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

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


and Integration” Kyoto International Conference Center (ICC Kyoto). Takaragaike, Sakyō-ka, Kyoto, Japan, 27 July to 01 August 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.
ACKNOWLEDGEMENTS

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I would also like to thank the staff of the Central Animal Services for their husbandry of the baboons and assistance during surgeries. Special thanks go to Professor Shane Maloney for the statistical advice, encouragement and setting up the telemetry system, Mrs. Marie Lawson for doing the radioimmunoassays for the samples, and Mr. Floyd Olsen of the National Health Laboratory Services for doing the urine creatinine assays. Finally I would like to thank my family and friends who have been there for me through the challenging times. I will always appreciate the support, patience and love that they gave me all the way. Many thanks go to Lavender Chaparadza for being there for me always and keeping me sane.

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