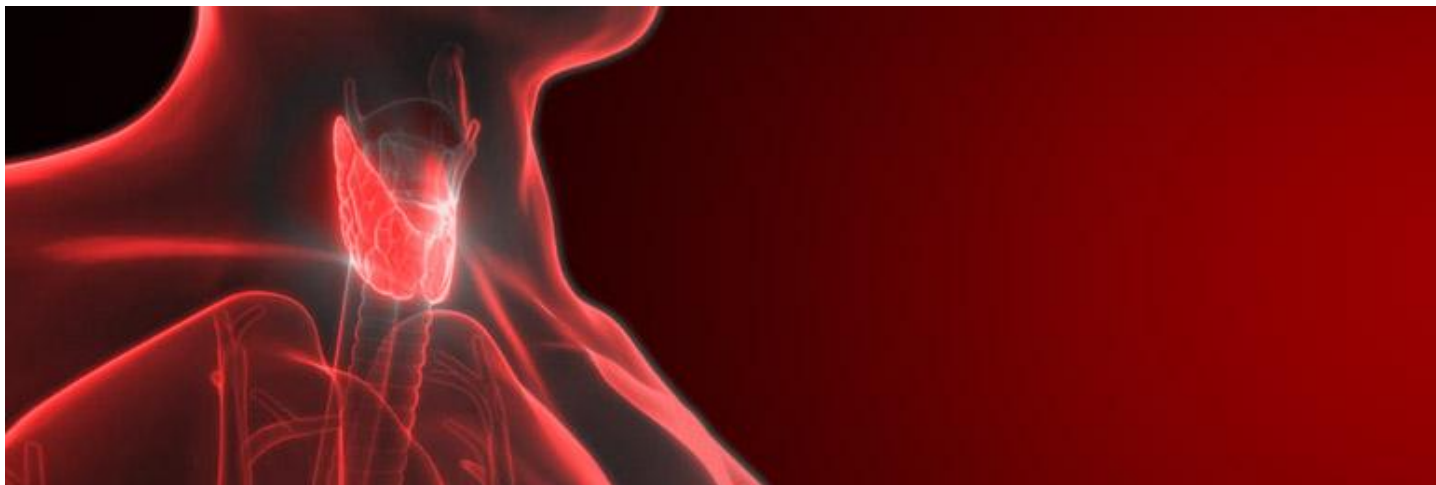


# Light therapy and hypothyroidism



Thyroid issues are pervasive in modern society, affecting all genders and ages to varying degrees. Diagnoses are perhaps missed more often than any other condition and typical treatment/prescriptions for thyroid issues are decades behind the scientific understanding of the condition.

The question we are going to answer in this article is – Can light therapy play a role in prevention and treatment of thyroid/low metabolism problems?

Looking through scientific literature we see that light therapy's effect on thyroid function has been studied dozens of times, in humans (e.g. Höfling DB et al., 2013), mice (e.g. Azevedo LH et al., 2005), rabbits (e.g. Weber JB et al., 2014), among others. To understand why light therapy may, or may not, be of interest to these researchers, first we need to understand the basics.

## Medical & Healthcare Disclaimer

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## Introduction

Hypothyroidism (low thyroid, underactive thyroid) should be considered more of a spectrum that everybody falls onto, rather than a black or white condition that only older people suffer from. Barely anyone in modern society has truly ideal thyroid hormone levels (Klaus Kapelari et al., 2007. Hershman JM et al., 1993. J. M. Corcoran et al., 1977.). Adding to the confusion, there are overlapping causes and symptoms with several other metabolic issues like diabetes, heart disease, IBS, high cholesterol, depression and even **hair loss** (Betsy, 2013. Kim EY, 2015. Islam S, 2008, Dorchy H, 1985.).

Having a 'slow metabolism' is in essence the same thing as hypothyroidism, which is why it coincides with other problems in the body. It's only diagnosed as clinical hypothyroidism once it reaches a low point.

In a nutshell, hypothyroidism is the state of low energy production in the entire body as a result of low thyroid hormone activity. The typical causes are complex, including various diet and lifestyle factors such as; stress, heredity, ageing, polyunsaturated fats, low carbohydrate intake, low calorie intake, sleep deprivation, alcoholism, and even excess endurance exercise. Other factors such as thyroid removal surgery, fluoride intake, various medical therapies, and so on also cause hypothyroidism.

