

## Comedy Cures: Laughter Therapy's Hormonal, Neurological, and Mechanistic Effects on the Cardiovascular, Musculoskeletal, Immunological, and Respiratory Systems and Common Psychological Disorders

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### Abstract

The ability to laugh is a trait shared by all people; studies have shown a positive association between humor and general health. Both humor and laughter therapy, a cognitive-behavioral therapy, have demonstrated verifiable psychological and physical benefits in certain health aspects—given that it lowers blood levels of cortisol, epinephrine, growth hormone, and 3,4-dihydro-phenylacetic acid.

Laughter therapy can be applied in certain psychological conditions. Furthermore, research has shown that laughter therapy is beneficial for body temperature, blood pressure (BP), respiratory rate, musculoskeletal activity, and brain activity (enhancing well-being and improving the quality of life [QoL] of those who are stressed). On the other hand, humor has improved communication, motivation, engagement, and performance. As a complement or primary therapy, laughter-inducing or humor therapies might be cost-effective for specific groups with psychological problems.

The objectives of this review are to outline the history of humor and laughter in healthcare and to investigate the psychological and psychological effects of humor and laughter on issues related to pain, heart, autoimmune system, and mental health. The future of laughter therapy is also discussed, along with a thorough analysis of laughter exercises and their promotion in hospital settings.

**Keywords:** Better Sleep; Depression; High Blood Pressure Cures; Mental Illness; Religious Practices

### Abbreviations

BP: Blood Pressure; CV: Cardiovascular; HPA: Hypothalamus-Pituitary-Adrenal; FMD: Flow-Mediated Dilation; QoL: Quality of Life; RA: Rheumatoid Arthritis; ROS: Reactive Oxygen Species; T2D: Type-2 Diabetes; UPDRS: Unified Parkinson’s Disease Rating Scale

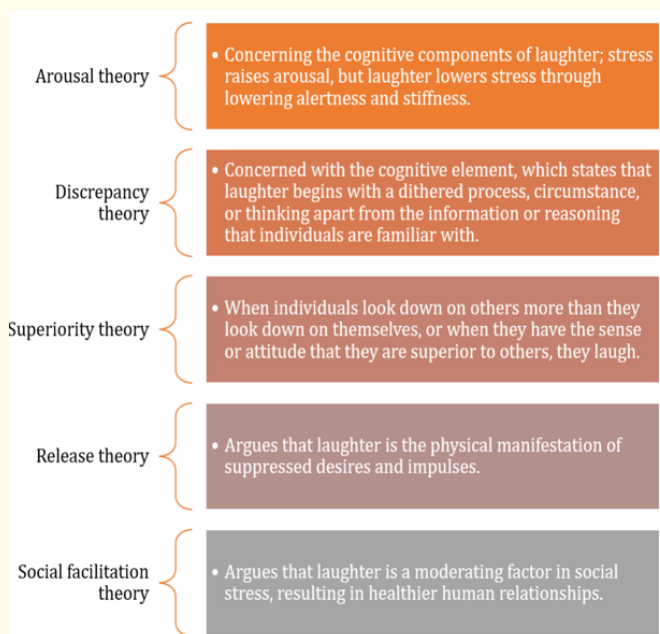
### Introduction

Laughter and humor therapy has a rich history and has been a component of human society for as long as one can trace. For example, ancient cave dwellers used laughter therapy to ease fear and anxiety. To demonstrate their friendliness and goodwill toward other tribes, they even used comedy/humor [1]. Even the Bible mentions the benefits of humor and laughter in the book of Proverbs: “A happy heart is a good medicine, but a shattered heart makes one sick” [2].

Laughter and humor are different but frequently combined activities that can happen simultaneously or separately. Humor can be related to a stimulus (for example, a comedy film), a mental process (awareness of hilarious inconsistencies), or a response (laughter, exhilaration).” Humor can also be a mental activity that depends on the individual’s point of view. As a result, it is generally accepted that a sense of humor is a psychological characteristic that differs from person to person and enables an individual to recognize and react to various forms of amusing stimuli [3].

Laughter, on the other hand, is described as a psychophysiological response to comedy that includes typical physiological reactions and positive psychological alterations [3,4].

