Space gynaecology

Far from being a futuristic discipline, space gynaecology is a growing specialty with implications for all women

VARSHA JAIN HAS an unusual profession – in fact she's one of the first of a new specialty. When she tells people that she works in space gynaecology she gets three main reactions: bewilderment (why research 'babies in space'?), confusion ('what does that even mean?') and the rewarding one: 'that's interesting, tell me more'.

Varsha has a long-standing interest in space that stems back to being a teenage fan of Star Trek. She was inspired especially by the Starship Enterprise's medic Dr Beverley Crusher. Even at that stage she knew she didn't want a 'normal' medical career. She feels she has achieved that with the emergence of the important discipline of 'space gynaecology' and a role for herself in increasing its profile.

Her connection with space medicine began in 2007 while she was studying at Imperial College London and had the opportunity to complete her elective at NASA Johnson Space Center, where she spent seven weeks as a student studying how space flight affects the inner ear mechanisms. As a result of her work she was able to design charts that could be used to track astronauts' balance recovery from the effects of weightlessness on the inner-ear mechanisms.

She found the experience exciting and wanted to get back to NASA as quickly as possible, but the challenge of not letting her passion for space medicine impact her clinical training needed to be overcome first.

"My work in space gynaecology has real implications for women on Earth"

Opening doors

The solution was a Master's degree in space physiology at King's College London with work at NASA as part of her dissertation. This in turn opened further doors for her as she was able to demonstrate her creative approach. It was at a space medicine conference in 2013 that she met Dr Virginia Wotring, NASA's chief pharmacologist, who was to become her mentor. Because female astronauts frequently use oral contraceptives to suppress menstruation, Dr Wotring had been asked to investigate what the best oral contraceptive would be to achieve the lowest thromboembolism risk.

Dr Wotring invited Varsha to work with her on the project but it took 18 months to finalise just the visa paperwork. She was then able to apply for access to the necessary data on female astronauts before and after their space flights. Her first placement in 2014 gave her time to develop her understanding of female health in space. As she gained ethics approval for the study and developed a network of trust at NASA Johnson Space Center, she was also able to confirm that the data she needed was available. The data sets had to be collated in NASA and Varsha worked closely with a NASA biostatistician to ensure that the analysis was

clinically applicable. Varsha was grateful for the support that Dr Wotring provided: "I feel very fortunate to have had a supervisor at NASA who was open minded to a data-related project like this one."

The thromboembolism paper is due to be published soon, but she already has a review article exploring menstrual suppression in female astronauts published in *npj Microgravity* (**www.nature.com/articles/npjmgrav20168**).

ABOVE Varsha Jain has a long-standing interest in space **INSET** Varsha completed a Master's degree in space physiology at King's College London and worked at NASA as part of her dissertation

Suppressing menstruation

Oral contraceptives have long been female astronauts' preferred method of suppressing menstruation while training and during space missions, but Varsha's review showed that alternative options such as subdermal implants and the levonorgestrel intrauterine system are viable options.

Varsha explains there are many situations where amenorrhoea is an advantage, ranging from astronauts in space to deployed military personnel on Earth. Full amenities are available for female astronauts on the International Space Station (ISS) should they choose to menstruate, but there are benefits to suppressing menstruation in space: the waste disposal systems on the ISS reclaim water from urine, but they are not able to process menstrual blood. It seems to be more common for astronauts to suppress their menstruation for long-duration missions.

There was a 20-year gap between the first female astronaut (the Russian Valentina Tereshkova) and the first American woman in space, Sally Ride. Varsha explains that this was due in part to concerns about the way that fluids behave in zero gravity. Fluids tend to pool within the body and nobody knew how that would affect women's bodies: there was a fear that it would cause retrograde menstruation, which has links to endometriosis. However, the experience of female pioneers has shown that this is not the case.

