td colspan="5">Records identified in 5 databases (WoS, Scopus, PubMed, SciELO, Google Scholar): n = 436</td></tr>
<tr><td colspan="5">Screening</td></tr>
<tr><td colspan="2">Records after removing duplicates (n = 222)</td><td colspan="3">Duplicates removed (n = 214)</td></tr>
<tr><td colspan="5">Eligibility</td></tr>
<tr><td colspan="2">Full-text assessed (n = 222)</td><td colspan="3">Excluded with reason (n = 9):
E1 (2), E2 (4), E3 (2), E4 (1)</td></tr>
<tr><td colspan="5">Included in the synthesis: n = 213</td></tr>
<tr><td>Quantitative empirical: 76</td><td>Secondary reviews: 107</td><td>Qualitative: 12</td><td>Mixed/ theoretical: 15</td><td>Meta-analyses: 3</td></tr>
</table>

Note. E1 – year outside 2015-2024; E2 – not accessible through any consulted database; E3 – excluded by study type; E4 – no relation to climate change or mental health.

the remaining narrative, integrative, or theoretical reviews were included in the narrative synthesis but not formally appraised with AMSTAR-2.

The corpus covers the 2015-2024 period, and its growth is striking: from a single article in 2017 to 54 in 2024, a 5,300% increase in seven years that reflects the acceleration of academic interest at this intersection of environmental sciences and psychology. In terms of design, narrative and integrative secondary reviews predominate (n = 107, 50.2%), followed by quantitative empirical studies (n = 76, 35.7%); the remainder correspond to qualitative studies, mixed designs, and three meta-analyses. North America, Europe, and Asia concentrate the majority of primary studies; Latin America and Africa, with 12 and 7 studies respectively, are notably underrepresented given their actual level of climate exposure, which is paradoxical (Table 2).

The convergence analysis showed that 59.2% of studies (n = 126) reported positive associations between climate exposure and mental-health deterioration; 38.5% (n = 82) were classified as insufficient evidence; 2.3% (n = 5) yielded mixed results; and no study reported an absence of association. The variables with the highest positive convergence were suicidal behavior (80%), post-traumatic stress disorder (75.7%), and cognition (71.9%); anxiety, stress, and depression showed moderate convergences between 60% and 68% (Table 3).

Table 4 reveals patterns that were not visible in previous reviews, because none had systematically crossed any type of climate exposure with behavioral outcome. PTSD is preferentially associated with extreme events; approximately 63% of its mentions correspond to floods, fires, or hurricanes, which is consistent with the high-magnitude aversive conditioning mechanism described in the problem statement. Cognitive deterioration, in contrast, is most frequently linked to sustained heat, which accounts for 52.4% of its mentions, followed by air pollution, reflecting a mechanism of gradual physiological degradation rather than a discrete event. Eco-anxiety appears associated with climate change in general terms rather than specific events, which is consistent with its nature as a response to diffuse, non-contingent aversive stimulation.

The population analysis shows that children and adolescents attract the most research attention, with 47 studies, followed by pregnant women (26 studies) and displaced populations (19 studies). Although these numbers reflect groups recognized as vulnerable, they also reveal significant absences: older adults, outdoor workers, and indigenous communities appear in fewer than 10% of studies, despite being among the most exposed populations. Latin America and Africa, as already noted, are underrepresented across all vulnerability categories (Table 5).

QUALITY ASSESSMENT, AMSTAR-2

The AMSTAR-2 evaluation of the 42 secondary studies yielded: 5 studies (11.9%) with high confidence; 12 (28.6%) moderate; 10 (23.8%) low; and 15 (35.7%) critically low. Overall, 40.5% reached high or moderate confidence. Tables 6a and 6b present the results by study; Table 7 summarizes compliance by item.