Laughter is an old evolutionary communication signal of high relevance to social interactions [5]. It can be triggered by actions such as being tickled and funny stories or ideas [6,7]. Figure 1 shows the theories behind every laugh (or the psychological motivations behind genuine or ‘spontaneous’ laughter) [6,8,9].



**Figure 1:** Theories behind laughter.

Laughter also plays a social role, and it is believed that laughter therapy, a form of cognitive-behavioral therapy, influences a person's interactions with others and their physical, mental, and interpersonal well-being [6,10,11].

### **Historical references to laughter therapy**

Laughter therapy has been around for a long time, and one of the oldest recorded tales of the therapeutic benefits of humor and laughter was given by King Solomon some 3000 years ago [12].

Ancient Greek physicians recommended attending the comedy hall as a crucial step in healing as an auxiliary to therapy. Similarly, early Native Americans used the tremendous effects of humor and laughter in the healing process [2].

Henri de Mondeville, a French surgeon, employed humor as a cure and a means of diversion for his patients during surgery in the 14th century [13]. In the book *Cyrurgia*, Mondeville endorsed this technique. He said, "The surgeon must take care to control the entire system of pleasures and pains of the patient's life, and his family and special friends also help him by encouraging and telling jokes".

In the sixteenth century, the English parson and scholar Robert Burton improved this technique by employing humor to cure mental problems, as detailed in his work, *The Anatomy of Melancholy* [14]. At the same time, Martin Luther, a German clergyman, employed humor to treat mental problems as an essential component of pastoral care. Luther urged those suffering from depression not to hide but to surround themselves with companions who could entertain them [15].

In the eighteenth century, Kant asserted that laughing contributes to maintaining physical equilibrium. Spencer similarly contended in the nineteenth century that laughter reduces anxiety and promotes health [6]. During the 1930s polio pandemic, hospitals recruited clowns to cheer up ailing young people [16].

Frankl (1969), a captive in a Nazi concentration camp, felt that laughter was essential to his survival. He found purpose in his life by being able to laugh, even in the most horrific situations. Even the enemies could not take away this profound experience, which gave him inner power [17].

Dr. Hunter "Patch" Adams founded the Gesundheit Institute in 1972 to provide humor, joy, and laughter to patients [18]. Norman Cousins further popularized the notion of laughter as part of the healing process in 1979. Cousins learned that 10 minutes of laughter could provide hours of painless sleep.

In his book *Head First: The Biology of Hope*, Cousins also discussed the pharmacological and physiological consequences of humor and laughter on the human body, including improvements in BP, blood oxygenation, digestion, and even the suppression of stress-related hormones [17].