Long-term impact

Varsha sees two main long-term effects of her work. She has demonstrated that, for female astronauts, although the combined oral contraceptive pill back-to-back is effective in suppressing menstruation, other methods are available. However, she is keen to stress that there are also earthbound applications: "Almost every aspect of space research has implications for Earth!"

The other major area where menstrual suppression is important is in the military. Studies have shown that two-thirds of female military personnel would like to know more about suppressing their periods while on active deployment, but this is an area of significant confusion: the literature suggests that GPs appear to believe the military doctors are discussing

"Menstrual suppression now has increased visibility in the media"

the options whereas the military physicians see it as the role of the GP. As Varsha explains, "A major benefit of my work has been that menstrual suppression now has increased visibility in the media."

Will her research be applicable to space tourists as the technology develops towards commercial space flight? She explains that her data come from a small number of astronauts who are extremely fit, so that data may not be immediately applicable to paying passengers.

"Don't compromise, and enjoy what you're doing"

Does Varsha have more aspirations for the future? "I'm doing my dream job already," she says. "And for the future I want more of it! But it's important to me that I stay grounded in clinical practice and that my work in space gynaecology has real implications for women on Earth."

Outreach work

Varsha has welcomed the opportunity to be active in public outreach work. The media interest in her research has meant that there have been opportunities to speak publicly, not only about her work but also about the importance of getting the right qualifications. She talks to young people who say that they never knew that this was possible. Varsha says, "You can do what you want to do! Go and get what you want! Don't compromise, and enjoy what you're doing."

Her speaking appearances have included talks about her research at the UK event for Major Timothy Peake's mission on board the ISS and she has been interviewed for a YouTube channel to help young people understand career options with STEM subjects as a base.

Varsha has also served as Coordinator for the UK Space Life and Biomedical Sciences Association, which aims to advance the research and conduct of space life and biomedical sciences in the UK, benefit terrestrial health care, enhance UK innovation and economic growth, prepare the UK to participate in future spaceflight and contribute to international human spaceflight collaboration.

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WOMEN IN SPACE

ON 16 JUNE 1963 Valentina Tereshkova began a three-day space flight and became the first woman in space. The first American woman in space, Sally Ride, followed almost exactly 19 years later (18 June 1982).

Some have suggested that the delay speaks volumes about the differences in culture between the US and the USSR, in that it was a reflection of Communist belief in female equality.

In the west, attitudes to women in the 1950s and 1960s were very different to today. In 1960, women were not allowed to serve in the US military, and only 25% of women had jobs.

Unequal criteria

NASA criteria for astronaut training were clear: candidates were required to be jet pilots who had graduated from a military test pilot school. It was, therefore, not possible for women to train as astronauts.

However, some individuals thought differently. Brigadier General Donald Flickinger (US Air Force) and W Randolph Lovelace (NASA Special Advisory Committee on Life Sciences) thought it was more practical to send women into space. The rationale was simple: women were lighter, required less oxygen, had fewer heart attacks than men, could outperform men in enduring cramped spaces, and had an internal reproductive system that was less susceptible to radiation. It was Lovelace who established the rigorous tests, both physical and psychological, that were being used for male astronauts, so a privately funded 'Women in Space' programme was set up to test female pilots. By the summer of 1961, 19 women had been recruited and tested and 13 passed. By comparison, only 18 of the 32 male candidates tested in the NASA programme passed.

Women in space

The Women in Space programme ended in August 1961. In spite of the outstanding performance of the 'Mercury 13', very little data was published. A 1964 publication by Betson and Secrest presents no data, only commentary, and is probably the first time it was suggested in print that the menstrual cycle could alter performance during space flight.

In spite of various appeals to restart a women's astronaut training programme, it wasn't until 1978 that any female astronaut candidates were selected, with Sally Ride becoming the first American woman in space in 1983.

To date, 59 of the 536 space travellers have been women.

ABOVE Seven of the Mercury 13 reunite at NASA in 1995 **INSET** Valentina Tereshkova was the first woman in space