ARTÍCULO DE REVISIÓN

Emotions, anxiety, depression and the immune system: an integrative view of psychoneuroimmunology from a meta-analytic review of the narrative

SUMMARY

The study focused on conducting a meta-analytic review of three variables psychoneuroimmunology, emotions, and the immune system, intending to find a relationship between them. The methodology was the PRISMA statement with inclusion criteria: production of the last five years, full text, exclusion criteria: book chapters, reviews, editorials, letters to the editorials, as well as systematic and meta-analytic reviews; a formula was created from the variables with Boolean operators (AND, OR, NOT) in databases: Web of Science, PubMed and Elsevier. The first sweep denotes (n=2237) articles and after the application of the screening, the final sample was (n=26). Among the findings is the emergence of three categories of analysis using a word map: cognitive abilities, mental fatigue, and stressors. In conclusion, psychoneuroimmunology is a science that articulates mental processes and the functioning of the nervous, immune, and endocrine systems that affect the individual in such a way that the psychological aspects linked to emotional management and control can present better management and intervention in mental illnesses.

DOI: https://doi.org/10.47307/GMC.2023.131.s3.20

ORCID: 0009-0007-7646-6287)
ORCID: 0000-0002-0887-2562)
ORCID: 0000-0002-4393-6621)
ORCID: 0000-0002-8411-1263)
ORCID: 0000-0002-2428-7750)
ORCID: 0000-0001-8756-1895)

1Docente investigador, Universidad de Pamplona, Norte de Santander, Colombia, E-mail: jorge.hernandez2@unipamplona.edu.co
2Docente investigadora, Universidad Sergio Arboleda, Santa Marta, Colombia, E-mail: andrea.ortiz@usa.edu.co
3Docente investigador, Corporación Universitaria del Caribe, CECAR, Sincelejo, Colombia, E-mail: alvaro.lhoeste@cecar.edu.co
4Docente investigadora, Corporación Universitaria del Caribe, CECAR, Sincelejo, Colombia, E-mail: eklimenko@correo.ieu.edu.co
5Docente investigadora, Corporación Universitaria del Caribe, CECAR, Sincelejo, Colombia, E-mail: francia.moncada@cecar.edu.co
6Docente investigadora, Corporación Universitaria del Caribe, CECAR, Sincelejo, Colombia, E-mail: Nubia.hernandezf@cecar.edu.co

*Corresponding author: Jorg Hernández-Flórez, Docente investigador, Universidad de Pamplona, Norte de Santander, Colombia, E-mail: Jorge.hernandez2@unipamplona.edu.co
**Keywords:** Anxiety, depression, emotions, immune system, psychoneuroimmunology.

**RESUMEN**

El estudio se centró en la realización de una revisión meta-analítica de tres variables psiconeuroinmunología, emociones, y el sistema inmunológico, con la intención de encontrar una relación entre ellos. La metodología fue la declaración PRISMA con criterios de inclusión: producción investigative de los últimos cinco años con texto completo; y criterios de exclusión: capítulos de libros, reseñas, editorialies, cartas a los editoriales, así como revisiones sistemáticas y meta-revisiones analíticas; se creó una fórmula a partir de las variables con operadores booleanos (AND, OR, NOT) en bases de datos: Web of Science, PubMed y Elsevier. El primer barrido arrojo (n=2237) artículos y después de la aplicación del cribado, la muestra final fue (n=26). Entre los hallazgos se encuentra la aparición de tres categorías de análisis utilizando un mapa de palabras: capacidades cognitivas, fatiga mental y factores estresantes. En conclusión, la psiconeuroinmunología es una ciencia que articula los procesos mentales y el funcionamiento de los sistemas inmunológicos y endocrinos son afectados por los aspectos psicológicos relacionados con el manejo y control emocional, siendo necesario un mejor manejo e intervención de estos en las enfermedades mentales.

**Palabras clave:** Ansiedad, depresión, emociones, sistema inmunológico, psiconeuroinmunología.

**INTRODUCTION**

Positive and negative emotions have generated in individuals diverse experimentations that have allowed linking the mind-body duality by analyzing the attitudes and mental habits that are associated with studies linked to psychoneuroimmunology (1), which has been described as the science that investigates the association between the psyche and the immune systems; identifying that there is a strong influence of the emotional management and control that individuals have on the functioning of the pituitary gland; thus implying that when experiencing an emotion this performs a transformation process that is related to a physical activity, which has an impact on the body, a situation that is explained through the reception of emotional inputs that trigger organic reactions. Psychoneuroimmunology is one of the areas of clinical intervention that approaches health problems and their link with the emotional states that affect the health of human beings (2).

