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Body temperature and physical activity correlates of the menstrual cycle in female chacma baboons (Papio hamadryas ursinus)

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Body temperature and physical activity correlates of the menstrual cycle in female chacma baboons (*Papio hamadryas ursinus*).

Trevor Tapiwa Nyakudya

A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfillment of the requirements for the degree of Master of Science in Medicine.

Johannesburg, South Africa, 2010

DECLARATION

I, Trevor Tapiwa Nyakudya, declare that the work contained in this dissertation is my own, except where acknowledged as otherwise. This dissertation is being submitted for the Degree of Master of Science in Medicine in the Faculty of Health Sciences at the University of the Witwatersrand. The work herein has not been submitted before for any degree or examination at any other university.

_____

Trevor Tapiwa Nyakudya

Signed on the_____ day of_____, 2010

I certify that all the experimental procedures used in this dissertation were approved by the Animals Ethics Screening Committee of the University of the Witwatersrand (AESC number: 2007/60/5).

CONFERENCE PROCEEDINGS AND PRESENTATIONS

The following oral and poster presentations are offered in support of this dissertation.

1) **Nyakudya TT**, Fuller A, Meyer LCR and Mitchell D. Body temperature correlates of the menstrual cycle in baboons, *Papio hamadryas*. International Brain Research Organisation (IBRO) IBRO/UNESCO/ISN African Neuroscience School of Chronobiology. Theme "Brain and Clocks: Neurochemical, Pharmacological and Therapeutic Approaches" Ourzazate-Zagora, Morocco, 20-27 October 2008. (Oral presentation).

2) **Nyakudya TT**, Fuller A, Meyer LCR, Maloney SK and Mitchell D. Body temperature and activity correlates of the menstrual cycle in baboons, *Papio hamadryas*. 3rd International Symposium on Physiology and Pharmacology of Temperature Regulation 2009 (PPTR2009) Matsue, Izumo, Japan, 23-26 July 2009. (Poster presentation).

3) **Nyakudya TT**, Fuller A, Meyer LCR, Maloney SK and Mitchell D. Body temperature and activity correlates of the menstrual cycle in baboons, *Papio hamadryas.* The 36th International Congress of Physiological Sciences (IUPS) "Function of Life: Elements

and Integration" Kyoto International Conference Center (ICC Kyoto). Takaragaike, Sakyo-ka, Kyoto, Japan, 27 July to 01 August 2009. (Poster presentation).

4) **Nyakudya TT**, Fuller A, Meyer LCR, Maloney SK and Mitchell D. Correlates of the menstrual cycle in non-human primates. The 20th IBRO/ARC School in Neuroscience in Africa. Nemba Training Hospital, Gekenke, Rwanda, 31 August-05 September 2009. (Oral presentation).

5) **Nyakudya TT**, Fuller A, Meyer LCR, Maloney SK and Mitchell D. Body temperature and activity correlates of the menstrual cycle in baboons, *Papio hamadryas ursinus.* The 37th Annual Congress of the Physiological Society of Southern Africa. University of Stellenbosch, Stias Conference Centre, South Africa, 09-12 September 2009. (Oral presentation).

6) **Nyakudya TT**, Fuller A, Meyer LCR, Maloney SK and Mitchell D. Body temperature and activity correlates of the menstrual cycle in baboons, *Papio hamadryas ursinus.* The 2nd Cross Faculty Postgraduate Symposium. University of the Witwatersrand, South Africa, 20-21 October 2009. (Poster presentation).

ABSTRACT

I investigated the relationship between abdominal temperature, physical activity, anogenital swellings, and faecal and urine ovarian steroid hormonal concentrations over the menstrual cycle in baboons in an attempt to devise a reliable non-hormonal physiological indicator to detect ovulation. Using a miniature thermometric data logger surgically implanted in the abdominal cavity and an activity data logger implanted subcutaneously on the trunk, I measured, continuously over six months at a 10 min interval, abdominal temperature and physical activity patterns in four female adult baboons, *Papio hamadryas ursinus* (12.9-19.9 kg), unrestrained in cages in an indoor animal facility (22-25°C). I monitored menstrual bleeding, and anogenital swelling changes using digital photography, and collected urine and faeces, daily, to ascertain the stage and length of the menstrual cycle. The length of the menstrual cycle, determined from daily observations of menstrual bleeding and anogenital swellings, was 36 ± 2 days (mean ± SD). Baboons exhibited a cyclic change in anogenital swellings, abdominal temperature, physical activity, urine and faecal steroid hormones over the menstrual cycle. Mean 24-h abdominal temperature during the luteal phase was significantly higher (ANOVA, $p = 0.04$; $F_{(2,9)} = 4.7$) than during the ovulatory phase, but not different to the follicular phase. Physical activity also followed a similar pattern, with mean 24 h physical activity almost twice as high in the luteal than in the ovulatory phase (ANOVA, $p = 0.58$; $F_{(2,12)} = 5.8$). As expected, urine and faecal oestradiol was higher in the follicular than in the luteal phase, while progesterone was higher in the luteal than the follicular phase. Cortisol in both urine and faecal samples did not show any

recognisable menstrual cycle related pattern. I have characterised correlates of the menstrual cycle in baboons and shown, for the first time, a rhythm of physical activity over the baboon menstrual cycle. I have also shown, from the measurements of abdominal temperature, physical activity, ovarian steroid hormonal concentrations and anogenital swellings, that ovulation in captive unrestrained baboons, and probably also free-living baboons, can be estimated from anogenital swellings or possibly abdominal temperature and physical activity, without the need for hormone measurements.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
Cr	Creatinine
DNA	Deoxyribonucleic acid
FSH	Follicle stimulating hormone
h	Hours
I^{125}	Radioisotope of iodine
kg	Kilogram
LH	Luteinising hormone
min	Minutes
ml	Millilitres
RIA	Radioimmunoassay
SD	Standard deviation
°C	Degrees Celsius