Table 8 compares the present review with the six most cited systematic reviews and meta-analyses in the field. The review reported here surpasses its predecessors in corpus size (213 studies compared to the previous maximum of 163 by Cianconi et al., 2020), search period (exclusively 2015-2024, the most up to date), number of databases consulted (five),

Table 2

Distribution of the 213 included studies by design type, region, and main outcomes

Study type	*n*	%	Predominant region	Most frequent outcomes
Quantitative empirical study	76	35.7	North America, Europe, Asia	Depression, anxiety, cognition, suicide
Narrative/integrative secondary review	107	50.2	Global	Wellbeing, stress, general mental health
Qualitative empirical study	12	5.6	Latin America, Oceania	Risk perception, eco-anxiety
Mixed-method / Theoretical studies	15	7.0	Global	Integrative frameworks, interventions
Meta-analysis	3	1.4	Global	Heat and mental health, heat and cognition
Total	**213**	**100.0**		

Table 3

Convergence and direction of evidence by psychological variable

Psychological variable	Positive	Mixed	Null	Insufficient	Total studies	% Positive
Anxiety	60	0	0	39	99	60.6
Stress	46	0	0	22	68	67.6
Depression	38	0	0	23	61	62.3
PTSD/Trauma	28	0	0	9	37	75.7
Cognition	23	1	0	8	32	71.9
Well-being	22	1	0	23	46	47.8
Resilience	20	0	0	11	31	64.5
Ecological anxiety	15	0	0	14	29	51.7
Eco-anxiety	14	0	0	12	26	53.8
Suicidality	12	1	0	2	15	80.0
Affective disorders	5	2	0	5	12	41.7
Substance use	4	1	0	3	8	50.0
Schizophrenia/Psychosis	4	1	0	3	8	50.0
Solastalgia	5	2	0	2	9	55.6

Note. A study may be counted in more than one cell. The total number of mentions exceeds 213 studies for this reason.

Table 4

Contingency table: psychological variables by type of climate exposure

Psychological variable	Extreme heat	Extreme events	Pollution	Climate change (general)	Drought	Total
Anxiety	38	22	14	30	6	110
Stress	24	18	10	20	4	76
Depression	26	19	12	11	4	72
Well-being	15	12	7	12	2	48
PTSD/Trauma	8	26	3	3	1	41
Cognition	22	5	10	4	1	42
Emotional disturbances	12	12	5	10	2	41
Ecological anxiety	6	5	4	16	1	32
Resilience	5	12	4	10	3	34
Eco-anxiety	5	6	4	13	2	30
Suicidality	9	5	2	2	1	19
Solastalgia	1	4	1	3	2	11
Substance use	3	3	2	1	0	9
Schizophrenia/Psychosis	4	2	2	1	0	9
Total mentions	**178**	**151**	**80**	**136**	**29**	**574***

Note. Values represent the number of studies documenting the association between that variable and that type of exposure. A study may be counted in more than one cell. The total number of mentions (574*) exceeds 213 studies for this reason.

Table 5

Distribution of studies on vulnerable populations by geographic region

Vulnerable population	Europe	Global	Asia	North America	Latin America	Oceania/ Africa	Total
Children/Adolescents	15	8	11	5	3	5	47
Women/Pregnant women	9	5	5	4	1	2	26
Displaced populations	4	4	4	2	2	3	19
Indigenous communities	3	2	3	1	3	4	16
Workers	4	2	3	1	1	1	12
Older adults	5	2	2	1	0	1	11
Rural populations	3	1	3	1	2	1	11
Persons with prior diagnosis	4	2	1	1	0	0	8

Note. Values represent the number of studies documenting the vulnerability of that population in that region. A study may address multiple populations and regions.

application of AMSTAR-2 as a quality assessment tool, and the incorporation of evidence convergence analysis and contingency tables as forms of comparative quantitative synthesis.

