

## Impact Objectives

- Investigate the hypothesis that diet interference with circadian rhythm has a negative effect on reproductive function
- Explore how dieting during puberty may contribute to the development of gynaecological disorders after reproductive function is restored

# Unknown mechanisms to boost reproductive health

*Dr Tomoko Fujiwara's important studies on the links between dietary habits and menstrual problems will elucidate valuable knowledge with the potential to alleviate reproductive issues*



**Firstly, can you explain what is the context of your research?**

Currently, the increase

in gynaecological diseases such as endometriosis, which causes dysmenorrhea, has become a major problem, in parallel with the spread of food skipping, dieting for cosmetic purposes, etc., among young women. Although the relationship between menstrual pain and eating habits has not been fully investigated, menstrual pain is also a sign of organic gynaecological diseases, and menstrual pain in students is extremely important information from a medical point of view.

In a world first, we reported that breakfast skipping is associated with menstrual pain in female students and that menstrual pain worsens after dieting. From these findings, we proposed the hypothesis that diet interference with circadian rhythm has a negative effect on reproductive function, and that dieting during puberty may contribute to the development of gynaecological disorders after reproductive function is restored.

**How did you become involved in this field?**

For many years, I have been teaching at a women's college in a field related to food science and nutrition. I have had many opportunities to learn about the dietary habits of young women aged 18 to 24, and at the same time, I have come into contact with

their physical problems, especially menstrual problems. Although there have already been many reports on the effects of breakfast skipping on daily performance and dieting on the menstrual cycle, there have been no studies examining the effects of breakfast skipping and dieting from the perspective of menstrual pain. Since dysmenorrhea is one of important clinical signs for gynaecological diseases, and menstrual pain in students is considered to be extremely important information from a medical point of view, I have been working on the analysis of the relationship between dietary habits and menstrual pain in young women.

**Can you tell us more about these investigations?**

In addition to breakfast skipping, another dietary issue for adolescent females to consider is excessive dieting. An important first finding regarding dieting was that college women who had previously dieted suffered more menstrual cramps, even though they were not currently dieting. This finding alerts us to the possibility that abnormal hunger stress during adolescence may lead to abnormal uterine function in the future.

**Why is this an important area of investigation?**

The links between breakfast skipping, dieting and abnormal hunger stresses are extremely important, especially in young women. This is because young women are in the period of development and maturation of

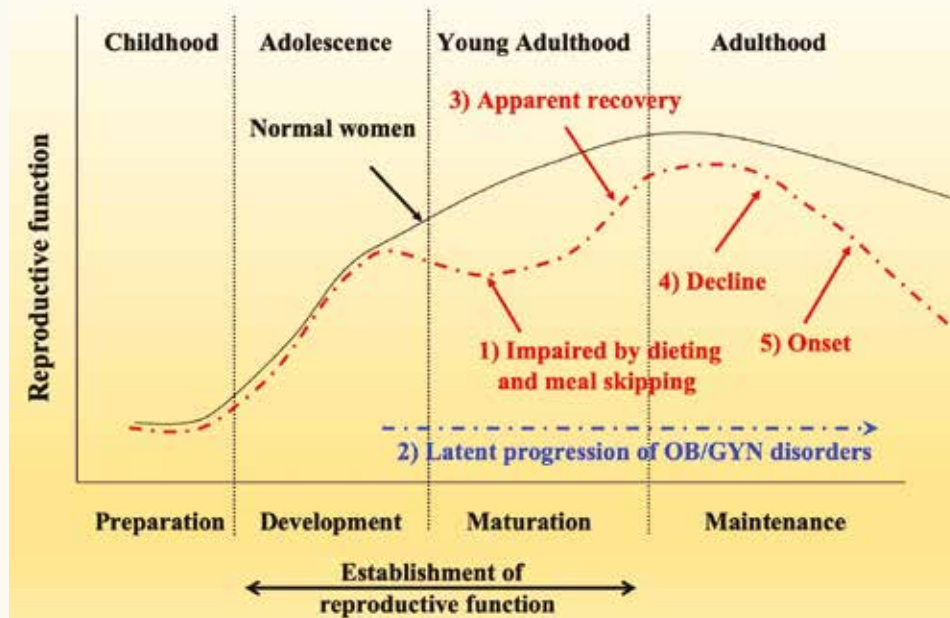
reproductive functions, and if abnormalities in reproductive organ functions are programmed, it may lead to problems such as decreased fertility. This new disease concept is ADHOGD (Adolescent Dietary Habit-induced Obstetric and Gynecologic Disease), and we believe it is necessary to elucidate these mechanisms and provide comprehensive guidelines for prevention based on this knowledge.

