

# Color therapy: Clinical applications of colors in adults and children

Sukhbir K. Shahid<sup>1\*</sup>

<sup>1</sup> Consultant Pediatrician, Neonatologist, Pediatric Pulmonologist, and Certified Color therapist, Mumbai, MH, IN

\*Corresponding Author: Dr. Sukhbir K. Shahid; Consultant Pediatrician, Neonatologist, Pediatric Pulmonologist, and Certified Color therapist, Mumbai, MH, IN;  
email address: s\_kaur\_shahid@yahoo.com

## Abstract

Colors are nothing but electromagnetic waves that energize us holistically. Colors abound in nature and influence our body and mind. But due to its universal presence, one tends to overlook its value and impact on health and disease. Color therapy is an ancient treatment modality that remains underexplored and understudied. Ancient healers used colors to manage illnesses and promote health in an individual. But it was not until the last few centuries that scientists began to explore this healing mode in a scientific way. Colors are now being used to treat certain chronic and refractory diseases of the body. Their main impact is on the neurological system and mind, thereby affecting emotions, moods, and behavior. Thus, it finds immense use in psychosomatic disorders and psychological diseases. It can affect the fatigue level and boost moods. There are few studies carried out to study the effect of colors on mind, body, and soul. But a major chunk of these studies are on adults. A few of the trials were in children but the sample size was small and the study design poor. It is a fact that colors deeply affect humans, but this field needs more systematic study with larger sample sizes and better-designed studies. This review tries to address the studies done in this field and how one can extrapolate them to minimize human sufferings.

**Keywords:** Color therapy, Chromotherapy, Clinical applications, Pediatric uses, Pediatric studies.

## INTRODUCTION

Colors abound in nature and are a form of energy that bathes everyone. They are also found in sunrays, and, thus, they have a profound effect on plants, animals, and humans [1]. They are an integral part of the lives of all living things in this Universe. Each color acts on the human body differently, and its hue, value, intensity, temperature, and energy level govern the overall effect.

Color therapy or Chromotherapy entails using this visible part of electromagnetic waves (of wavelength from 380 to 780 nm or 3800 to 7800 Angstrom units or AU) to treat various diseases, prevent them, and for the general well-being and health of an individual. The other term for this therapy is Colorology. It is a therapy that traditional healers of ancient civilizations used to cure diseases and heal people [2].

In the 19<sup>th</sup> century, Western scientists started taking interest in this prehistoric healing method and began looking at it in a

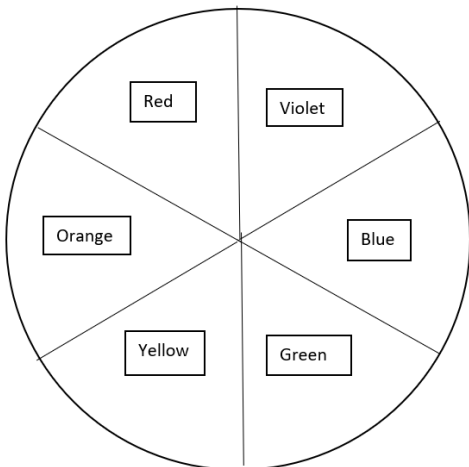
scientific way. They devised several novel gadgets to administer the different colors as a therapy for ailing and sick patients. Color therapists, as they were called, tried to look at the health outcomes in an objective way. These color scientists furthered this therapy and developed phototherapy and photobiomodulation/low level laser therapy or LLLT [3]. In the former mode of light treatment, polychromatic light is used to heal a patient, whereas, in the latter method, electromagnetic rays that are near red or infrared are employed to help regenerate tissues and for healing [3]. The action of these forms of electromagnetic radiation is believed to be at the mitochondrial level, and also on the enzyme, cytochrome oxidase C. For better penetration of these energy waves and for improved efficacy of color therapy, especially for treatment of diseased deeper internal organs, subcutaneous light emitting probes and intravascular laser therapy were invented [4]. Photodynamic therapy (PDT) is another addition to the therapeutic repertoire of light therapy, in which a light-sensitive drug is used with a light source to specifically target and destroy cancer cells [5]. The light rays activate the drug and this helps in better local effects with diminished side-effects.

