



# Potential health benefits of simulated laughter: A narrative review of the literature and recommendations for future research

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## KEYWORDS

Laughter therapy;  
Laughter  
intervention;  
Simulated laughter;  
Laughter yoga;  
Laughter research;  
Complementary and  
alternative medicine;  
Lifestyle medicine;  
Mind–body medicine;  
Health care;  
Patient care

## Summary

**Introduction:** Scientific research has shown that laughter may have both preventive and therapeutic values. Health-related benefits of laughter are mainly reported from spontaneous laughter interventional studies. While the human mind can make a distinction between simulated and spontaneous laughter, the human body cannot. Either way health-related outcomes are deemed to be produced. Simulated laughter is thus a relatively under-researched treatment modality with potential health benefits. The aim of this review was firstly to identify, critically evaluate and summarize the laughter literature; secondly to assess to which extent simulated laughter health-related benefits are currently sustained by empirical evidence; and lastly to provide recommendations and future directions for further research.

**Methods:** A comprehensive laughter literature search was performed. A list of inclusion and exclusion criteria was identified. Thematic analysis was applied to summarize laughter health-related outcomes, relationships, and general robustness.

**Results:** Laughter has shown different physiological and psychological benefits. Adverse effects are very limited and laughter is practically lacking in counter-indications. Despite the limited number of publications, there is some evidence to suggest that simulated laughter has also some effects on certain aspects of health, though further well-designed research is warranted.

**Conclusions:** Simulated laughter techniques can be easily implemented in traditional clinical settings for health and patient care. Their effective use for therapeutic purposes needs to be learned, practiced, and developed as any other medical strategy. Practical guidelines and further research are needed to help health care professionals (and others) implement laughter techniques in their health care portfolio.

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## Introduction

Laughter is an essential component of human happiness, and its absence is a pathology that is related to maladaptive and other dysfunctional behaviors. Scientific research has shown that laughter may have both preventive and therapeutic values. While several kinds of laughter have been described which are depending on various parameters and different fields of the scientific research,<sup>1–3</sup> five large groups can be summarized from a medical and therapeutic point of view<sup>4</sup>: (1) genuine or spontaneous laughter; (2) simulated laughter; (3) stimulated laughter; (4) induced laughter; and (5) pathological laughter. *Spontaneous laughter*, unrelated to one's own free will, is triggered by different (external) stimuli and positive emotions. It has been reported that spontaneous laughter causes typical contractions of the muscles around the eye socket (Duchenne laughter/smile<sup>5</sup>). *Simulated laughter* is triggered by oneself at will (self-induced), with no specific reason (purposeful, unconditional), and therefore not elicited by humor, fun, other stimuli or positive emotions. *Stimulated laughter* happens as a result of the physical contact or action (reflex) of certain external factors (i.e. to be ticklish, specific facial or bodily motions, by pressing laughter bones<sup>6</sup>). *Induced laughter* is a result of the effects of specific drugs or substances (i.e. alcohol, caffeine, amphetamines, cannabis, lysergic acid diethylamide or LSD, nitrous oxide or "laughing gas", and more). Lastly, *pathological laughter* is secondary to injuries to the central nervous system caused by various temporary or permanent neurological diseases and may also occur with certain psychiatric disorders. Pathological laughter is developed with no specific stimulus, is not connected with emotional changes, has no voluntary control of its duration, intensity or facial expression, and sometimes comes with "pathological crying".<sup>7</sup>

Health-related benefits of laughter are mainly reported from spontaneous laughter interventional studies, although the therapeutic value of laughter would concern in particular the first two types, spontaneous laughter and simulated laughter (Table 1), and to a lesser extent stimulated laughter. Modern laughter techniques are based on the following fundamental principle: through several exercises, activities and dynamics, a person or a group of people is transferred to a feeling of lack of inhibitions to achieve the binomial simulated laughter–spontaneous laughter and to experiment its physical, psychological, emotional and spiritual benefits. While the human mind can make a distinction between simulated and spontaneous laughter, the human body cannot,

only the difference in the intensity of the abdominal contractions that are created; therefore, their corresponding health-related benefits are alleged to be alike provided the simulated laughter is done with a minimum of enthusiasm ("motion creates emotion" theory). Simulated laughter is thus a relatively under-researched treatment modality with potential health benefits. Indeed, simulated laughter may lead to a higher "laughter exposure" both by achieving greater intensity and duration at will, or by triggering contagious and turning into spontaneous laughter, which might create greater accompanying psychophysiological changes.

The aim of this review was firstly to identify, critically evaluate and summarize the laughter literature across a number of fields related to health, health care, patient care and medicine; secondly to assess to which extent simulated laughter health-related benefits are currently sustained by empirical evidence; and lastly to elucidate whether certain recommendations for further research are needed so that future directions can be provided.

