**How body temperature is affected by thyroid hormone**

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**Researchers say they have discovered how thyroid hormone affects blood vessels to determine body temperature, potentially explaining why people who have disorders of the thyroid gland have higher sensitivity to environmental temperature.**

An overactive thyroid ([hyperthyroidism](http://www.medicalnewstoday.com/articles/9153.php)) can cause a person to feel too hot, while an underactive thyroid ([hypothyroidism](http://www.medicalnewstoday.com/articles/163729.php)) can cause a person to feel too cold.

The researchers from the Karolinska Institutet in Sweden said that previous studies have attributed this to how thyroid hormone affects the metabolism within cells.

The thyroid produces hormones that are able to influence how much the blood vessels dilate. In turn, this affects how much heat can escape the body.

For the study, published in the *Proceedings of the National Academy of Sciences*, the researchers studied mice with a mutated thyroid hormone receptor (receptor-mediated hypothyroidism). This particular mutation only affects one type of hormone receptor called TRalpha 1.

According to the researchers, TRalpha 1 is only expressed in certain tissues, and the mutation makes the tissue unresponsive to thyroid hormone, particularly in the central nervous system, bone and all muscle types.

Dr. Amy Warner, researcher at the Department of Cell and Molecular Biology at the Karolinska Institutet, told *Medical News Today*:

*"This makes it easier to study certain aspects of thyroid dysfunction, while others remain normal. It's well known that thyroid hormone drives up basal metabolic rate, by affecting how quickly cells metabolize, and hypothyroidism should therefore show the opposite."*

**Mutated hormone receptor causes irregular temperature**

Previous studies have shown that mice with this defect had an overactive metabolism, caused by the energy needed to generate heat from brown fat.

"When our supposedly hypothyroid mice showed an increase in metabolism and were burning energy through activating their brown fat, we were confused by this paradox and wanted to find out why this occurred," Dr. Warner added.

**The researchers took infrared images of the mice, which revealed that they were losing a significant amount of heat through their tails. This showed that the mutated thyroid hormone receptor meant the mice were unable to sufficiently regulate the constriction of their blood vessels.**

Dr. Warner explained the findings to *Medical News Today*:

*"Mice with a non-functioning TRalpha 1 receptor cannot properly regulate their body temperature, and this is due to impaired control of their blood vessels, in areas where they are used for temperature regulation, such as the tail."*

She continued:

"Shown through infrared imaging, at room temperature, the tail blood vessels do not constrict properly, and too much heat is lost. The mice cannot defend their body temperature correctly, and therefore need to generate heat from their brown fat to keep warm. Activation of brown fat requires an increase in energy demands to maintain, hence why these mice have a higher metabolism, despite being hypothyroid."

When the researchers gave the mice a drug (midodrine) to artificially cause vascular constriction, they found that this reversed the heat loss from the tail, meaning the mice could maintain normal body temperature, and activation of the brown fat was "turned off."

"Oxygen consumption and food intake were also normalized, meaning that the increased metabolism in these mice was due to the energy demands of the brown fat, not a consequence of the mutation itself," Dr. Warner added.

"By looking at the function of isolated smooth muscle from tail artery, we know that (sympathetic) signal from the brain to the tail is intact in these mice, and the defect is within the smooth muscle itself."

**Potential for improved thyroid disorder treatment**

Dr. Warner said that until now, temperature sensitivity as a result of thyroid disorders has been attributed solely to the basal metabolic rate effects of too much or too little thyroid hormone.

"However, this study shows that thyroid hormone's role in the vascular control of body temperature may be of particular importance," she added.

**Dr. Warner noted that the findings of this study may open up the possibility to treat thyroid patients who find their temperature sensitivity to be significantly detrimental to their quality of life.**

"Similarly, having a better understanding of all the conceivable consequences of thyroid hormone disorders is important for comprehensive patient care."

Dr. Warner said that the team would like to carry out further research in order to determine exactly why the smooth muscle does not respond correctly in the mice to regulate their body temperature.

She added: "We'd also like to see the use of infrared thermography extended to humans, to see if any heat dissipation differences can be seen between euthyroid and different thyroid conditions."

Written by Honor Whiteman