
High Response of Human Muscles to Soundwaves in Electromyography and Artificial Intelligence Based Studies Supports the Effectiveness of Sound Therapy and Confirms the Existence of Sound-Induced Diseases

Uzoma Divinelove Moses Ozuomba

MD, MSc, and PhD Georgian Technical University, Georgia. Email: muozin3@gmail.com

ABSTRACT

Human Muscle, by virtue of its nature is a good medium of sound propagation into the body where the propagated soundwaves can positively or negatively influence biological homeostasis from atomic, molecular and cellular levels to systemic level. A sound is a vibration moving through a medium as a mechanical wave composed of mountain and valley shaped compressions and rarefactions called soundwaves. Soundwaves can be of natural origin and can equally be generated or created. Music is sound and sound can be music but not always except when noise is perceived as music. Both music and noise are sound, but while music has a discrete structure with a pleasing nature, noise has a continuous structure with unpleasing nature. Sound heals and music heals but any of them with abnormal entropy can kill. Sound therapy and music therapy are cost effective none-invasive medical remedies that involves no surgeries or medications. Everything vibrates and anything that vibrates vibs with vibrating sound, music, noise or other matter, and the effects can be healthful or unhealthful. Many cultures in antiquity indulged in several sound healing practices. For instance, the ancient Igbo understood the adsorptive, absorptive, adaptive or responsive nature of humans or human muscle to sound energy, and to sun energy, water energy, earth energy and air energy that they summed up and called Ahĩa-Anọ, so they meditatively listened to natural sounds or sounds made from their native instruments while undergoing sun baths, water cleansing, earthing and air baths for all-encompassing healing. The sounds that those ancient Igbo listened to while undergoing these frequency energy therapies included sounds from animals, vegetation, wind, rainfall, waterfalls, flowing waters such as stream, river, ocean, and sounds of mbem or elele chants, and sounds from their native instruments such as ụbọ, ọja, ogele, igba, udu, aro, ọyọ, ịchaka, ekwe, and atañiri. To amplify and venerate sound effects, the ancient Igbo built gigantic sound instruments called Oke Ikoro just as they built step pyramids that by age and cultural relevance and essence rival or precede those of ancient Egypt and Nubia in veneration of Earth Energy called Mmụọala and other Ahĩa-Anọ Energies by association, and during their celebrations, several melodious elele chants and music sounds were played for several purposes including healing. Soundwaves, whether by generation or of natural origin are a product of

vibration that its transmissions is through air, solid or water medium. Human body is predominantly water, so it is a good medium of sound propagation. Any soundwave that influences this human-water medium during propagation can influence the human health. Calm soundwave calms biological homeostasis resulting in health while chaotic soundwaves causes chaos in biological homeostasis resulting in inflammations and finally in ill-health. What we call ill-health or disease is actually an inflammation in cells' mitochondria of affected organ(s) or system(s). This project work used values of average muscle response and average accuracy of AI models that I built to delve into a comprehensive review of research studies on both therapeutic and harmful effects of soundwaves on human-beings.

KEYWORDS: Electromyography, EMG Signals, SoundWaves, Sound Therapy, Sound Healing, Frequency Hz, Amplitude dB, CleveLab Kit, Artificial Intelligence, Machine Learning, MATLAB, Microsoft Excel.

AIM: My objective is to review research works on both therapeutic and harmful effects of soundwaves on humans using value of average muscle response and accuracy value of the AI models that I built with numerical data gotten from the electromyography studies.

ABBREVIATIONS: AI = Artificial Intelligence, EMG = Electromyography, Hz =Hertz, dB = Decibel, EMF = Electromagnetic Field, AAAM =Average Accuracy of AI Models, ARMS = Average Response of Muscles to Soundwaves, HPA-Axis =Hypothalamic pituitary adrenal Axis.

INTRODUCTION

According to the first scientific studies on the effects of soundwaves on EMG signals using artificial intelligence, muscle tissue, apart from reacting and responding differently to different sound signals, it is also found in virtually all body organs and systems where they champion or augment and enhance cardiovascular, gastrointestinal, respiratory, reproductive, endocrine, immune, vision, functional, structural, postural, protective and metabolic activities as well as body temperature regulation and maintenance of general body homeostasis, so any soundwaves that affect any of these activities that muscle tissue takes part in can end up making a therapeutic or harmful impacts on the humans' health (Ozuomba & Z, 2025). Soundwaves are energies produced by vibrations, and they are propagated longitudinally in the sense that they moves in the same direction as the vibration through gas/air medium, liquid/water medium or solid medium such as membrane, metal as well as wood (Raghu, 2018; Radi & Rasmussen, 2013; Peterson, 2012). While sound therapy utilizes specific healing frequencies and harmonics to achieve its therapeutic goals on the body, music therapy utilizes frequencies and harmonies that instigate immune response on the body; moreover, music therapy has been incorporated into major university curriculum for more researches that will facilitate its full incorporation and recognition as an alternative therapy to conventional therapies (ENTClinicSydney, 2014), and among the universities and institutions of higher learning that now offer music courses are many United States of America's institutions (Masters In Special Education Program Guide, 2025). Music therapy is not only a clinically based therapy but also an evidence based therapy designed to achieve individualized goals that fall within the confines of working alliance by a qualified music therapist dully trained and certified (American Music Therapy Association, 2005) Consonantly, a