## Review of the literature

### Design and methods

A narrative review was conducted. This type of review is particularly useful where the aggregation of data is difficult because diverse definitions, many studies or fields, and different outcomes are being analyzed.<sup>8,9</sup> A comprehensive laughter and humor literature search was performed using a variety of electronic databases (Medline, PubMed, Cochrane Library and Google Scholar) and following keywords: laugh; laughing; laughter; laughter yoga; mirth, mirthful; humor; therapy; intervention; mind–body; medicine; health; health care; patient; and patient care. A manual search of additional relevant sources (specific publishers and their journals, and grey literature) was also included. A list of selection criteria was identified: (1) inclusion criteria: simulated laughter intervention main focus of paper; direct or indirect relationship to health-related outcomes; and paper either research or seminal in some form; (2) exclusion criteria: humor research only, non health-related research; textbooks, media-related items; and non-English, non-Spanish publications. All relevant published articles up to 2011 (March) were reviewed. No papers were excluded in respect of quality because of the dearth of literature meeting both the established inclusion or exclusion criteria. Thematic analysis was applied to summarize health-related

**Table 1** Health-related laughter types: main characteristics of spontaneous laughter and simulated laughter.

	Spontaneous laughter	Simulated laughter
Genuine expression of positive emotions	Always	Not necessarily
Humor-related or humor-dependant	Very often, but not always	Very rarely
Laughing "at" or "with" others	Commonly "at"	Always "with"
Personal engagement/effort to think	Often necessary	Rarely necessary
Presence of "Duchenne laughter/smile" <sup>a</sup>	Typical (when not fake)	Only when done with a minimum of enthusiasm
Together with bodily motion	Yes (uncontrolled)	Yes (controlled)
One's own free will	No, unrelated	Yes, purposeful
Triggering off stimulus	Identifiable (external)	None (self-induced)
Contagious	Yes (often)	Yes (very often)
Self-control on intensity and duration	Minimum or less	Maximum or more
Mean ratio vocal/consonant sounds	1:1 (50% of each one) <sup>106</sup>	At will
Most common vocalizations	Ha/ho	At will: Ha/he/hi/ho/hu & others
Evidence of therapeutic value in medicine	Yes (several studies)	Yes (a few studies so far)
Best dynamics for experimenting laughter	In a group	Alone/in a group
Laughter technique samples	Playing; clowning; disguising; dancing; singing; having fun, humor, music; by surprise, emotional release, positive emotions or contagion	Laughter yoga exercises, laughter gymnastics; laughter practice; solo laughter

<sup>a</sup> Contraction of the muscles around the eye socket.

outcomes, patient outcomes, relationships, and general robustness.<sup>10</sup> This review was not funded.

## Overall results

Laughter health-related outcomes were identified in the following areas of medicine and patient care (references cited are not exhaustive): oncology<sup>11–14</sup>; allergy and dermatology<sup>15,16</sup>; immunology<sup>17,18</sup>; pulmonology<sup>19–21</sup>; cardiology, endocrinology and metabolism<sup>22–26</sup>; internal medicine and rheumatology<sup>27</sup>; rehabilitation<sup>28,29</sup>; psychiatry and medical psychology<sup>30–33</sup>; anatomy, neurology and imaging<sup>34–40</sup>; biophysics and acoustics<sup>41–45</sup>; geriatrics and aging<sup>46–48</sup>; pediatrics<sup>49–51</sup>; obstetrics<sup>52</sup>; surgery<sup>53–55</sup>; dentistry<sup>56–58</sup>; nursing<sup>59–64</sup>; critical care, palliative and terminal care<sup>65–72</sup>; hospice care<sup>73–75</sup>; home care<sup>76</sup>; general patient care and primary care,<sup>77–80</sup> epidemiology and public health,<sup>81,82</sup> complementary and alternative medicine<sup>83,84</sup>; and medical and health sciences training.<sup>85–87</sup>

Laughter has numerous effects involving the muscular, cardiovascular, respiratory, endocrine, immune, and central nervous systems. The research reviewed in this area relates to the impact of laughter on the entire body and can be lumped into the following main physiological effects<sup>4,22,88–91</sup>: (1) exercises and relaxes muscles, (2) improves respiration, (3) stimulates circulation, (4) decreases stress hormones, (5) increases immune system's defenses, (6) elevates pain threshold and tolerance, and (7) enhances mental functioning. The psychological effects of laughter relate primarily to it as a coping mechanism and, to a lesser extent, to its enhancement of interpersonal relationships.<sup>92</sup> The research available in this area,<sup>93–106</sup> somehow larger and much stronger than the evidence for the physiological health benefits, can be summarized as follows:

(1) laughter reduces stress, anxiety, tension and counteracts depression symptoms; (2) elevates mood, self-esteem, hope, energy and vigor; (3) enhances memory, creative thinking and problem-solving; (4) improves interpersonal interaction, relationships, attraction and closeness; (5) increases friendliness, helpfulness and builds group identity, solidarity, and cohesiveness; (6) promotes psychological well-being; (7) improves quality of life and patient care; and (8) intensifies mirth and is contagious. The side effects of laughter are very few. In specific cases the appearance of a laughter-induced syncope has been reported.<sup>107</sup> Contra-indications are nearly non-existent, however precaution is advised with patients recently released from surgery, with certain cardiovascular or respiratory diseases or glaucoma.