## PHYSICS OF COLORS

Visible light is made up of and can be broken down into 7 colors of rainbow: violet, indigo, blue, green, yellow, orange and red (VIBGYOR). The color red has the largest wavelength of 780 nm in this visible spectrum and violet has the lowest at 380 nm. The frequency of red is the least but its tissue penetration is better than the other colors of the rainbow. The wavelength, intensity, beam width, illumination geometry and tissue type govern the penetration of that particular color [6, 7]. Red has higher heating power or temperature compared to blue [8].

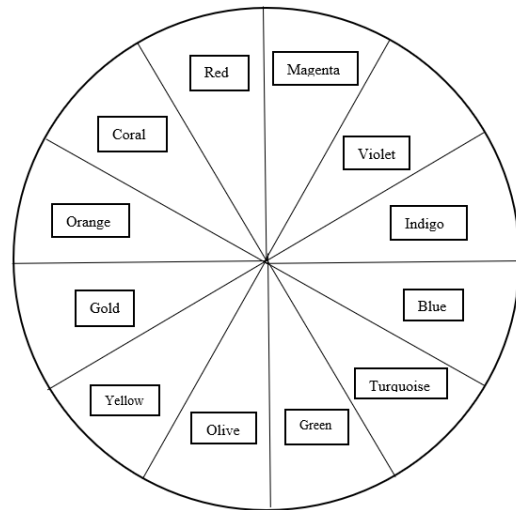
When light falls on an object, it is reflected, refracted, absorbed, transmitted, and diffracted. When an object is green, all colors of light get absorbed except green, which is reflected back to our eyes and we perceive the color through the photoreceptors (rods and cones) in our retina. White objects reflect all colors, while black objects absorb all colors. Each object has its own individual molecular structure, density, and pigmentation and these affect the reflection, absorption, refraction, diffraction, and transmission of colors through it. Dark objects absorb more, while light-colored objects reflect more [9].

Red, blue and yellow are the primary colors. When two primary colors mix, they form secondary colors. Thus, red and blue yield violet, red and yellow yield orange and blue and yellow become green [Figure 1]. Tertiary colors are derived by the mixing of a primary with a secondary color. Alternatively, it is mixing one part of one primary color with half part of the primary color furthest from it. Thus, the magenta color is produced with  $\frac{2}{3}$  red and  $\frac{1}{3}$  blue color. On the other hand, coral is  $\frac{2}{3}$  red or pink and  $\frac{1}{3}$  yellow. Therefore, one can say that magenta has red and violet, indigo has blue and violet, turquoise is blue and green, olive is green and yellow, golden color is yellow and orange and coral is red and orange [10] [Figure 2].



Red, blue and yellow are primary colors

**Figure 1:** Secondary colors from primary colors



Magenta, indigo, turquoise, olive, gold, and coral are tertiary colors

**Figure 2:** Tertiary colors

In color therapy, light or color energy is believed to be imbibed via skin, eyes, water, food, breathing air and lungs, and even by imagination/visualization. Various tools are used for this and include nature, flowers, different colored foods, colors of the interiors of houses, offices or treatment sanctuaries, chromotized water or charged water (elixirs or tinctures), essential oils, ointments (salves) of different colors, different-colored bath salts, colored lighting in a space, candles of different colors, paintings and drawings as wall hangings, garment colors, shoe colors, colors of jewelry and accessories, crystals, gems, make-up color, hair color, color of wine glasses and glassware etc. The ways that one can incorporate colors into your lives are endless [11]. Nowadays, virtual modes are used to have these colors in one's life. These are easier and cheaper than, but, as effective as colored room therapies [12].