medically certified music therapist must apply music therapy with total adherence to ethical and safety principles with prime objective of addressing the patients' medical needs within the bounds of not only communicative, musical, physical and spiritual settings but also within the ambit of emotional, cognitive and social settings. In the same vein, people of diverse social-economic status and ages, people of different abilities and musical backgrounds in hospital settings as well as in private and community settings can also use and benefit from therapeutic values of music sounds. Additionally, music sound therapy are found very useful in the following living and medical conditions; in palliative care units, in cases of brain injury, in obstetrical and oncological situations, in emotional or psychological problems and mental health difficulties, in neonatal and geriatric care units, in critical cares, in cases of hearing and visual impairments as well as speech and language impairments, in cases of substance abuse or in cases of victims of abuse, in developmental and physical disabilities, in autism cases, in cases of AIDS, in cases of pain management and personal growth (Canadian Association of Music Therapists, 2020). A British body is not left out in acknowledgement of effectiveness of music sound therapy (British Association For Music Therapy, 2020).

Sound therapy is a frequency medicine (AMs Project Consultants, 2020) that Albert Einstein had predicted to be the future of medicine (Loh, 2017). Nikola Tesla through his experimentations with electromagnetic field EMF in late nineteenth and twentieth century brought frequency medicine into scientific consideration in the West proclaiming that anyone who wants to know the secrets of the universe should think of it in the dimension of energy, frequency and vibration (Hunt & Schooler, 2019). However, millennia before the ancient Igbo built step pyramids that by age and cultural or spiritual significance rival or precede those of ancient Egypt that were built way before the Greeks, Nikola Tesla's and Albert Einstein's births, experiments, proclamations and prediction, several frequency energy medicines including sound therapy had been extensively practiced by the ancient Igbo during meditative sun baths, water cleansing, grounding and air baths listening to calming melodious sounds from nature or sound beats from their native sound instruments for a prime purpose of all-inclusive healing. Till date, sound energy or music sound energy is extensively used by the Igbo in Afa diagnostic procedures and during meditative healing practices and festivals in acknowledgment and veneration of Mmụọkụ, Mmụọmiri, Mmụọala and Mmụọikuku which are the four cardinal entities represented as the four cardinal points of East, West, North and South just as they are represented also as plasm, liquid, solid and gas the four most basic states of matter, and through their representations in all spheres of existence, these four cardinal entities stand out as the foundational basis of reality, spirituality, quantum knowledge, science and its branches as well as other forms of knowledge. The four cardinal entities called Mmụọkụ, Mmụọmiri, Mmụọala and Mmụọikuku are also represented as a four-market-day system singly called Eke, Oriẹ, Afọ, Nkwọ and collectively called Ahịa-Anọ with which the ancient Igbo used to study and classify the essence of everything including humans, delving deeply into mastering the celestial bodies, the space, the aquatic bodies, the terrestrial bodies and the physical universe in general thereby forming a 13 zodiac sign system and inventing a 13 month calendar system that became the pioneer basis of astrology and every other calendar month systems in existence, and during their commemorations, a lot of music sound melodies were played for many purposes including healing objectives. The ancient Igbo understood science and astronomy reasonably well that

