The brain also produces the sex hormone oestrogen

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We tend to think that only ovaries produce oestrogen. Credit: Hey Paul Studios

The female sex hormone oestrogen can be produced and released from the brain as well as the ovaries, according to a study.

The research, recently published in the *Journal of Neuroscience*, shows that the hypothalamus – a part of the brain involved with regulating the

menstrual cycle and reproduction – can actively release the hormone in rhesus monkeys. The findings have implications for humans because the reproductive neuroendocrine system (which makes and releases hormones) of rhesus monkeys is identical to humans.

The researchers discovered that estradiol – one of three major naturally occurring oestrogen hormones and the predominant one involved in female reproduction – can be rapidly produced in the brain. Estradiol influences other functions in the body including our weight and memory.

Although scientists had suspected that the hypothalamus area of the brain played a role in regulating the menstrual cycle and reproduction, Ei Terasawa, professor at Wisconsin-Madison's School of Medicine and Public Health, said the finding that it could rapidly produce estradiol and help control gonadotrophin releasing hormone (GnRH) – protein hormones that help regulate growth, sexual development and reproductive function – still came as a surprise.

"These findings not only shift the concept of how reproductive function and behaviour is regulated but have real implications for understanding and treating a number of diseases and disorders," Terasawa said.

Although oestrogen is commonly associated with sex and reproduction, and is used in the contraceptive pill to prevent pregnancy, an imbalance of the hormone could be linked to a number of conditions including Alzheimer's, stroke and depression.

It could also be interesting for women who have been through the menopause and who are given hormones like oestrogen to prevent problems such as osteoporosis and the effects of the menopause including dizziness and fatigue. Or for girls with issues in puberty.

The experiments showed a number of ways of triggering rapid

production of estradiol in the brain, including by electrical stimulation of a part of the hypothalamus. While the researchers aren't sure why the brain does this, they said the study indicated that the hypothalamus directly controlled the release of GnRH. Although the researchers were able to isolate this function because the monkeys in the study didn't have ovaries, it isn't clear how oestrogens from the ovary also affect this system.

"Having said that, our finding has raised a possibility that during the ovulation cycle estradiol in the hypothalamus also participates in control of the ovulatory GnRH surge as well as normal menstrual periods," said Terasawa.

She added: "Neuroestradiol may be very important in situations where the ovary is inactive, such as menopause and before puberty – we need much more research. I am sure that a similar phenomenon can be seen in males as well."

Terasawa said it questioned the old dogma that steroid hormones from the gonads (in this case the ovaries) regulate the brain and pituitary gland system.

We are beginning to know more about how sex hormones are produced in the body. Philipa Saunders, a reproductive health specialist from the University of Edinburgh, said it was known that oestrogen could be produced by many non-gonadal tissue and this could "play a key role in disease progression in cancers of the breast" for example.

Her group recently published a paper on oestrogen biosynthesis in the human endometrium, which also functions as a lining for the womb, which they suggest contributes to the establishment of pregnancy.

More information: "Neuroestradiol in the Hypothalamus Contributes

to the Regulation of Gonadotropin Releasing Hormone Release." Brian P. Kenealy, Amita Kapoor, Kathryn A. Guerriero, Kim L. Keen, James P. Garcia, Joseph R. Kurian, Toni E. Ziegler, and Ei Terasawa. The *Journal of Neuroscience*, 4 December 2013, 33(49): 19051-19059; DOI: 10.1523/JNEUROSCI.3878-13.2013

DA Gibson, KJ McInnes, HOD Critchley, and PTK Saunders. "Endometrial intracrinology – generation of an estrogen-dominated microenvironment in the secretory phase of women." *JCEM* jc.2013-2140; DOI: 10.1210/jc.2013-2140

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