## PRINCIPLES OF COLOR THERAPY

Normal human physiology depends a lot on light. The diurnal circadian rhythm and the sleep-wake cycle are examples of it. Whenever this biological clock is disrupted, diseases ensue. The biological clock resides in the anterior hypothalamus at the supra-chiasmatic nucleus (SCN). Light sensation reaches the brain from the eyes and causes stimulation of the nucleus to produce a neuro-hormonal balance and physical health and well-being [13].

Color therapy assumes that diseases are nothing but an imbalance of the various energy forces in the body. These include color, sound, heat, movement, touch, and pressure. And when colors in the body get either deficient or are in excess due to various reasons, diseases result. This color imbalance affects the person psychologically and physically, and produces varied symptoms. Therefore, in order to rid the person of this disease, the appropriate color that the body lacks would be needed. Providing the person with this deficient color would restore normalcy in the individual and eliminate the ill-state. Studies have also shown that plants also grow and yield better with color therapy [14].

## EFFECT OF COLORS ON THE BODY

Colors have a deep impact on the mind, body, and soul of humans. They produce mental, emotional, biochemical, physiological, and physical changes in the person. But the effect is more on the psyche, which is either partly or wholly responsible for several diseases of the body. Psychosomatic diseases occur due to mental problems, and emotional overlay is an inevitable part of almost all physical diseases. Colors help in correction of these emotional and mental issues and, hence, their ill-effects on the body are reduced [15].

Ancient healers who used colors believed that red can excite the mind and move blood, blue or white cools the mind and body, and yellow can decrease body aches, pains, and inflammation. The American physician, Edwin Dwight Babbitt (1828-1905), was one of the early pioneers in the science of color therapy. According to him, the red color can stimulate blood and, to a lesser extent, it also influences nerves. He stated that the colors, orange and yellow, are neural excitators, while the blue color soothes and cools [16].

Takkata was the first researcher to show the co-relation between sunlight and blood. American scientist and author, Jonathan Ott (1949-present) in the 1950s showed that light rays and colors affect flocculation index of human blood albumin and they change menstrual cycles. Ott also talked about the effect of these rays on body enzymes [17]. *In vitro* studies have shown that colors do affect body enzymes. Purple color (464 nm) increases the activity of glucose oxidase enzyme, while dark violet (400 nm) enhances the activity of cholesterol oxidase, cholesterol esterase and lipase [18]. This could be extrapolated and used in diabetics for better outcomes.

In 1958, an American scientist, Dr. Robert Gerard showed that warm colors (red, orange, and yellow) increase heart rate, blood pressure, respiratory rate, respiratory movements, blink frequency of eyes, cortical activation, muscle contraction, and palmar conductance (suggestive of arousal of the autonomic nervous system). He used electroencephalography (EEG) in his studies and also stated that cool colors have opposite effects [18, 19].

Several researchers studied the effect of each color on the mental state of an individual and generally, it is noted that red color enhances physical energy, stamina, stability, and vitality, orange color improves creativity, optimism, emotional expression, and enthusiasm, yellow color increases intellect, personal power, joy, and lightness, green color balances, harmonizes, and helps in communication, blue and indigo colors can calm, give inner peace and increase emotional depth and love, while indigo and violet colors can promote imagination, universal flow, and artistic skills [20]. Some observations attributed an increase in street crime to sodium yellow street lamps. While blue-colored streetlights installed in Japan and Scotland were said to reduce crime rates in these places [21]. Another study found that pink paint on prison walls can decrease aggression in jail inmates [22].

