IS LAUGHTER THE BEST MEDICINE?
AN EVALUATION OF THE PHYSIOLOGICAL EFFECTS OF LAUGHTER

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ABSTRACT

Laughter directly affects one's physiology. Laughter causes various muscle contractions which, in turn, affect body systems. Specifically, the cardiovascular, immune, and respiratory systems are impacted by laughter. Stress levels and pain tolerance thresholds are also directly impacted by laughter. Research has been done on the effects of laughter in patients with cancer, dementia, and atopic dermatitis. Based on the review of multiple experiments, a direct correlation between laughter and multiple body systems and diseases seems to exist.

INTRODUCTION

Laughter is an audible expression of happiness and content. It is the physiological response to humor and other similar stimuli. Laughter is contagious and has the ability to create a positive atmosphere that can lift people's spirits. Scientific evidence indicates that laughter is more than just a pleasant act that people like to engage in. In fact, laughter is thought to directly affect the physiology and a number of systems of the body, possibly even having healing abilities. Research indicates that the cardiovascular, immune, and respiratory systems may benefit from laughter. Stress and pain tolerance levels also seem to be directly affected by laughter. Patients suffering from prevalent diseases such as cancer, dementia, and atopic dermatitis may benefit from laughter therapy as well.

That laughter is beneficial to one's health is not a new concept. In ancient Greece, hospitals were built next to amphitheaters, for they believed in the healing effects of laughter. Similarly, William Shakespeare believed in the health benefits of laughter. In a play he produced, *The Taming of the Shrew*, he writes, "And frame your mind to mirth and merriment, which bars a thousand harms and lengthens life" (Zillmann et al. 1993). It was only as recent as 1989, though, that the Journal of the American Medical Association acknowledged that laughter therapy has healing effects on chronic diseases and immediate symptom-relieving effects (Ljungdahl 1989).

NORMAN COUSINS

One of the pioneers of laughter therapy who had first-hand experience with the effects of laughter is Norman Cousins. Cousins is known as the man who "laughed his way out of a crippling disease" (Cousins 1976). In 1964, Cousins exhibited severe joint pain and fever. He was diagnosed as having ankylosing spondylitis (AS), a progressive rheumatoid disease involving inflammation of the spine (Martin 2004). He hypothesized that since laughter is a eustress, or positive from of stress, perhaps it would have the opposite effects that stress has. Based on that, he hired a nurse to read to him humorous stories and watched Marx Brother movies (Sahakian and Frishman 2007). These helped relieve his pain, allowing him to fall asleep. He claimed that 10 minutes of hearty laughter can provide two hours of pain-free sleep (Martin 2001). Against all odds, he was out of the hospital within a few weeks and lived to be 75 years old. He was the inspiration and driving force for scientists to investigate and research the healing effects of laughter (Sahakian and Frishman 2007). Nevertheless, despite the evidence indicated by this incident, it is possible to attribute Cousins' recovery to the high doses of vitamin C that were administered simultaneously with the laughter therapy (Martin 2001).

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EFFECTS ON PHYSIOLOGY

What happens to the body while laughing? What are the actual physiological effects of laughter on the body? Laughter, being a physical act, causes motion of several groups of muscles (more than 300 individual muscles altogether), the most visible being motion of the facial muscles (Figure 1), specifically near the oral region (Mora-Ripoll 2010). When smiling, the zygomaticus major, orbicularis oris, and orbicularis oculi contract. When laughing, these muscles contract along with simultaneous contraction of the facial, pharyngeal, and respiratory muscles (Takeda et al. 2010). Laughter also causes contraction of powerful muscles of the diaphragm. The audible sound of laughter is due to the repetitive vocal sounds produced by the actions of the chambers of the pharynx, nasal cavities, and mouth (Mora-Ripoll 2010), accompanied by changes in respiratory patterns (Sahakian and Frishman 2007). These movements directly affect the cardiovascular, respiratory, immune, muscular, and neuroendocrine systems, both short term and long term (Fry 1994). Additionally, there may be both healing and preventive effects against various diseases.