To achieve an intervention from psychoneuroimmunology and health states in individuals, it is necessary to analyze the interconnections between organic components (biological), psychological (emotional), and environmental (contexts) (3) that are linked to the basis of the elements associated with the states of stress, anxiety, and depression. Because psychotherapists holistically focus their intervention on the dysfunctions that concatenate to trigger organic symptoms that manifest in behavioral patterns (4). In this way, the neuroendocrine system presents neurochemical failures characterized by altered responses in depressive and anxiogenic manifestations, which alter the functioning of neurotransmitters generating clinical indicators, affecting the adrenal autonomous system and with it its incidence in mood affectations; creating collateral effects that influence glutamatergic neurotransmission that requires pharmacological and psychological interventions to inhibit the effects linked to the central nervous system (5).

The relationship between the immune, endocrine, and central nervous system is articulated from the functioning and regulation between hormones and neurotransmitters, generating an autonomous defence system in the organism that has an association of reciprocal modulation between immunocytes, the reticuloendothelial and hematopoietic systems that influence the regulation of hormone production levels and on the psychological variables that present experimental evidence associated to the behavioral patterns that explain the health-disease dyad in individuals (6), identifying the dysfunctions associated to the pathologies that are presented from the emotional substrate, which influences from the theological postulate and the receptor functions coming from the stimuli that affect the corporal systems from the position of the biological base, explainable from the methods of neuropathology in relation to the holistic position of the mind and the body (7).
For its part, mental health from the positive dimension has been defined as a complete state of well-being that includes physical, mental, and social aspects (8). Understanding in this way that when speaking from the integrity of the sphere of health, it is necessary to mention the emotional component, because the brain within its functions generates substances that stimulate neurotransmitters that are connected to the immune system, thus generating defences in the body and activating changes from the immune system (9). So from the neuroimmune factors it has been established that the connection between emotional factors and perceived vulnerability significantly increases the risks of suffering from major diseases because it generates more symptoms and increases the presence of negative emotions due to dissatisfaction that is linked to the factors of psychological discomfort and inhibitory personality patterns (10).

Therefore, the relationship between mind and body is adjusted to the emotional processes and how thoughts originated, linking these components to the levels of satisfaction with life, an increase of psychological well-being, and thus an increase of health determinants that are fundamental in human beings (11); because the responses that are generated from the immune system, represent physical and emotional psychic aspects that are adjusted to the aspects that determine the social and cultural components that allow the increase of the states of satisfaction with oneself and that lead to increase directly the states of health, due to the subjective expressions and self-representation that affect the manifestation of symptoms that are assumed by the individual from an experimental perspective (12).

The biopsychosocial processes of the individual are linked to cognitive factors and the existing relationships between the central nervous system, endocrinology, and immunology (13), because the information that comes from the environmental determinants fulfil a regulation function between the events and how they are perceived, determining in this way that the greater the increase of positive emotions such as joy, optimism, love, the greater the increase of health determinants presented by the subject; thus suggesting that the specific aspects related to emotional regulation and biological immunity are presented satisfactorily if there is a positive correlation with psychic states, providing explanatory support for the relationship between pathogenic factors and the link with attitudes, thoughts and personality traits (14).

Finally, psychoneuroimmunology is fundamental to achieving an understanding of the psychological factors related to diseases of the body, the proper management of emotions will allow you to improve and contribute to patient treatments, establishing the articulations that exist between behavior and the constitution of some diseases in the body (15). Determining the significant increases in states of well-being that are associated with increases in health determinants that lead individuals to develop relational aspects with self-care processes in favor of mental health status and the increase of positive emotions as a defence strategy from the functioning of the autoimmune system (16).

**METHOD (PRISMA)**

The prism statement performs documentation employing a systematic review of the literature, employing which first identification of the scientific advances in the subject is made, to be subsequently selected according to the inclusion criteria to evaluate and synthesize the corresponding studies that provide a state of knowledge from the approach of a research question that seeks to study a particular phenomenon (17).

Thus, the analysis of observational documentation evaluates the evidence from a quantitative synthesis of the results obtained from an iterative process that analyzes the retrospective contributions, synthesizing the findings in an organized manner, where the biases of systematic reviews are reduced (18).

**Inclusion criteria**

Among the aspects taken into account for the processing of the information, intellectual production published in the last five years was identified, in studies under full text, which had
as a characteristic a variable associated with the subject of analysis, in the English language, with adult participants (19).

**Exclusion criteria**

We excluded texts related to book chapters, reviews, editorials, letters to publishers, as well as systematic and meta-analytic reviews, documents in languages other than English, and findings outside the range of the last five years and whose samples were not representative (20).

**Search strategies**

The search was conducted in specialized databases, which were selected according to the thematic relevance in the areas of health, in line with the reports of advances that incorporate interventional treatments in the area of psychoneuroimmunology and its relationship with emotions in individuals from the psychopathological perspective of diseases such as depression and anxiety as shown in Table 1.