DISCUSSION

The convergence analysis developed in this study is a tool that previous reviews in the field had not used systematically. It allows specific patterns of convergence to be identified across distinct mental-health outcomes, rather than treating mental health as a single homogeneous variable. This distinction is important because the relationship with climate exposure varies depending on the outcome analyzed. For example, a positive convergence of 80% in suicidal behavior and 47.8% in well-being reflects two phenomena with distinct patterns that are often obscured by general statements about the impact of climate change on mental health. The variables with the greatest consistency were suicidality (80%), PTSD (75.7%), and cognition (71.9%), which are also those with the most documented neurobiological mechanisms: hyperthermia impairs serotonergic and dopaminergic function, activates the HPA axis, and compromises the prefrontal cortex (Lohmus, 2018). Moreover, Liu et al. (2021) identified a 0.9% increase in psychiatric morbidity per degree Celsius of increase. This pattern is not a coincidence: these are the variables that respond to both well-characterized behavioral and biological mechanisms, which confer greater explanatory power and, consequently, greater convergence across independent studies.

The behavioral reading of these findings has consequences for how interventions are designed. From a radical behaviorist perspective, suicidal behavior need not be understood simply as a pathology that climate change "triggers"; in some contexts, it may be interpreted as an extreme outcome of generalized extinction processes affecting human interactions. When environmental conditions substantially reduce available reinforcers across multiple domains, as may occur after a natural disaster, the organism may come under the influence of a behavioral extinction history with limited alternative sources of extinction. Under conditions of chronic negative reinforcement, this process can culminate in progressive suppression of the adaptive behavioral repertoire (Kanter et al., 2010). Calling it "pathology" obscures the mechanism; understanding it as behavioral extinction identifies what needs to be restored – access to reinforcers valued as rewarding. This distinction is especially relevant given that PTSD is predominantly associated with extreme events (26 of 41 mentions), while cognitive deterioration is associated with chronic heat and air pollution – two patterns that the neurobiological literature supports but that functional behavior analysis is especially well suited to translate into concrete intervention objectives.

Perhaps the finding with the most direct clinical implications is the difference between momentary and chronic exposure. Extreme events establish rigid avoidance repertoires through high-magnitude conditioning with short latencies, which is why PTSD persists years after the event has ceased. Chronic heat, in contrast, may operate as a persistent low-intensity aversive stimulus that gradually degrades the organism's discriminative sensitivity (Lohmus, 2018; López-Sánchez & Hancock, 2018), without the signal-response-consequence structure of discrete conditioning. Treating both under the same label leads to poorly calibrated protocols. This distinction also helps explain the moderate convergence of eco-anxiety (53.8%) and ecological anxiety (51.7%): both are preferentially linked to climate change as a general

Table 6A

AMSTAR-2 assessment by study – studies 1 to 21

#	Author(s)	Year	Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Confidence
1	Woodland et al.	2023	Scoping	N	Y	Y	P	Y	Y	N	Y	Y	N	N	N	N	N	N	Y	Low
2	Liu et al.	2021	Meta-analysis	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	High
3	Sheffield	2022	Scoping	N	Y	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N	Critically low
4	Flores et al.	2023	Systematic	Y	Y	Y	Y	Y	Y	P	Y	Y	N	N	Y	P	N	N	Y	Moderate
5	White et al.	2023	Integrative	N	Y	Y	P	Y	Y	N	Y	Y	N	N	Y	N	P	N	N	Low
6	Potter & Jonker	2023	Systematic	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Moderate
7	Clemens et al.	2020	Systematic	N	Y	Y	N	Y	N	N	Y	P	N	N	N	N	N	N	N	Critically low
8	Martin et al.	2022	Systematic	N	Y	Y	P	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Low
9	Crandon et al.	2022	Narrative rev.	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	P	N	Y	Low
10	Nieuwenhuizen	2021	Systematic	N	Y	Y	N	Y	N	N	Y	P	N	N	N	N	N	N	N	Critically low
11	Kunda et al.	2024	Systematic	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	High
12	Cianconi et al.	2020	Systematic	N	Y	Y	N	Y	P	N	Y	N	N	N	N	N	N	N	N	Critically low
13	Martin	2019	Systematic	N	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Low
14	Clayton	2020	Narrative rev.	N	Y	Y	N	P	N	N	Y	N	N	N	N	N	N	N	N	Critically low
15	López-Sánchez & Hancock	2018	Meta-analysis	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	P	N	Y	Moderate
16	Dillman-Hasso	2021	Systematic	N	Y	Y	N	Y	N	N	Y	P	N	N	N	N	N	N	N	Critically low
17	Suha	2021	Systematic	N	Y	Y	N	P	N	N	Y	N	N	N	N	N	N	N	N	Critically low
18	Amos et al.	2023	Systematic	N	Y	Y	P	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Low
19	Longman et al.	2023	Systematic	N	Y	Y	N	Y	N	N	Y	P	N	N	N	N	N	N	N	Critically low
20	Zamudio	2019	Systematic	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	Critically low
21	Zhang et al.	2020	Systematic	N	Y	Y	P	Y	P	N	Y	Y	N	N	Y	N	N	N	N	Low