## Specific results

As a laughter type, simulated laughter is getting increasingly popular worldwide since it is the foundation of the Laughter Club movement (laughter yoga). Simulated laughter exercises can be focused on the following categories<sup>108</sup>: (1) *emotional wellness* (pantomiming any action and adding laughter on top); (2) *physical workout* (aerobic training; balance, flexibility, mobility, resistance and strength training, and improving lung capacity); (3) *playful behaviors* (engaging in playful movements to help dissolve inhibitions); and (4) *special techniques* (cross-brain exercises; dancing and singing exercises; empowering behaviors and conversations; group games; floor exercises; laughter and ideokinesis; laughing alone; and laughter meditation). The library of simulated laughter techniques is virtually infinite, and by considering many different possibilities, further exercises can be developed and added: to laugh alone, in pairs or in a group; for kids, adults, seniors, or just any patient;



**Table 2** Effects of simulated laughter interventions on health-related outcomes.

Publications identified	Main health-related outcomes
<i>Randomized controlled trials</i>	
Nagendra et al. <sup>113</sup>	On healthy IT professionals (both male and female), 20–30 min of laughter yoga ( $n = 53$ ) led to a reduction in blood pressure, endocrine stress markers (cortisol levels) as well as perceived level of stress, when compared to the waiting list control group ( $n = 51$ )
Shahidi et al. <sup>114</sup>	Ten sessions of laughter yoga ( $n = 23$ ) were at least as effective as exercise therapy ( $n = 23$ ) or a control group ( $n = 24$ ), in improvement of depression scores (Yesavage Geriatric Depression Scale) and life satisfaction scores (Diener Life Satisfaction Scale) of elderly depressed women
Ko <sup>115</sup>	One hour of simulated laughter once a week was considered to be useful, cost-effective and easily accessible intervention that had positive effects on depression (Geriatric Depression Scale), insomnia (Insomnia Severity Index), and sleep quality (Pittsburg Sleep Quality Index) in 41 elderly individuals, when compared to a control group ( $n = 61$ )
<i>Interventional studies</i>	
Foley <sup>93</sup>	Participants ( $n = 17$ ) rated their mood before and after 1 min of forced laughter. Although the participants generally rated their mood as positive prior to the intervention, after forced laughter more participants rated positive affect significantly higher
Neuhoff <sup>94</sup>	Effects of forced laughter on mood were assessed and compared laughter with two other possible mood-improving activities, smiling and howling. While howling did not substantially improve mood, both smiling and laughing did. Moreover, laughter seemed to boost positive affect more than just smiling by 22 adults
Beckman <sup>109</sup>	15 sessions of simulated laughter significantly increased positive feelings, social identification, optimism, positive emotions, personal efficacy, and morale of 33 healthy employees in the workplace
De la Fuente-Mochales <sup>111</sup>	After 8 laughter therapy sessions, one per week, laughter led to a 55% reduction in pain scores; a 12% increase in functional mobility; and a 50% reduction in depression symptoms and 42% in anxiety symptoms of 107 chronic pain patients (mainly fibromyalgia). They maintained these gains at follow-up (12 months)
<i>Humor/laughter interventions</i>	
Walter <sup>110</sup>	20 patients with late-life depression and 20 patients with Alzheimer's disease (AD) were evaluated. Ten patients in each group underwent a humor/laughter therapy group (HLT) once every two weeks for 60 min in addition to standard pharmacotherapy, which was given as usual to the other group as standard therapy (ST). The quality of life scores improved both in HLT and ST groups for depressive patients but not for patients with AD irrespective of the therapy group. Depressive patients receiving HLT showed the highest quality of life after treatment and had also improvements in mood, depression score, and instrumental activities of daily living
Falkenberg <sup>112</sup>	Six patients with major depression participated in a group training program specifically designed to enhance humor/laughter abilities. After 8 weeks of training, short-term mood improvement was observed and the patients considered themselves more capable of using humor and laughter as a coping strategy. Acquired humor and laughter skills also helped to sustain the patients' motivation throughout the training period

safe (anybody can relate); playful (best done once you have warmed up your laughter muscles) and exaggerated (appropriate only once you are in that laughter mindset); to laugh standing up, on a chair, lying on the floor; with or without props; using different body parts; depending on level of physical fitness (from 0 to very fit), underlying health conditions, or preventive or therapeutic aims.

In this review, six interventional studies<sup>93,94,109–112</sup> and three randomized controlled trials<sup>113–115</sup> were identified experimenting simulated laughter in some form and then assessing its health-related outcomes specifically. Overall, simulated laughter has also shown some quantifiable effects on certain aspects of health. In particular, both physiological and psychological benefits have been reported and the results found in these studies are summarized in Table 2.