Colors have a deep action on the body at the cellular and molecular levels. They affect cell mitochondria, RNA, and DNA [23, 24]. Research has shown that pineal gland production of the hormone melatonin, a chronobiotic molecule, rises at nighttime. It binds to specific receptors (MT1, MT2) present on cell surfaces and depresses the central nervous system. It also acts on other cell surface receptors and cell signaling molecules. Melatonin interacts with epidermal growth factor (EGF) and affects cell proliferation and differentiation. Melatonin also impacts mitogen-activated protein kinase kinase and extracellular signal-regulated kinase systems (MAPKK/ERK) that regulate gene expression. It interacts with the calmodulin complex that upregulates the anti-oxidative enzymes. These enzymes mop up the harmful free radicals from the body and blood stream. Melatonin also immunomodulates and has an anti-apoptotic effect on body cells. The levels of this hormone are altered in depressed, bipolar, post-traumatic stress disorder (PTSD), and dyssomniac patients [25]. Its levels are high in those suffering from winter depression, amenorrhea, anorexia nervosa, and in men with low sperm counts [17]. On the other hand, serotonin is a daytime hormone that has a neuro-excitatory action. Its low levels coincide with the above psychiatric disorders [25]. Whereas it is present in high amounts in hallucinogenic states of mind and in psychotic brain disorders [25].

Light also affects the secretion of cortisol. Its production rises with both blue and red lights [26, 27]. A small-sampled study on 10 patients using near infrared spectrophotometry (NIRS) showed that chromotherapy can improve oxygenation to the brain and muscles [28]. Another study conducted on the skin of children with atopic dermatitis has shown that non-selective chromotherapy along with hydrotherapy and low intensity laser blood irradiation can improve skin moisture, skin pH, and transepidermal water loss (TEWL) in these patients [29].

## CLINICAL APPLICATIONS OF LIGHT AND COLORS

Colors have been utilized in diagnosis and treatment of diseases. In the past, the famous Faroese/Danish scientist, Niels Ryberg Finsen (1860-1904) used a source of artificial radiation in the treatment of lupus vulgaris, tuberculosis, and small pox. He won the Nobel Prize in 1903 for his work in this field [23]. An American militia general during the American Civil War, Augustus James Pleasonton (1808-1894), initiated the blue glass craze. He inferred that blue is best for injuries, pains, and burns. He felt that it improves physical development and fertility. He treated several cases of rheumatoid arthritis with blue light [17]. Edwin D. Babbitt used red color therapy for neuroparalysis, physical fatigue, weakness, and chronic rheumatism. He prescribed yellow for increasing bowel movements, to induce emesis, and for bronchial difficulties. And he used blue as a cure for headaches, sciatica, mental irritation, nervous imbalances, meningitis, sunstroke, and other inflammatory body conditions. American scientist and author, Charles Klotsche, made a list of 123 diseases that he had successfully managed with chromotherapy [17].

## Adult studies on chromotherapy

The scientists of the modern age carried forward research of old color healers. They found that color therapy can help as a supplementary mode of therapy in a host of diseases such as anorexia nervosa, bulimia nervosa, insomnia, jetlag, SAD (seasonal affective disorder or winter blues or winter depression), chronic alcoholism, drug addiction, anxiety, phobias, panic attacks, depression, aggressive and violent behavior, diabetes, hypertension, immune disorders, headaches and migraines, hyperacidity and peptic ulcer, hematoma, spondylitis, hyperthyroidism, and cancer especially breast cancer [17, 23, 30]. Red light assists in wound healing and constipation [31]. Colors have been shown to have an inhibitory action on pathogens [31]. Therefore, they can improve outcomes in dengue fever, other life-threatening fevers, cutaneous leishmaniasis, and hepatitis B [30]. Azeemi STY et al reported a case of cutaneous leishmaniasis that was successfully treated with color therapy and showed no recurrence after 6 months of follow up [32].

Colors can enhance performance in athletes; red color gives an instant and brief energy burst while blue color provides an overall better performance [17, 23]. Chromotherapy is excellent for stress relief [24]. Chromotherapy rooms are used for stress reduction and to enhance focus in special needs schools. Virtual reality can produce a similar effect with low cost and high portability [12]. A recent study confirmed this and showed that there was no difference in relaxation felt by the group that used chromotherapy rooms and those who used the commercial head mounted display for it. EEG and the relative gamma waves were used to objectively monitor the relaxation in these patients [12].