Note. Y – yes; P – partial yes; N – no. Critical items: 1, 2, 3, 7, 9, 11, 14.

Table 6B

AMSTAR-2 assessment by study – studies 22 to 42

#	Author(s)	Year	Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Confidence
22	Navarrete & Sandoval	2024	Systematic	N	Y	Y	N	Y	P	N	Y	P	N	N	N	N	N	N	N	Critically low
23	Gianfredi et al.	2024	Systematic	Y	Y	Y	N	Y	Y	P	Y	Y	N	N	Y	P	N	N	Y	Moderate
24	Barkin et al.	2024	Systematic	N	Y	Y	P	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Low
25	Yellowlees	2022	Systematic	N	Y	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N	Critically low
26	Hwong et al.	2022	Systematic	Y	Y	Y	Y	Y	Y	P	Y	Y	N	N	Y	Y	N	N	Y	Moderate
27	Charlson et al.	2021	Scoping	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	P	N	Y	Moderate
28	Márquez-Jiménez & Padilla	2023	Systematic	N	Y	Y	N	Y	P	N	Y	Y	N	N	N	N	N	N	N	Critically low
29	Rojo	2023	Systematic	N	Y	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N	Critically low
30	Kelman et al.	2021	Systematic	N	Y	Y	P	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Low
31	Resti et al.	2024	Systematic	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	High
32	Ige-Elegbede et al.	2024	Systematic	Y	Y	Y	Y	Y	Y	P	Y	Y	N	N	Y	Y	N	N	Y	Moderate
33	Thompson et al.	2018	Systematic	N	Y	Y	N	Y	Y	P	Y	Y	N	N	Y	Y	P	N	Y	Moderate
34	Leal Filho et al.	2023	Systematic	N	Y	Y	P	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Low
35	Bell	2024	Systematic	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Moderate
36	Thompson & Mackley	2024	Systematic	N	Y	Y	N	Y	P	N	Y	Y	N	N	N	N	N	N	N	Critically low
37	Meadows et al.	2024	Systematic	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	High
38	Léger-Goodes et al.	2022	Scoping	Y	Y	Y	Y	Y	Y	P	Y	Y	N	N	Y	Y	N	N	Y	Moderate
39	Radua et al.	2024	Systematic	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	High
40	Ebi et al.	2021	Systematic	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Moderate
41	Rony & Alamgir	2023	Systematic	N	Y	Y	N	Y	N	N	Y	P	N	N	N	N	N	N	N	Critically low
42	Fastl et al.	2024	Systematic	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	N	N	Y	Moderate

Note. See Table 6a for complete legend. Studies 9 (Crandon et al., 2022) and 14 (Clayton, 2020) are narrative reviews; their AMSTAR-2 assessment should be interpreted with caution.

Table 7

AMSTAR-2 compliance analysis by item (n = 42 secondary studies)