Emotion AND psychoneuroimmunology OR anxiety NOT symptoms; Emotion AND psychoneuroimmunology OR depression NOT dysfunctions; Positive health AND system OR immune NOT stress; Immune system AND neuroendocrine OR cortisol NOT suppression; Health AND disease OR neurogenesis NOT abilities; Emotional AND pathogens OR glucocorticoids NOT effects; Immune system AND emotional OR hypothalamus NOT mechanisms; Emotional AND treatments OR depression AND anxiety OR affective states NOT manifestations.

**Data collection process**

The analysis of the documents was based on the PRISMA system that takes into account the inclusion of information through evidence, reviewing the relevant findings on the subject that included the analysis of the variables taking into account the contributions made by the scientific community, taking into account that advances in mental health are focused from the perspective of psychoneuroimmunology because the trend in intervention indicates that patients with pathologies or dysfunctions have a high probability of rehabilitation. After all, the different states of mind present direct repercussions on the health status of individuals (Table 1).

**Search equations**

Table 1. Information search criteria

<table>
<thead>
<tr>
<th>Databases</th>
<th>Equations in data bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web of Science</td>
<td>Emotion AND psychoneuroimmunology OR anxiety NOT symptoms; Emotional AND treatments OR depression AND anxiety OR affective states NOT manifestations. Emotion AND psychoneuroimmunology OR depression NOT dysfunctions.</td>
</tr>
<tr>
<td>PubMed</td>
<td>Immune system AND emotional OR hypothalamus NOT mechanisms; Positive health AND system OR immune NOT stress; Emotional AND pathogens OR glucocorticoids NOT effects.</td>
</tr>
<tr>
<td>Elsevier</td>
<td>Immune system AND neuroendocrine OR cortisol NOT suppression; Emotional AND treatments OR depression AND anxiety OR affective states NOT manifestations. Emotion AND psychoneuroimmunology OR anxiety NOT symptoms</td>
</tr>
</tbody>
</table>

Own elaboration (2023)
Table 2. Cross-referencing of search terms in the databases.

<table>
<thead>
<tr>
<th>Crosses/ databases</th>
<th>Web of Science</th>
<th>PubMed</th>
<th>Elsevier</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotion AND psychoneuroimmunology OR anxiety NOT symptom, Immune system AND emotional OR hypothalamus NOT mechanisms</td>
<td>321</td>
<td>125</td>
<td>157</td>
<td>603</td>
</tr>
<tr>
<td>Emotional AND treatments OR depression AND anxiety OR affective states NOT manifestation; Positive health AND system OR immune NOT stress</td>
<td>432</td>
<td>256</td>
<td>243</td>
<td>931</td>
</tr>
<tr>
<td>Emotion AND psychoneuroimmunology OR depression NOT dysfunctions; Emotional AND pathogens OR glucocorticoids NOT effects</td>
<td>467</td>
<td>147</td>
<td>89</td>
<td>703</td>
</tr>
<tr>
<td>Total</td>
<td>1 220</td>
<td>528</td>
<td>489</td>
<td>2 237</td>
</tr>
</tbody>
</table>

Own elaboration (2023)

Table 3. Process of identification, elimination, and selection of articles.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Databases</th>
<th>No filtering</th>
<th>No access</th>
<th>Revisions/Incomplete/Duplicates</th>
<th>Not met Criteria</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotion AND psychoneuroimmunology OR anxiety NOT symptom, Immune system AND emotional OR hypothalamus NOT mechanisms</td>
<td>Web of Science PubMed Elsevier</td>
<td>1 220</td>
<td>545</td>
<td>512</td>
<td>154</td>
<td>9</td>
</tr>
<tr>
<td>Emotional AND treatments OR depression AND anxiety OR affective states NOT manifestation; Positive health AND system OR immune NOT stress</td>
<td>Web of Science PubMed Elsevier</td>
<td>528</td>
<td>348</td>
<td>180</td>
<td>169</td>
<td>11</td>
</tr>
<tr>
<td>Emotion AND psychoneuroimmunology OR depression NOT dysfunctions; Emotional AND pathogens OR glucocorticoids NOT effects</td>
<td>Web of Science PubMed Elsevier</td>
<td>489</td>
<td>284</td>
<td>205</td>
<td>199</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>2 237</td>
<td>1 177</td>
<td>897</td>
<td>522</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

Own elaboration (2023)
Selection of the studies

The selected studies were based on the analysis of the variables that imply dual pathologies in the processes of mental health affectation in the area of psychoneuroimmunology. The main articles were reviewed from the databases, applying Boolean equations, and then the information was classified by eliminating duplicate files (18) (Table 2).