### **Discussion**

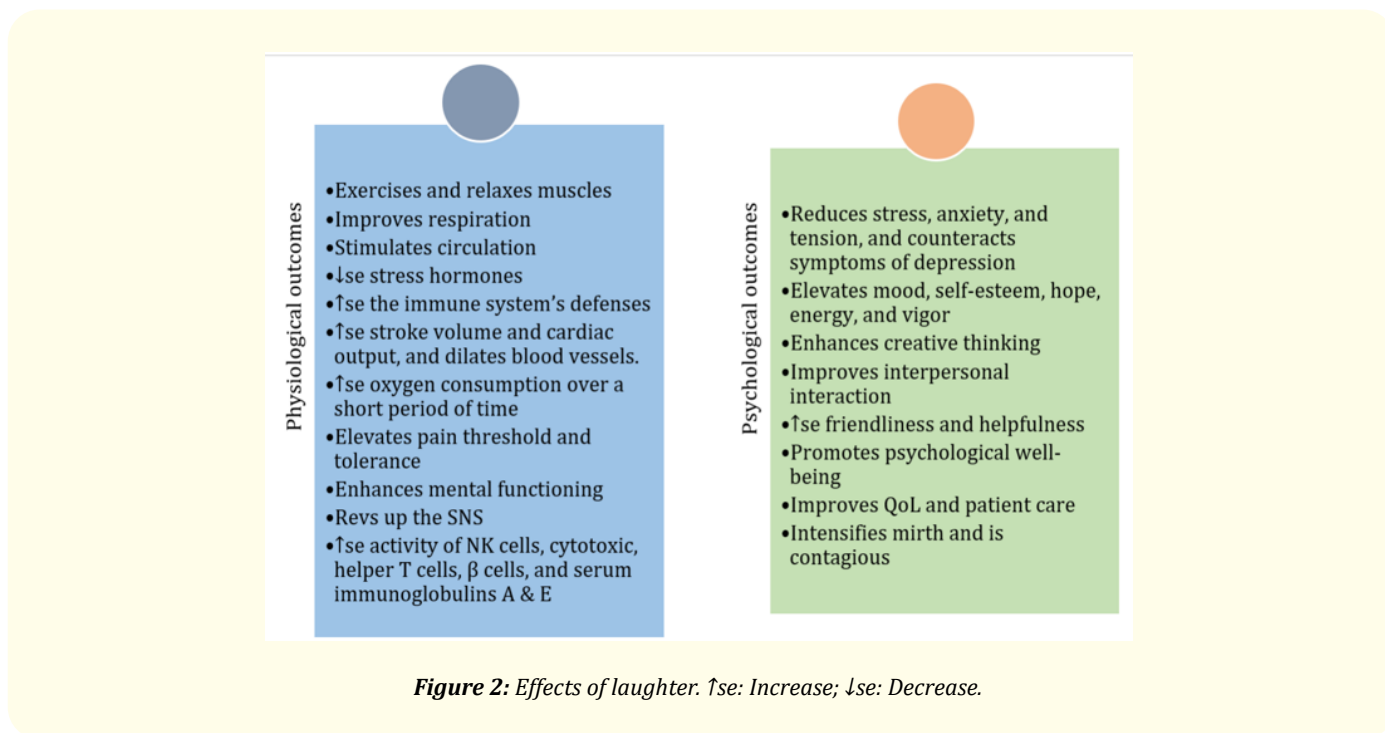
Laughing therapy improves people's lives by preserving, repairing, and safeguarding their physical, emotional, interpersonal, intellectual, and spiritual competence via spontaneous and forced laughter [19]. In the clinical environment, it can be applied as a preventive measure or as an additional or different treatment option from other well-established therapeutic approaches.

Laughter therapy is used primarily in the social area for preventive interventions to improve health advantages in the job, community, family, or personal environments [19-21]. Laughter therapy causes the production of a variety of chemicals and hormones that are vital to

good health and are incredibly useful, including NK cells, endorphins, serotonin, cortisol, dopamine, growth hormone, and several other compounds [22].

According to Hasan and Hasan (2009), the brain’s cognitive, physical, and affective areas all have a role in managing laughter. The frontal cortex, the focus of the cognitive component, enables an individual to understand various humorous stimuli. The motor component is housed in the supplementary motor cortex, producing a sequence of the facial expressions required for laughter. Finally, the emotional element of laughter, mainly located in the nucleus accumbens, a region of the brain’s reward circuitry or ‘pleasure’, enables the individual to feel and justify enjoyment [23]. Additionally, EEG mapping investigations on a person’s brain during laughter reveal that the right occipital area or hemisphere exhibits a noticeable increase in activity [24].

The muscular, circulatory, respiratory, endocrine, immunological, and central neurological systems are affected by laughter in various ways (Figure 2) [6,25,26].



**Figure 2: Effects of laughter. ↑se: Increase; ↓se: Decrease.**

Generally, laughter is produced through a simulated or spontaneous pathway. Emotions evoked by an external stimulus cause the laughter that follows the spontaneous path. This automatic channel through the neurological system involves several parts of the brain, such as the amygdala, thalamus, hypothalamus, subthalamic, and dorsal brain stem. However, if laughter is not motivated by emotion, it is stimulated and takes a distinct route through the nervous system. This voluntary channel begins in the premotor opercula areas and travels to the ventral brain stem through the motor cortex and dendritic tract [3].

Researchers also identified five clinically and clinically important categories of laughter, as they can occur with or without humor (Figure 3) [3,6,7].



Figure 3: Different groups of laughter.

### Humor-induced hormonal responses to stress and anxiety

Stress is linked to 90% of all cases of the disease. Today’s most common stress-related illnesses are depression, anxiety and asthma, alcohol or drug addiction, heart disease, diabetes, high BP, and cancer [22]. Humor is beneficial for stress management as it lowers levels of stress hormones (cortisol and adrenaline) and increases activation of the mesolimbic dopaminergic reward system [2].