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## Light therapy potentially of aid to low thyroid people?

Red & infrared light (600-1000nm) may potentially be of use to metabolism in the body on several different levels.

*Light therapy directly on the neck is highly effective for thyroid treatment*

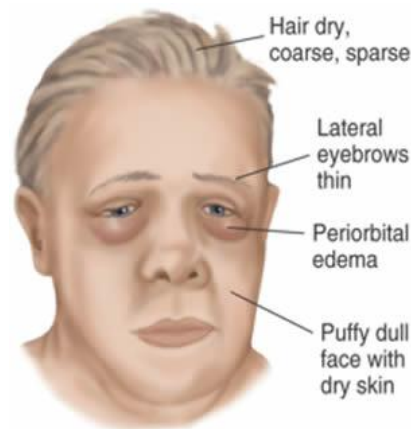
1. Some studies conclude that applying red light appropriately may improve production of the hormones. (*Höfling et al., 2010,2012,2013. Azevedo LH et al., 2005. Вера Александровна, 2010. Gopkalova, I. 2010.*) Like any tissue in the body, the thyroid gland requires energy to perform all of its functions. As thyroid hormone is a key component in stimulating energy production, you can see how a lack of it in the gland's cells decreases further thyroid hormone production – a classic vicious cycle. Low thyroid -> low energy -> low thyroid -> etc.
2. Light therapy when applied appropriately on the neck may potentially break this vicious cycle, in theory by improving local energy availability, thus increasing natural thyroid hormone production by the gland again. With a healthy thyroid gland restored, a host of positive downstream effects occur, as the entire body finally gets the energy it needs (*Mendis-Handagama SM, 2005. Rajender S, 2011*). Steroid hormone (testosterone, progesterone, etc.) synthesis picks up again – mood, libido and vitality are enhanced, body temperature increases and basically all symptoms of a low metabolism are reversed (*Amy Warner et al., 2013*) – even physical appearance and sexual attractiveness increases.
3. Alongside potential systemic benefits from thyroid exposure, applying light anywhere on the body may also give systemic effects, via the blood (*Ihsan FR, 2005. Rodrigo SM et al., 2009. Leal Junior EC et al., 2010*). Although red blood cells have no mitochondria; blood platelets, white blood cells and other types of cells present in the blood do contain mitochondria. This alone is being studied to see how and why it may lower inflammation and cortisol levels – a stress hormone that prevents T4 -> T3 activation (*Albertini et al., 2007*).
4. If one were to apply red light to specific areas of the body (such as the brain, skin, **testes**, wounds, etc.), some researchers hypothesize that it could perhaps give a more intense local boost. This is best shown by studies of light therapy on skin disorders, wounds and infections, where in various studies the healing time is potentially reduced by red or infrared light (*J. Ty Hopkins et al., 2004. Avci et al., 2013, Mao HS, 2012. Percival SL, 2015. da Silva JP, 2010. Gupta A, 2014. Güngörmüş M, 2009*). The local effect of light would seem to potentially be different yet complementary to the natural function of thyroid hormone.

The mainstream and generally accepted theory of light therapy's direct impact involves cellular energy production. The effects are supposedly exerted primarily by photodissociating nitric oxide (NO) from the mitochondrial enzymes (cytochrome c oxidase, etc.). You can think of NO as a harmful competitor to oxygen, much like carbon monoxide is. NO basically shuts down energy production in cells, forming an extremely wasteful environment energetically, which downstream raises cortisol/stress. Red light is theorized to prevent this nitric oxide poisoning, and resulting stress, by removing it from mitochondria. In this way red light can be thought of as 'protective negation of stress', rather than immediately increasing energy production. It's simply allowing your cells' mitochondria to work properly by alleviating the dampening effects of stress, in a way that thyroid hormone alone doesn't necessarily do.

