

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



# Psychological Intervention Based on Psychoneuroimmunology in Children and Adults

*Margarita del Valle Chacin Fuenmayor  
and Josymar Chacin de Fernandez*

## Abstract

Psychoneuroimmunology (PNI) is a field that has developed significantly during the last three decades; it has come to scientifically demonstrate the importance of the mind in the prevention, development and treatment of diseases. Throughout this chapter, we describe the evolution of PNI, the interaction of these systems to actively develop them, not only in adults but also in children. Similarly, it explains the influence of stress on the health of the individual and the importance of knowledge of psychoneuroimmunology to achieve the proper management of disease and quality of life. It also accounts for how psychological interventions have been proven effective and can serve as a model for researching and treating other diseases.

**Keywords:** psychoneuroimmunology (PNI), stress, psychological intervention, children, quality of life

## 1. Introduction

This chapter will describe the main clinical implications of psychoneuroimmunology and how to improve clinical evolution, quality of life and immunity of adults and children. The investigation of the multiple relationships between emotions and human cognition and health is an area of study that involves much knowledge, such as neurosciences, endocrinology, immunology, pharmacology, psychology, and psychiatry. These knowledge areas provide a partial vision to make a complete approach to the relationship between the disease, the body and the mind-brain.

The concept of health is a complex process, and it is based on a balance between biological, social and psychological factors. Engel, in 1977 [1], worked on the recognition of the intricate relationship between disease, body and mind-brain, argued that biological factors, as well as genetic factors, are not enough to explain all the phenomena that have to do with health, and that if you want to understand the origin and evolution of the disease, you must take into account the interaction of psychological and social factors in addition to genetic and biological factors; He also emphasized his criticism of the traditional biomedical model that tends to separate the mind-brain and the body; model where the body is conceived as a machine that must be repaired, leaving aside the emotions; patients are seen almost as objects, and their subjective perception is not relevant in medical evaluation and management, contributing to the dehumanized procedure of traditional medicine.

Considering the relevance around the advances in the medical field, this chapter will provide a better understanding of Psychoneuroimmunology and describe the psychological protocols developed for adult and children, which has been proven to improve clinical evolution, quality of life and immunity.

## **2. Psychoneuroimmunology (PNI)**

Psychoneuroimmunology (PNI) consolidates itself as an interdisciplinary research field towards the end of the 70s. It owes its name to the psychologist Robert Ader, who first introduced the term in his presidential address of the American psychosomatic society in 1980 [2]. Later this neologism was presented more formally by Ader, 1981 as the title of a landmark book of this novel discipline in which state of the art was presented, emphasizing the central nervous system's role in the interaction of behavior and the immune system [3].

One of the newest research fields resulting from the biopsychosocial conception of health is psychoneuroimmunology (PNI), which embraces the main guideline of this model, such as the analysis of the interaction between psychosocial and biological factors in etiology, evolution and treatment of the disease. Psychoneuroimmunology is a prominent new scientific field where many sciences converge responsible for the study, analysis, understanding, and application of the complex interactions between behavior and the three systems that guarantee the human body's homeostasis, between the nervous system, the endocrine and immune system [4].

This hybrid new discipline tries to demonstrate if the mind-brain mediates the susceptibility to illness or intervenes to recover a physical ailment, an infectious or autoimmune disease. The relationship of some psychological processes with alterations of the immune system and the interrelation of mental illnesses, mainly emotional and affective, with impaired immune function [5]. Psychoneuroimmunology provides more detailed knowledge of the intricate biological dynamics of human health. It provides novel complementary medical options or techniques and invites exploring alternative non-linear models to address the health-disease process. PNI is thus a discipline that establishes a meeting point for the different traditional health fields [2].

PNI is thus a discipline that establishes a meeting point for the different traditional health fields. Many research pieces have proven the relevance to the scientific field, which has helped to acknowledge and understand these systems' link to improve adults and children's health integrally.

## **3. Stress and psychoneuroimmunology**

Studies on the effect of stress on the immune system have allowed understanding the complex interaction between the nervous, endocrine and immune systems, which has allowed that in situations of stress, the human organism has protection mechanisms to preserve homeostasis.

In the fourteenth century, the term stress began to refer to difficult, adverse, suffering and negative situations. However, it was not until 1857, when Claude Bernard stated that environmental changes could alter the body. In 1929 the neurologist Walter Cannon recognized that stressors that cause physiological reactions resulting from threatening or adverse situations could be physical and/or emotional. Cannon also warned, later in 1932, about the importance of the person maintaining

an internal balance that he called homeostasis and that in case of intense changes, a readjustment occurred through the endocrine and vegetative system [6].

Later, Hans Seyle, physiologist and physician, considered by many to be the father of the modern concept of stress, defined it in 1936 in the British journal *Nature* the General Adaptation Syndrome (SGA), also known as Seyle's Law, as an automatic mechanism that is triggered by any stressful situation and that involves a set of reactions that mobilize energy reserves that implies activation of the hypothalamic-hypophyseal-adrenal axis and the central nervous system, which makes the body go through three phases: alarm, resistance or adaptation of the organism and exhaustion, being able, if the threat is sufficiently severe and prolonged, even cause death [6].

When stress exceeds certain limits, the immune system is affected, numerous organs of our body, and there is a propensity for the appearance or aggravation of diseases by weakening certain immune cells that make people more susceptible to the pathogens that cause infections such as asthma, rheumatoid arthritis, herpes simplex, tuberculosis, cancer and the progression of HIV to AIDS, among others [6].