they founded a 13 months calendar year in which 4 market days make up one week, 7 weeks make up one month and 13 months make up one year giving a total of 364 days per year which includes September and March equinox called Ọdaomumụ; and most days are shorter or longer and not really 24 hours but approximately 24 hours, so the remainders collectively make up this 364 giving a total of 365 days per year, and the same applies to leap years. Several sound healing practices for physical and mental healings are conducted on people during equinoxes and new moons the actual new months starting from the first month to the 13th month and names of the Igbo months include Ọnwambụ, Ọnwabụo, Ọnwaifeke, Ọnwanọ, Ọnwagwụ, Ọnwaihejiokụ, Ọnwalomchị, Ọnwailommụo, Ọnwala, Ọnwaokike, Ọnwajala, Ọnwaedeajala, Ọnwaụzọarushi. The Igbos especially the children and teenagers usually welcome new moons with joyful songs and shouts of ya ya ya wo wo wo or we we we in admiration, honor and praise of the emerging new moon during which physical and mental healings occur. Many great Igbo Dibia avail themselves the natural essence of June and December solstices called Ọsaa/Ọsaraa/Ọraa/Ọharaa or Sugoo/Sunie or Ọmumụ which are divided into rainy season solstice called summer solstice and dry season solstice called winter solstice to carry out several healing practices including sound healing practices. The four cardinal entities called Mmụokụ, Mmụomiri, Mmụọala and Mmụoikuku are the natural energies behind the frequency energy medicines of sun baths, water cleansing, grounding and air baths that the ancient Igbos practiced extensively during which they meditatively listened to healing sounds for their general well-being. In ancient time and till recently, Eke, Orie, Afọ and Nkwọ represented a four partitioned cross road called Mgbakinọ or Kirisitiri or karaishitiri where Iyiwu healing practice and other natural healing practices that involve sound energy took place, and it is this cross road that later became worship or major symbols of many ancient and modern religions. Sound energy is also used during celebration of one's infinite creative powers called Agwụ and during celebration of one's Chi which is actually the person's maternal and paternal genetic energy compositions called Mmụoikwunne and Mmụoikwunna and this Chi is superior but related to sub-concepts termed Onyeuwa and Agụ in both Igbo traditional norms and natural realities called Omenala and Ọdinala. As far back as over 3000 BC when Igbos smelted iron in Lejja area of Igbo land, sound energy was used as energizing or a motivating incentive to the workers in the site for enhancement of production. Among well cultured people of Igbos extraction, you cannot talk about ancient sound therapy without relating it with protective healing super energies such as Ala, Elu or Enu or Anu, Ekwensu, Yawe, Ụrashi, Agwura, Ọmọnwā, Odere, Ngele, Ethiope, Anụnụbe, Ngwu, Inyagbaokụ, Ọfọ., Ebelebe, Abọshi, Ọji, Oseoji, Ebubeagu, Ụdara, Ojukwu, Umune, Ọgbunechendu, Ọrji, Ụlụ, Njụ, Apimmụo, Akwụ, Akpụljitete, Akpụọkaletete, Iruopa, Ọgba, Eshi, Umendnluisi, Akwariomumụ or Ọdaomumụ, Arobinagu, Ogwugwu, Udo, Amadioha, Nnamueke, Mmụototi or Mut, Enem, Nneoti or Nut, Ejeala Ụnammiri and ultimately Nneagwụ that one of its major celebration centers is still know and it is at Uhu- Nneagwụ in Ụmueshiahuruike Amọkwụ Ezemeazụ Urualla. The name Igbo means infinitely ancient, and fortunately, most frequency and energy medicines including sound therapy practiced by the Igbos started in the ancient time.

Indeed, sound therapy is an ancient medical therapy (Goldsby & Goldsby, 2020) that heals (Habibi & Damasio, 2014) and it is equally called sound bath, sound meditation or a holistic sound healing approach that utilizes vibration as a healing ingredient for enhancement of physical, emotional and

mental states (Goldsby, Goldsby, McWalters, & Mills, 2016; EliteCare Health Centers, 2023). With special reference to the use of music sound therapy by Igbo people, music sound is acknowledged for possessing the natural capability to enhance not just spiritual, physical and mental states of patients, it also has the natural potency to improve aesthetic, emotional and social wellbeing of the patients; and can equally repair brain damage enhancing its functions, boosting immunity, helping in stress reduction and helping people suffering from stroke to recover faster (Nwobu, 2018). Other people that utilized music sounds in religious activities to get rid of evil energies in the olden days include the ancient Egyptians, Indians, Middle Easterners and the Chinese (McCaffrey, 2015). Sound therapy has not only been described as a revolutionary medical technique for prevention and treatment of diseases (Oghenetega, et al., 2022), it is also a healthy product of sound which is a form of energy (Raghu 2018, Choi, Jung and Kang 2019) that when propagated into human bodies has either healthy or unhealthy effects on both physical and mental well-being of the people (Bass and Clark, The Physical Acoustic of Underwater Sound Communication 2003, World Health Organization 2018, Reybrouck, Podlipniak and Welch, Music and Noise: Same or Different? What Our Body Tells Us 2019). For instance, University of Michigan developed a non-invasive soundwaves treatment called HistoSonic that physically breaks down tumors in a medical sound healing technique called histotripsy during which it activates immune system, causes apoptosis of the cancer cells releasing the antigen unlike in radiation or chemotherapy treatments where the cancer cells die alongside the antigens; and America's Food and Drugs Administration (FDA) has approved the use of this soundwaves-powered histotripsy in the USA (Santillan & LYNCH, 2023; Lynch, 2023; Neuroendocrine Tumor Research Foundation (NETRF, 2024). As a non-invasive medical treatment, intervention or remedy involving no surgical operations or medications (The University of Utah, 2020; Huang & Huang, 2023), music sound therapy has been chosen as a therapeutic option in integrative treatment for people suffering from cancer (Boyde, Linden, Boehm, & Ostermann, 2012). Another sound influenced and non-invasive healing remedy is vibroacoustic therapy which involves passing of low frequency sine wave vibrations into one's body via a specially constructed chair, bed or device with amplifying speakers for a prime purposes of healing, relieving of pain, stress reduction, enhancement of circulation, enhancement of relaxation, assessment of progress of labor and the baby's position as well as general wellbeing of the baby (Punkanen & Ala-Ruona, 2012; Birth For Men, 2022). This non-invasive vibroacoustic therapy has also been described as new sound technology that utilizes soundwaves from vibrations to ameliorate disease symptoms in cancer patients undergoing chemotherapy, induce relaxation, manage pain and also mitigate stress suffered by these patients. (Boyd-Brewer & McCaffrey, 2004). During SAR-Co-2 pandemic, biofield-based sound therapy was through zoom applied on some volunteers who had moderate to high degree anxiety and the results showed a significant reduction of anxiety and enhancement of mental health in the volunteers (Jain, McKusick, Ciccone, Sprengel, & Ritenbaugh, 2023). A research has shown that sonic vibration at frequency 90 Hz greatly increased secretion of a potent anti-inflammatory cytokine in a mice specimen and this same sonic vibration (SV) at 90 Hz of frequency did not only improve lipopolysaccharide (LPS)- induced lethality, it also mitigated symptoms of colitis in colitis affected model hence the scientific proof that vibrations are therapeutic by virtue of their natural capabilities to increase expression of an anti-inflammatory protein (Ahn, et al., 2024). Sound frequency vibration-induced cell differentiation and elongation of Alzheimer and