## Recommendations for future research and practical guidelines

### Laughter research challenges

While some authors advocate that the practice of medicine is still an art, and it may not be necessary to do controlled studies and provide evidence-based data to support the therapeutic use of humor and laughter,<sup>68</sup> there is a real need for more research in the field. Laughter research designs can be quite challenging. One of the largest methodological problems in laughter research is the failure to distinguish humor from laughter. Humor and laughter are distinct events (although often associated): while humor is

a stimulus and can occur without laughter, laughter is a response and can occur without humor.<sup>116</sup> It is necessary to distinguish between these variables, as many studies have used a humor stimulus (such as a comic movie) to determine the effect of 'humor' on a health-related outcome, while others look specifically at the effects of laughter on these outcomes. Still others explore different ways to assess sense of humor, in an attempt to analyze whether scoring higher on a sense of humor scale is associated to certain health outcomes. Thus it is crucial that future laughter research includes some measure of subject response to the different stimuli whenever they are used to help elicit laughter, as some individuals who are exposed to a particular (especially humor-centered) stimulus do not always laugh. Laughter also may not be able to be studied at a conventional "active ingredient" or "dose" level. A design to help preclude laughter absence, and to adjust for its intensity, dosage and duration, is to conduct simulated laughter intervention trials. Simulated laughter is entirely achievable and appears to be the most realistic, sustainable and generalizable intervention to be used in future laughter research. Another methodological concern is that of control groups. Larger samples of healthy subjects and trials in different clinical populations are also warranted. Therefore, it may be useful for researchers in an area dominated by psychology to carry out interdisciplinary well-designed studies involving experts from different health care fields.

### Future directions

Research on simulated laughter is still in its early infancy. Laughter researchers may also have difficulty defining precise and measurable outcomes for a therapy for which the main effect is often subjective or highly dependent on the skill of the practitioner and the laughter him/herself. Clearly, more groundwork is needed to determine the best methods of assessing and documenting simulated laughter health-related outcomes in different patient populations. However, some remarkable results on the first exact system for the measurement of laughter itself (diaphragm electromyogram) have been published recently.<sup>117</sup> Since this measuring system can specify the starting point and duration of laughter precisely of 1/3000 s, it will make detailed analysis of the healthy effects of simulated laughter (or any kind) possible in different clinical settings.

### Practical guidelines

Health care professionals can play a significant part in eliciting better understanding of laughter benefits in clinical conditions and real-world life for both patients and themselves.<sup>118</sup> But like any other skill, the effective use of simulated laughter and other laughter techniques for therapeutic purposes needs to be learned, practiced, and developed as any other medical strategy. Nevertheless, practical guidelines or further advice are needed to help health care professionals (and others) implement laughter techniques in their health care portfolio. In particular, a unique and comprehensive handbook on simulated laughter exercises and a companion book on FUN-damentals (Gendry<sup>119,120</sup>) are already available, and a "Handbook on

Laughter Medicine and Therapy" (Mora-Ripoll<sup>121</sup>) is, to our knowledge, the first one published specifically on this subject.

### Conclusions

To date there is sufficient evidence to suggest that laughter has positive, quantifiable physiological and psychological effects on certain aspects of health.<sup>122–124</sup> However, current empirical data for the benefits associated with simulated laughter is much more limited, and further well-designed research is warranted. Nevertheless, the health community is still very slow in accepting and considering laughter as a healing tool within the complementary/alternative medicines (CAM)<sup>125</sup> or lifestyle medicine.<sup>126,127</sup> In order to offer patients the benefits of laughter, health care professionals must be willing to break loose from conventional therapeutic constraints, regain their own laughter, and learn the techniques to facilitate laughter in their patients. Laughter deserves a special place in medical practice and daily life. Moreover, proponents of 'positive psychology' have identified humor and laughter as one of the 24 positive personal values and attributes.<sup>128,129</sup> Simulated laughter techniques (i.e. "laughter yoga"<sup>130</sup>) can be easily implemented in traditional clinical settings for health and patient care. The following seems to be a good advice for both patients and health care professionals: "add simulated laughter to your working and daily life, remember to laugh regularly, share your laughs and help others to laugh too".<sup>122</sup>

### Conflict of interest

None disclosed.

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### References

1. Holden R. *La risa, la mejor medicina*. Barcelona: Ediciones Oniro; 1999.
2. Temprano E. *El arte de la risa*. Barcelona: Ed. Seix Barral; 1999.
3. García Larrauri B. *Programa para mejorar el sentido del humor*. Madrid: Ediciones Pirámide; 2008.
4. Berk R, Martin R, Baird D, Nozik B. *What everyone should know about humor and laughter*. Aliso Viejo: Association for Applied and Therapeutic Humor (AATH). <http://aath.org/documents/AATH-WhatWeKnowREVISED.pdf>; 2008 [accessed 20.02.2010].
5. Ekman P, Davidson R, Friesen W. The Duchenne Smile: emotional expression and brain physiology II. *J Pers Social Psychol* 1990; **58**(2):342–53.
6. García-Rodera MC. *Cómo beneficiarse del poder de la risa*. Barcelona: Morales i Torres Editores; 2007.
7. Wortzel HS, Oster TJ, Anderson CA, Arciniegas DB. Pathological laughing and crying. *Epidemiology, pathophysiology and treatment. CNS Drugs* 2008; **22**(7):531–45.