**Can you describe the expected influence from this work?**

The ultimate impact of this study is to provide a programme for young dieters with exacerbated hunger stress that can be converted to favourable hunger stress and achieve weight loss goals without inducing abnormalities in hypothalamic, reproductive, muscular and metabolic function. Those who will benefit from the results of the study will be young women and men in general and athletes who require weight management. ●



Regular dietary habits



# Reproductive health for generations to come

At the *Department of Human Life Environments, Kyoto Notre Dame University*, interrelated studies are unravelling the links between dietary habits and menstrual problems, ultimately establishing educational strategies for promoting reproductive health and preventing issues

Dieting can be both mentally and physically detrimental, with the potential to lead to disordered eating behaviours and cause unhealthy changes in body composition, as well as hormonal changes and menstrual disturbances. These are just a few of the potential issues known to be associated with dieting and it can be particularly nefarious for adolescents who are still developing both mentally and physically. They can suffer growth deceleration and permanent damage to bones and organs caused by nutritional deficiencies, including poor brain development and even malnutrition, which can be fatal.

Another important area to consider is reproductive health. Diet is inextricably linked to reproductive health and dieting in adolescence can have long-term impacts on this, including infertility. This is a research area of interest for Dr Tomoko Fujiwara. In the context of rising incidence of gynaecological diseases in parallel with food skipping and dieting in young women, Fujiwara is establishing unknown links, including the relationship between menstrual pain and eating habits, which is one that is yet to be fully investigated.

Fujiwara is focusing on female students due to their still-developing status and the potential long-term issues dieting may cause. 'When abnormal hunger stresses occur during adolescence, when the body and organs are developing, the basis for future life activities, such as appetite and metabolic efficiency, may be programmed in accordance with the living environment during this period,' she articulates. The team is interested in the concept of hunger stress and the implications of negative hunger stress. 'We assume the existence of two types of hunger stress: good stress, which resets the physical body cycle and makes it more balanced, and bad stress, which conversely disrupts the cycle, i.e., disrupts the clock function of central and peripheral organs,' outlines Fujiwara. The researchers are using animal models to explore hunger stress and interrelated concepts in more detail, with a focus on future disease development caused by habits in adolescence.

In a world first, Fujiwara and her team who are based in the Department of Human Life Environments, Kyoto Notre Dame University, Japan reported that breakfast skipping is associated with menstrual pain

and menstrual pain worsens after dieting. 'We conducted a large-scale health survey of female students and confirmed that breakfast skipping is associated with menstrual cramps and that students with a history of dieting have a higher frequency of menstrual problems,' explains Fujiwara.

## THE IMPORTANCE OF BREAKING THE FAST

Building on this important finding, the team conducted research to establish further links between dietary habits and menstrual disorders, as well as explore whether breakfast skipping can be an effective predictor for the management and prevention of menstrual disorders. In this work, they surveyed more than 3,000 female students on health and lifestyle and analysed the relationship between dietary habits and menstrual disorders. It was found that troubles or worries with menstruation were significantly higher in those with a history of dieting and breakfast skipping and also that the female students who skip breakfast have a significantly higher incidence of period pain (also known as dysmenorrhea) which suggests that skipping breakfast can negatively impact ovarian and

uterine functions. The researchers believe that, as meal skipping can be corrected with education, these findings have the potential to help manage and even prevent menstrual issues.

In another line of investigation, expanding on their previous research, Fujiwara and the team unearthed findings that support the existence of a new hypothesis called Adolescent Dietary Habit-induced Obstetric and Gynecologic Disease (ADHOGD). 'In this research, we posited that the circadian rhythm and reproductive rhythm are closely linked and that the peripheral clock system in the uterus plays a critical role in reproductive diseases and proposed naming the concept ADHOGD,' describes Fujiwara. The researchers are currently summarising these findings in a paper and expect to elucidate further detailed mechanisms leading to preventative methods in the future. With more testing of the hypothesis, they hope that the ADHOGD concept will contribute to furthering understanding of, and developing treatments for, reproductive diseases, including polycystic ovary syndrome, hypothalamic amenorrhea, endometriosis, infertility, and preterm labour. Fujiwara points out that there are important educational impacts from this work. 'The results obtained from the analysis of this study may not only open up a new academic field, but also provide a theoretical basis for proposing a 'nutrition education programme to reduce the adverse effects of dieting based on the mechanism of circadian rhythm regulation of reproductive function by diet' for diet-conscious young women,' she comments.