Data extraction

The selection of the articles was carried out taking into account the observation window of the last five years, taking into account the compliance of the variables studied, subsequently, the studies that were duplicated or did not meet the criteria were eliminated, additionally, the publications that were available in the full text were taken into account, eliminating the abstracts and research notes (19) (Table 3).

![Flowchart of the process of study selection.](image)
According to what is expressed in the figure and in relation to the study variables, three categories of analysis are denoted as follows:

**Cognitive functions or skills**

They are defined as the mental processes that allow the individual to receive, process, and elaborate information, taking an active role in the sensory perception of the surrounding environment (21). These allow learning, storage, and comprehension processes to be carried out in the integration of information processing, thus playing an important role in decision-making and dual execution. Determining that the link between emotions and thinking generates positive behaviors that allow the control of mental states related to the psychological response that is linked to information processing and the formation of thought (22).

This indicates that behavioral determinants are linked to the experience of situations and experiences that are related to feelings (23). Thus, the link between behavior and the brain is presented in an interdependent manner but correlated through the development of socio-emotional skills that integrate the regularization and evaluation of thought from the articulation with positive or negative emotions that lead to the experience of well-being, the strengthening of social skills and healthy relationships that influence health components (24).

**Mental fatigue**

Fatigue is a state that presents a lack of energy and motivation, as well as symptoms related to drowsiness, apathy, boredom, and emotional stressors, this emotional fatigue leads to the experience linked to the appearance of headaches, muscle tension, and breathing difficulties, among others (25). Within this there is an alteration that affects the decrease in mental functioning, which leads to emotional states presented negatively hindering concentration, skill development, and attentional processes that directly affect feelings.
and emotions, increasing the risks of the onset of heart disease and chronic diseases that have a negative impact on mental health (26).

One of the problems that have a greater impact on mental health is the appearance of depressive and anxious conditions that trigger other comorbid pathologies, among which fibromyalgia and cancer stand out, due to the threats and the experience of organic reactions that have a direct impact on internal and external factors that cause psychological disorders and alterations in the central nervous system, due to immunological reactions caused by stress (27); the presence of acute and chronic diseases and immunoregulation disorders and the appearance of neuropsychiatric markers that interfere in the ability to develop activities of daily living that present physical, mental and emotional chronicity due to the difficulty they present in finding a balance in the linking of states of well-being (28).

Stressors

Stress is an emotional response generated by the perception of threats and the security of individuals that are identified in the alteration of neuronal and endocrine functions that impede the psychological adjustment in the human being (29). In this way, the interactions that occur between the nervous system and the immune system present alterations in the adrenergic neurotransmitters obstructing the neuropeptides that prevent a regulation between the central nervous system and the immune system that is linked to the immunosuppression behavior product of the psychophysiological changes that occur in the brain in the face of threatening responses (30).

For the above-mentioned (31), the pituitary ovens present pathophysiological alterations through the chromaffin cells and the activation of the adrenal medulla that generate in the individual an autoimmune response linked to the growth, maturation, and functioning of the immune system (32). Thus, the activating and inhibitory effects of adrenocorticotropic hormones release corticotropin that acts on activated lymphocytes and glucocorticoid receptors that prepare the individual to generate neuromodulation in the synaptic interconnection that transforms the information from the amygdala to the brain through a bidirectional communication that generates a response to psychological stress and stressful experiences that alter the immune parameters in individuals (33).

RESULTS

The results are presented in Table 4.

DISCUSSION

Psychoneuroimmunology focuses its interventions on the psychic and physical interaction processes that occur in the central nervous, endocrine and immune systems (34), thus generating an integrative vision of the processes of health and disease that occur in the individual from the appearance, course and development of somatic diseases that are linked to the psychological alterations that occur more frequently such as anxiety, depression and stress that involve negative manifestations associated with the extrapolation of the psychological alterations that occur more frequently such as anxiety, depression and stress, course and development of somatic diseases that are linked to the psychological alterations that occur more frequently such as anxiety, depression and stress that involve negative manifestations associated with the extrapolation of feelings and emotions that integrate an approach to health problems that are interrelated in the proper functioning of emotions and their impact on the body (35). Consequently, the relevant manager will help to improve the different interventions that the patient has had in their treatments, and their direct incidence in the forms of behavior that lead to the appearance of symptomatology associated with organic diseases (36).