Among the consequences of chronic stress on the immune, central nervous and endocrine systems, Ortega Navas, M, 2011, highlights the following:

Chronic stress effects on health	
Immune system	<ul style="list-style-type: none"><li>• Depressed immune activity.</li><li>• Weakening of the immune system: Acceleration of infectious processes, colds and autoimmune diseases.</li><li>• Problems with blood clotting.</li><li>• Reactivation of inflammatory diseases: atopic dermatitis and psoriasis.</li><li>• Increased retention of the virus in tissues</li></ul>
Nervous system	<ul style="list-style-type: none"><li>• Depression, anxiety, loss of sleep.</li><li>• Cognitive abilities such as memory and the ability to take decisions can be adversely affected.</li><li>• Increased risk of developing neurodegenerative diseases such as multiple sclerosis, central nervous system infections, and others inflammatory diseases.</li></ul>
Endocrine System	<ul style="list-style-type: none"><li>• Increase of sugars and fats in the blood.</li><li>• Hypothyroidism and hyperthyroidism.</li><li>• Cushing's syndrome.</li><li>• Hormonal changes: increased secretion of catecholamines and cortisol, which have an immunosuppressive effect.</li><li>• Modification of prolactin, growth hormone and <math>\beta</math>-endorphin levels</li></ul>

On the other hand, stress is also necessary and positive in our lives' evolution at certain levels since it constitutes an essential part. Positive stress is a means of adaptation to daily situations, a means for productivity, creativity, increases alertness, improves concentration, and decision-making, making us feel safe and better prepared to face and definitively find ourselves in a more balanced situation the face of adversity and disease.

Sometimes we adults have the fantasy that children are not stressed because we see them playing or entertaining themselves in their activities, which is absolutely false since, on the contrary, the fact that the child has a high power to imagine also causes you to present abundant thoughts and that when events are not clearly explained or because of your cognitive level, you cannot interpret them clearly, it is possible that the thoughts are negative, which generates high stress and therefore also affects your immune system.

In this sense, it is essential to provide children with information, according to their age, of the events that are being generated, whether they are associated with themselves, as in the case of their health, as if it is about the people around you. It is recommended to address critical situations such as divorces, moves, bereavement and maintain close contact, with the openness to answer any question that arises at the time, to reduce the anxiety of uncertainty that is very harmful to the child.

#### **4. Emotions and psychoneuroimmunology**

Emotions govern all the organism's systems. The field of psychoneuroimmunology is studying how emotions are translated into chemical substances (information molecules) that can trigger chain reactions that affect internal chemistry, optimizing or weakening our functional state. Furthermore, that impacts our immune system, endocrine system, nervous system and other systems of our body. In fact, if we repress the expression of emotions, we also repress our organic functions, which in the long term translates into discomfort or diseases [6].

Research indicates that positive emotions can be enhanced and help prevent certain diseases' appearance. What we do and what we think has positive and negative effects on our physical and emotional health. Positive emotions allow us, in addition to supporting the difficulties of an illness and facilitating its recovery by triggering a series of positive effects on our metabolism that strengthen our health, achieve, among other goals, healthy self-esteem, satisfaction for the work well done and making more effective decisions and ultimately, improve our quality of life. In fact, positive emotions also help make people more resistant to adversity and help build psychological resilience [7].

Maruso in 2009 [8], considered that emotions influence immunity and that the third revolution in medicine is precisely psychoneuroimmunoendocrinology. He insists that the mind and the body are intrinsically linked and that as a result of the mind-body interaction, reactions are triggered that affect internal chemistry, optimizing or weakening our functional state and that it is in our own hands to launch a new culture of health which implies that people are capable of maintaining and ensuring health on a physical and mental level.

Advances in psychoneuroimmunology indicate that emotional states can modify and alter health in general so that positive emotions help the person be better able to overcome diseases that may arise in life. Likewise, Ortega Navas in 2009, affirms that emotions play a vital role in health, "they are an undeniable part of our lives and are fundamental for its positive state by helping to promote healthy behaviour; on the contrary, if they are negative, they are a risk to our health, they can constitute an activating or inhibiting signal of health symptoms or a disease".

The emotional attitude directly relates to the immune system, harmonizing better with good health than a negative attitude. A person who normally expresses happiness, good humor, love, friendship, joy and positivism is much less likely to contract a serious illness than another who, on the contrary, is angry, fearful, angry, depressed or apprehensive. In fact, when states of mind such as anger, fear, or hopelessness seize us, cortisol levels rise, which hinders the immune system's functioning.

In sum, although emotions play a decisive role in the onset and/or course of numerous diseases, among cardiovascular, respiratory, gastrointestinal, endocrine, muscular, dermatological disorders and alterations of the immune system stand out, it is important to highlight that emotional education as a subject. The current debate is increasingly being debated in educational settings, a consequence of the need to educate people to know themselves and others better to face the challenges of their



daily work better and adopt healthier lifestyles. Its purpose is to help people prevent and reduce risk behaviors through skills training or avoid possible consequences.

## 5. Quality of life (QoL)

In recent times, the use of the term quality of life (QoL) has become frequent in a wide variety of contexts. Environmentalists emphasize the physical/biological environment, economists on parameters such as gross national product, doctors on symptoms, psychologists on human needs, and satisfaction. It follows that quality of life should be considered a multidisciplinary entity that is applicable and inherent to all society and the world, and its consideration by all leaders and scientists of humanity should be contemplated [9]. That is why it affirms Grau, in 1996 that the Quality-of-Life study invites us to abandon traditional positions and glimpse common sources of approach.

Almost all the authors agree that the term appears in the decade of Within Health Psychology; according to Grau, 1996, there are three large groups of problems when approaching the development of studies in Quality of Life. The first is that of its conceptual indistinctness, determined by its complex nature, the second referring to problems related to Quality of Life and the third problem inherent to the difficulties in its evaluation.