In 80 patients, Newman MG and Stone AA (1996) investigated whether humor formation affects the emotional and physiological responses of individuals with high- and low-trait humor. The findings showed that when comedy was delivered as opposed to harrowing tales, fewer adverse effects, less tension, and fewer psychophysiological reactions were formed.

These findings revealed that humor creation might be a helpful coping approach even for those who generally do not use humor as a stress reduction tool. Furthermore, this research indicates that being around humorous stimuli reduces anger and violent conduct, induces sadness, and elicits feelings of helplessness [27]. Other studies on the benefits of humor appreciation found that it improves individual performance by capturing and retaining attention, minimizing anxiety, promoting participation, and increasing motivation [2].

### Therapeutic benefits of laughter

Laughter therapy increases oxygen uptake, energizes the heart, lungs, and muscles, and releases endorphins. These interact with the brain’s opioid receptors to alleviate pain and arouse pleasure [28,29]. In addition, it aids in recovery from mental illness. According to Kheirandish, *et al.* (2015), an imbalance of neurotransmitters and neuropeptides in the blood could contribute to depression [29].

Laughter alleviates symptoms of depression by changing the activity of the neurotransmitter dopamine and serotonin [6]. Another study with 30 people with schizophrenia discovered that 10 hours of humor skill training could improve rehabilitative outcomes and sense of humor (including a significant reduction in PANSS negative symptoms and depression/anxiety mood) [30]. Figure 4 illustrates the impact of laughter therapy on mental health [6].



**Figure 4:** Effects of laughter therapy on mental health.

Laughter also improves blood vessels’ performance and blood flow to the heart, increasing circulation and oxygenation to the body’s major organs and helping prevent heart attacks and other cardiovascular (CV) problems [6,22]. Figure 5 illustrates the overall positive impact of laughter on the cardiovascular system [31].

Hayashi, *et al.* (2003) examined the relationship between laughing and the incidence of CV diseases (n = 20,934 people). The incidence of heart disease and stroke was shown to be 1.21 times and 1.60 times greater in people who seldom or never laughed than in those who laughed every day, even after correcting for hypercholesterolemia, BP, despair, body mass index, as well as other risk factors [32]. Similarly, Bruschi, *et al.* (2008) showed that laughter and clowns could help reduce hyperinflation of the lungs by approximately 10% in individuals with severe COPD [33].

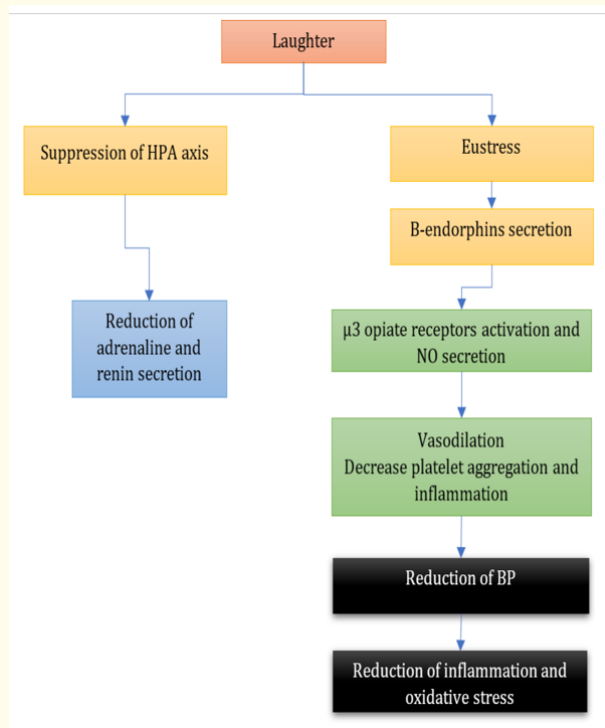


Figure 5: Mechanisms of laughter in cardiomyopathy. (HPA: hypothalamus-pituitary-adrenal).