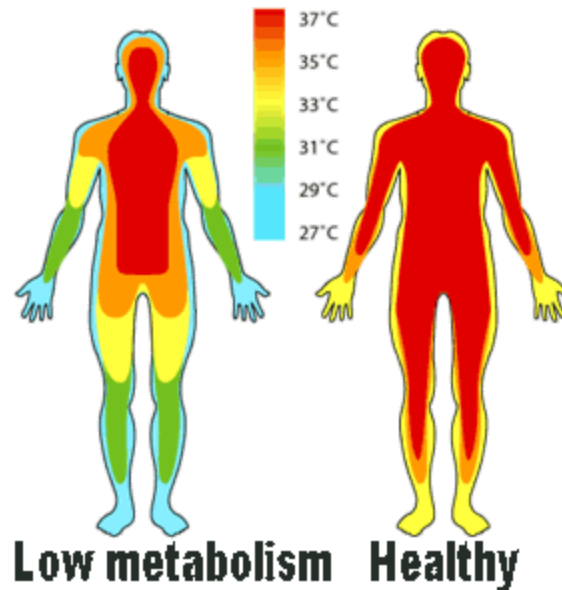
So while thyroid hormone improves mitochondria counts and effectiveness, the hypothesis around light therapy is that it may enhance and ensure the effects of the thyroid by inhibiting the negative stress-related molecules. There may be several other indirect mechanisms by which both thyroid and red light reduce stress, but we won't go into them here.

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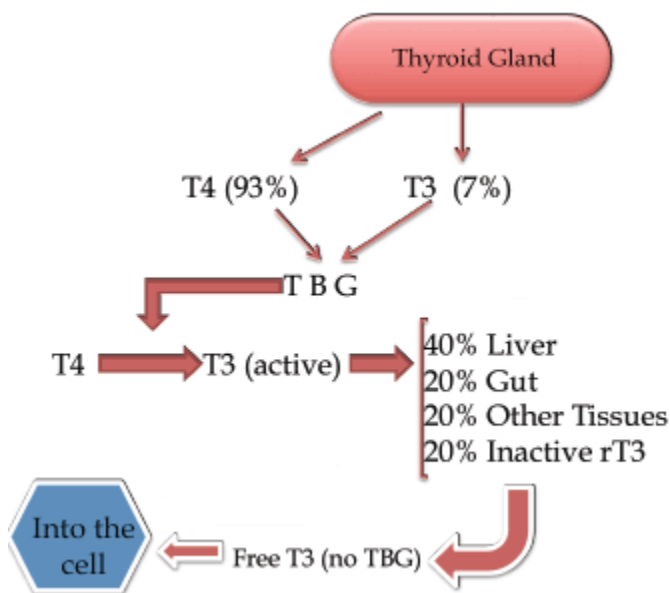
## Symptoms of low metabolic rate/hypothyroidism



- Low heart rate (below 75 bpm)
- Low body temperature, less than 98°F/36.7°C
- Always feel cold (esp. hands and feet)
- Dry skin anywhere on body
- Moody / angry thoughts
- Feeling of stress / anxiety
- Brain fog, headaches
- Slow growing hair/fingernails
- Bowel issues (constipation, crohns, IBS, SIBO, bloating, heartburn, etc.)
- Frequent urination
- Low/no libido (and/or weak erections / poor vaginal lubrication)
- Yeast/candida susceptibility
- Inconsistent menstrual cycle, heavy, painful
- Infertility
- Rapidly thinning/receding hair. Thinning eyebrows
- Bad sleep