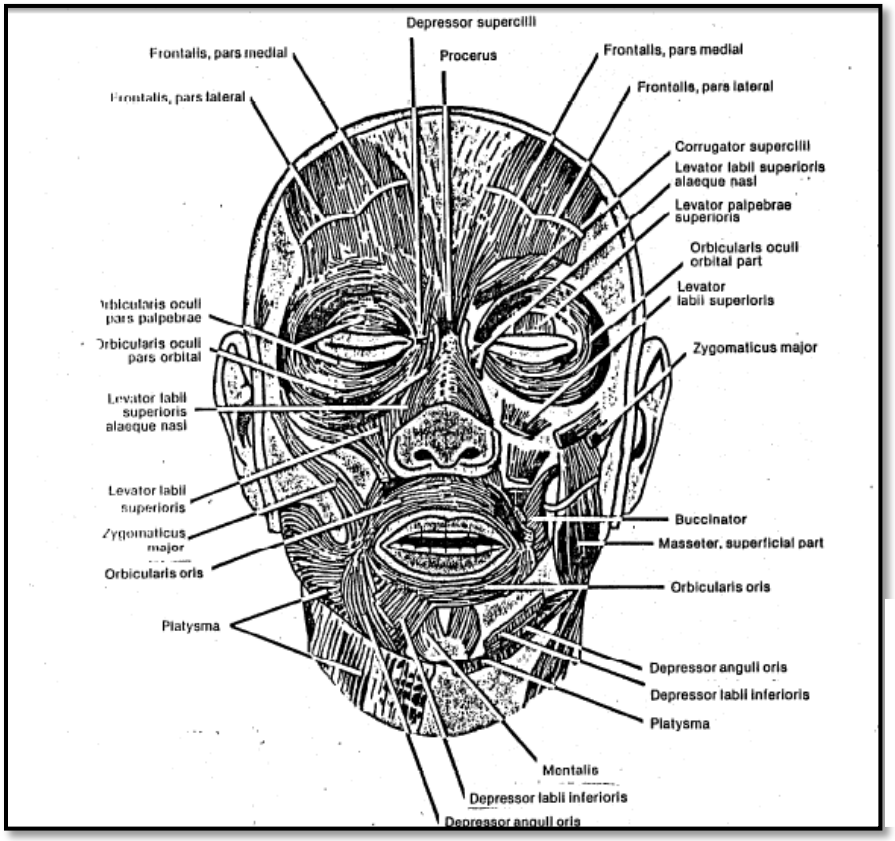


Figure 1: Muscles of the face and neck affected by laughter and smiling. Source: Ruch and Ekman 2001

Laughter can have negative physiological effects too, albeit few. Intense laughter can cause spasmodic contraction of skeletal muscles throughout the body, triggering profound physiological effects (Sahakian and Frishman 2007). There have been cases reported in which intense laughter led to a gelastic (laughter-induced) syncope. Fainting due to intense laughter is a rarity, however, and can be prevented if the laughter is controlled (Braga et al. 2005). Asthma can be exacerbated by strong laughter as well (Sahakian and Frishman 2007).

LAUGHTER TYPES

There are various forms of laughter. Different kinds of laughter have different effects on one's physiology. Therapeutic laughter is mainly derived from spontaneous laughter. Spontaneous laughter, triggered by external stimuli and positive emotions, causes contractions of muscles around the eye socket. Self-induced laughter, triggered by oneself at will, is another form of therapeutic laughter. Stimulated laughter, resulting from the physical action of certain external factors, such as tickling to one who is ticklish, is another form of therapeutic laughter, although to a lesser extent (Mora-Ripoll 2010). These laughter types are not necessarily a result of humor.

EFFECTS ON THE CARDIOVASCULAR SYSTEM

One of laughter's greatest impacts is on the cardiovascular system. The contraction of skeletal muscles during laughter increases venous return, thus reducing causes of venous stasis (Sahakian and Frishman 2007). The movements of laughter also help exercise the heart, thus increasing oxygenation of the blood (Martin 2001) and, consequently, also increasing stroke volume and thus cardiac output (Mora-Ripoll 2010). Additionally, laughter may prevent cardiac related diseases as it directly affects both systolic and diastolic arterial blood pressures (Fry and Savin 1988; Sugawara et al. 2010). Heart rate is also directly related to laughter (Sugawara et al. 2010).

An experiment was done to study and assess the direct effects of laughter on circulation (Miller et al. 2006; Sahakian and Frishman 2007). A group of 20 men and women were assigned to watch one of two 30-minute films to induce either stress or laughter. They returned two days later to watch the 30-minute segment not previously seen. Over a 100 vascular flow measurements were taken before and after the video segments. The findings showed that 95% of the volunteers demonstrated an increase in flow-mediated vasodilation during the laughter phase, and 74% showed a decrease during the mental stress phase (Figure 2) (Miller et al. 2006). These results clearly indicate a correlation between laughter and increased cardiovascular function.

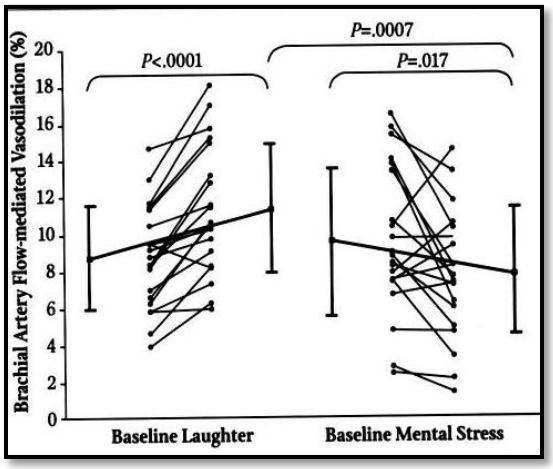
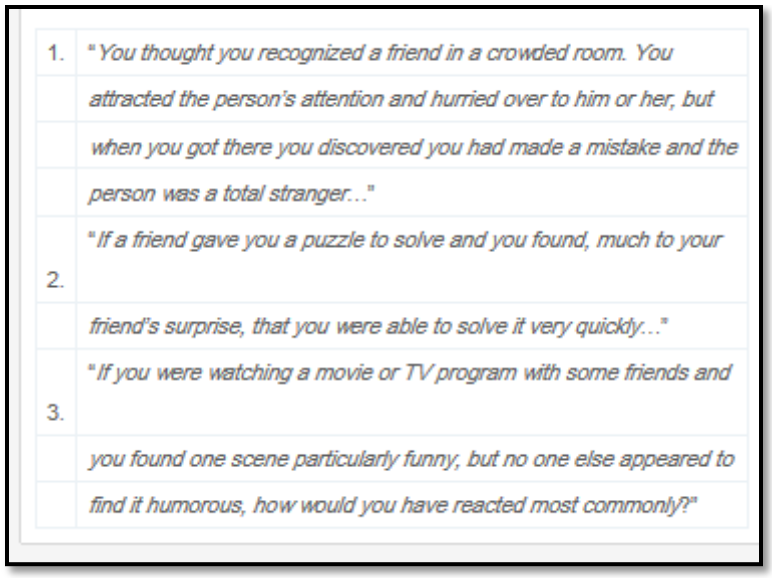


