The Effects of the Menstrual Cycle and Oral Contraceptive Cycle on Body Composition

A thesis submitted for the degree of
Master of Philosophy in Exercise & Sport Science
November 2017

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Statement of Originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository**, subject to the provisions of the Copyright Act 1968.

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24-Nov-2017
Date Signed
Acknowledgements

There are a number of people who I must thank for their leadership and support throughout this entire master research process.

To my parents, I would like to acknowledge your constant support to allow me to follow my dreams and accomplish any challenge life throws at me. You have always been there for me and I will forever love you and appreciate your support, strength, and love.

To Daniel who I love and who inspires me to be better every day, thank you for your unending support and advice. I am very lucky to have you in my life, you put a smile on my face and warmth in my heart. You have been there every step of the way. Thank you for your love, encouragement, and patience throughout this process.

I would like to express my very great appreciation to my main supervisor Dr. Xanne Janse de Jonge for her valuable and constructive suggestions during the planning, development, and collection of this research work. Her willingness to give her time so generously has been very much appreciated. If it weren’t for her hard work, care and belief in me, in helping me to be awarded a scholarship, this degree wouldn’t have been possible.

I would like to offer thanks to my secondary supervisor Dr. Sandra Hunter for your guidance.

My grateful thanks are also extended to Dr. Dean Sculley and Dr. Zoe Yates for their help in lending time, knowledge and materials towards completing the hormone analysis for this research work.

To all the volunteers who made themselves available for testing, I am very grateful for your participation and commitment throughout the research studies. Without your assistance, this research would not have been able to be completed.

To my colleagues past and present from the ESS department it has been a pleasure to work with you all over this time, and many thanks for all your invaluable advice and help along the way.

To Meghan Healy and LouAnn Counihan, if it weren’t for your generous letters of recommendation (and acceptance of my procrastination) I wouldn’t have ended up on a study abroad placement in Australia, and wouldn’t have been afforded this wonderful opportunity.

To all my previous school teachers thank you for your educational support. Special thanks extended to my first-year chemistry TA, Mandy Long for believing in me and helping me through tough times in order to still achieve my undergraduate degree at Madison. You taught me what being a great teacher means.

To all my other family and friends both in the States and Australia, thank you for your support.
Abstract

Throughout their reproductive years, women are exposed to continuously changing female steroid hormone profiles. Large fluctuations of both oestrogen and progesterone are thought to cause many physiological effects on the body. Potential effects on fluid regulation may, in turn, result in changes in body composition over the course of a menstrual cycle or oral contraceptive (OC) cycle. The current research literature is however equivocal concerning the effects of female-specific hormone fluctuations on measures of body composition. Where effects have been observed, limited attention has been given to accurate verification of the menstrual cycle phase. Therefore, the overall aim of this thesis was to investigate the potential changes in body composition over the course of the menstrual cycle (study one) and the oral contraceptive cycle (study two), while including cycle phase verification via hormone analysis.

Study one investigated the potential effects of the menstrual cycle on body composition in women of reproductive age (n=10; age: 29.7 ± 7.8 years; height: 164.7 ± 5.0 cm; weight: 66.8 ± 11.0 kg; BMI: 24.6 ± 3.4). Study two investigated the potential effects of the oral contraceptive cycle on body composition in women of reproductive age taking an oral contraceptive (n=9; age: 22.3 ± 3.1 years; height: 166.2 ± 6.8 cm; weight: 63.5 ± 8.1 kg; BMI: 23.0 ± 2.7). Various methods of body composition measurement were used, including weight, girths, skinfolds, bioelectrical impedance analysis (BIA), ultrasound, dual energy x-ray absorptiometry (DXA), and peripheral quantitative computed tomography (pQCT), resulting in measures of percent body fat (skinfolds, DXA, BIA), fat mass (DXA, BIA), lean mass (BIA), and fat and muscle thickness (ultrasound, pQCT). Furthermore, urine specific gravity (USG) was measured to provide an indication of hydration status.
Repeated measures ANOVA was used to compare the changes in body composition variables over the three phases of the menstrual cycle or oral contraceptive cycle. The three phases of the menstrual cycle were defined as early follicular (day 1-4), late follicular (day 10-13) and luteal phase (day 19-23). While the oral contraceptive cycle was split into sugar pill (day 3-6 sugar pill), early OC (day 5-8 hormonal pill) and late OC (day 14-18 hormonal pill). Overall, no significant changes over the menstrual cycle were found for any of the measures of body composition, while for the oral contraceptive cycle only thigh girth showed a change. The main limitation, however, was the small sample sizes in these studies, while the strict menstrual cycle verification used resulted in the exclusion of participants. The high percentage (30%) of anovulation and/or luteal phase deficiency found in study one indicates the need for higher participant numbers in future menstrual cycle research due to the likely need for exclusion of participants.