Femila P showed in her study that color therapy was effective in lowering depression in patients with head and neck cancer [33]. Scientists used the Self-Rating Depression Scale, Self-Rating Anxiety Scale (SAS), Hamilton Depression Scale, Hamilton Anxiety Scale (HAMA), and Positive and Negative Affect Scale at 0 and 3 weeks to assess the efficacy of chromotherapy with conventional anti-anxiety treatment in the management of patients with generalized anxiety disorder. Chromotherapy did help decrease anxiety and improve positive feelings in the treated group [34]. An Indonesian study also revealed that chromotherapy with purple color aided in marked reduction of hallucinations in the treated group compared to the control group [35].

Chromotherapy has found ample use in dentistry [36]. One study revealed that the anxiety levels of patients going for endodontic treatment lessens with color therapy [37]. Auricular chromotherapy has yielded excellent results for management of psychological trauma, panic attacks, and phobias [38]. One uncontrolled study on it showed a 93% positive response in the recipients. Dr. Daniel Asis and Dr. Frederico Zarragoicochea (both from Argentina), along with Dr. Jorge Boucinhas (from Brazil) and Dr. Rafaël Nogier (from France) have developed this technique. The Turkish physician, Bozer C, also utilized auricular chromotherapy with eye movement desensitization and reprocessing [EMDR] to decrease chronic pain following PTSD [39].

Paragas Jr. ED *et al* did a quasi-experimental study on older adults and found that red and green colors produced a significant increase in cognition of older adults compared to those who were exposed to white color [40]. Emani *et al* from Iran studied the role of color therapy on the job satisfaction and quality of life of intensive care nurses. They found that it helped improve the compassion satisfaction and compassion fatigue. It also decreased secondary post-traumatic stress in them [41]. Color therapy also benefited patients of multiple sclerosis [42].

Chromotherapy (selective and non-selective) can also reduce blood pressure and mean stress score in hypertensive individuals [43, 44]. Duodenal ulcer healing was better in the patient group that had traditional pharmacotherapy along with laser and chromotherapy [45]. Nikitin *et al* conducted a study that showed that laser therapy with chromotherapy can help in treatment of inner organ diseases efficiently [46]. Another adult study showed that anti-inflammatory medicines coupled with chromotherapy had better benefits than medicines alone in management of osteoarthritis [47]. In a similar study, non-selective chromotherapy was administered by means of the medically certified Bioptron Hyperlight Therapy System (Swiss product) with positive outcomes [48]. This ancient therapy is also useful in elderly patients to relieve pains of distal diabetic angiopathy [49]. But more large-scale studies are required to confirm the positive effect, if any, of this treatment modality on the management of diabetic neuropathy.

Color therapy not only treats illnesses but also helps in maintaining a good health balance. A study published in *Trakia Journal of Sciences* in 2021 confirmed this, wherein active women experienced an improved health balance with color therapy [50].

Combining chromotherapy with other modes of complementary alternative therapies seems to have a synergistic effect. Aromatherapy with chromotherapy can control pulmonary and nervous system diseases [51]. Infrared saunas provide mental improvement and can assist in ameliorating disease symptoms. The authors suggest that these color therapy-based saunas along with olfactory and auditory stimulation of the person would have a more beneficial effect [52]. Magnetotherapy and chromotherapy also have a similar enhanced action [53]. Polish researchers found that silvotherapy (forest bathing or forest therapy) along with chromotherapy, music therapy and bibliotherapy promotes health and reduces risk of civilization-induced diseases [54].

Color therapists use various devices to administer colors to humans. Grakov's virtual scanning system is one such system for the use of colors to diagnose, prevent, and treat chronic diseases. It is little known outside Russia but is said to be an extremely useful aid in complementary medicine [55].

## Pediatric studies on chromotherapy

Colors can be used for diagnosis, prevention, and treatment of diseases in children. A well-established use of colors in pediatric therapy is phototherapy for physiological neonatal jaundice. In this, sunlight, blue light, or full-spectrum white light is used in the



management of neonatal jaundice of the non-obstructive type. As we know, Faber Birren's emotion in single color, Aura-soma therapy, and Grunwald's space disposition can help to know the emotional status of a person. One study [56] from Japan proposed a fuzzy logic inference system for it based on the above theories. Color your life is a form of play therapy that can assess and treat psychological problems in kids [57].