For its part (37), depression has a direct impact on the immune system causing a decrease in serotonin and noradrenaline levels that cause immune reactions linked to dysfunctions and disorders that produce negative emotions related to frustration, anger, fear, and sadness (38). This affects the organism in the appearance of dual pathologies such as stress, fibromyalgia, and cancer since the deterioration of the patient leads to psychological alterations that make
<table>
<thead>
<tr>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 <a href="https://doi.org/10.1177/2077553121100117">https://doi.org/10.1177/2077553121100117</a></td>
<td>Psychoneuroimmunology of Meditation</td>
<td>2022</td>
<td></td>
<td>Therapeutic Role of Yoga and Meditation Preksha (MP)</td>
<td>New Delhi/ India</td>
<td>25 years</td>
<td>N/A</td>
<td></td>
<td>Meditation may have positive benefits in regulating cognitive and emotional behavior</td>
</tr>
<tr>
<td>2 doi:10.1001/jama.2021.2608</td>
<td>Oxytocin, cortisol, and cognitive control during acute and naturalistic stress</td>
<td>2021</td>
<td>37 participants</td>
<td>Experimental session of acute stress through videos</td>
<td>California/ USA</td>
<td>22 Years</td>
<td>37 women</td>
<td></td>
<td>Oxytocin may provide women with an anxiolytic and affective effect that favors social synchrony and makes it easier to overcome stressful moments</td>
</tr>
<tr>
<td>3 <a href="https://doi.org/10.1001/jama.2021.2608">https://doi.org/10.1001/jama.2021.2608</a></td>
<td>Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry</td>
<td>2020</td>
<td>76 psychiatric patients 109 healthy people</td>
<td>Impact of Event Scale-Revised (IES-R)</td>
<td>Chongqing/ China</td>
<td>18 years</td>
<td>74.6%</td>
<td></td>
<td>Study confirms the severity of the negative psychological impact on psychiatric patients during the COVID-19 epidemic</td>
</tr>
<tr>
<td>4 <a href="https://doi.org/10.1001/jama.2021.2608">https://doi.org/10.1001/jama.2021.2608</a></td>
<td>A mindfulness meditation mobile app improves depression and anxiety in adults with sleep disturbance: Analysis from a randomized controlled trial</td>
<td>2021</td>
<td>239 participants</td>
<td>Insomnia Severity Index (ISI)</td>
<td>Arizona/ USA</td>
<td>Average age 44.5 years</td>
<td>74.6% women 40.6% of the racial population diverse</td>
<td></td>
<td>A meditation app can improve depression and anxiety in adults with sleep disorders.</td>
</tr>
</tbody>
</table>

Continued in page S453...
<table>
<thead>
<tr>
<th>No.</th>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><a href="https://doi.org/10.1038/s41598-020-62652-1">https://doi.org/10.1038/s41598-020-62652-1</a></td>
<td>Mindfulness Meditation Activates Altruism</td>
<td>2020</td>
<td>326 participants</td>
<td>Calm app (meditation)</td>
<td>Connecticut/USA</td>
<td>25 years</td>
<td>58,28% women</td>
<td>The current findings are the first to identify a relationship between mindfulness meditation and cooperation.</td>
</tr>
<tr>
<td>6</td>
<td>doi:10.1080/13607863.2021.1876636</td>
<td>Early-life stress, depressive symptoms, and inflammation: the role of social factors</td>
<td>2022</td>
<td>3,416 participants</td>
<td>Meditation through mindfulness</td>
<td>Los Angeles/USA</td>
<td>From 36 years to 97.</td>
<td></td>
<td>The frequency of social contact and social support can moderate depressive symptoms.</td>
</tr>
<tr>
<td>7</td>
<td>doi:10.1016/j.bbi.2019.03.004</td>
<td>Depressive Symptoms and Immune Transcriptional Profiles in Late Adolescents</td>
<td>2019</td>
<td>87 participants</td>
<td>Psychosocial questionnaire Depression Scale of the Center for Epidemiological Studies</td>
<td>Los Angeles/USA</td>
<td>18 years</td>
<td></td>
<td>Teens with levels Depressives may be at increased risk of developing immune-related somatic diseases in adulthood.</td>
</tr>
<tr>
<td>8</td>
<td><a href="https://doi.org/10.1093/abm/kaab106">https://doi.org/10.1093/abm/kaab106</a></td>
<td>Psychological Predictors of Self-reported COVID-19 Outcomes: Results From a Prospective Cohort Study</td>
<td>2022</td>
<td>1,087 participants</td>
<td>Psychological factors survey Patient Health Questionnaire (PHQ-9) Generalized Anxiety Disorder Scale</td>
<td>United Kingdom</td>
<td>18 years onwards</td>
<td></td>
<td>COVID-19 infection and symptoms can increase among people with distress elevated psychological.</td>
</tr>
</tbody>
</table>