Figure 2: Measurements of flow mediated vasodilation during laughter and mental stress. Source: Miller et al. 2006

Coronary heart disease is known as the leading cause of death in the United States (Clark et al. 2001). Doctors at the University of Maryland have conducted research to determine the association between laughter and this prevalent disease. Questionnaires were given to 300 men and women, half of whom had coronary heart disease. The questions presented every day scenarios that can be found either humorous or annoying (Figure 3). The results showed that people with coronary heart disease laughed 40% less than those that were healthy, indicating an inverse association between laughter and coronary heart disease (Clark et al. 2001). This research is not very convincing as it was done on people that already have a disease. Perhaps it was the disease that was responsible for them laughing less rather than the lack of laughter being responsible for the disease.



1.	"You thought you recognized a friend in a crowded room. You attracted the person's attention and hurried over to him or her, but when you got there you discovered you had made a mistake and the person was a total stranger…"
2.	"If a friend gave you a puzzle to solve and you found, much to your friend's surprise, that you were able to solve it very quickly…"
3.	"If you were watching a movie or TV program with some friends and you found one scene particularly funny, but no one else appeared to find it humorous, how would you have reacted most commonly?"

Figure 3: Samples from the Situational Humor Response Questionnaire. Source: Clark et al. 2001

A study was done suggesting that laughter can positively impact people who suffered myocardial infarctions (MI). Two groups of patients exhibiting myocardial infarctions were followed during rehabilitation. The experimental group was allowed to watch self-selected humorous videos for 30 minutes each day. Results showed that the group viewing the humor tapes had less arrhythmias, lower plasma and urinary cholamines, required less beta blockers and nitroglycerine, and had less recurrence of myocardial infarctions (Balick and Lee 2003; Berk et al. 2001). These results show that recovery for MI patients can be positively impacted by laughter and humor. Similarly, research has shown that mirthful laughter led to a lower incidence of myocardial infarction in high-risk diabetic patients (Mora-Ripoll 2010).

Research conducted to determine the effects of laughter on various hormones points to cortisol, a stress hormone that can raise blood pressure and thus directly related to the cardiovascular system, as being greatly affected by laughter (Mora-Ripoll 2010). An experiment was done by Dr. Lee Berk, a well-known researcher in the field of laughter therapy, that took several blood samples from a group of volunteers before and after they watched a humor movie. The blood samples were examined to compare cortisol levels (among other hormone levels) before and after the laughter. The results indicated that laughter decreases cortisol levels (Sahakian and Frishman 2007). This would indicate that laughter can lower blood pressure, thereby decreasing one's chances of contracting chronic hypertension and heart failure.

Effects On the Immune System

Research has proven that people who laugh more respond better to disease. Laughter boosts immunity by increasing production and activity of interferon-gamma, natural killer cells, activated T cells, and B cells (Ziegler 1995). Laughter also affects immunoglobulin A, immunoglobulin G, and immunoglobulin M levels (Mora-Ripoll 2010).

Interferon-gamma, also known as immune interferon, is the only member of the type II class of interferons. It is a protein that is released by host cells in reaction to tumor cells, viruses, bacteria, and parasites. Interferon-gamma is secreted specifically by helper T cells, cytotoxic T cells, and natural killer cells. Interferon-gamma has antiviral, anti-tumor, and immunoregulatory properties. A study on the effects of laughter on interferon-gamma demonstrated that not only does mirthful laughter lead to an increase of interferon-gamma levels, but the heightened levels lasted into the next day as well (Ziegler 1995).

Natural killer cells are integral for the innate immune system. Natural killer cells provide rapid responses to virally infected cells and to tumor cells. They play an integral role in fighting cancer and in dealing with viral illnesses (Bennett et al. 2003). Multiple studies have been done to assess the effects of laughter on natural killer cell activity. A group of 33 women were randomly assigned to watch a humor video or a distraction video. The subjects' laughter was measured using the standard human response scale. Results indicated a correlation between laughter and natural killer cell activity (Figure 4). Lee Berk conducted a similar experiment with male subjects and yielded similar results (Berk et al. 2001).

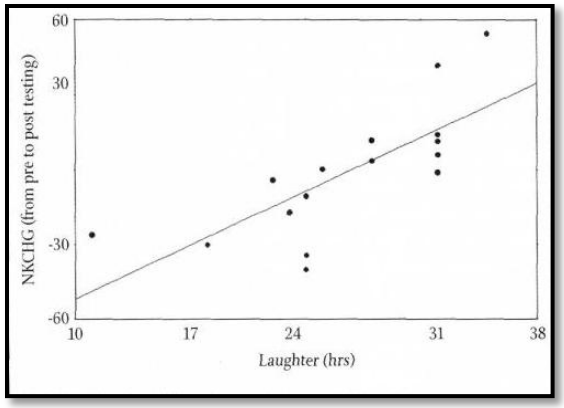


Figure 4: Effect of laughter on natural killer activity. Source: Bennett et al.