In summary, the current studies purposefully addressed the methodological problems associated with previous research on this topic. Although no significant changes in body composition over the menstrual cycle or oral contraceptive cycle were found, it is very likely that these findings were limited by the relatively small participant numbers. Research on body composition over the menstrual cycle and oral contraceptive cycle is not only of interest to researchers, but also to the general population of women, and especially those involved in sports where body composition has the potential to affect performance and/or team selection. Future research with strict methodological control and high participant numbers is therefore warranted to further investigate the potential effects of the menstrual cycle and oral contraceptive cycle on measures of body composition.
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACE</td>
<td>Angiotensin Converting Enzyme</td>
</tr>
<tr>
<td>ADP</td>
<td>Air Displacement Plethysmography</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>AT1</td>
<td>Angiotensin 1</td>
</tr>
<tr>
<td>AT2</td>
<td>Angiotensin 2</td>
</tr>
<tr>
<td>BBT</td>
<td>Basal Body Temperature</td>
</tr>
<tr>
<td>BIA</td>
<td>Bioelectrical Impedance Analysis</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>C</td>
<td>Celsius</td>
</tr>
<tr>
<td>cm</td>
<td>centimetre</td>
</tr>
<tr>
<td>CNS</td>
<td>Central Nervous System</td>
</tr>
<tr>
<td>CT</td>
<td>Computed Tomography</td>
</tr>
<tr>
<td>DXA</td>
<td>Dual-Energy X-ray Absorptiometry</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme-Linked Immunosorbent Assay</td>
</tr>
<tr>
<td>FFM</td>
<td>Fat-Free Mass</td>
</tr>
<tr>
<td>FM</td>
<td>Fat Mass</td>
</tr>
<tr>
<td>FSH</td>
<td>Follicle Stimulating Hormone</td>
</tr>
<tr>
<td>g</td>
<td>grams</td>
</tr>
<tr>
<td>GnRH</td>
<td>Gonadotropin Releasing Hormone</td>
</tr>
<tr>
<td>HPO</td>
<td>Hypothalamic-Pituitary-Ovarian Axis</td>
</tr>
<tr>
<td>ICC</td>
<td>intraclass correlation coefficient</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>ℓ</td>
<td>litre</td>
</tr>
<tr>
<td>L4</td>
<td>4th Lumbar vertebrae</td>
</tr>
</tbody>
</table>
L5  5th Lumbar vertebrae
LH  Luteinizing Hormone
LPD Luteal Phase Deficiency
m   Metre
MAN Manual clinical refractometer
MC  Menstrual Cycle
ml  Millilitre
mm  millimetre
MRI Magnetic Resonance Imaging
NCAA National Collegiate Athletic Association
nm  nano metre
OC  Oral Contraceptive
pQCT peripheral Quantitative Computed Tomography
RAAS Renin Angiotensin Aldosterone System
SD  Standard Deviation
TBW Total Body Water
USG Urine Specific Gravity
UWW Underwater Weighing
β   Beta
µl  Microlitre