Parkinson models' neuritis has proven to be medically useful in both cell engineering and regenerative medicine (Grosman-Dziewiszek, et al., 2022). Tibetan singing bowl meditation has shown to be helpful in enhancement of relaxation and stress reduction (Goldsby, Goldsby, McWalters, & Mills, 2016). Soundwaves from music triggers release of major regulator of vascular tone called nitric oxide which actually enhances the endothelium dependent vasodilation functions thereby improving cardiovascular health (Ilic, Pavlovic, Kocic, Simonovic, & Lazarevic, 2017). In post cardiac surgery, music sound therapy is used to reduce both anxiety and pain (Kakar, et al., 2021) and this has been very beneficial in terms of reducing dependence on analgesia. Music sound has also been shown as cardiac rehabilitation therapy (Mandel, et al. 2007). Noisy and loud sounds can instigate stress chain reactions in people's brain resulting in secretion of stress hormone such as cortisol which can in turn negatively influence the people's general wellbeing thereby increasing their chances of developing long-term health problems and complications, but if these affected people are exposed to a well-balanced sound environment with cool and relaxing soundwave energies, they get well and reinvigorated (Lim, et al., 2018). Additionally, while noisy sound disrupts concentration, causes sleep disturbance and attendant cardiovascular diseases, a well-balanced sound environment promotes general well-being and quality of life of the people (arturel, 2024). Soundwaves from road traffic noise or aircraft noise constitutes stress and this noise-induced stress has been shown to increase cortisol concentration in sleeping persons, and chronic activation of hypothalamic-pituitary-adrenal axis (HPA –axis) due to increased cortisol concentration resulting from noise-induced stress can cause insulin resistance problem such as diabetes, immunity problem such as eosinophilia, cardiovascular diseases such as hypertension and arteriosclerosis, intestinal issue such as stress ulcer, problem of catabolism such as osteoporosis (Spreng, 2000). Consonantly, stress has been linked to metabolic diseases which include insulin resistance, cardiovascular diseases, obesity, type 2 diabetes, fatty liver disease, immune dysfunction and inflammation, non-communicable diseases and infections, biological aging and senescence, addiction, dysfunctional metabolism, worsening of genetic diseases, tension, behavioral and mental health problems (Kivimäki, Bartolomucci, & Kawachi, 2022; Backé, Seidler, Latza, Rossnagel, & Schumann, 2011; Vitaliano, et al., 2002). Excess stimulation of nervous system during stress produces excess concentrations of vasoconstrictor a hormone capable of causing increased blood pressure (Kulkarni, O'Farrell, Erasi, & Kochar, 1998). Systemic chronic stress can cause systemic chronic inflammation which have been linked to many chronic diseases such as chronic kidney diseases, cardiovascular diseases, cancer, diabetes, autoimmune diseases, arthritis, non-alcoholic fatty liver disease, neurodegenerative diseases and other chronic diseases (Libby, 2007; Medzhitov, 2010). Excess stress is capable of causing anxiety and depression which can in turn lead to increased inflammation (Vogelzangs, Beekman, P de Jonge, & Penninx, 2013). Inflammation is a defense mechanism of the body against infections, physical injury, toxic substances, damaged or dead cells, pathogens and other harmful stimuli especially in acute cases (Medzhitov, 2010; Nathan & Ding, 2010; Ferrero-Miliani, Nielsen, Andersen, & Girardin, 2007), and this acute cases if unchecked escalate into chronic cases altering body physiology thereby leading to many chronic inflammatory diseases (Zhou, Hong, & Huang, 2016). According to (McDade, Adair, Feranil, & Kuzawa, 2010) systemic chronic inflammation is also linked to impaired response to vaccines. All these stress and stress induced inflammation and diseases can be managed or cured using a meditative music sound therapy, and in other words, music

sound therapy is used to trigger emotional healings for positive mood, good affect, calmness, relaxation enhancement, anxiety reduction and physical pain management (Kulkarni, O'Farrell, Erasi, & Kochar, 1998). Sound therapy has been applied to lower stress, glucose levels, heart rate and blood pressure in diabetic patients (Eseadi & Amedu, 2023). Music sound has also been shown to trigger cells to release insulin within minutes and this is healthily helpful to diabetic patients (Department of Biosystems Science and Engineering, 2023). Sound therapy and music sound therapy utilize specific tones, frequencies, rhythms of nature particularly, activate alpha or theta waves and instigate endorphin secretions to instigate and improve sleep and relaxation, heart rate and blood pressure as well as anxiety and stress reductions (Ratliff, n.d.; Fatehimoghadam, Molavynejad, Rokhafroz, & Seyedian, 2023; Lorber & Divjak, 2022; Mir, et al., 2020).