Hayashi, *et al.* (2003), in their study, also showed that laughter could affect postprandial glucose levels, the most noticeable deviation associated with type-2 diabetes (T2D) [32]. T2D interferes with the renin-angiotensin system (RAS), which can cause nephropathy and high BP. Following this hypothesis, Nasir, *et al.* (2005) examined the impact of laughter on RAS in 18 T2D patients.

The results revealed that laughter therapy reduced plasma renin concentrations (8.2 ng/ml/h after three months and 7.7 ng/ml/h after six months) and restored mean plasma angiotensinogen concentrations (0.47 g/ml after three months and 0.42 g/ml after six months). In addition, this study showed that using laughter therapy as an additional treatment helped prevent diabetic microvascular problems [34].

Laughter therapy also influences both central hemodynamics and arterial stiffness. In one study, 18 healthy participants watched a comedy film for 30 minutes, and the results showed that laughter reduced PWV ( $p < .01$ ) and the augmentation index ( $p < .05$ ), which represents vascular flexibility [35].

Another study found that after watching a 30-minute comedy movie that caused laughter, 19 of 20 volunteers had improved brachial vasodilation ( $p < .0001$ ). A substantial (22%) increase in flow-mediated dilation (FMD) was also observed after seeing the humor movie ( $p < .0001$ ), indicating that laughter can affect endothelial function [36].



Regarding lowering blood pressure (BP), research has shown that people who laugh enthusiastically daily have lower standing BP than the typical person [37]. A study by Jalali, *et al.* (2008) to assess the impact of laughter therapy on BP in hypertensive patients found a statistically significant difference between BP before and after the test at  $p < 0.05$  [38]. However, Berk, *et al.* (1988) study proved that laughter strengthens one's immune system by keeping the individual healthy [17].

Patients with rheumatoid arthritis (RA) who laugh may also experience a reduction in joint inflammation. In general, the deregulation of IL-1Ra and IL-1 production can contribute to the pathophysiology of RA. Therefore, an increase in IL-1Ra production may be advantageous in RA. Matsuzaki T, *et al.* (2006) discovered that mirthful laughter stimulates the release of IL-1Ra in difficult-to-treat RA patients. Furthermore, RA patients decreased IL-4 or IL-6 levels [39].

In addition to improving CVD and inflammatory symptoms, laughter therapy may also help with neurodegenerative disorders. Bega D, *et al.* (2016) researched to see if a theatrical program (comedy) may improve the quality of life (QoL) in patients with Parkinson's disease ( $n = 22$ ). The results showed that 21/22 people loved the humor and felt it helped their disease. The Unified Parkinson's Disease Rating Scale (UPDRS) sections I-IV also showed a substantial improvement from pre-to-post treatment [40].

Miller and Fry have developed a visual portrayal of the influence of laughter on endothelial function [41]. They claimed that laughter triggers the production of endorphins from the pituitary and brain, which go to the endothelium and interact with the I3 opioid receptor to produce nitric oxide [42]. Nitric oxide then induces vasodilation, reduces pain and blood clotting, and impedes leukocyte trafficking through cellular signaling pathways, including a cGMP-dependent route [43].

Laughter therapy also reduces reactive oxygen species (ROS). ROS has been shown to play a role in the etiology of chronic inflammatory disorders, cancer, and aging. For example, in a study involving 36 healthy participants, Atsumi, *et al.* (2008) revealed that watching a humorous film increased the scavenging of free radical activity systems, which were negatively related to ROS levels ( $p < .001$ ) [44].

### **Other potential benefits of laughter therapy**

Laughter therapy allows for proactive approaches to improve QoL by maximizing health benefits in the family, community, workplace, and athletic performance [45]. Elamathi E (2022) evaluated the impact of laughter therapy on quality of life (QoL) in elderly patients ( $n = 60$ ) and compared QoL after laughter therapy in the experimental and control groups. Following laughter, the QoL of the experimental group improved significantly (in all six dimensions, such as physical, psychological, degree of independence, social interaction, environment, spirituality, and personal belief) [46].

Stress can affect a person's ability to learn and maintain memory as they age (due to the chronic release of cortisol). However, humor and joyous laughter can alleviate this stress by lowering cortisol levels. For example, Bains GS, *et al.* (2015) studied the effects of a hilarious video on short-term memory in older people. They discovered that watching a 20-minute humorous film boosted cognitive performance, particularly learning ability (38.5%), delayed recall (43.6%), and object recognition (12.6%) [47].