## How does the thyroid system work?



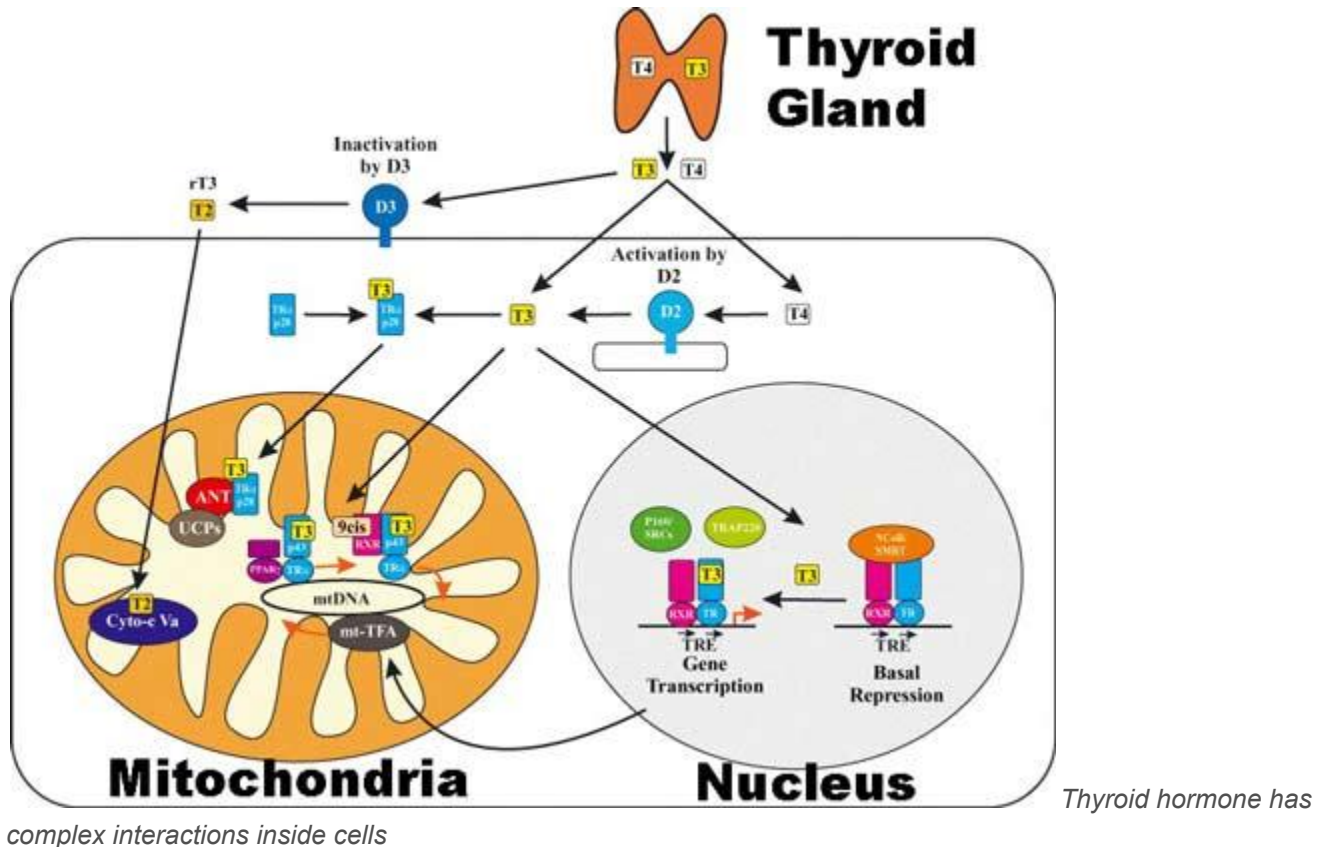
Thyroid hormone is first produced in the thyroid gland (located in the neck) as mostly T4, and then travels via the blood to the liver and other tissues, where it is converted into a more active form – T3. This more active form of thyroid hormone then travels to every cell of the body, acting inside the cells to improve cellular energy production. So thyroid gland -> liver -> all cells.

What usually goes wrong in this production process? In the chain of thyroid hormone activity, any point can pose a problem:

1. The thyroid gland itself could not be producing enough hormones. This could be down to; a lack of iodine in the diet, an excess of polyunsaturated fatty acids (PUFA) or goitrogens in the diet, previous thyroid surgery, the so-called 'autoimmune' condition Hashimoto's, etc.
2. The liver could not be 'activating' the hormones (T4 -> T3), due to a lack of glucose/glycogen, an excess of cortisol, liver damage from obesity, alcohol, drugs and infections, iron overload, etc.
3. Cells may not be absorbing the available hormones. Cells' absorption of active thyroid hormone is usually down to dietary factors. Polyunsaturated fats from the diet (or from stored fats being released during **weight loss**) actually block thyroid hormone from entering cells. Glucose, or sugars in general (fructose, sucrose, lactose, glycogen, etc.), are essential for both absorption and usage of active thyroid hormone by cells.