In pediatric literature, quality of life is defined as multidimensional. It includes the child's social, physical and emotional functioning and, if necessary, of his family [10]. Quality of life questionnaires have generally been validated related to health in which information from people close to children has been used; the ability of children to report their health status has not been considered adequate [11].

For a child, it is difficult to discriminate what is quality of life, since it has no source of comparison because due to its short life and the experiences it has had, it can build its concept of life, that is why on many scales to measure the quality of life of the child takes into account the perception that family members have of well-being in the child.

In this sense, a child's quality of life must be focused on providing a healthy environment, where they can fully develop their mental, physical and social capacities, allowing them to carry out childhood activities, reinforcing healthy beliefs that imply responsibility in their immunological condition.

### 5.1 Quality of life factors to consider in psychoneuroimmunology

Quality of Life is based on the construction that a person makes of their living standards according to their personal beliefs and environment, which determines their general well-being. Among the elements to consider are the following:

- **Physical condition:** In this aspect, the person's body conditions, energy level, vitality and the care that the person performs to maintain it, such as exercise and daily activity, are considered.
- **Lifestyle and well-being:** The way the person organizes their time in a balanced way, taking into personal account spaces, free time, interpersonal relationships, academic and work activities, indicates a healthy lifestyle.
- **Healthy interpersonal relationships:** The way the person relates is closely linked to personal well-being, especially close relationships.

- Physical and emotional symptoms: The awareness on the part of the person of the feelings he is experiencing at the physical and mental level is vital to assess her quality of life. In this regard, it is essential to consider the manifestations of pain in the organic and emotional sphere.
- Cognitive considerations: The mental construction that the person makes of his experience, that is, the perception of it, will influence how he responds to the environment and therefore affects his quality of life.
- Introspection, self-esteem and self-care: Intrapersonal communication, which implies communication with me, being compassionate and with a motivating dialog that reinforces self-esteem, is vital. Also accompanied by self-love that implies effective self-care in all areas.
- Sleep quality: it is considered relevant to validate problems falling asleep, interrupted sleep, insomnia, among others.
- Image and Sexuality: Self-image, added to the interest in sexual relations, desire and level of satisfaction, are factors to consider.

## **6. Psychological interventions based on psychoneuroimmunology in adults**

Psychological interventions based on psychoneuroimmunology must be structured, taking into account:

1. Conviction in the patient of the mind-body relationship.
2. Knowledge of the immune system's primary authors and how it is related to the endocrine system and the nervous system.
3. Awareness in the patient that his mental and physical condition is linked to internal factors.
4. Identification of harmful behavioral patterns that must be modified to improve the quality of life.

### **6.1 Some techniques used in psychoneuroimmunology**

#### *6.1.1 Cognitive-behavioral psychotherapy*

In this therapy applied to psychoneuroimmunology, the way of thinking on the immune response is explained to the person. A variety of cognitive strategies have helped identify the unhealthy beliefs that affect the individual's health condition. In general, the following process is followed:

- Identify the unhealthy belief
- Recognize the connections between thought - emotion - behavior.
- Examine the evidence that is for or against your thoughts.

- Correct distorted thoughts
- Replace cognitions with healthy beliefs.

#### *6.1.2 Relaxation techniques*

Relaxation techniques commonly used in psychoneuroimmunology usually include muscle relaxation and deep breathing to decrease neurovegetative activation. The training is the same as those used in clinical contexts, only adapting the procedure to health conditions.

#### *6.1.3 Guided imagery techniques*

The body does not discriminate between what we imagine and the actual events, which is why people who carry out a treatment based on psychoneuroimmunology must become aware of the power of their mind, and the care they must have at the time to worry in advance or imagine catastrophic events that alter their physical conditions.

Guided imagination in PNI includes 2 phases. Initially, the patient is guided through a relaxation process, and then he is induced to imagine the activation of his nervous, endocrine and immune systems to regulate his disease. This imagination can be general or specific according to his illness.

#### *6.1.4 Psychoeducation*

- Information about the disease:

In PNI, the patient must know all the details related to his disease. For example, if he has a tumor in any part of the body, it is essential that he can see the exams, know where it is located, its size, shape, texture, everything that allows him to imagine it or even draw it later.

- Treatment information:

In psychoneuroimmunology, the patient has an active role in his clinical condition and recovery of health; that is why he must know all the treatment details, the approximate time that he will receive them and the side effects. It is relevant that the patient can mentally potentiate or reject these treatments; that is why it is necessary to verify the distracted or catastrophic thoughts that can alter him emotionally and affect the immune response.

In children, it is very important to foster a collaborative attitude towards treatment, which stems from the understanding that some treatments, although painful, are promoting their health. Also, strengthening communication with their parents and health professionals.

- Information on the Immune System

The patient is required to recognize the main authors of the immune system to develop greater control over his physical symptoms and disease.

The content provided implies understanding the defense system, represented by white blood cells, and its function is to defend the person from viruses, bacteria, and any invading agent, such as tumor cells.



In psychoeducation, the different types of cells must be present, and their characteristics and general functions are explained according to the age group and cognitive level. Among the actors that stand out are T Lymphocyte, B Lymphocyte, Macrophage, Natural Killer Cell or NK and Neutrophil Polymorphonuclear.