Immunoglobulin A, immunoglobulin G, and immunoglobulin M are affected by laughter as well. Immunoglobulin levels seem to increase as the amount of laughter increases (Martin 2001). Immunoglobulin A is an antibody that plays a great role in mucosal immunity (Bennett et al. 2003). Secretory immunoglobulin A is a component of the immune system, found in saliva. It is involved in defense against upper respiratory infections. An experiment done showed a significant increase in secretory immunoglobulin A due to laughter (Martin 2001). There are skeptics who question the use of immunoglobulin A to measure one's immunity, because of variations in individual salivary flow rate (Bennett et al. 2003). Therefore, natural killer cells seem to be a better method of assessing one's immune function.

EFFECTS ON THE RESPIRATORY SYSTEM

The respiratory system is another system greatly affected by laughter. The physical act of laughing assists with breathing by helping eliminate air and clear respiratory secretions during the process (Lebowitz et al. 2011). Additionally, vocalization of laughter leads to higher positive airway pressures and activation of additional muscle groups (Ruch and Ekman 2001). In one study, individuals with a sense of humor seemed to experience fewer respiratory diseases (Bennett et al. 2003).

Specifically, research has been done on the effects of laughter on patients with chronic obstructive pulmonary disease (COPD). Chronic obstructive pulmonary disease is a progressive disease characterized by chronic obstruction of airflow, hyperinflation of the lungs, and persistent ventilator impairment (Lebowitz et al. 2011). Data suggest that smiling and laughing may result in temporary reduction of hyperinflation of the lungs in individuals with chronic obstructive pulmonary disease (Brutsche et al. 2008).

An experiment was done on 19 patients suffering from chronic obstructive pulmonary disease and 10 healthy individuals. A humorous clown was used as the means to trigger laughter. Plethysmography, a test used to measure changes in volume in different parts of the body, was done before and 24 hours after the intervention. The subjects' laughter and smiling were recorded on video and analyzed, and their real-time breathing was assessed. The results indicated that smiling and moderate laughter were able to reduce hyperinflation in patients with severe chronic obstructive pulmonary disease. Intense laughter, on the other hand, was shown to potentially lead to hyperinflation, because higher intensities of laughter demand increased ventilation and oxygen consumption (Figure 5) (Brutsche et al. 2008). A similar experiment that

used a humor video as the means to trigger laughter showed analogous results (Lebowitz et al. 2011). Thus, maintaining a balance of laughter strength would seem to be most beneficial for the respiratory system.

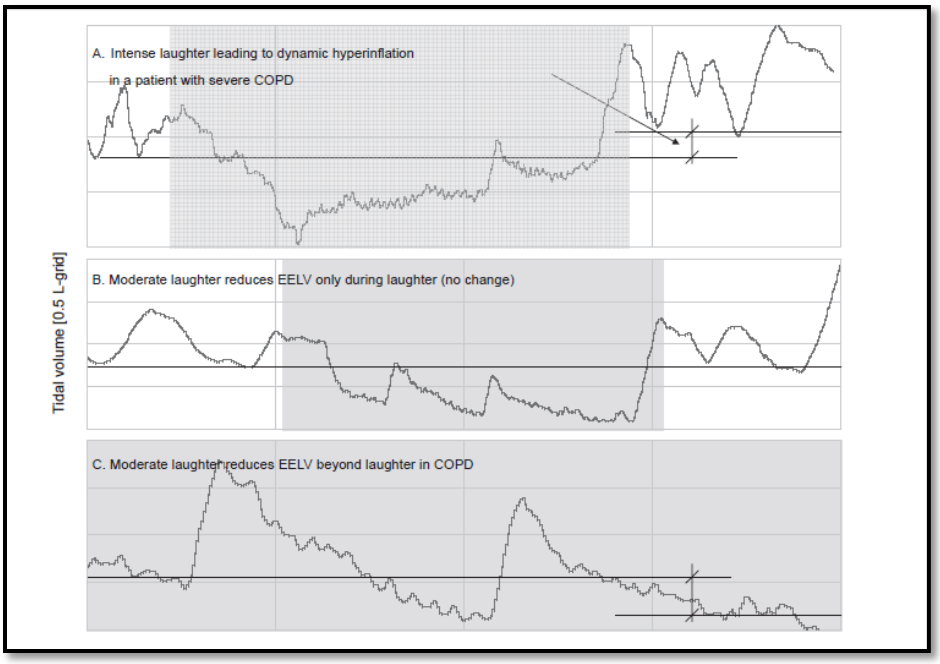


Figure 5: Spirogram from the real time monitoring of the breathing pattern showing the varying effect of laughter on end-expiratory lung volume (EELV) in patients with COPD. Source: Brutsche et al. 2008

EFFECTS ON STRESS

Stress can have negative physiological effects on the cardiovascular system and can lead to suppression of the immune system as well (Martin 2001). Therefore, if laughter can lower stress levels, it may prevent various problems related to the cardiovascular and immune systems. The Association for Applied and Therapeutic Humor has proposed that humor and laughter may stimulate an appreciation for the absurdities in life, thereby relieving stress while simultaneously promoting healing (Sahakian and Frishman 2007). Stress levels seem to be directly associated with laughter. Humor and laughter may, thus, be a possible complimentary therapy to reduce stress levels. Laughter seems to affect both the physiological as well as the psychological components of stress (Martin 2001). Similarly, laughter can reduce anxiety levels (White and Winzelberg 1992).