Laughter therapy programs were also found to benefit cancer patients undergoing radiation treatment. Kim SH, *et al.* (2015) discovered that participants in the experimental laughter group improved tremendously in four of the six subcategories used to describe mood (tension, despair, anger, and vigor), as well as in the degree of TMD [48].

### **Laughter therapy exercises and methods**

Laughter-inducing interventions come in a multitude of forms. Humor therapy often incorporates laughter exercises with humor, such as funny films or clowns. Laughter therapy exercises are shown in figure 6 [21,49].



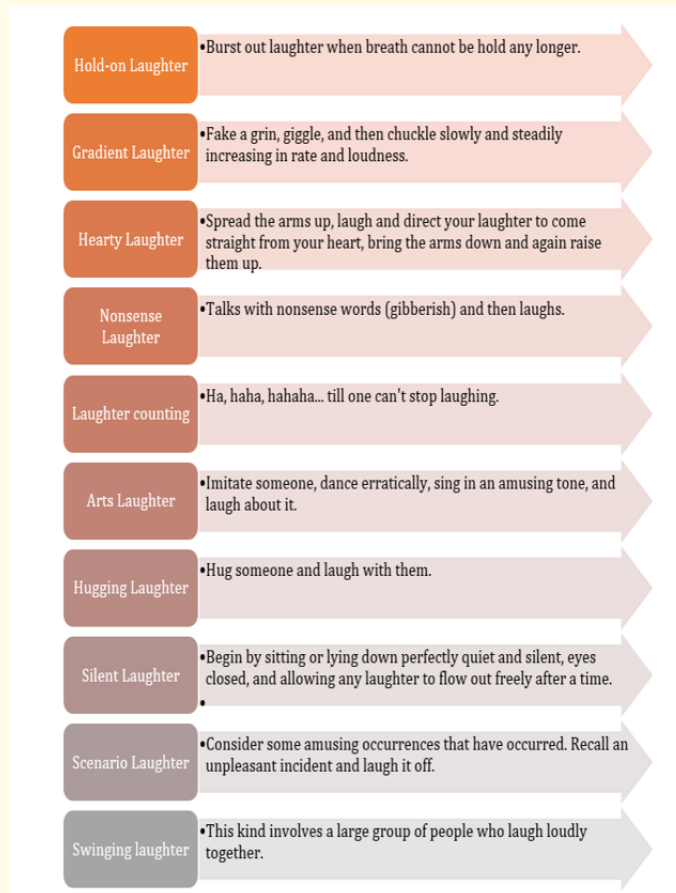


Figure 6: Laughter techniques or methods.

As laughter therapy can be performed sitting down or sitting up with populations with limited mobility. Elderly or cognitively disabled groups may benefit from non-humorous laughter since it does not rely on things like linguistic abilities or wordplay [50].

A specific non-humorous laughter-inducing treatment is laughter yoga, which is best practiced in groups. Madan Katarya, a Hindi physician, established laughter yoga in 1995. It mixes traditional yoga breathing techniques with laughter exercises, as well as a variety of enjoyable activities [51,52]. A 2011 study on laughter yoga by Shahidi M found that laughter yoga programs dramatically reduced depression in older people [52].

### Contraindications to laughter applications

Although with minimal risks, laughter therapy can induce physical strain, trunk compression, and increase intra-abdominal pressure in rare circumstances. Figure 7 shows some contraindications to laughter [7,20,53,54].



**Figure 7:** Contraindications to laughter.

### Laughter therapy variability and need for age or gender specificity

Gender comparison surveys revealed that women laugh more than men, yet the daily frequency of laughter does not change. Laughter is more likely a stress reduction strategy for women and is related to more vital social support in partnerships. Men are likelier to use humor and amusement when discussing delicate health issues [20].

Regarding age diversity, surveys show that youngsters laugh 400 times more daily than adults, who averagely laugh 15 times daily. However, both adults and children require laughter therapy at some point in their lives. Their stress and anxiety levels increase when they experience recurrent bouts of loneliness, are away from their familiar home environment, confront unexpected routines, or are hospitalized for medical treatments.