8. Editors. Reviews: making sense of an often tangled skein of evidence (editorial). *Ann Intern Med* 2005;142:1019–20.
9. Collins A. Balancing the strengths of systematic and narrative reviews. *Hum Reprod Update* 2005;11(2):103–4.
10. Dixon-Woods M, Agarwal S, Jones D, Young B, Sutton A. Synthesising qualitative and quantitative evidence: a review of possible methods. *J Health Serv Res Policy* 2005;10(1):45–53.
11. Penson RT, Partridge RA, Rudd P, Seiden MV, Nelson JE, Chabner BA, et al. Laughter: the best medicine? *Oncologist* 2005;10:651–60.
12. Evans W. Ottawa Lodges add humor to armamentarium in fight against cancer. *Can Med Assoc J* 1990;142:163–5.
13. Erdman L. Laughter therapy for patients with cancer. *Oncol Nurs Forum* 1991;18:1359–63.
14. Bellert JL. Humor, a therapeutic approach in Oncology nursing. *Cancer Nurs* 1989;12:65–70.
15. Kimata H. Effect of humor on allergen-induced wheal reactions. *JAMA* 2001;285:738.
16. Kimata H. Laughter elevates the levels of breast-milk melatonin. *J Psychosom Res* 2007;62(6):699–702.
17. Bennett MP, Zeller JM, Rosenberg L, McCann J. The effect of mirthful laughter on stress and natural killer cell activity. *Altern Ther Health Med* 2003;9(2):38–45.
18. McClelland R, Cheriff A. The immunoenhancing effects of humour on secretory IgA and resistance to respiratory infections. *Psychol Health* 1997;12(3):329–44.
19. Bukutu C, Le C, Vohra S. Asthma: a review of complementary and alternative therapies. *Pediatr Rev* 2008;29(8):44–9.
20. Boiten FA. The effects of emotional behaviour on components of the respiratory cycle. *Biol Psychol* 1998;49(1–2):29–51.
21. Svebak S. Respiratory patterns as predictors of laughter. *Psychophysiology* 1975;12(1):62–5.
22. Fry WF. The biology of humor. *Humor: Int J Humor Res* 1994;7:111–26.
23. Boone T, Hansen S, Erlandson A. Cardiovascular responses to laughter: a pilot project. *Appl Nurs Res* 2000;13(4):204–8.
24. Nahas R. Complementary and alternative medicine approaches to blood pressure reduction. *Can Fam Physician* 2008;54:1529–33.
25. Hayashi T, Urayama O, Hori M, Sakamoto S, Nasir UM, Iwanaga S, et al. Laughter modulates prorenin receptor gene expression in patients with type 2 diabetes. *J Psychosom Res* 2007;62(6):703–6.
26. Sugawara J, Tarumi T, Tanaka H. Effect of mirthful laughter on vascular function. *Am J Cardiol* 2010;106(6):856–9.
27. Yoshino S, Fujimori J, Kohda M. Effects of mirthful laughter on neuroendocrine and immune systems in patients with rheumatoid arthritis. *J Rheumatol* 1996;23(4):793–4.
28. Basmajian JV. The elixir of laughter in rehabilitation. *Arch Phys Med Rehabil* 1998;79:1597.
29. Schmitt N. Patients' perception of laughter in a rehabilitation hospital. *Rehabil Nurs* 1990;15(3):143–6.
30. Saper B. The therapeutic use of humor for psychiatric disturbances of adolescents and adults. *Psychiatr Q* 1990;61:261–72.
31. Gelkopf M, Kreitler S, Sigal M. Laughter in a psychiatric ward. Somatic, emotional, social, and clinical influences on schizophrenic patients. *J Nerv Ment Dis* 1993;181:283–9.
32. van Alphen PJ. Humor as diagnostic and therapeutic tool in psychiatry. Laughter is healthy. *TVZ* 1997;107(22):674–7.
33. Seaward BL. Humor's healing potential. *Health Prog* 1992;73(3):66–70.
34. Krack P, Kumar R, Ardouin C, Dowsey PL, McVicker JM, Benabid AL, et al. Mirthful laughter induced by subthalamic nucleus stimulation. *Mov Disord* 2001;16(5):867–75.