## **7. Psychoneuroimmunology research in adults**

There are several reasons to investigate whether a psychological intervention, in patients or healthy subjects, alters immunity: 1) Because it is possible to know if there is a causal relationship between psychological factors and the functioning of the immune system 2) because the improvement of the immunity obtained after the psychological intervention would be an added benefit (eg. Some stressors can cause a decrease in some forms of immunity. The psychological intervention would reduce stress and increase the multidisciplinary treatment of patients affected by organic diseases [5].

In this sense, any psychological variable can influence the appearance or the course and outcome of a certain disease in which the immune system is involved. As the psychological determinants that influence behavior can come directly from the CNS or indirectly through the stress response (hormonal mechanisms), any change in behavior that is associated with personality characteristics or coping styles in emergencies (stressful), as well as negative emotional states, could affect the immune system (for example, people who smoke or overeat when stressed or people who generate more stress than necessary in everyday situations by evaluating them exaggeratedly threatening). It also happens that, on some occasions, individuals see a threat where there is none (or they exaggerate it), resulting in the acquisition of a phobia; either they do not have adequate coping resources at a given moment (they do not know how to solve problems), or they have wrong ideas about how the world should work (irrational ideas or cognitive distortions) [10].

This can be evidence in a work carried out by Antoni in 2003 [12], through a 10-week group program based on cognitive stress control and relaxation strategies, the results show that there are effects of psychological intervention on mood, as well as neuroendocrine changes in the HHC, HHG (Hypothalamic–Pituitary–Gonadal) axis as well as in the hormones of the Sympathetic Nervous System and the state of the Immune System in people infected with HIV. The changes produced by the effects of relaxation and cognitive coping strategies, and social support can mediate mood changes. In turn, these changes affect the regulation of adrenal hormones evaluated through changes in urinary cortisol, norepinephrine, and testosterone levels. As suggested by Antoni, the changes in these hormones as a result of the intervention could also explain, in part, the short-term changes in IgG antibodies and the longer-term changes in CD4 lymphocytes.

Similarly, Robinson in 2002 [13] showed encouraging results with an 8-week program to reduce stress in people infected with HIV. Subjects who received this treatment showed increased activity in the killer (NK) cells and their number. The same measurements were taken three months after completing the intervention, noting that the increases in NK cells and decreases in tension, anger or depression also remained, thus showing the subjects a much-improved state of mind.

In any case, the psychological influence of the mind on the body, and more specifically in the field of PNI since the mid-70s, have been treated from multidisciplinary approaches that include medicine, psychology, sociology, social work and even religion [3].

For this reason, and as far as psychologists are concerned, psychotherapies are usually directed towards two final objectives: to reduce or eliminate levels of stress

and/or depression. Although stressors can be physical or psychological, the disparity between them is a mere illusion when it comes to the emission of a stress response [3]. Therefore, any treatment aimed at eliminating or reducing the stress response will be favoring the improvement of depression, this being, in this way, considered a dependent variable.

How an individual interprets and responds to a certain stressor determines its reaction (flight, freeze or flight) and the immune system's response and disease behaviors [14]. Therefore, any intervention from health psychology, designed to modulate stress, provides problem-solving strategies, identifies both phobic stimuli and real or potentially dangerous stimuli, adopts healthy behaviors, and interprets life events from a perspective adaptive (not a perfectionist or tremendous), will walk in the direction sought.

It has been scientifically proven that there are significant decreases in hormones related to stress, such as thyroxine or GH, decreases in Cortisol, THS, and prolactin have also been described during relaxation. Visualization produces increases in IgA levels in saliva. Decreases in the sensitivity of beta-adrenergic receptors measured in circulating lymphocytes have also been described without variations in the number of receptors or catecholamines' plasma concentration [15].

It has also been demonstrated that loneliness, social support, stressful situations such as exams, personality variables, etc., have been studied. The treatments carried out have shown certain effectiveness, these being mainly: Visualization techniques, Directed Imagination, Relaxation, Cognitive-Behavioral Stress Control Techniques, as well as Meditation, Shamanic Techniques, Prayers, etc. Any of these techniques can be useful if it is practised with the necessary rigor, whatever the psychological approach used. However, relaxation produces physiological states that, combined with the representation of images (imagination), can become so-called meditation techniques, positive visualization, directed imagination, etc. That is to say, positive emotion, in this case pleasant, would be the combination of the body state with a mental representation in the form of an image and thought [15].

Furthermore, Bower in 2003 [16], developed a handy tool that achieved more significant control of emotions and cognitive processes called guided imagination. To develop desired changes in behavior, guided imagery can be used to relieve muscle tension, reduce or eliminate pain, and facilitate the process of managing stressful situations through behavioral change. In this technique, it is important to describe the positive physiological and psychological effects of imagining scenes.

Understanding the communications between the brain and the immune system at their most intimate levels will also help health professionals believe in their patients when they tell them that their beliefs in the recovery process, hope, and laughter make you feel good.

## **8. Psychoneuroimmunology in children**

There are very few studies on interventions based on psychoneuroimmunology (PNI) in pediatric patients. Studies reported that inappropriate clinical settings, knowledge of PNI could improve outcomes for pediatric surgical patients. Additionally, parents who receive these same services may also experience better psychological health, allowing them to be more available and prepared to support their children's recovery [17].