Stress levels can be lowered by the hormone cortisol. Since laughter helps to decrease cortisol levels, laughter can be used to reduce stress levels as well (Bennet et al. 2003). An experiment was done to determine the connection between laughter and stress. Volunteers were brought to laughter by watching a humorous video of their choice (Sahakian and Frishman 2007). The experiment results indicated that increased mirthful laughter correlated with decreased stress scores (Figure 6). Additionally, those who laughed more reported a lower level of stress post-laughter (White and Winzelberg 1992). A similar experiment was done on dental patients. The study showed that patients who joked and laughed before dental procedures reported less stress during and after the procedures (Bennet et al. 2003).

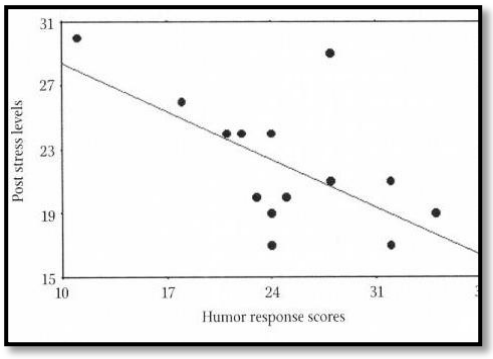


Figure 6: The relationship between laughter and post stress levels. Source: Bennett et al. 2003

At Stony Brook University, another study was conducted to assess the relationship between laughter and stress. Groups of people were shown a stressful movie containing images of a gory industrial accident. The subjects were told to describe what they saw in both a serious manner and in a manner that they found humorous. Their stress levels were measured before and after their descriptions. Stress levels were determined by monitoring heart rate, skin conductivity, and skin temperature. The results were identical for both those subjects who were humorous by nature and those subjects not humorous by nature but with just an appreciation for humor. In both subject types, when describing the video humorously, the subjects had lower measurements on all three accounts. This indicated that through the humor and laughter, they alleviated the stress caused due to viewing the gory accident. When describing the video in a serious manner, results indicated that their stress levels increased (Ziegler 1995). This is likely due to the fact that stress is affected by the actual laughter and not by the source of laughter.

EFFECTS ON PAIN TOLERANCE

Norman Cousins' life experience and research suggest potential analgesic effects of laughter (Martin 2001). Laughter seems to reduce pain and increase one's pain tolerance levels. Perhaps it is by stimulation of the production of endogenous opioids, such as beta endorphin, that pain levels are reduced. Laughter also seems to lower pain thresholds, thereby proving as effective as relaxation (Christie and Moore 2004). Much experimentation has been done to prove and to further understand these theories.

A study was done to determine the effects of various degrees of laughter and humor on pain tolerance. A humor video was shown to 56 female subjects who were randomly assigned to one of three groups. Depending on what group they were part of, they were told to react to the humor film a certain way. Those assigned to the cheerfulness group were expected to get into a cheerful mood without laughing, those assigned to the exhilaration group were told to smile and laugh extensively, and those assigned to the humor production group were expected to not only laugh but to produce humorous commentary as well. As part of the study, the cold pressor test was used to measure pain tolerance levels. The cold pressor test works by submerging a subject's hand in ice-cold water and determining how long the pain can be tolerated (Zweyer et al. 2004). In this study, the cold pressor test measured the pain tolerance levels of the three groups before, immediately after, and 20 minutes after the humor film. In all three groups, the cold pressor test

results indicated that pain tolerance levels increased due to laughter and remained high even 20 minutes later (Figure 7). The subjects' enjoyment levels were assessed using the facial action coding system. This is an objective coding technique that measures facial movement (due to laughter) and its intensity and duration. Subjects also answered a questionnaire that indicated their enjoyment level of the film (Zweyer et al. 2004). The results showed that even cheerfulness alone can lead to an increase in pain tolerance levels, although actual laughter is likely to achieve more significant results. In order to assess the effects of pain tolerance levels on men, a similar experiment using male subjects should be done.

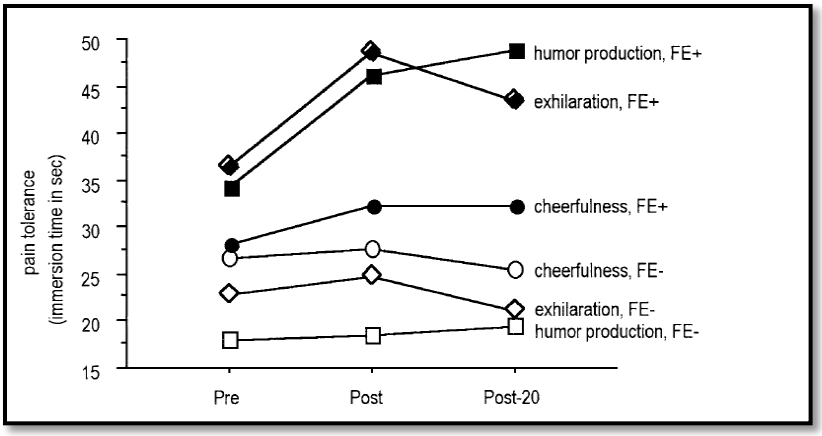


Figure 7: Changes in pain tolerance for the three groups. (FE - = few enjoyment displays, FE+ = many enjoyment displays). Source: Zweyer et al. 2004