A very small scale study on 5 students showed that colors can help elementary school students to lessen their anxiety while learning the subject of mathematics [58]. Chromotherapy administered to school students during the covid-19 pandemic and lockdown helped them to cope with the changed life and prevented psychological breakdowns in them [59]. Another study on Pakistani college students showed that blue light with 453 nm was successful in lowering anxiety in them. It was a controlled trial and the treatment group received hydrochromotherapy and viewed the blue color [60]. Primary school children with stuttering had an improved psycho-emotional state after chromotherapy [61].

This therapy can also reduce the academic stress level in nursing students and improve the color expression capacity of adolescents [62, 63]. Color therapy can also be administered to children by using coloring art therapy. It enhances focus and makes a child with cancer happy [64, 65]. In the latter study, students of the age group of 6 to 10 years of age were studied. ADHD children get lots of benefits with this form of therapy [66]. Another study revealed that coloring activity in a group helped children overcome the trauma post-Mount Semeru eruption [67]. Colored luminiphores that glow in the dark can be utilized in color art therapy for children. This can help in distracting them from the digital gadgets and improving their expressive abilities in a low-cost way [68].

Carefully chosen color schemes for interiors also assisted in improvement of the symptoms of autism and hyperactivity in children [69]. Chromotherapy and/or music therapy is incorporated into home automation programs for autistic people that gets activated whenever the monitoring of these people reveals that they have become anxious and disturbed [70]. Also, color therapy can lessen the anxiety associated with hospitalization in pre-school children. Their crying decreases and they demonstrate better acceptance of treatment [71]. Hospital greenery helped children on long term inpatient care to have psychological stability [72].

Another study showed that green light helps to reduce asthma symptoms and improve lung functions and the psyche of allergic children. While blue light has a positive impact on the skin lesions of atopic dermatitis. It lessens the area of affected skin and itching, and improves sleep [73]. The action is probably on the skin barrier function, which is measured by means of skin pH, skin moisture (corneometry), and transepidermal water loss (TEWL) [29]. This was confirmed by means of a study that showed that hydrotherapy, non-selective chromotherapy, and low intensity laser blood irradiation had a profound effect on lessening lesions of atopic dermatitis [74]. Colors could lessen the respiratory symptoms of asthmatic children [74]. Traditional Chinese medicine five-color therapy was found to be

significantly better in management of children with chronic urticaria [75]. Frequently ill children also benefit from this non-invasive intervention [76].

## SAFETY AND LIMITATIONS

Color therapy is relatively safe and well-tolerated. But there is a theoretical possibility of retinal damage due to blue light and white LED light [77]. Japanese researcher Takahashi S also points out that color therapy has its limitations. It might not work in all situations in the way one desires. Though it does affect emotions, behavior, and cognition, the effect may vary in quality and quantity. Most of these deviations are probably due to the different meaning and association of color in different cultures of the world. Individual choices and likings for a particular color also tend to affect the results [78].

## CONCLUSION

Studies on chromotherapy exist but these are limited and most of these studies are poorly designed and poorly executed. Nonetheless, there seem to be benefits of this therapy for the mind and body of a person. The reductive effect of chromotherapy on stress is undebatable and it could be used as a low-cost, non-invasive, and safe supplementary treatment in management of chronic cases. It is simple and easy to administer and does not require sophisticated tools. But it has its limitations and potential dangers. Hence, before it is recommended as a complementary therapy on a mass scale, more large-scale and multi-centric studies using objective monitoring and outcome parameters need to be conducted. The various modes of administration employed need standardization and proper quantification. Such research would be able to uplift the role of this ancient healing therapy in health promotion, as well as disease prevention and treatment.

### Conflict of Interest

There is no conflict of interest in this study.

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