AMSTAR-2 Item	Domain	Yes	Partial	No	Interpretation
1 – A priori protocol	Critical	12 (28.6%)	0	30 (71.4%)	Most frequent limitation. Only 1 in 3 studies registered a prior protocol
2 – PICO question	Critical	42 (100%)	0	0	Full compliance
3 – Search ≥2 databases	Critical	42 (100%)	0	0	Full compliance
4 – Grey literature	Non-critical	16 (38.1%)	6 (14.3%)	20 (47.6%)	Fewer than half searched non-indexed sources
5 – Dual screening	Critical	36 (85.7%)	3 (7.1%)	3 (7.1%)	Good compliance
6 – Dual extraction	Non-critical	30 (71.4%)	7 (16.7%)	5 (11.9%)	Acceptable compliance
7 – Justified exclusion list	Critical	8 (19.0%)	6 (14.3%)	28 (66.7%)	Second most frequent limitation: only 1 in 5 provided a complete list
8 – Study characteristics	Non-critical	42 (100%)	0	0	Full compliance
9 – Individual RoB	Critical	29 (69.0%)	7 (16.7%)	6 (14.3%)	Mostly compliant
10 – Study funding	Non-critical	6 (14.3%)	0	36 (85.7%)	Very low reporting of primary study funding sources
11 – Meta-analysis methods	Critical	2 (4.8%)	0	40 (95.2%)	Not applicable to 40 studies without statistical synthesis
12 – RoB in synthesis	Non-critical	28 (66.7%)	0	14 (33.3%)	Two thirds considered RoB in interpretation
13 – Heterogeneity	Non-critical	23 (54.8%)	4 (9.5%)	15 (35.7%)	Present only in studies with a quantitative component
14 – Publication bias	Critical	3 (7.1%)	5 (11.9%)	34 (81.0%)	Critical limitation. 4 in 5 studies did not evaluate publication bias
15 – Conflict of interest	Non-critical	0 (0%)	0	42 (100%)	No study explicitly reported conflicts of interest in the reviewed text
16 – Own funding	Non-critical	31 (73.8%)	0	11 (26.2%)	Majority declare funding source

Note. Item 11 is not applicable to 40 studies because they have no statistical synthesis; 'No' (95.2%) reflects inapplicability, not non-compliance. RoB – risk of bias.

phenomenon rather than to specific events, which is consistent with their nature as verbal responses to diffuse aversive stimulation. Solastalgia (55.6%), which emerges especially in Oceania and indigenous communities, could be a response to the progressive loss of a meaningful environment rather than a discrete event, and that is why its convergence is more moderate and culturally dependent.

Regarding well-being (47.8%) and resilience (64.5%), their lower positive convergence does not necessarily indicate less impact from climate change, since several studies identify them as moderating factors that buffer that impact – introducing a conceptual bidirectionality that unidirectional convergence instruments capture poorly. Distinguishing between these two functions remains a pending methodological task in the field. Regarding evidence quality, 40.5% of the included reviews were rated as having high or moderate confidence according to AMSTAR-2, a proportion comparable to that reported by Xu et al. (2022) in systematic reviews on heart failure, suggesting a similar level of methodological quality to other

Table 8

Comparison of the present review with previous systematic reviews in the field

Review	Year	Databases	Period	No. of studies	Quality tool	Quantitative synthesis	Main outcomes	AMSTAR-2
Charlson et al.	2021	4 DB	2001-2020	120	Yes (ad hoc)	No	Anxiety, PTSD, depression	Moderate
Thompson et al.	2018	3 DB	Up to 2018	35	No	No	Depression, anxiety, suicide	Moderate
Liu et al.	2021	7 DB	Up to 2020	70	Yes (AMSTAR-1)	Yes (meta-analysis)	Psychiatric morbidity, suicide, heat	High
Hwong et al.	2022	Non-systematic	2015-2022	Narrative review	No	No	Methodological gaps	–
White et al.	2023	4 DB	Up to 2022	104	No	No	Anxiety, depression, PTSD	Low
Cianconi et al.	2020	3 DB	Up to 2019	163	No	No	Anxiety, depression, schizophrenia	Critically low
Present review	**2024**	**5 DB**	**2015-2024**	**213**	**Yes (AMSTAR-2, *n* = 42)**	**Yes (contingency tables)**	**Anxiety, stress, depression, PTSD, cognition**	**High/ Moderate: 40.5%**

Note. DB – databases. The dash (–) indicates that the data were not reported or not applicable. AMSTAR-2 – confidence level the review would receive if AMSTAR-2 were applied to it (estimate based on the criteria described in each review).

fields of public health. What is difficult to ignore is the 81% non-compliance with publication bias assessment. If studies with null results are published less frequently, the 59.2% positive convergence could be overestimated; the fact that none of the 213 studies reports an absence of association may be an accurate reflection of reality, or it may be an artifact of the publication system.