### TIMING IS EVERYTHING

In a further study, using nocturnal rodents, Fujiwara and her collaborators explored the effects of meal timing during the circadian cycle on ovarian function. This involved dividing young female rats into three different groups, each of which was fed at a different time and different amounts of calories and nutrients. The researchers evaluated changes in body weight and ovulation, ultimately discovering that ovarian function was impaired by daytime feeding, which confirmed that the timing of food intake during the circadian cycle is a key factor influencing reproductive function. 'We have created an animal model of the disease in which breakfast deprivation is regarded as an abnormality in the hunger rhythm, thereby inducing clock gene dysfunction,' explains Fujiwara. It was pleasing for the team that their results support this hypothesis.

Collaborations are an important part of this research, and help advance the learnings. 'We are currently collaborating with experts in clock genes, genetically engineered mice, obstetrics and gynaecology, and metabolism,' highlights Fujiwara. 'We believe this is important for elucidating the mechanisms by which excessive hunger stress during adolescence induces abnormalities in hypothalamic, reproductive, muscular and metabolic functions, and for developing diagnostic, therapeutic and preventative methods,' she says. Looking ahead, the researchers will continue to build on their important findings so far and will seek to clarify a particular point. 'We plan to continue our analysis of the effects of abnormal eating rhythms during adolescence on future quality of life and its gender differences,'

observes Fujiwara. 'In particular, it has been suggested that excessive hunger stress during adolescence may be a cause of eating disorders, and we hope to clarify this point as well.'

Fujiwara's work is paving the way to promoting improved reproductive and menstrual health. She is investigating key areas and unearthing crucial findings that could help establish healthier eating habits and prevent long-term reproductive issues. ●

## Project Insights

### FUNDING

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### COLLABORATORS

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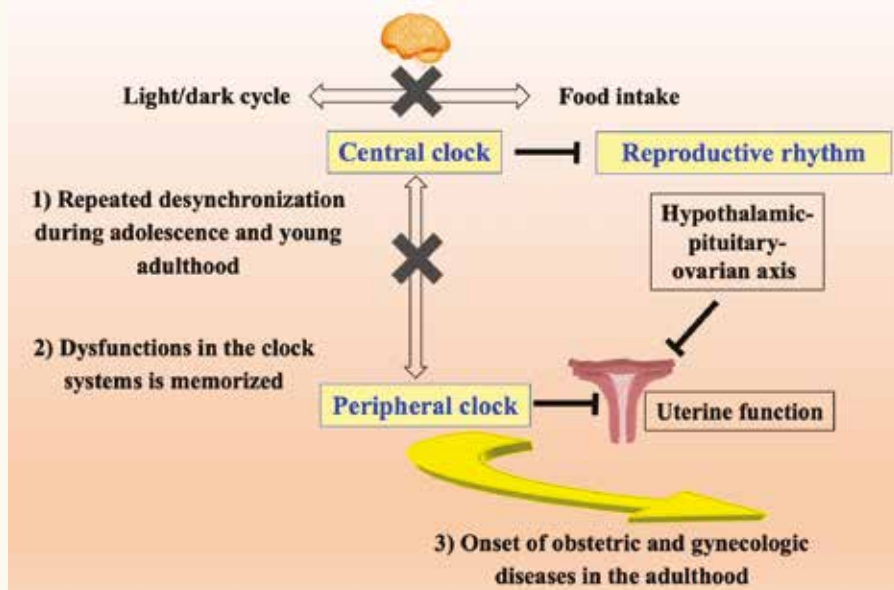
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### BIO

**Dr Tomoko Fujiwara** graduated from Nara Women's University in 1984 and obtained her Doctor of Philosophy in 2009. From 2015, she has been a Professor at the Kyoto Notre Dame University, Kyoto.



Clock systems in ADHOGD - Desynchronisation between central and peripheral clocks from adolescence to young adulthood by adverse dietary habits (1) is memorised in the hypothalamic-pituitary-ovarian axis and the uterus from the developing to mature stages (2), leading to ADHOGD (3)