A similar experiment, using 40 college students, was done on both male and female subjects. Students assigned to the laughter group listened to a 20-minute comedy audiotape, students assigned to the relaxation group listened to a 20-minute progressive muscle relaxation audiotape, students assigned to the dull narrative group listened to a 20-minute audiotape on ethics, and another group did not receive any listening material. Discomfort thresholds were measured using a blood-pressure cuff. The cuff was inflated until the subject could not tolerate the pain, and the maximum pressure was recorded. Pain thresholds for the laughter group were significantly higher after the 20-minute movie, further suggesting a correlation between laughter and pain tolerance levels (Martin 2001).

EFFECTS ON ATOPIC DERMATITIS

Atopic dermatitis is a chronic inflammatory skin disorder that involves scaly and itchy rashes (Kimata 2001). In patients with atopic dermatitis, plasma nerve growth factors (NGF) and neurotrophin-3 (NT-3) levels are elevated (Kimata 2004). Patients with atopic dermatitis also exhibit allergic skin wheal responses in which their skin flares up, forming red blotchy rashes. Recent studies indicate that laughter may help to reduce these symptoms (Kimata 2001; Kimata 2004). Consequently, laughter may also reduce the number of incidents of nighttime awakenings among children with atopic dermatitis. Additionally, laughter may reduce allergen-specific Immunoglobulin-E production. (Mora-Ripoll 2010).

An experiment was done to observe the effects of laughter on patients with this disease, specifically observing the wheal responses. The experiment studied 26 patients with atopic dermatitis, all of them allergic to dust mites. Skin prick tests, using commercial allergen extract, were performed before and after viewing an 87-minute humor video. Wheal size was measured 15 minutes after each of the skin prick tests. The results indicated that wheal size induced by house dust mite allergens were significantly reduced after the humor intervention (Figure 8). Wheal response size was also measured before and after the patients watched an 87-minute informative video, and no change in wheal size was observed (Kimata 2001). The same experiment was performed using cedar pollen and cat dander, and again the results indicated a

significant reduction of the wheal size for allergies in atopic dermatitis patients. The wheal caused by cedar pollen was reduced from 8 mm to 2 mm, and the wheal caused by cat dander was reduced from 7mm to 2mm (Kimata 2001).

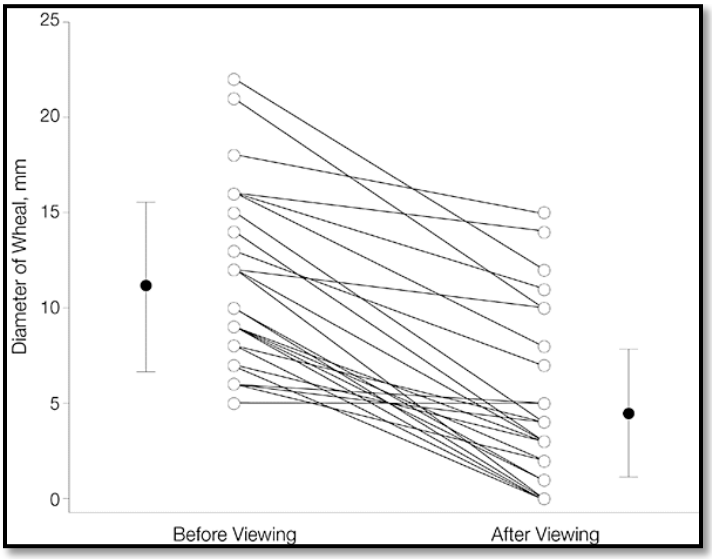


Figure 8: Effect of laughter on wheal responses induced by house dust mite allergen. Source: Kimata 2001

Another experiment was done to determine the connection between laughter and allergic responses in patients with atopic dermatitis. In addition to assessing the effect of laughter on the skin wheal size, changes in plasma nerve growth factors (NGF) and neurotrophin-3 (NT-3) levels were observed as well (Kimata 2004). The results indicated that wheal size was reduced significantly due to the laughter and that laughter caused the NGF and NT-3 levels to be reduced as well (Table 1).