MATERIALS AND METHODS

- A. Average Accuracy of the AI Models (AAAM)
- B. Average Response of Muscles to Soundwaves

For this study and review work, I used average accuracy of best accuracy results of several artificial intelligence (AI) models that I built with numerical data results of healthy volunteers who participated in the studies. The electromyography numerical data that I used to build the (AI).Models in MARLAB were recorded with CleveLab system and analyzed in Microsoft Excel. I also used average response value of the human muscles to different soundwaves that the volunteers were exposed to.

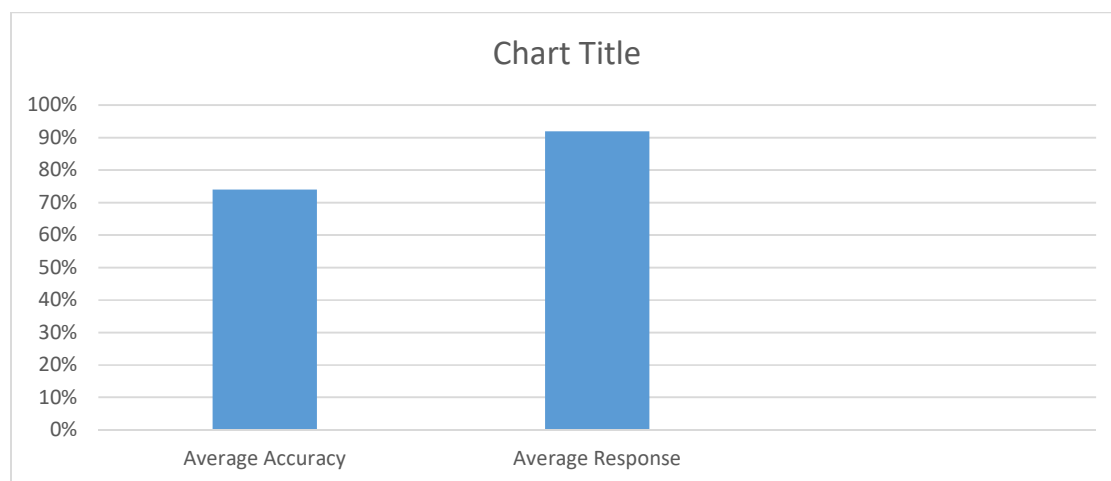
RESULTS

1. Average Accuracy of the AI Models (AAAM) = 74%.
2. Average Response of Muscles to Soundwaves (ARMS) = 92%.

Table 1

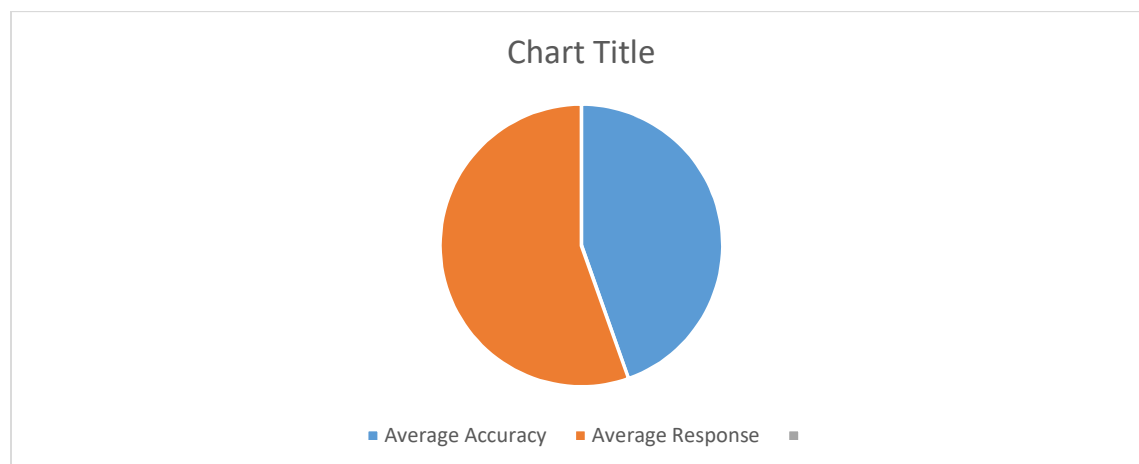
Average Accuracy	Average Response
74%	92%.
AAAM and ARMS in Percentage	

Figure 1



Average Accuracy and Muscle Response Strength

Figure 2



Average Accuracy and Muscle Response Strength

DISCUSSION

As represented in **table 1, figures 1 and 2**; while artificial intelligence (AI) model that I built showed 74% accuracy on the average, the muscles' response to soundwaves showed 92% on the average which is comparable to the 92.5% effectiveness of a sound therapy model called Homeseek app which proved to be healthily helpful to many Chinese suffering from homesickness (Zhou, Nah, & Tan, 2024).

The 74% average accuracy and the 92% response value of human muscle tissue to soundwaves in this study signify the high effects of sound energy on humans and interactions between human muscle and soundwaves are comparable to the 72% accuracy and 100% response values gotten in AI model of another scientific study (Ozuomba & Z, 2025).