35. Fried I, Wilson CI, MacDonald KA, Behnke EJ. Electric current stimulates laughter. *Nature* 1998;391:650.
36. Taber KH, Redden M, Hurley RA. Functional anatomy of humor: positive affect and chronic mental illness. *J Neuropsychiatry Clin Neurosci* 2007;19(4):358–62.
37. Meyer M, Baumann S, Wildgruber D, Alter K. How the brain laughs. Comparative evidence from behavioural, electrophysiological and neuroimaging studies in human and monkey. *Behav Brain Res* 2007;182(2):245–60.
38. Kawakami K, Takai-Kawakami K, Tomonaga M, Suzuki J, Kusaka T, Okai T. Origins of smile and laughter: a preliminary study. *Early Hum Dev* 2006;82:61–6.
39. Pearce JMS. Some neurological aspects of laughter. *Eur Neurol* 2004;52:169–71.
40. Wild B, Rodden FA, Grodd W, Ruch W. Neural correlates of laughter and humor. *Brain* 2003;126:2121–38.
41. Luschei ES, Ramig LO, Finnegan EM, Baker KK, Smith ME. Patterns of laryngeal electromyography and the activity of the respiratory system during spontaneous laughter. *J Neurophysiol* 2006;96:442–50.
42. Bea JA, Marijuán PC. The informational patterns of laughter. *Entropy* 2003;5:205–13.
43. Kohler KJ. Speech–smile, speech–laughter, laughter and their sequencing in dialogic interaction. *Phonetica* 2008;65:1–18.
44. Bachorowski JA, Smoski MJ, Owren MJ. The acoustic features of human laughter. *J Acoust Soc Am* 2001;110(3):1581–97.
45. Bachorowski JA, Owren MJ. Not all laughs are alike: voiced but not unvoiced laughter readily elicits positive affect. *Psychol Sci* 2001;12(3):252–7.
46. Williams H. Humor and healing: therapeutic effects in geriatrics. *Gerontion* 1986;1:14–7.
47. O'Brien ME. Integrative geriatrics. Combining traditional and alternative medicine. *N C Med J* 1996;57(6):364–7.
48. Tennant KF. Laugh it off. The effect of humor on the well-being of the older adult. *J Gerontol Nurs* 1990;16(12):11–7.
49. Evans S, Tsao JC, Zeltzer LK. Complementary and alternative medicine for acute procedural pain in children. *Altern Ther Health Med* 2008;14(5):52–6.
50. Henderson SW, Rosario K. But seriously: clowning in children's mental health. *J Am Acad Child Adolesc Psychiatry* 2008;47(9):983–6.
51. Reddy V, Williams E, Vaughan A. Sharing humour and laughter in autism and Down's syndrome. *Br J Psychol* 2002;93(Pt 2):219–42.
52. Beddoe AE, Lee KA. Mind–body interventions during pregnancy. *JOGNN* 2008;37:165–75.
53. Cantó MA, Quiles JM, Vallejo OG, Pruneda RR, Morote JS, Piñera MJ, et al. Evaluation of the effect of hospital clown's performance about anxiety in children subjected to surgical intervention. *Cir Pediatr* 2008;21(4):195–8.
54. Robinson V. The purpose and function of humor in OR nursing. *Today's OR Nurse* 1993;15(6):7–12.
55. Liechty RD. Humor and the surgeon. *Arch Surg* 1987;122(5):519–22.
56. Morse DR. Use of humor to reduce stress and pain and enhance healing in the dental setting. *J N J Dent Assoc* 2007;78(4):32–6.
57. Wilde JA. Laughing all the way. *Dent Today* 1998;17(12):38–41.
58. Davis DM, Fiske J, Scott B, Radford DR. The emotional effects of tooth loss in a group of partially dentate people: a quantitative study. *Eur J Prosthodont Restor Dent* 2001;9(June (2)):53–7.
59. McCreadie M, Wiggins S. The purpose and function of humour in health, health care and nursing: a narrative review. *J Adv Nurs* 2008;61(6):584–95.
60. MacDonald CM. A chuckle a day keeps the doctor away: therapeutic humor and laughter. *J Psychosoc Nurs Ment Health Serv* 2004;42(3):18–25.