Continued in page S454...
...continuation Table 4 from page S453

<table>
<thead>
<tr>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/ City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Neuroinflammation as a pathophysiological factor in the development and maintenance of functional seizures: A hypothesis</td>
<td>2021</td>
<td>12 participants</td>
<td>Hospital Anxiety and Depression Scale (HADS). Profile of Mood States</td>
<td>Alabama/ USA</td>
<td>23 y 50 years</td>
<td>12 women</td>
<td>2021</td>
</tr>
<tr>
<td>10</td>
<td>More than a skin disease: stress, depression, anxiety levels, and serum neurotrophins in lichen simplex chronic.</td>
<td>2021</td>
<td>36 participants</td>
<td>Hospital Anxiety Scale Depression Scale</td>
<td>Istanbul, Turkey</td>
<td>Average age 37 years</td>
<td>7 men 29 women</td>
<td>2021</td>
</tr>
<tr>
<td>11</td>
<td>Psychosocial Resilience to Inflammation - Associated Depression: A Prospective Study of Breast-Cancer Survivors</td>
<td>2022</td>
<td>270 participants</td>
<td>Center for epidemiologic Studies - Depression (CES-D) blood samples for</td>
<td>California/ USA</td>
<td>270 Women</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This study revealed that the data provided is not sufficient to corroborate the hypothesis. However, psychiatric and immune functioning has given rise to a new field of study called psychoneuroimmunology.

Patients with Lichen Simplex Chronicus (LSC) are at risk of increased levels of stress, anxiety, depression, impaired quality of life, and decreased levels of neurotrophins.

The importance of psychosocial resilience by demonstrating a relationship between psychosocial resources and sensitivity to depressive symptoms associated with inflammation.

Continued in page S455...
Title: Age, BMI, and inflammation: Associations with emotion recognition

Year of publication: 2021

Sample: 90 participants

Gender %: 60% women

Mean age: 21 to 35 years and 63 and 80 years

Treatment: protein (CRP) evaluation

Evaluation scales:
- Event Impact Scale (EIS)
- Attachment subscale of the Social Dispositions Scale (SDS)
- Revised Life Orientation Test (LOT-R)
- Pearlin Mastery Scale
- Rosenberg Self-esteem scale
- Positive and Negative Affect Schedule (PANAS)
- Mindfulness Awareness Scale

Country/City: Birmingham/England

Young people with a high BMI performed worse on the RMET compared with their normal BMI counterparts, while the opposite pattern was observed in older individuals.

Continued in page S456...
<table>
<thead>
<tr>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Goal-Focused Emotion-Regulation Therapy (GET) for young adult survivors of testicular cancer: a pilot randomized controlled trial of a biobehavioral intervention protocol</td>
<td>2020</td>
<td>60 participants</td>
<td>Goal-Focused Emotion Regulation Therapy (GET)</td>
<td>California/US</td>
<td>18 and 39 years</td>
<td>Men</td>
<td>GET may have the potential to improve overall adjustment to cancer</td>
</tr>
<tr>
<td>14</td>
<td>Association Between Systemic Immune-Inflammation Index and Diabetic Depression</td>
<td>2021</td>
<td>2,556 participants</td>
<td>Depression was assessed using the PHQ-9.26 Blood samples</td>
<td>Yanji, China</td>
<td>Average 61.4 years</td>
<td>1,252 women; 1,314 men</td>
<td>Systemic inflammation is a risk factor for depression in patients with diabetes mellitus.</td>
</tr>
<tr>
<td>15</td>
<td>CD157 and Brain Immune System in (Patho)physiological Conditions: Focus on Brain Plasticity</td>
<td>2020</td>
<td>Mice</td>
<td>CD157 on neuronal and glial cells</td>
<td>Krasnoyarsk, Russia</td>
<td>Average 15.4 years</td>
<td>40 men; 60 women</td>
<td>CD157 could play a role in the regulation of anxiety and social avoidance</td>
</tr>
<tr>
<td>16</td>
<td>Evaluation of Inflammatory Response System (IRS) and Compensatory Immune Response</td>
<td>2022</td>
<td>100 participants</td>
<td>Children's Depression Inventory (CDI) Blood test</td>
<td>Zilina, Slovakia</td>
<td>Average 15.4 years</td>
<td>40 men; 60 women</td>
<td>Importantly, the association between the inflammatory response system (IRS) and the compensatory immune response system (CIRS) in adolescent depression appears to be gender-specific.</td>
</tr>
</tbody>
</table>

Continued in page S457...
### Table 4 (Continued from page S4546)