## Thyroid hormone in the cell

Assuming no impediment exists for thyroid hormone production, and it can reach cells, it acts directly and indirectly on the process of respiration in cells – leading to the complete oxidation of glucose (into carbon dioxide). Without sufficient thyroid hormone to ‘uncouple’ the mitochondrial proteins, the respiration process cannot complete and usually results in lactic acid rather than the end product of carbon dioxide.



Thyroid hormone acts on both the mitochondria and nucleus of cells, causing short term and long term effects that improve oxidative metabolism. In the nucleus, T3 is thought to influence expression of certain genes, leading to mitochondriogenesis, meaning more/new mitochondria. On the mitochondria that already exist, it exerts a direct energy improving effect via cytochrome oxidase, as well as uncoupling respiration from ATP production.

This means that glucose can be pushed down the respiration pathway without necessarily having to produce ATP. While this may seem wasteful, it increases the amount of beneficial carbon dioxide, and stops glucose being stockpiled as lactic acid. This can be seen more closely in diabetics, who frequently get high levels of lactic acid leading to a state called lactic acidosis. Many hypothyroid people even produce significant lactic acid at rest. Thyroid hormone plays a direct role in alleviating this harmful state.

Thyroid hormone has another function in the body, combining with vitamin A and cholesterol to form pregnenolone – the precursor to all steroid hormones. This means that low thyroid levels inevitably result in low levels of progesterone, testosterone, etc. Low levels of bile salts will also occur, thereby hampering digestion. Thyroid hormone is perhaps the most important hormone in the body, supposedly regulating all essential functions and feelings of wellbeing.

## Summary

- Thyroid hormone is considered by some to be the body's 'master hormone' and production relies mainly on the thyroid gland and liver.
- Active thyroid hormone stimulates mitochondrial energy production, formation of more mitochondria, and steroid hormones.
  - Hypothyroidism is a state of low cellular energy with many symptoms.
- Causes of low thyroid are complex, relating to diet and lifestyle.
  - Low carb diets and high PUFA content in the diet are prime offenders, along with stress.

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## Thyroid light therapy?

As the thyroid gland is located under the skin and fat of the neck, near infrared is the most studied type of light for thyroid treatment. This makes sense as it is more penetrating than visible red (*Kolari, 1985; Kolarova et al., 1999; Enwemeka, 2003, Bjordal JM et al., 2003*). However, red as low in wavelength as 630nm has been studied for thyroid (*Morcos N et al., 2015*), as it is a relatively superficial gland.

The following guidelines are commonly adhered to studies:

- Infrared LEDs/lasers in the 700-910nm range.
- 100mW/cm<sup>2</sup> or better power density

These guidelines are based on effective wavelengths in studies mentioned above, as well as studies on tissue penetration also mentioned above. Some of the other factors affecting penetration include; pulsing, power, intensity, tissue contact, polarization and coherence. Application time can be reduced if other factors are improved.

In the right strength, infrared LED lights could potentially affect the entire thyroid gland, front to back. Visible red wavelengths of light on the neck will also provide benefits, although a stronger device will be needed. This is because visible red is less penetrative as mentioned already. As a rough estimate, 90w+ red LEDs (620-700nm) should provide good benefits.

Other types of light therapy technology like low level lasers are fine, if you can afford them. Lasers are studied more frequently in the literature than LEDs, however LED light is generally considered equal in effect (*Chaves ME et al., 2014. Kim WS, 2011. Min PK, 2013*).

Heat lamps, incandescents and infrared saunas are not as practical for improving metabolic rate / hypothyroidism. This is due to wide beam angle, excess heat/inefficiency and wasteful spectrum.

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# Bottom Line

- Red or infrared light from an LED source (600-950nm) is studied for the thyroid.
  - Thyroid hormone levels are looked at and measured in every study.
- Thyroid system is complex. Diet and lifestyle should be addressed too.

LED light therapy or LLLT is well studied and ensures maximum safety. Infrared (700-950nm) LEDs are favoured in this field, visible red is fine too.

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