CONCLUSION

The average accuracy of the artificial intelligence (AI) models that I built showed a high value of 74% and average response value of the volunteers' muscles showed 92%. It is important to note that the values of AI model accuracy and muscle response to different soundwaves are high both on the average and on individual basis. In fact, some of the muscles' response values on individual basis showed 100%, indicating a very high effects of soundwaves on humans. The fact of these high values with respect to accuracy of AI Models in terms of recognition, prediction, detection and divulgence of hidden information about muscle EMG signals when exposed to diverse sound signals, and how strongly and differently the volunteers' muscles reacted and responded to the different sound signals is a clarion call for more indulgences in evidence based research studies on the therapeutic and harmful effects of soundwaves on humans. These high effects of soundwaves on human-beings through their muscles do not only support the effectiveness of sound therapy, the effects also confirm the existence of sound-induced diseases. Nevertheless, I am still of the opinion that more research works be conducted on both therapeutic and harmful effects of soundwaves on humans and their environments by extension.

References

Ahn, H., Jung, E.-M., Cho, M.-W., Shin, M.-G., Choi, J.-Y., & Lee, G.-S. (2024). Sonic vibration ameliorates inflammatory diseases via the up-regulation of IL-10. PubMed PMID: 38686362 PMCID: PMC11057401 DOI: 10.1080/19768354.2024.2346598.

American Music Therapy Association. (2005). About Music Therapy. Retrieved from music therapy.org: <https://www.musictherapy.org/about/musictherapy/>

AMs Project Consultants. (2020). Sound frequency is the future of medicine. India: Medium. Retrieved from <https://medium.com/@media.amsindia/sound-frequency-is-the-future-of-medicine-607e87fbafb5>

arturel. (2024, January 25). The Scientific Side of Sound - How Acoustics Affect Our Brain. Retrieved from arturel: <https://arturel.com/blogs/news/how-acoustics-affect-our-brain>

Backé, E.-M., Seidler, A., Latza, U., Rossnagel, K., & Schumann, B. (2011). The role of psychosocial stress at work for the development of cardiovascular diseases: a systematic review.

Bass, A. H., & Clark, C. W. (2003). The Physical Accoustic of Underwater Sound Communication. Retrieved from Springer Handbook of Auditory Research 2003 Springer-Verlag New York, Inc. NY DOI https://doi.org/10.1007/0-387-22762-8_2

Birth For Men. (2022, May 23). Vibroacoustic Stimulation Definition Fetal Accoustic Stimulation Fetal Heart Rate. Retrieved from Birth For Men: <https://www.birthformen.com/blog/vibroacoustic-stimulation-definition/>

- Boyd-Brewer, C., & McCaffrey, R. (2004). Vibroacoustic sound therapy improves pain management and more. PubMed.
- Boyde, C., Linden, U., Boehm, K., & Ostermann, T. (2012). The Use of Music Therapy During the Treatment of Cancer Patients: A Collection of Evidence.
- British Association For Music Therapy. (2020). Promoting the Profession and practice of Music Therapy. Retrieved from bamt.org: <https://www.bamt.org/>
- Canadian Association of Music Therapists. (2020, September). About Music Therapy. Retrieved from musictherapy.ca/: <https://www.musictherapy.ca/about-camt-music-therapy/about-music-therapy/>
- Choi, J., Jung, I., & Kang, C.-Y. (2019). A brief review of sound energy harvesting. ScienceDirect <https://doi.org/10.1016/j.nanoen.2018.11.036>.
- Department of Biosystems Science and Engineering. (2023, August 08). Cells with an ear for music release insulin. Retrieved from ETH Zurich: <https://bsse.ethz.ch/news-and-events/d-bsse-news/2023/08/cells-with-an-ear-for-music-release-insulin.html>
- EliteCare Health Centers. (2023, August 22). The Power of Sound Wave Therapy for Senior Wellness. Retrieved from elitecarehc.com: <https://www.elitecarehc.com/blog/the-power-of-sound-wave-therapy-for-senior-wellness/>
- ENTClinicSydney. (2014, October 17). The Sound of Music: What Is Sound Healing and Music Therapy? Retrieved from ENTClinicSydney: <https://ent-surgery.com.au/the-sound-of-music-what-is-sound-healing-and-music-therapy/>
- Eseadi, C., & Amedu, A. N. (2023). Potential impact of music interventions in managing diabetic conditions.
- Fatehimoghadam, S., Molavynejad, S., Rokhafroz, D., & Seyedian, S. M. (2023). Effect of Nature-Based Sound Therapy on Stress and Physiological Parameters in Patients with Myocardial Infarction. DOI:10.4103/ijnmr.ijnmr_221_21.
- Ferrero-Miliani, L., Nielsen, O. H., Andersen, P., & Girardin, S. E. (2007). Chronic inflammation: importance of NOD2 and NALP3 in interleukin-1 β generation.
- Goldsby, T.L. and Goldsby, M.E. (2020). Eastern Integrative Medicine and Ancient Sound Healing Treatments for Stress: Recent Research Advances. Integrative Medicine: A Clinician's Journal, [online] 19(6), p.24. Available at: <https://pmc.ncbi.nlm.nih.gov/articles/PMC7819493> [Accessed 16 May 2025].
- Goldsby, T. L., Goldsby, M. E., McWalters, M., & Mills, P. J. (2016). Effects of Singing Bowl Sound Meditation on Mood, Tension, and Well-being: An Observational Study.
- Grosman-Dziewiszek, P., Wiatrak, B., Dziewiszek, W., Jawień, P., Mydlikowski, R., Bolejko, R., Szandruk-Bender, M., Karuga-Kuźniewska, E. and Szeląg, A. (2022). Influence of 40 Hz and 100 Hz