61. Mathew FM. Laughter is the best medicine: the value of humour in current nursing practice. *Nurs J India* 2003;**94**(7):146–7.
62. Astedt-Kurki P, Isola A. Humour between nurse and patient, and among staff: analysis of nurses' diaries. *J Adv Nurs* 2001;**35**(3):452–8.
63. Bakerman HM. Humour as a nursing intervention. *Axone* 1997;**18**(3):56–61.
64. Herth KA. Laughter. A nursing Rx. *Am J Nurs* 1984;**84**(8):991–2.
65. Berry S. Humor me on this one. The healing role of humor in EMS. *JEMS* 2003;**28**(11):66–79.
66. Ratzan RM. Laughter in the temple of pain and illness. *Emerg Med* 1996;**14**(1):92–5.
67. Leiber DB. Laughter and humor in critical care. *Dimens Crit Care Nurs* 1976;**5**:162–70.
68. Borod M. SMILES — toward a better laughter life: a model for introducing humor in the palliative care setting. *J Cancer Educ* 2006;**21**(1):30–4.
69. Dean RA, Gregory DM. Humor and laughter in palliative care: an ethnographic investigation. *Palliat Support Care* 2004;**2**(2):139–48.
70. Dean RA. Humor and laughter in palliative care. *J Palliat Care* 1997;**13**:34–9.
71. Herth K. Contributions of humor as perceived by the terminally ill. *Am J Hosp Care* 1990;**7**:36–40.
72. Graham LL, Cates JA. Responding to the needs of the terminally ill through laughter and play. *Am J Hosp Care* 1989;**6**(1):29–30.
73. Vagnoli L, Caprilli S, Robiglio A, Messeri A. Clown doctors as a treatment for preoperative anxiety in children: a randomized prospective study. *Pediatrics* 2005;**116**:563–7.
74. Parish AB. It only hurts when I don't laugh. *Am J Nurs* 1994;**94**(8):46–7.
75. Strickland D. Overcome terminal seriousness: let go laugh, and lighten up. *Semin Perioper Nurs* 1999;**8**:53–9.
76. Hunter P. *Humor therapy in home care*, September. Caring Magazine; 1997. pp. 56–57.
77. Ruiz Gómez MC, Rojo Pascual C, Ferrer Pascual MA, Jiménez Navascués L, Ballesteros García M. Terapias complementarias en los cuidados. Humor y risoterapia. *Index Enferm (Gran)* 2005;**48–49**:37–41.
78. Harries G. Use of humour in patient care. *Br J Nurs* 1995;**4**(17):984–6.
79. Mallet J. Use of humour and laughter in patient care. *Br J Nurs* 1993;**2**:172–5.
80. Granek-Catarivas M, Goldstein-Ferber S, Azuri Y, Vinker S, Kahan E. Use of humour in primary care: different perceptions among patients and physicians. *Postgrad Med* 2005;**81**:126–30.
81. Fowler JH, Christakis NA. Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. *BMJ* 2008;**337**:a2338.
82. Chapell M, Batten M, Brown J, Gonzalez E, Herquet G, Massar C, et al. Frequency of public laughter in relation to sex, age, ethnicity, and social context. *Percept Mot Skills* 2002;**95**(3 Pt 1):746.
83. Demmer C. A survey of complementary therapy services offered by hospices. *J Palliat Med* 2004;**7**(4):510–6.
84. Astin JA, Shapiro SL, Eisenberg DM, Forsy KL. Mind–body medicine: state of the science, implications for practice. *J Am Board Fam Pract* 2003;**16**:131–47.
85. Zagvazdin Y. Movies and emotional engagement: laughing matters in lecturing. *Fam Med* 2007;**39**(4):245–7.
86. Park CM. Diversity, the individual, and proof of efficacy: complementary and alternative medicine in medical education. *Am J Public Health* 2002;**92**(10):1568–72.
87. Tiralongo E, Wallis M. Integrating complementary and alternative medicine education into the pharmacy curriculum. *Am J Pharm Educ* 2008;**72**(4):74.
88. Sahakian A, Frishman WH. Humor and the cardiovascular system. *Altern Ther Health Med* 2007;**13**(4):56–8.
89. Martin RA. Humor, laughter, and physical health: methodological issues and research findings. *Psychol Bull* 2001;**127**:504–19.
90. Martin RA, Lefcourt HM. Sense of humor and physical health: theoretical issues recent findings, and future directions. *Humor* 2004;**17**(1):1–20.
91. Mora-Ripoll R, Garcia-Rodera MC. El valor terapéutico de la risa en medicina. *Med Clin (Barc)* 2008;**131**(18):694–8.
92. Martin RA. *The psychology of humor: an integrative approach*. London: Elsevier; 2006.
93. Foley E, Matheis R, Schaefer C. Effects of forced laughter on mood. *Psychol Rep* 2002;**90**(1):184.
94. Neuhoff CC, Schaefer C. Effects of laughing, smiling, and howling on mood. *Psychol Rep* 2002;**91**(3 Pt 2):1079–80.
95. Szabo A, Ainsworth SE, Danks PK. Experimental comparison of the psychological benefits of aerobic exercise, humor, and music. *Humor: Int J Humor Res* 2005;**18**(3):235–46.
96. Morgan AJ, Jorm AF. Self-help interventions for depressive disorders and depressive symptoms: a systematic review. *Ann Gen Psychiatry* 2008;**7**:13, doi:10.1186/1744-859X-7-13, <http://www.annals-general-psychiatry.com/content/7/1/13>.
97. Abel MH. Interaction of humor and gender in moderating relationships between stress and outcomes. *J Psychol* 1998;**132**(May (3)):267–76.
98. Kuiper NA, Martin RA. Laughter and stress in daily life: relation to positive and negative affect. *Motivation Emotion* 1998;**22**(2):133–53.
99. Moore DB. Make them laugh. Therapeutic humor for patients with grief-related stress or anxiety. *Adv Nurse Pract* 2000;**8**(8):34–7.
100. Gelkopf M, Sigal M, Kramer R. Therapeutic use of humor to improve social support in an institutionalized schizophrenic inpatient community. *J Soc Psychol* 1994;**134**(2):175–82.
101. Gelkopf M, Gonen B, Kurs R, Melamed Y, Bleich A. The effect of humorous movies on inpatients with chronic schizophrenia. *J Nerv Ment Dis* 2006;**194**(11):880–3.
102. Abel MH. Humor, stress and coping strategies. *Humor: Int J Humor Res* 2002;**15**(4):365–81.
103. Nezelek JB, Derks P. Use of humor as a coping mechanism, psychological adjustment, and social interaction. *Humor: Int J Humor Res* 2001;**14**(4):395–413.
104. Arminen I, Halonen M. Laughing with and at patients: the role of laughter in confrontations in addiction group therapy. *Qualitative Rep* 2007;**12**(3):483–512.
105. Ventis WL, Higbee G, Murdock SA. Using humor in systematic desensitization to reduce fear. *J Gen Psychol* 2001;**128**(2):241–53.
106. Scholl JC, Ragan SL. The use of humor in promoting positive provider–patient interactions in a hospital rehabilitation unit. *Health Commun* 2003;**15**(3):319–30.
107. Thiagarajah PH, Finkielstein D, Granato JE. A case series and literature review of gelastic (laughter-induced) syncope. *Postgrad Med* 2010, doi:10.3810/pgm.2010.11.2231.
108. Gendry S. *Chair laughter yoga*. Pasadena: American School of Laughter Yoga. <http://www.laughteryogaamerica.com>; 2010 [accessed 12.02.2011].
109. Beckman H, Regier N, Young J. Effect of workplace laughter groups on personal efficacy beliefs. *J Prim Prev* 2007;**28**(2):167–82.
110. Walter M, Hänni B, Haug M, Amrhein I, Krebs-Roubicek E, Müller-Spahn F, et al. Humor therapy in patients with late-life