Variable	Control		Laughter	
	Before viewing	After viewing	Before viewing	After viewing
Plasma (pg/ml)				
NGF	2159 ± 154	2193 ± 145	2267 ± 156	1831 ± 83**
NT-3	1784 ± 72	1859 ± 81	1859 ± 80	1201 ± 47**
Wheal (mm)				
HDM	8.3 ± .3	8.5 ± .3	8.5 ± .3	6.7 ± .2**
JCP	9.6 ± .3	9.4 ± .3	9.6 ± .3	7.3 ± .3**
Cat dander	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Histamine	7.3 ± .2	7.2 ± .2	7.5 ± .3	7.2 ± .2
Control	0 ± 0	0 ± 0	0 ± 0	0 ± 0

(NGF= Nerve Growth Factors; NT- 3= Neurotrophin-3; HDM- House Dust Mites; JCP- Japanese Cedar Pollen; **Significant reduction compared with before viewing)

Table 1: Effect of laughter on plasma neurotrophins and wheal responses for various allergies. Source. Kimata 2004

Although the effect of laughter on skin wheal reactions was observed only on patients with atopic dermatitis, it is possible that these effects may occur in patients with other allergy

diseases as well. In order for this to be confirmed, further experimentation on those patients would have to be done. Even though there is no indication that laughter cures atopic dermatitis, laughter seems to greatly enhance the quality of life for patients with atopic dermatitis.

LAUGHTER THERAPY MAY AFFECT PATIENTS WITH CANCER

Cancer is a prevalent and deadly disease. Although no experimentation was done on the effects of laughter on cancer, cancer patients have reported greatly benefitting from the use of humor intervention (Christie and Moore 2004). Humor and laughter was cited as the second most common form of intervention (after prayer) for patients with cancer (Bennett et al. 2003).

A study conducted on a group of women suffering from breast cancer demonstrated humor and laughter as powerful tools in coping with a breast cancer diagnosis. The women felt a strong need to laugh to survive low moments, find humor with others through support groups, and use humor to help them relax (Johnson 2002). Although this study is suggestive that humor may enhance the quality of life and treatment period for cancer patients, experimentation would have to be conducted in order to assess the healing effects of laughter on cancer patients.

Although there is no clear evidence that indicates a relationship between laughter and cancer patients, the relationship between natural killer cells and laughter may lead to further speculation of this possibility. Natural killer cells play an integral role in fighting cancer, as they attack and fight off tumor cells. Since natural killer cells seem to be directly affected by laughter (Bennett et al. 2003), perhaps it is indicative that cancer can be affected as well. In order to fully assess these ideas, though, further research would need to be done.

LAUGHTER THERAPY MAY AFFECT PATIENTS WITH DEMENTIA

Dementia is a progressive disease in which patients lose many of their cognitive abilities (Takeda et al. 2010). Similar to cancer patients, humor and laughter therapy may be helpful and therapeutic for dementia patients as well. Laughter may be able to help these patients release tension and help to alleviate their pain (Zillmann et al. 1993). However, due to dementia being a disease in which patients lose many of their cognitive abilities, the forms of humor intervention deemed appropriate may be limited. Therefore, it is worth studying the different forms of laughter generation. Laughter can be evoked by a release in tension, it can be associated with pleasant feeling, and it can be used as a form of social communication. These categories can be further subdivided as delineated in Table 2.

As a patient's dementia progresses, the ability to process information is lost. Therefore, laughing as a communication tool is lost already in the early stages (Table 3). Laughing due to release of tension, however, is preserved throughout the disease. Thus, dementia patients placed in a relaxed, tension-free environment are more likely to laugh, and, if used appropriately, humor can be an effective form of therapy (Takeda et al. 2010). In order to further assess how the physiology of dementia patients is affected by laughter and how it may affect the disease, further research and experimentation would have to be done.

CONCLUSION

Laughter has profound effects on human physiology; it is an internal jogging mechanism that stimulates the physiological systems. Various kinds of laughter have effects on the cardiovascular, immune, and respiratory systems, among others. Stress levels and pain tolerance thresholds seem to be affected as well. There seems to be use for laughter therapy to help ease and possibly even heal the discomfort of patients with various diseases, including coronary heart disease, chronic obstructive pulmonary disease (COPD), atopic dermatitis, cancer, and dementia. Based on experimentation, it seems that laughter rather than humor is what has an impact on the physiology. Laughter seems to have effects both during and after laughing. Laughter, however,

may also have negative effects, specifically intense laughter. Therefore, one must be careful if using laughter therapy.

Laughter therapy is easy to use and is a relatively cheap and safe form of therapy. Although there is much speculation to the validity of this seemingly easy course of treatment, the evidence is very suggestive and the negative effects are few. However, in order to incorporate laughter therapy into a medical setting and in order to determine if laughter can be an all-around healing agent, more investigation should be done to fully assess all the possible risks and benefits. Further research should also be done to determine the effective duration of laughter and to assess how long these effects can last.

A) Laughter evoked by a release of tension- laughing in order to relax	
A1. Release from strong tension	Spontaneous laughter as a result of a release of strenuous tension
A2. Release from weak tension	Spontaneous laughter as a result of a release of lesser tension
B) Laughter associated with pleasant feelings	
B1. Fulfillment of instinctive needs	i.e.- a baby smiles after feeding
B2. Fulfillment of expectations	i.e.- one has a pleasant feeling after an accomplishment
B3. Feelings of superiority	Scornful laughter or a cold smile
B4. Feelings of disharmony	i.e.- one laughs after a harmless mishap
C) Laughter used for social communication	
C1. Cooperative	i.e.- smiling when one shakes a hand
C2. Defensive	i.e. -when one smiles/laughs to conceal their inner feelings (of hurt)
C3. Aggressive	Scornful laughter - laughing at someone else
C4. Devaluating	Smiling to devalue something. i.e.- smiling after a train door slams in one's face