Castes in 1999 [18], carried out an investigation in the Isla de Coche, Venezuela, entitled: "Clinical, immunological changes associated with a psychosocial support program based on psychoneuroimmunology in asthmatic children", the authors state that anatomical evidence is presented, physiological and functional that

demonstrate the interaction between the central nervous system (CNS), the endocrine system and the immune system. Likewise, it is shown that this communication is bidirectional, and the scientific bases that establish communication between the immune system and the CNS are provided. Likewise, the relationship between stress and the immune response is pointed out. We also present the results of our group that show that a psychosocial intervention based on psychoneuroimmunology (PNI) produced a significant decrease ( $p < 0.05$ ) in the number of asthmatic attacks and the consumption of inhaled  $\beta_2$  agonist, together with a significant improvement ( $p < 0.05$ ) of lung function (FEV1), when compared before the PNI intervention. A significant decrease was also found in specific IgE antibodies against *Ascaris lumbricoides* and in the marker CD23 (low-affinity receptor for IgE) post-intervention. In contrast, a significant increase ( $p < 0.001$ ) of NK cells (CD56) and T cells with the receptor for IL-2 (CD25) was found after PNI intervention. None of these significant changes was found in children in the non-operated control group. These results demonstrate that the PNI intervention induces immunological alterations that are probably responsible for the clinical and physiological improvements observed in the group under study.

In summary, these studies were able to demonstrate that the disease process and the quality of life of a child can present favorable changes as a result of the application of a psychological intervention protocol based on psychoneuroimmunology, which systematically contains activities that allow the patient to work on the awareness of their disease and exercise active participation in their self-healing.

### **8.1 Psychoneuroimmunology intervention protocol for children with cancer**

The authors developed a psychological intervention protocol based on psychoneuroimmunology principles for children with leukemia, and it was published in 2019 [19]; given its proven effectiveness at the research level, we allow ourselves to show its structure in detail.

It is a structured programme aimed at children between 5 and 15 years of age diagnosed with leukemia. A total of 30 pediatric patients with the diagnosis of acute lymphoblastic leukemia were evaluated. The BFM chemotherapy treatment protocol (Berlin-Frankfurt-Münster, 2009) was applied to the entire sample. From the sample, 18 patients were assigned to the experimental group. The psychoneuroimmunology-based psychological intervention protocol was applied during the remission induction period, and 12 children who belonged to the control group did not receive said protocol.

This protocol consists of different activities grouped together to psycho-educate the child and achieve learning about his illness, medical treatment and the influence of her emotions on his Immune System. The protocol has a printed and digital didactic story (audiobook) called “A Battle Won, My Fight Against Leukemia”. It is made up of four chapters: Knowing my body, now I know what is happening to me, my treatment and the power of my mind. Likewise, an activities notebook is included to verify the knowledge that the child has acquired, including the development of activities that motivate and reinforce the knowledge that the patient must have to face their disease and complete their oncology treatment successfully physically and mentally.

Play therapy in psychoneuroimmunology aims to give the child the opportunity to become familiar with stimuli or objects of interest in the disease process or interact with objects symbolically loaded with medical content to stimulate thoughts and fantasies about the procedures to be performed, which will be submitted.

Among the playful techniques used is drawing, since it allows the individual to externally represent how he imagines his disease, the immune system and its

treatment, among others. These actions allow the therapist to evaluate the perception that he is having in a conscious or unconscious way of the disease and treatment experience.

For this reason the Program is complemented with playful strategies, employing puppets representing the immune system, a memory game referring to the psychoeducational story “A Battle Won, My Fight Against Leukaemia.” These strategies seek to maintain the child’s attention and interest in learning and know more about her body and consolidate the story’s informative content and the manual (see table by phases).

Objective	Session No.	Strategy / Activity	Procedure
Provide information to the patient around their body, specifically about the function of their bone marrow, through recreational activities adjusted to their evolutionary development.	Session 1	Personal History - 1st Part Activity Notebook	Encourage the writing of their own story about the onset of the disease.
		Cover of your personal story	Encourage the realization of the cover of your story.
		Draw your bone marrow	Encourage the child to draw his blood factory.
		Draw your platelets	Encourage the child to capture how he imagines his platelet battalion, stimulate the importance of using his imagination.
	Session 2	Alphabet soup	Indicate the search for words in the alphabet soup. Provide help and review the meaning of each word.
		Draw your red blood cells	Encourage the child to capture how he imagines his oxygen battalion, stimulate the importance of using his imagination.
		Draw your white blood cells	Encourage the child to capture how he imagines his white blood cells, highlight the importance of using his imagination.
Psychoeducation to the patient about his disease: Leukemia	Session 3	Questions of interest	Allow the use of their own expressions and ideas.
		Draw your Hospital	Encourage the patient to draw a picture of the hospital, allow him the space to express what he likes about the Institution.
		Name or draw the people who support you in your treatment.	Encourage the child to capture through drawing the people who accompany him during his treatment.
		Complete the next phrases	Guide the patient to respond correctly
		Draw the Blastos	Encourage the child to capture how he imagines the blasts, encourage the importance of using her imagination.
Psychoeducation to the patient in relation to the oncological treatment of Leukemia	Session 4	Some questions of interest	Tell the child or adolescent the questions to answer.



Objective	Session No.	Strategy / Activity	Procedure
		Draw how the QT works	Encourage the child to use her experience and capture how he imagines QT acting on his body
		Draw the professional team	Encourage the patient to draw the medical personnel accompanying him during treatment. Provide a space to express your thoughts
		Coloring your friends the medicines	Encourage creative use
		Draw yourself receiving QT	Encourage the child to use her experience and draw himself receiving his cancer treatment.
Psychoeducation to the child about his immune system and the influence of emotions in his battle against Leukemia.	Session 5	Some questions of interest	Tell the child or adolescent the questions to answer.
		put the words in order	Point out to the child that with the use of her imagination he can draw what her illness is like inside her body.
		Draw the disease	Encourage the child to use her imagination and draw what her active defense system is like in her body
	Session 6	Draw your immune system	Encourage the child to use her imagination and draw how she imagines her neutrophils. It is important to rely on playful material (dolls or puppets)
		Draw your neutrophils	Stimulate the patient imagine and draw their B Lymphocytes. It is important to rely on playful material (dolls or puppets)
		Draw your B Lymphocytes	Give directions for the completion of these activities and motivate him to express his knowledge about these characters: Mac, Lympho T, Lympho B.
		Link the dots	Stimulate the patient to imagine and draw the immunological battle in her body, allow her to narrate it and translate it into the Manual
		Complete the drawing	Allow the child space to express how he imagines himself totally healthy, relate the activities that he visualizes doing to draw in the manual.