- Vibration on SH-SY5Y Cells Growth and Differentiation—A Preliminary Study. *Molecules*, [online] 27(10), p.3337. doi:<https://doi.org/10.3390/molecules27103337>.
- Habibi, A., & Damasio, A. (2014). Music, feelings, and the human brain. *Psychomusicology: Music, Mind, and Brain*, 24(1), 92–102. <https://doi.org/10.1037/pmu0000033>
- Huang, E., & Huang, J. (2023). Music Therapy: A Noninvasive Treatment to Reduce Anxiety and Pain of Colorectal Cancer Patients—A Systemic Literature Review. *Medicina* 2023, 59(3), 482; <https://doi.org/10.3390/medicina59030482>.
- Hunt, T., & Schooler, J. W. (2019). The Easy Part of the Hard Problem: A Resonance Theory of Consciousness. *Frontiers in Human Neuroscience*, 13, 378. <https://doi.org/10.3389/FNHUM.2019.00378>
- Ilic, M. D., Pavlovic, R. F., Kocic, G., Simonovic, D., & Lazarevic, G. (2017). Effects of Music Therapy on Endothelial Function in Patients With Coronary Artery Disease Participating in Aerobic Exercise Therapy.
- Jain, S., McKusick, E., Ciccone, L., Sprengel, M. and Ritenbaugh, C. (2023). Sound healing reduces generalized anxiety during the pandemic: A feasibility study. *Complementary Therapies in Medicine*, [online] 74, p.102947. doi:<https://doi.org/10.1016/j.ctim.2023.102947>.
- Kakar, E., Billar, R. J., Rosmalen, J. v., Klimek, M., Takkenberg, J. J., & Jeekell, J. (2021). Music intervention to relieve anxiety and pain in adults undergoing cardiac surgery: a systematic review and meta-analysis.
- Kivimäki, M., Bartolomucci, A., & Kawachi, I. (2022). The multiple roles of life stress in metabolic disorders.
- Kulkarni, S., O'Farrell, I., Erasi, M., & Kochar, M. S. (1998). Stress and Hypertension.
- Libby, P. (2007). Inflammatory mechanisms: the molecular basis of inflammation and disease.
- Lim, J., Kweon, K., Kim, H.-W., Cho, S.W., Park, J. and Sim, C.S. (2018). Negative Impact of Noise and Noise Sensitivity on Mental Health in Childhood. *Noise & Health*, [online] 20(96), pp.199–211. doi:https://doi.org/10.4103/nah.NAH_9_18.
- Loh, E. (2017). The future of medicine. *The Quarterly, Journal of the Royal Australasian College of Medical Administrators*.
- Lorber, M., & Divjak, S. (2022). Music Therapy as an Intervention to Reduce Blood Pressure and Anxiety Levels in Older Adults With Hypertension: A Randomized Controlled Trial. DOI: 10.3928/19404921-20220218-03.
- Lynch, J. (2023, October 9). University of Michigan. Retrieved from VICE PRESIDENT FOR COMMUNICATION, MICHIGAN NEWS, UNIVERSITY OF MICHIGAN.:

- <https://news.umich.edu/tumor-destroying-sound-waves-receive-fda-approval-for-liver-treatment-in-humans/>
- Mandel, S. E., Hanser, S. B., Secic, M., & Davis, B. A. (2007). Effects of music therapy on health-related outcomes in cardiac rehabilitation: a randomized controlled trial.
- Masters In Special Education Program Guide. (2025, December). Top 25 Master's Degrees in Music Therapy 2025. Retrieved from Masters in Special Education Program Guid Updated December 2024: <https://www.masters-in-special-education.com/best/masters-music-therapy-2016/>
- McCaffrey, T. (2015). Music therapy's development in mental healthcare: An historical consideration of early ideas and intersecting agents. *Music and Medicine* <https://doi.org/10.47513/mmd.v7i2.158>.
- McDade, T. W., Adair, L., Feranil, A. B., & Kuzawa, C. (2010). Positive antibody response to vaccination in adolescence predicts lower C-reactive protein concentration in young adulthood in the Philippines.
- Medzhitov, R. (2010). Inflammation 2010: new adventures of an old flame. .
- Mir, I. A., Chowdhury, M., Islam, R. M., Ling, G. Y., M, A. A., Hasan, Z. M., & Higashi, Y. (2020). Relaxing music reduces blood pressure and heart rate among pre-hypertensive young adults: A randomized control trial. *JCH The Journal of Clinical Hypertension* <https://doi.org/10.1111/jch.14126>.
- Nathan, C., & Ding, A. (2010). Nonresolving inflammation.
- Neuroendocrine Tumor Research Foundation (NETRF. (2024, February 13). Neuroendocrine Tumor Research Foundation (NETRF. Retrieved from FDA Paves Way for New Liver Tumor Treatment with Histotripsy: <https://netrf.org/2024/02/13/fda-paves-way-for-new-liver-tumor-treatment-with-histotripsy/>
- Nwobu, S. N. (2018). Possibilities of human healing through music: the Igbo experience. *African Research Review*, 12(3), 99. <https://doi.org/10.4314/afrrrev.v12i3.11>
- Oghenetega , E. A., Rashad , R., Kerna, N. A., Carsrud, V., Brown, S. M., Pruitt, K. D., . . . Nwokorie, U. (2022). Sound Therapy: Vibratory Frequencies of Cells in Healthy and Disease States. DOI:10.31080/eccmc.2022.05.00532
- Ozuomba, U.D.M. and Gurtskaia, Z. (2025). LEARNING SOUND WAVES' EFFECTS ON EMG SIGNALS USING ARTIFICIAL INTELLIGENCE. *GEORGIAN SCIENTISTS*, 7(1), pp.579–585. doi:<https://doi.org/10.52340/gs.2025.07.01.53>.
- Peterson, H.A. (2011). Sound Waves. Springer eBooks, pp.329–330. doi:https://doi.org/10.1007/978-3-642-22563-5_15.
- Punkanen, M. and Ala-Ruona, E. (2012). Contemporary Vibroacoustic Therapy: Perspectives on Clinical Practice, Research, and Training. *Music and Medicine*, 4(3), pp.128–135. doi:<https://doi.org/10.1177/1943862112445324>.

- Radi, H., & Rasmussen, J. O. (2013). Sound Waves. ResearchGate DOI:10.1007/978-3-642-23026-4_15. Retrieved from ResearchGate: https://www.researchgate.net/publication/278713766_Sound_Waves
- Raghu, M. (2018). A Study to Explore the Effects of Sound Vibrations on Consciousness. *International Journal of Social Work and Human Services Practice*, [online] 6(3), pp.75–88. doi:<https://doi.org/10.13189/ijrh.2018.060302>.
- Ratliff, R. (n.d.). 5 Ways Sound Therapy is Like ASMR. Retrieved from Ratliff, R. (2024). Ruth Ratliff, Vibrational Sound Therapy. [online] Ruth Ratliff, Vibrational Sound Therapy. Available at: <https://www.ruthratliff.com/blog/5-ways-sound-therapy-is-like-asmr> [Accessed 16 May 2025].
- Reybrouck, M., Podlipniak, P. and Welch, D. (2019). Music and Noise: Same or Different? What Our Body Tells Us. *Frontiers in Psychology*, [online] 10(1153). doi:<https://doi.org/10.3389/fpsyg.2019.01153>.
- Santillan, M., & LYNCH, J. (2023, October 9). Biomedical Engineering. Retrieved from BIOMEDICAL ENGINEERING - Tumor-destroying soundwaves receive FDA approval for liver treatment in humans: <https://bme.umich.edu/2023/10/09/tumor-destroying-soundwaves-receive-fda-approval-for-liver-treatment-in-humans/>
- Spreng M. (2000). Possible health effects of noise induced cortisol increase. *Noise & health*, 2(7), 59–64.
- StackExchange. (2016, April 7). A (440 Hz) and A (880 Hz) are completely different sounds to me. Does this mean I'm tone deaf? Retrieved from Music Practice and Theory: <https://music.stackexchange.com/questions/43335/a-440-hz-and-a-880-hz-are-completely-different-sounds-to-me-does-this-mean>
- The University of Utah. (2020, May 20). A sound treatment. Retrieved from [attheu.utah.edu](https://attheu.utah.edu/facultystaff/a-sound-treatment/): <https://attheu.utah.edu/facultystaff/a-sound-treatment/>
- Vitaliano, P. P., Scanlan, J. M., Zhang, J., Savage, M. V., Hirsch, I. B., & Siegler, I. C. (2002). A path model of chronic stress, the metabolic syndrome, and coronary heart disease.
- Vogelzangs, N., Beekman, A. T., P de Jonge, P., & Penninx, B. W. (2013). Anxiety disorders and inflammation in a large adult cohort.
- World Health Organization. (2018). Environmental Noise Guidelines for the European region - Executive Summary. WHO Regional Office for Europe UN City, Marmorvej 51 DK-2100 Copenhagen Ø, Denmark: World Health Organization Document number: WHO/EURO:2018-3287-43046-60243 WHO-EURO-2018-3287-43046-60243-eng .
- Zhou, Y., Hong, Y., & Huang, H. (2016). Triptolide Attenuates Inflammatory Response in Membranous Glomerulo-Nephritis Rat via Downregulation of NF-κB Signaling Pathway.
- Zhou, Y., Nah, K., & Tan, S. (2024). A Study on the Sound Therapy Interaction Design to Alleviate Homesickness: The HomeSeek App among Chinese Users. DOI:10.3390/app14198940.