Table 2: Various forms of laughter that were tested on dementia patients. Source: Takeda et al. 2010

Preservation in dementia		
Type of laughter/smile	**Early Stages**	**Late Stages**
A1. Release from strong tension	+	+
A2. Release from weak tension	+	+
B1. Fulfillment of instinctive needs	+	+
B2. Fulfillment of expectations	+	-
B3. Feelings of superiority	+	-
B4. Feelings of disharmony	+/-	-
C1. Cooperative	-	-
C2. Defensive	-	-
C3. Aggressive	-	-
C4. Devaluating	-	-

Table 3: Relationship between laughter/smile and the progression of dementia. (+ = humor that is preserved in dementia patients; - = humor that is not preserved in dementia patients). Source: Tikada et al. 2010

REFERENCES

Balick MJ, Lee R. 2003. The role of laughter in traditional medicine and its relevance to the clinical setting: Healing with Ha! Alternative Therapies in Health and Medicine 9(4): 88-91.

Bennett MP, Zeller JM, Rosenberg L, McCann J. 2003. The effect of mirthful laughter on stress and natural killer cell activity. Alternative Therapies in Health and Medicine 9(2):38-44.

Berk L, Felten D, Tan S, Bittman B, Westengard J. 2001. Modulation of neuroimmune parameters during the eustress of humor-associated mirthful laughter. Alternative Therapies in Health and Medicine *7*(2):62-76.

Braga SS, Manni R, Pedretti RF. 2005. Laughter-induced syncope. Lancet 366:426.

Brutsche MH, Grossman P, Muller RE, Wiegand J, Pello, Baty F, Ruch W. 2008. Impact of laughter on air trapping in severe chronic obstructive lung disease. International Journal of Chronic Obstructive Pulmonary Disease 3(1):185-192.

Christie W, Moore C. 2004. The impact of humor on patients with cancer. Clinical Journal of Oncology Nursing *2*(9):211-217.

Clark A, Seidler A, Miller M. 2001. Inverse association between sense of humor and coronary heart disease. International Journal of Cardiology 80:87-88.

Cousins N. 1976. Anatomy of an illness (as perceived by the patient). The New England Journal of Medicine 295:1458-1463.

Fry W, Savin W. 1988. Mirthful laughter and blood pressure. Humor: International Journal of Humor Research 1(1):49-62.

Fry W. 1994. The biology of humor. Humor: International Journal of Humor Research 7(2):111-126.

Johnson P. 2002. The use of humor and its influences on spirituality and coping in breast cancer survivors. Journal of the Oncology Nursing Society 29(4):691.

Kimata H. 2001. Effects of humor on allergen-induced wheal reactions. Journal of the American Medical Association 285(6):738.

Kimata H. 2004. Laughter counteracts enhancement of plasma neurotropin levels and allergic skin wheal responses by mobile phone-mediated stress. Behavioral Medicine 29:149-152.

Lebowitz KR, Suh S, Diaz PT, Emery CF. 2011. Effects of humor and laughter on psychological functioning, quality of life, health status, and pulmonary functioning among patients with chronic obstructive pulmonary disease: A preliminary investigation. Heart and Lung: The Journal of Acute and Critical Care 40(4):310-319.

Ljungdahl L. 1989. Laugh if this is a joke. Journal of the American Medical Association 261(4):558.

Martin RA. 2001. Humor, laughter, and physical health: Methodological issues and research findings. Psychological Bulletin 127(4):504-519.

Martin RA. 2004. Sense of humor and physical health: Theoretical issues, recent findings, and future directions. Humor: International Journal of Humor Research 17:1-19.

McCaffery M. 1983. Laughter is the best medicine: An interview with Norman Cousins. Canadian Family Physician 29:805-807.

Miller M, Magamo C, Park Y, Goel R, Plotnick GD, Vogel RA. 2006. Impact of cinematic viewing on endothelial function. Heart 92:261-262.

Mora-Ripoll R. 2010. The therapeutic value of laughter in medicine. Alternative Therapies in Health and Medicine 16(6):56-64.

Ruch W, Ekman P. 2001. The expressive pattern of laughter. Emotions, Qualia, and

Consciousness 42:426-443.
Sahakian A, Frishma WH. 2007. Humor and the cardiovascular system. Alternative Therapies in Health and Medicine 13(4):56-58.
Sugawara J, Tarumi T, Tanaka H. 2010. Effect of mirthful laughter on vascular function. The American Journal of Cardiology 106(6):856-859.
Takeda M, Hashimoto R, Kudo T, Okochi M, Tagami S, Morihara T, Sadick G, Tanaka T. 2010. Laughter and humor as complementary and alternative medicines for dementia patients. BMC Complementary and Alternative Medicine 10:28.
White S, Winzelberg A. 1992. Laughter and stress. Humor: International Journal of Humor Research 5(4):343-356.
Ziegler J. 1995. Immune system may benefit from the ability to laugh. Journal of the National Cancer Institute 87:342-343.
Zillmann D, Rockwell S, Schweitzer K, Sundar SS. 1993. Does humor facilitate coping with physical discomfort? Motivation and Emotion 17(1):1.
Zweyer K, Velker B, Ruch W. 2004. Do cheerfulness, exhilaration, and humor production moderate pain tolerance? A FACS study. Humor: International Journal of Humor Research 17:85-119.