In these cases, laughter therapy can eliminate psychological stereotypes, increase self-esteem, and improve patients’ emotional well-being with chronic diseases or physical or intellectual disabilities [45].

### **Laughter promotion and its prescription in the healthcare setting**

Laughter therapy has been incorporated into medical practice (treatment plans) because it does not need particular setups, such as adequate premises and equipment, and is easy to access and well tolerated by patients [6]. Laughter therapy can also be used in critical or long-term care settings, such as for patients undergoing stroke rehabilitation, waiting for an organ transplant, or undergoing hemodialysis.

Clown physicians, clowns, and comedy or laughter rooms are some techniques used. Laughter speeds up healing and rehabilitation, allowing patients to spend less time in the hospital [7,22]. It may also be included in nurses' occupational health and wellness programs [7].

Health care providers also advocate humor as a therapeutic method in patient-centered care settings. Humor provides an environment where patients are less guarded and more ready to interact with others [3].

Laughter prescriptions are still mostly hypothetical, but the available research suggests that effective laughter "treatments" often occur once a week or less, for 30 to 60 minutes [53]. However, lower frequencies and periods, such as 20-minute individual sessions, could strongly influence [55]. An improvement in self-rated health, an increase in objective bone mineral density, and a drop in HbA1c levels were observed in a randomized controlled study in Japan that assigned 27 adults over 60 years to weekly 120-minute group laughter sessions and exercise for 3 months. This finding suggests that group laughter sessions may be a strategy to motivate the elderly to exercise [56].

### **Laughter and religion**

All religions have humor, and laughter is the basic foundation of it [57,58]. According to the Hindu pantheon, "God Ganesha", the elephant head is created by Shiva's laughter. Not just in Hindu religious contexts but also in Buddhism and Jainism, Ganesha, the "laughter God," is revered. Zeus' amorous exploits in Greece were humorous and inspired many neighbors to discuss them after midnight surreptitiously.

The Dionisia and the Anthesteria festivities were held in Athens yearly to celebrate the god Dionisius; joy and laughter filled the air from dusk to dawn. Likewise, yearly festivals at various Shinto shrines in Japan where the phrase "Laugh, Laugh!" is shouted out in unison while worshippers dance [59]. Some sūfis have also linked laughter and humor with the highest of religious experiences [60].

Surprisingly, the psychological link between humor and laughter in religions has not been studied theoretically or practically [57].

### **Current research and the future of laughter therapy**

Despite the accumulation of evidence for various interventions, the seemingly limitless potential of laughter has yet to be realized. Due to the poor quality of the data, the scientific study is still in its early stages when trying to determine its therapeutic effectiveness [50] experimentally. Furthermore, in the hospital, nursing, or office setting, laughter therapy and its prescription for patients (who experience stress or anxiety) are not fully employed [8]. To better understand the physiological consequences of laughter, future research should focus on appropriately powered preregistered randomized controlled treatments with large sample sizes, extended therapy periods, and follow-up [50].

Humanoid robots have recently been implemented in several nations (Japan and Hong Kong) to reduce stress or anxiety caused by loneliness. They can discern human emotions and provide lonely people with companionship (particularly the elderly) [61]. Similarly,

significant progress has been achieved in the area of automatically identifying (real) laughter through the processing of social signals.

This finding could be a valuable indicator of the extent to which the purportedly beneficial effects of the treatments are mediated by laughter. Recently, the introduction of web or smartphone-based interventions, which measure laughter using facial recognition and audio analysis, has been the subject of ongoing research [62,63].

## Conclusion

One of the most distinguishing and enigmatic aspects of human communication is laughter, which has recently received attention in the general press and medical literature as an alternative therapy. Laughter therapy encourages physiological, emotional, and psychological engagement and ultimately improves the QoL. Laughter therapy can also be used with other prophylactic and rehabilitative therapies. These dual interventions have been proven to improve mental health and the immune response. Additionally, humor and laughter in the healthcare industry can be relevant to patients while receiving treatment, the relationship between the patient and the caregiver, the psychological happiness of healthcare professionals, and the effect of the environment on group dynamics.

## Conflict of Interest Statement

The authors declare that this paper was written without any commercial or financial relationship that could be construed as a potential conflict of interest.

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