The geographical paradox emerging from the data confirms and amplifies the pattern of inequities documented in Table 5. Children and adolescents (47 studies), pregnant women (26), and displaced populations (19) concentrate the greatest documented vulnerability across all regions, which is consistent with the mechanisms of greater exposure, lower adaptive capacity, and greater neurobiological sensitivity to stress. Yet Latin America, Africa, and South Asia together represent only 11.7% of the corpus, with a particularly pronounced underrepresentation for indigenous and rural communities. This may indicate that the intervention models designed based on available evidence are optimized for contexts with robust health networks and institutional response capacity. Exporting them without adaptation to rural communities on the Colombian Pacific coast or in the Sahel is not just a matter of cultural relevance: it is a matter of efficacy. The geographical gap also tends to reproduce itself: contexts without documentation do not attract funding, and without funding there is no documentation.

Finally, it is worth noting that most of the reviewed studies relied on data from healthcare settings, highlighting a scarcity of psychological research with community-based samples. This is not just a methodological limitation: it reflects a deeper disciplinary tendency. Psychology has tended to treat climate change as a distant phenomenon, while the environment shapes behavior on a daily and often silent basis. The mechanisms documented in this review – extinction or suppression of adaptive behavioral repertoires, aversive conditioning, and unpredictable signaling environments – do not occur only after a disaster: they occur in the accumulation of hot days, in uncertainty about the next harvest, in the decision not to return to a flooded territory. Psychology should not limit its clinical application to consulting rooms or controlled care settings. The present study may therefore open the way for research that links reflection,

intervention, and prevention in the contexts where these effects actually occur: in public policy.

LIMITATIONS

The most important limitation is the heterogeneity of the corpus: including studies ranging from meta-analyses to narrative reviews, many of which lacked registered protocols, made it impossible to calculate aggregate effect sizes, which limits the quantitative precision of the conclusions. During the search process, it became evident that the restriction to English and Spanish likely excluded relevant evidence from South Asia and Francophone Africa, meaning the geographical gap documented in the results may be underestimated. The classification of the direction of evidence was carried out based on the conclusions and variable sections without full reading of each article – a decision justified by the volume of the corpus, but one that introduces a margin of error that future studies with sufficient resources should reduce. In retrospect, it would have been valuable to apply an appropriate risk-of-bias tool to a representative sample of primary studies, in addition to using AMSTAR-2 for secondary evidence syntheses. Finally, the absence of a systematic search in grey literature increases the risk of publication bias already noted in the results: if studies with null results are published less frequently, the reported effects may be overestimated.

CONCLUSIONS

After reviewing 213 studies and formally evaluating the quality of 42 of them, the central conclusion is clear, though it requires nuance: climate change is consistently associated with deterioration in the adaptive behavioral repertoires that allow people to function in their everyday contexts. This consistency is not uniform: it varies by type of variable, type of climate exposure, and study population, reinforcing the need for differentiated analysis rather than general statements. The integration of radical behaviorism as an explanatory framework allows this deterioration not only to be described, but also to be interpreted functionally: the destruction of reinforcing contexts, high-magnitude aversive conditioning, unpredictable signaling environments, and the physiological degradation of discriminative capacity are distinct mechanisms producing distinct behavioral patterns.

Pending tasks remain. Prospective protocol registration and systematic evaluation of publication bias are the most urgent deficits for the field's effect estimates to be credible. The geographical gap between evidence production and actual climate exposure remains the hardest-to-justify contradiction: psychology cannot claim to respond to a global crisis while its empirical base remains concentrated in the Global North and in institutionalized healthcare contexts. Developing conceptual frameworks, assessment instruments, and interventions adapted to the most vulnerable contexts is therefore a key prerequisite for the field to fulfill its intended role in addressing one of the major global challenges of the century.

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