At the end of the Psychoeducation, the phase of guided imagination based on psychoneuroimmunology continues, which is programmed in an important phase of the child’s medical treatment protocol for day 33 for patients with Acute Lymphoid Leukemia according to the ALL Protocol. IC-BFM 2009.



For the guided imagination phase, the authors created audio, intending to relax and take an imaginary journey in your body to activate your immune system and thus activate your healing process. These exercises were carried out in the hospital and at home. A record was made daily and was complemented with didactic activities where the child could capture visualizations of her within her body through drawing.

This phase is accompanied by an information session for parents that reinforces the importance of psychoneuroimmunology techniques and the importance of them being involved in the treatment of the child and motivating them to carry out relaxation sessions at home.

Variables	Dimensios	Subdimensions	Indicators	Measurement
ILLNESS PROCESS	Immunological parameters	Lymphocyte population	Total Lymphocytes Natural killer T lymphocyte B lymphocyte	Peripheral blood analysis by flow cytometry.
		Lymphocyte subpopulation	CD4, CD8	Peripheral blood analysis by flow cytometry.
		Immunoglobulins	IgA, IgM, IgG	Peripheral blood analysis in clinical laboratory.
	Clinical parameters	Hospitalization	Days of Hospitalized stay Frequency of hospital admissions. Induction duration	Clinical History Record
		Signs and symptom	Fever Pain Skin paleness Vomiting Liquid Evacuations Hyporexia Dyspnoea Tachycardia Lymphadenopathy Signs of Bleeding Hepatosplenomegaly	Clinical History Record
		Complications during the induction phase	Febrile neutropenia Mucositis Diabetes Septic shock Bronchial hyperactivity Pneumonia Phlebitis Enterocolitis Convulsive syndrome Others	Clinical History Record
	Pharmacological parameters	Medication and support administration	Medicines Antibiotics Analgesic Pain Therapy Antipyretic Antiemetic	Clinical History Record

Variables	Dimensios	Subdimensions	Indicators	Measurement
			Supportive Therapy: Colony Stimulating Factor Globular (Blood) Transfusion Platelet transfusion Parental nutrition Respiratory therapies	

To evaluate the disease process, the immunological, clinical, and pharmacological parameters in the child are considered during the induction phase of chemotherapy treatment by recording medical records during hospitalization and laboratory tests for Immunoglobulins Lymphocytes and subpopulation of Lymphocytes by cytometry (See below table).

To evaluate the Quality of Life: It is obtained by applying the Quality Questionnaire in Pediatric Oncology by Jordi Bernabeu, standardized in the applied child population (2014). The dimensions of the Questionnaire were

- Social functioning.
- Symptoms.
- Autonomy
- School performance.
- Psychological discomfort.
- Psychological well-being.

8.2 Results to highlight from the research

The results of the study indicate that the intervention protocol based on psychoneuroimmunology (PNI) positively modified the clinical evolution (symptoms and treatment) of the patients, substantially improved their immune parameters and significantly increased the quality of life of children with cancer, specifically in a sample of children with acute lymphoblastic leukemia.

Summary of the effects of the Psychological Intervention based on PNI

Clinical Parameters		
Signs and symptoms	Fever	↓ ↓
	Pain	O
	Skin paleness	O
	Vomiting	O
	Liquid stools	O
	Hyperoxia	O
	Dyspnoea	O

Clinical Parameters		
	Tachycardia	O
	Lymphadenopathy	O
	Signs of Bleeding	O
	Hepatosplenomegaly	O
Complications	Febrile neutropenia	O
	Pneumonia	O
	Phlebitis	
	Enterocolitis	
	Convulsive syndrome	
	Others	
	Mucositis	O
	Phlebitis	O
	Diabetes	O
	Enterocolitis	O
	Septic shock	O
	Convulsive syndrome	O
	Bronchial hyperactivity	O
	Others	O
Pharmacological and support parameters		
Medicines	Pain Therapy	↓
	Antibiotics	
	Antipyretic	
	Antiemetic	
	Antibiotics	↓
	Antipyretic	
	Antiemetic	
	Antipyretic	↓
Support therapy	Antiemetic	O
	Colony Stimulating Factor	O
	Globular (Blood) Transfusion	O
	Platelet transfusion	O
	Parenteral nutrition	O
	Respiratory Therapies	↓
Immune parameters		
Lymphocyte population	Natural Killer	↑
	T lymphocyte	↑
	B lymphocyte	↑
Lymphocyte subpopulation	CD4	↑
	CD8	↑
Immunoglobulins	IgM	↑
	IgA	
	IgA	↑
	IgG	O
Quality of life		↑

↑ ↓	Statistically significant difference
O	No statistically significant differences

**8.3 Some effects of the intervention protocol based on psychoneuroimmunology on clinical parameters**

*8.3.1 Symptoms and signs*

In this regard, the PNI-based intervention protocol’s efficacy was directly appreciated in its clinical picture, especially the symptoms and signs compatible with infectious and inflammatory processes secondary to chemotherapy; Among these, statistically significant differences stand out on the days with fever during the induction process. The operated group had six days less fever than the control group. There was a lower frequency of vomiting, dyspnea and tachycardia in the operated patients than the controls; Although these differences did not reach statistical significance due to the values’ variance, they could be taken as likely trends in a larger sample of patients.