- depression or Alzheimer's disease: a pilot study. *Int J Geriatr Psychiatry* 2007; **22**(1):77–83.
111. De la Fuente-Mochales MB, González-Cascante ME. Laughter therapy for chronic skeletal muscular pain. *Rev Enfer* 2010; **33**(6):43–4.
  112. Falkenberg I, Buchkremer J, Burtels M, Wild B. Implementation of a manual-based training of humor abilities in patients with depression: a pilot study. *Psychiatry Res* 2011; **186**(2–3):454–7.
  113. Nagendra HR, Chaya MS, Nagarathna R, Kataria M, Manjunath MK, Rao R. *The efficacy of laughter yoga on IT professionals to overcome stress*. Mumbai: Laughter Yoga International; 2007.
  114. Shahidi M, Mojtahed A, Modabbernia A, Mojtahed M, Shafabady A, Delavar A, et al. Laughter Yoga versus group exercise program in elderly depressed women: a randomized controlled trial. *Int J Geriatr Psychiatry* 2011; **26**:322–7.
  115. Ko HJ, Youn CH. Effects of laughter therapy on depression, cognition and sleep among the community-dwelling elderly. *Geriatr Gerontol Int* 2011, doi:10.1111/j.1447-0594.2010.00680.x.
  116. García-Rodera MC. *El poder de la risa*. Barcelona: Editorial M&T-Morales i Torres, S.L.; 2003.
  117. Kimata H, Morita A, Furuhashi S, Itakura H, Ikenobu K, Kimura K. Assessment of laughter by diaphragm electromyogram. *Eur J Clin Invest* 2009; **39**(1):78–9.
  118. Richman J. The lifesaving function of humor with the depressed and suicidal elderly. *Gerontologist* 1995; **35**: 271–3.
  119. Gendry S. *From 0 to laughter in 0.5 seconds. The indispensable handbook on simulated laughter exercises for better health and more joy*. third ed. Los Angeles: American School of Laughter Yoga; 2007.
  120. Gendry S. *Laughter FUN-damentals. The ultimate simulated laughter exercises companion book*. Los Angeles: American School of Laughter Yoga; 2007.
  121. Mora-Ripoll R. *Manual de medicina y terapia de la risa*. Bilbao: Desclee de Brouwer, S.A.; 2010.
  122. Mora-Ripoll R. Therapeutic value of laughter in medicine. *Altern Ther Health Med* 2010; **16**(6):56–64.
  123. Bachorowski JA, Smoski MJ. The acoustic features of human laughter. *J Acoust Soc Am* 2001; **110**(3 Pt. 1):1581–97.
  124. Mora-Ripoll R, Quintana-Casado I. Risa y terapias positivas: moderno enfoque y aplicaciones prácticas en medicina. *Rev Psiquiatr Salud Mental* 2010; **3**(1):27–34.
  125. Mora-Ripoll R. La risa como tratamiento médico: una opción complementaria/alternativa en educación y atención sanitarias. *Med Clin (Barc)* 2011; **136**(3):111–5.
  126. Egger GJ, Binns AF, Rossner SR. The emergence of "lifestyle medicine" as a structured approach for management of chronic disease. *Med J Aust* 2009; **190**(3):143–5.
  127. Hyman MA, Ornish D, Roizen M. Lifestyle medicine: treating the causes of disease. *Altern Ther Health Med* 2009; **15**(6):12–4.
  128. Vera B. *Psicología positiva: una nueva forma de entender la psicología*. Madrid: Calamar Ediciones; 2008.
  129. Seligman MCP, Stee RA, Park N, Peterson C. Positive psychology progress: empirical validation of interventions. *Am Psychol* 2005; **60**(5):410–21.
  130. Kataria M. *Laugh for no reason*. Mumbai: Madhuri International; 2005.