Sex Ends as Seasons Shift and Kisspeptin Levels Plummet

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Siberian hamsters are used by scientists to study seasonal physiology and behavior. Credit: Gregory Demas

A hormone implicated in the onset of human puberty also appears to control reproductive activity in seasonally breeding rodents, report Indiana University Bloomington and University of California at Berkeley scientists in the March 2007 issue of *Endocrinology*. The paper is now accessible online via the journal's rapid electronic publication service.

The researchers present evidence that kisspeptin, a recently discovered neuropeptide encoded by the KiSS-1 gene, mediates the decline of male Siberian hamsters' libido and reproduction as winter approaches and

daylight hours wane.

"Ours isn't the first study to link the peptide to reproduction, but it is the first to connect kisspeptin to how animals interpret seasonal cues, including day length," said IUB biologist Gregory Demas. "Kisspeptin likely plays an integral role in coordinating seasonal reproduction in a wide range of animals."

Kisspeptin joins a select few proteins believed to act as switches that connect environmental changes to a physiological response.

"This peptide is poised to act as an integrator of environmental information to allow for the optimal neuroendocrine control of reproduction in vertebrates, including humans," said UC Berkeley neuroscientist Lance Kriegsfeld. "In humans and other species, if the environment is not satisfactory, sex drive will decline; kisspeptin is likely part of the pathway responsible for this regulation."

The scientists divided a population of male Siberian hamsters (Phodopus sungorus) into treatment groups: those housed in long, summer-like photoperiods and those in short, winter-like photoperiods. In a separate experiment hamsters were also treated with exogenous injections of kisspeptin after eight weeks of either short- or long-day photoperiod exposure. At the conclusion of the experimental period, scientists analyzed the hamsters' reproductive system status, blood levels of reproductive hormones, as well as the number of kisspeptin-expressing cells in the brain.

They found hamsters in wintry conditions experienced marked reductions of kisspeptin in a critical brain region important for regulating reproduction and sex behavior compared to hamsters in simulated summer conditions.

Winter hamsters, however, were just as responsive to kisspeptin, elevating a key hormone -- luteinizing hormone -- as much as hamsters in simulated summers. This finding indicates the ability of this hormone to turn on the reproductive switch even in the presence of cues signaling a winter, non-breeding environment.

"What is really striking is the disappearance of kisspeptin in animals experiencing winter-like days, yet the ability to respond to kisspeptin when we provide it," said Timothy Greives, lead author of the study. "These data show that the disappearance of kisspeptin in the brain is likely critical in turning off reproduction during winter."

Recent research by scientists in the U.K. and France have shown human kisspeptin triggers the release of gonadotropin-releasing hormone and luteinizing hormone, both of which are important to puberty and other sex-related functions.

"Studies in humans have shown that individuals with deficits in the receptor for kisspeptin have severe reproductive impairments," Demas said.

Kisspeptin's role in seasonal human reproduction, however, is unknown -- that is, if it even has one. It is interesting to note the CDC reports fertility rates in the United States decrease rapidly in autumn. The phenomenon is particularly clear-cut among Caucasians, believed to have originated in more temperate climes.

KiSS-1 and kisspeptin were not named whimsically. They were originally associated with metastatic tumor suppression (the SS in KiSS-1 stands for "suppressor sequence"). The subsequent connection of KiSS-1 and kisspeptin to reproductive function was entirely fortuitous.

Source: Indiana University