<table>
<thead>
<tr>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 <a href="https://doi.org/10.1038/s4177-021-00508-z">https://doi.org/10.1038/s4177-021-00508-z</a></td>
<td>(CIRS) in Adolescent Major Depression Neuromodulation by the immune system: a focus on cytokines</td>
<td>2021 mice</td>
<td>Cytokine immune molecules</td>
<td>Virginia/USA</td>
<td>-specific.</td>
<td>Cytokines can be used to send signals to neurons and thus regulate neuronal activity. Stimulation of neurons with D1 receptors in the region of the nucleus accumbens suppressed the tumor progression and improved the immune system. It may be a valuable and useful approach to cancer therapy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 <a href="https://doi.org/10.1186/s13041-022-00902-1">https://doi.org/10.1186/s13041-022-00902-1</a></td>
<td>Tumor suppression and improvement in immune systems by specific activation of dopamine D1 receptor-expressing neurons in the nucleus accumbens</td>
<td>2022 mice</td>
<td>Stimulation a repeat of neurons with D1 receptors</td>
<td>Tokyo, Japan</td>
<td></td>
<td>The prototype allows the monitoring of autoimmune diseases before, during and after inflammatory crises, thus responding to personal needs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 <a href="https://doi.org/10.3390/s22103834">https://doi.org/10.3390/s22103834</a></td>
<td>“Listen to Your Immune System When It’s Calling for You”: Monitoring Autoimmune Diseases Using the iShU App</td>
<td>2022 15 participants</td>
<td>Aveiro, Portugal</td>
<td>From the age of 9 women to the age of 59 men</td>
<td></td>
<td>The Hero program was a useful online application to enhance positive emotions and promote prosocial behavior in uncertain times.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 <a href="https://doi.org/10.1371/journal.pone.0272922">https://doi.org/10.1371/journal.pone.0272922</a></td>
<td>Promoting positive emotions and instilling concern for the needs of others during the COVID-19</td>
<td>2021 237 participants</td>
<td>Hero Program Buenos Aires, Argentina</td>
<td>12 to 15 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doi</td>
<td>Title</td>
<td>Year of publication</td>
<td>Sample</td>
<td>Treatment</td>
<td>Country / City</td>
<td>Mean age</td>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------</td>
<td>--------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>----------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>10.2478/rae-2021-0001</td>
<td>Emotions in music and their impact on the emotions of percipients: research on human voice and singing</td>
<td>2021</td>
<td>56 participants</td>
<td>POMS Questionnaire, BRUMSMood Questionnaire</td>
<td>Presov, Slovakia</td>
<td>From 18 years to 44</td>
<td>34 women 22 men</td>
<td></td>
</tr>
<tr>
<td>10.3389/fnbeh.2022.869526</td>
<td>Hypothalamic Neurochemical Changes in Long-Term Recovered Bilateral Subdiaphragmatic Vagotomized Rats</td>
<td>2022</td>
<td>Wistar rats</td>
<td>Vagotomy surgical process</td>
<td>Poland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.3389/fnbeh.2022.945661</td>
<td>Acute sleep deprivation disrupts emotions, cognition, inflammation, and cortisol in young healthy adults</td>
<td>2019</td>
<td>23 participants</td>
<td>Pittsburgh Sleep Quality, Depression Scale of the Center for epidemiological Studies (CES–D)</td>
<td>Presov, Slovakia</td>
<td>Average age 20.78</td>
<td>9 women 14 men</td>
<td></td>
</tr>
<tr>
<td>10.1111/jpey.12909</td>
<td>Does emotion matter? An investigation into the relationship between emotions and science learning outcomes in a game-based learning environment</td>
<td>2020</td>
<td>119 participants</td>
<td>Humunology, Taiwan, 12 and 13 years</td>
<td>Houston</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The sound, the voice, and the singing are relaxing, stabilize the physical and mental state and emotional condition, allowing to reach a condition of deep concentration.

The results show that, in the long term, vagotomy affects the concentration of hypothalamic amino acids, but not the mRNA expression of the genes analyzed.

Lack of sleep increases negative emotional states such as anxiety, fatigue, confusion, and depression.

Learning through play Humunology was effective and the long-term effect on learning retention was promising compared to education traditional.

Continued in page S459…
Title: Emotion Regulation and Immune Functioning During Grief: Testing the Role of Expressive Suppression and Cognitive Reappraisal in Inflammation Among Recently Bereaved Spouses

Behavioral Immune System Responses to Coronavirus: A Reinforcement Sensitivity Theory Explanation of Conformity, Warmth Toward Others and Attitudes Toward Lockdown

### Table 4 from page S458

<table>
<thead>
<tr>
<th>Doi</th>
<th>Title</th>
<th>Year of publication</th>
<th>Sample</th>
<th>Treatment</th>
<th>Country/City</th>
<th>Mean age</th>
<th>Gender %</th>
<th>(Follow-up time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Emotion Regulation and Immune Functioning During Grief: Testing the Role of Expressive Suppression and Cognitive Reappraisal in Inflammation Among Recently Bereaved Spouses</td>
<td>2020</td>
<td>99 participants</td>
<td>cognitive reappraisal</td>
<td>Huston USA</td>
<td></td>
<td>28% men</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Behavioral Immune System Responses to Coronavirus: A Reinforcement Sensitivity Theory Explanation of Conformity, Warmth Toward Others and Attitudes Toward Lockdown</td>
<td></td>
<td>605 participants</td>
<td>RST Personality Questionnaire</td>
<td>Plymouth, United Kingdom</td>
<td>426 mujeres</td>
<td>173 hombres</td>
<td></td>
</tr>
</tbody>
</table>

The use of emotion regulation strategies is associated with a peripheral inflammatory response as measured by peripheral inflammation levels and cytokine levels.