*8.3.2 Complications during the induction phase*

The intervened group had a tendency (statistically not significant) to a lower frequency of complications during the induction phase, especially those of an infectious type such as febrile neutropenia, mucositis, septic shock, pneumonia, abscesses, chickenpox and enterocolitis. However, although there was no apparent effect on the duration of some symptoms of an infectious nature, the need to use antibiotics for fewer days in those treated - as described below - suggests that these processes were less severe or easier to manage.

**8.4 Effects of the intervention protocol based on psychoneuroimmunology on pharmacological parameters**

According to the results, although there was an improvement in the clinical evolution, it was not reflected in fewer days of hospitalization, if it was consistently associated with a lower frequency in the use of treatments to control fever and infectious and inflammatory processes: antibiotics, antipyretics, pain therapy and respiratory therapies in the intervened group compared to controls.

There was evidence to support the view that the lower use of antibiotics in operated patients was related to improved cellular immunity, although not humoral. The use of antibiotics was linearly and inversely correlated with a higher number of CD8 T lymphocytes and NK cells, mediators of cellular immunity, but not with the number of B lymphocytes, which participate in humoral immunity.

On the other hand, in the study, three variables estimated pain: directly, days with pain as a symptom (clinical parameter) and indirectly, days of pain therapy and days with analgesics (treatment parameters). A tendency to report pain for a smaller number of days was observed in those operated on than controls, although this difference did not reach statistical significance. However, the number of days during which pain therapy was administered was significantly lower in patients concerning controls. This suggests that the psychotherapeutic intervention markedly influenced the sensory function of leukemia patients during chemotherapy induction.

#### *8.4.1 Supportive therapy*

It was observed that the operated patients required respiratory therapy for 82% shorter periods than the controls. This smaller statistically significant difference in the intervened group may be due to a greater recurrence of infections that required this type of support for their recovery.

It was also evidenced that the intervened patients required colony growth factor therapies for periods 50% shorter than the controls. However, statistical significance was not reached due to the wide variability of the control group. However, this finding suggests that the intervened group presented a lower level of leukopenia during this period, as it required less use of this pharmacological agent.

### **8.5 Effects of the intervention protocol based on psychoneuroimmunology on immune parameters**

Significant changes in the immune parameters' values, both cellular and humoral, were observed during the induction process in pediatric patients with acute lymphoblastic leukemia. These changes suggest that the better clinical evolution of the operated patients was linked to a substantial improvement in their immune function.

#### *8.5.1 Cellular immunity*

Specifically, there was a significant increase in the number of natural killers NK cells and CD8 and CD4 type T lymphocytes in the intervened group, especially at the end of the chemotherapy induction period (day 64), compared to the control group.

It is important to remember that both natural killer cells or NK cells and T lymphocytes are involved in cellular immunity mechanisms against neoplastic cells. Within the T lymphocytes population, there are two subpopulations of lymphocytes, CD4 and CD8, both of great clinical importance. CD4 lymphocytes act mainly against parasites, bacteria and fungi, and to a lesser degree, against viruses and tumor antigens, while CD8 lymphocytes will act mainly against tumor cells and viruses. Therefore, a more significant number of natural killer NK cells and CD8 lymphocytes, specialized in the destruction of malignant cells, in children treated with the protocol based on psychoneuroimmunology implied an improvement in their cellular immunity, and as a result, a lower frequency of infectious symptoms, which led to less need for antibiotics and antipyretics in the children treated in this study.

#### *8.5.2 Humoral immunity*

Serum levels of IgM and IgA antibodies were significantly higher in the intervened group in relation to the control group, which suggests that the PNI-based intervention increased humoral immunity. It is important to remember that B lymphocytes are immunocompetent cells whose primary function is to produce antibodies, a specific type of protein called immunoglobulins. Thus, it can be assumed that the higher serum antibody levels in the operated children were significantly related to the increase in the number of B lymphocytes.

### **8.6 Effect of the intervention protocol based on psychoneuroimmunology on quality of life**

The recovery of quality of life was significantly greater in the operated patients than in the controls. This was linked to an improvement in both clinical symptoms



and immunological parameters. It is important to highlight that this recovery of quality of life was linearly and positively correlated with the number of NK cells and CD8 lymphocytes, suggesting that an immunological substrate made this change possible.

## **9. Psychoneuroimmunology: present and future in clinical and health practice**

The amount of research that reports the mind-body expresses that there is no longer any doubt about this relationship since its biochemical mechanism is recognized. That is why health professionals' objective is to encourage the promotion of developing health plans that incorporate psychoneuroimmunology techniques and promote the reduction of psychosocial risk factors.

On the other hand, it is exposed that Psychoneuroimmunology gives us the understanding of the mental factors that modulate the immune system, offering a transdisciplinary perspective of the way of understanding health and disease. This leads us to reflect on the need to incorporate public health measures considering these aspects and the challenges and opportunities for researchers and teachers in the health area to promote training and treatment programs oriented to these findings.

The consideration of Psychoneuroimmunology in understanding the disease is also of high impact in the prevention and proposals of public health policies, considering the high levels of stress to which children and adults are subjected in some harmful environments.

The information presented here wants to be a great incentive to promote mechanisms that integrate all disciplines within the academic, governmental, clinical and health sectors to generate policies and mutual support to develop plans that promote health and influence the healing of diseases on a physical and mental level.

## **10. Conclusion**

Psychoneuroimmunology has provided a clear scientific insight into the mind-body relationship. This knowledge allows an integrative view of both prevention and treatment of diseases, representing a significant challenge. Research has shown the evident influence of stress and other psychological factors that can affect health through interactions with the immune, endocrine and nervous systems. This has provided a solid evidence base and has also improved our understanding of people's central role in their healing, both for adults and children, which implies both recovery of their physical condition and their quality of life.

## **Acknowledgements**

Special thanks to Dr. Marianela Cástes, pioneer of psychoneuroimmunology in Latin America, researcher and main personal inspiration at the PNI level.

To Dr. Rosario Montilva, pediatric oncologist and Coordinator of the Pediatric Oncology Unit of the Pediatric Specialties Hospital, and to the entire team: Dr. Betty Urdaneta de Ramos (Hematologist), Dr. Fatima Vilorio (Pediatric Oncologist), Dr. Yoleida Colmenares (Pediatric Oncologist), Lic. Leila Nouheid (Nutritionist), Lic Maira Alvarez and Mayra Vargas, both committed nurses.

Special thanks to the children and family members of the Pediatric Specialties Hospital, who participated in the research and who continue to be active in putting forth the greatest force to heal.

IntechOpen

IntechOpen

### **Author details**


Margarita del Valle Chacin Fuenmayor<sup>1\*</sup> and Josymar Chacin de Fernandez<sup>2</sup>

1 Horley Psychology and Shineeq, Horley, United Kingdom

2 Avantem, San José, Costa Rica

\*Address all correspondence to: [margarita@horleypsychology.co.uk](mailto:margarita@horleypsychology.co.uk)

### **IntechOpen**

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Engel, G. L. The need for a new medical model: A challenge for biomedicine. *Science*. 1977; 196, 129–136.
- [2] Solomon, G.F., Segerstrom, S.G., Grohr, P., Kemeny, M., and Fahey, J. Shaking up immunity: psychological and immunologic changes following a natural disaster. *Psychosomatic Medicine* 1997; 59, 114-127.
- [3] Fleshner, M. , Laudenslager, M. L. , Simons, L. , & Maier, S. F. Reduced serum antibodies associated with social defeat in rats. *Physiology & Behavior*, 1989, 45, 1183-1187.
- [4] Alford, L., Findings of interest from immunology and psychoneuroimmunology. *Manual therapy*, 2007, 10.1016/j.math.2006.06.007
- [5] Vidal, J. *Psiconeuroinmunología*. Barcelona: Ediciones de la Universidad de Barcelona. 2006
- [6] Ortega, MC. *La Psiconeuroinmunología y La Promoción de la Salud*. Universidad Nacional de Educación a Distancia, 2011.
- [7] Lyubomirsky, S., et al. The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, 131, (6), 2005, 803-855.
- [8] Maruso, S. M. . *El laboratorio del alma. Historias para sanar que merecen ser contadas*. Buenos Aires: Ediciones B; 2009.
- [9] Oblitas, L. *Encyclopedia of Health Psychology*. Bogotá: PSICOM. 2007
- [10] Bradlyn, A. S.; Pollock, B. H. Quality of life research in the Pediatric Oncology Group. *Journal of the National Cancer Institute*. 1996; 20: 49-53
- [11] Parsons, S K; Barlow, S E; Levy, S L; Supran, S E; Kaplan, S H (1999). Health-relates quality of life in pediatric bone marrow transplant survivors: according to whom?. *International journal of cancer* 12: 46-51
- [12] Antoni, MH. Stress Management Effects on Psychological, Endocrinological, and Immune Functioning in Men with HIV Infection: Empirical Support for a Psychoneuroimmunological Model. *Stress: The International Journal on the Biology of Stress*, 2003; 6, 173-188.
- [13] Robinson, FP. (2002). Psycho-endocrine-immune response to mindfulness-based stress reduction in HIV-infected individuals. *Dissertation Abstracts International: Section- B: The Sciences and Engineering*, 63(1-B), 179.
- [14] Lutgendorf, S & Costanzo, E (2003) Psychoneuroimmunology and health psychology. An integrative model. *Brain, Behavior and Immunity*. 17, 225-232.
- [15] Ramos, V., Rivero Burón, R., Piqueras J. A., García, L. J. & Oblitas, L. A. *Psiconeuroinmunología: Conexiones Entre Sistema Nervioso Y Sistema Inmune*. *Suma Psicológica*, 2008; 15(1) 115-141.
- [16] Bower JE, Kemeny ME, Taylor SE, et al. Finding positive meaning and its association with natural killer cell cytotoxicity among participants in a bereavement-related disclosure intervention. *Annals of Behavioral Medicine*. 2003; 25: 146–155.
- [17] Tagge, E. P., Natali, E. L., Lima, E., Leek, D., Neece, C. L., & Randall, K. F. Psychoneuroimmunology and the pediatric surgeon. *Seminars in Pediatric Surgery*. 2013; 22(3), 144–148.
- [18] Castes, M; Hagel, I., Palenque, M., Canelones, P., Corao, A and Lynch, N. Immunological changes associated with

clinical improvement of asthmatic children submitted to psycho-social intervention. *Brain, Behavior and Immunity*. 1999; 13, 1 -13

[19] Chacin-Fernández J, Chacin Fuenmayor M, Piñerua-Shuhaibar L, Suarez-Roca H. Psychological intervention based on psychoneuroimmunology improves clinical evolution, quality of life, and immunity of children with leukemia: A preliminary study. *Health Psychol Open*. 2019 Apr 1;6(1): 2055102919838902. doi: 10.1177/2055102919838902.