Coronavirus-related behavior is not driven solely by fear, but also by protective and social goals to limit the spread of the virus.
them more prone to develop bidirectional psychophysiological changes between the nervous system and its articulation with the brain, due to the negative psychological manifestations that affect the determinants of health and prevent the harmonious functioning between the psyche and neurotransmitters (39).

With regard to anxiety and the modulation of the central nervous and immune systems, it affects the production of cytokines that affect cortical activation, which modifies the balance of neurotransmitters and their influence on mental pathologies (40). So the relationship with mood directly influences the hypertrophy of the adrenal glands that link emotion with anxiety and depression through the coactivation of the hypothalamic-pituitary-adrenal system characterized by adaptive mechanisms in the release of cortisol and noradrenaline that provides a release pathway induced by negative emotions that generate qualitative and quantitative changes in the anxiogenic behavior of individuals, due to the reception of cognates that generate an imbalance in the cells of the immune system causing hormonal changes that increase the level of cortisol and weaken the immune system due to the manifestations of anxiety (41).

Stress, therefore, distorts the homeostasis of the immune system, increasing the levels of probability of deteriorating health conditions due to the negative changes that occur on the immune system that progressively deteriorates the organism because stressful situations directly affect the functioning of the pituitary gland due to the sympathetic innervation that occurs between the adrenal capsules and the lymph node (42), which brings effects on the central nervous system that according to pathologies such as neoplasia, cancer, anemia, among others, cause adverse effects of psychological and psychiatric nature that are evidenced in cognitive defects, psychotic symptomatology, anorexia, somnolence and suicidal tendencies; explained from the affections and alterations that are presented in the immune system in association with the appearance of psychological stress, where alterations are identified by the immunological changes that influence the appearance of cell migration and inflammatory mediators that lead to neoplastic diseases (43).

Regarding the components of mental health, these can be altered and thus alter the function of the immune system of the subject (44), particularly in the occurrence of stress, which can directly affect emotions, generating dysfunctions in the central nervous system from the secretion of high levels of hormones and chemicals. This is explained by the conditions of association in patients who carry cancer cells, where the presence of alterations in the functioning of the immune system and the acceleration of inflammatory conditions in the body is identified. Originating changes in mood that frequently present depressive and anxiogenic symptomatology that cause alterations in behaviors, through the neurophysiological immunosuppression of the biochemical determinants that modify the central nervous system (45).

**CONCLUSIONS**

The affectations of the emotional states, generate changes and a series of somatic symptomatologies that are evidenced due to the presence of clinical indicators related to physical pain, eating disorders, and sleep disorders among others, which leads the subject to decrease the immune system and cause alterations in the body, which negatively affect the regulation and control of emotions that are linked to the states of integral health within the proper functioning in the environmental determinant contexts in which it evolves (46). Impacting in this way, the conditions of quality of life that are linked to the health processes in individuals, under the formation of the relational elements between the immune system and brain functioning from the constructs of cortical arousal (47).

The neuroendocrine and immune systems generate developmental processes that are linked to psychological aspects that directly affect human behavior in such a way that the interaction between emotional and mental alterations generates maladaptive situations that lead to the appearance of stress, anxiety, and anxiety, due to the development of pathogens that alternate the functioning of hormones and molecules that are secreted against receptors and immune cells that secrete adrenaline, glucocorticoids, and
noradrenaline among others (48). On the other hand, corticoids are produced under the constancy of the circadian rhythm, increasing the period of stress and increasing the probability of occurrence of chronic pathologies that are linked to the poor control of emotions in daily functioning (49).

Finally, psychoneuroimmunology is a science that articulates mental processes and the functioning of the nervous, immune, and endocrine systems that affect the individual in such a way that the psychological aspects linked to emotional management and control can present better management and intervention in mental illnesses (50). This requires a multidisciplinary intervention process from the contributions of neurosciences, psychology, psychiatry, and neurobiology, to integrate the context of integral health in the individual from the psychosocial factors and in the mind-body interaction.

**REFERENCES**


20. Barrios-Serna K, Orozco-Núñez D, Pérez-Navas E, Conde-Cardona G. Nuevas recomendaciones de la
EMOTIONS, ANXIETY, DEPRESSION AND THE IMMUNE SYSTEM


