Individual, behavioural and environmental pathways to adolescent obesity

Paola Teresa Chivers
University of Notre Dame Australia

Follow this and additional works at: http://researchonline.nd.edu.au/theses

Part of the Medicine and Health Sciences Commons

COMMONWEALTH OF AUSTRALIA
Copyright Regulations 1969

WARNING
The material in this communication may be subject to copyright under the Act. Any further copying or communication of this material by you may be the subject of copyright protection under the Act.
Do not remove this notice.

Publication Details

This dissertation/thesis is brought to you by ResearchOnline@ND. It has been accepted for inclusion in Theses by an authorized administrator of ResearchOnline@ND. For more information, please contact researchonline@nd.edu.au.
Appendix A

Related Publications

Each paper listed below, is presented in full overleaf.


Other Publications During Candidature

- Hands, Beth; Chivers, Paola; and Jetson, Tim (2009) 'Book reviews', *Sport, Education and Society, 14* (1), 141-146.
Appendix B

Activity Classification Protocol

Physical Activity Categories

<table>
<thead>
<tr>
<th>LIGHT: minimal effort  (CODE as 1)</th>
<th>Sailing, other Boating Activities</th>
<th>Snorkelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushwalking – leisurely</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubs, Scouts etc - team games</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kicking a ball (alone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing in a park or playground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pool/Snooker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODERATE: not exhausting, sweat after 20 minutes  (CODE as 2)</td>
<td>Kayaking</td>
<td>Lifesaving/Little Nippers</td>
</tr>
<tr>
<td>Aerobics (classes or home)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletics/Little Athletics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Badminton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ballet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling – Easy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body surfing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boogie board riding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board surfing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canoeing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dancing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast walking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horseriding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIGOROUS: heart beats rapidly, Light sweat w/ 5 minutes  (CODE as 3)</td>
<td>Orienteering</td>
<td>Rock climbing</td>
</tr>
<tr>
<td>Basketball training/game/miniball/3 on 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling – long distance, racing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMX/trail bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Football training/game</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gymnastics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hockey/Minkey training/game</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lacrosse/Modercross training/game</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Martial arts (judo, karate, etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netball/Netball training/game</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C

Ethics
28 November 2007

Paola Chivers
School of Health and Physical Education
University of Notre Dame
P.O. Box 1225
FREMANTLE WA 6959

Dear Paola

Submission for PhD – Paola Chivers – University of Notre Dame

PROJECT TITLE: Individual, behavioural and environmental pathways to healthy weight from birth to early adolescence.

On behalf of the Chief Investigators of the Reine Study we thank you for the opportunity to review your PhD proposal. We are in agreement for you to utilise data previously collected on the Reine Cohort as detailed in your proposal.

Data requests will be made through the Reine Study Co-ordinator and we anticipate that regular contact will be maintained with agreed Reine Investigators.

Yours sincerely

[Signature]

Professor Fiona Stanley AC
Director, Telethon Institute for Child Health Research
Professor, School of Paediatrics and Child Health,
The University of Western Australia

[Signature]

Professor Nick de Klerk
Head of Division (Biostatistics and Genetic Epidemiology)
Telethon Institute for Child Health Research
14 December 2007

Paola Chiaveri
16 Como Court
Katoomba, WA 6232

Dear Paola,

I am writing to you in regard to your Application for Ethical Clearance for your proposed research project to be undertaken for the research component of your course at the University of Notre Dame Australia.

The title of this project is: Individual, behaviour and environmental pathways to healthy weight from birth to adolescence.

I am pleased to advise that your proposal has been reviewed by the University’s Human Research Ethics Committee and has been assessed as having met all expected ethical standards that are relevant to the nature of the proposed research and the instrumentation you have chosen to use. Ethical Clearance has been granted for this proposed study.

Should the design of the study, the choice of instrument or its manner of administration be altered in any significant way as the study progresses, you will be required to provide an update of your clearance application for fresh consideration by the University.

On behalf of the Human Research Ethics Committee, I wish you well with what promises to be an interesting and valuable study.

Yours sincerely,

John Cremin
Executive Officer, Human Research Ethics Committee
Appendix D

Technical Report CD ROM
Appendix E

Linear Mixed Model Development
### Table 1

**Comparison of Higher Order Transformations of Age Models**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>32963.958</td>
<td>32355.637</td>
<td>32367.162</td>
<td>32482.669</td>
<td>32609.618</td>
</tr>
<tr>
<td>age^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>age^3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>age^4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>age^5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fixed effects**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Weight Status</td>
<td>*</td>
<td>**</td>
<td>NS</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Gender</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Age</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Age^X</td>
<td>***</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Age*gender</td>
<td>***</td>
<td>NS</td>
<td>*</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Age^X*gender</td>
<td>**</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
</tr>
<tr>
<td>Age*weight status</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>’’</td>
</tr>
<tr>
<td>Age^X*weight status</td>
<td>***</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
<td>’’</td>
</tr>
</tbody>
</table>

**Estimates**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>15.1(0.04)***</td>
<td>15.5(0.05)***</td>
<td>15.5(.05)***</td>
<td>15.4(.04)***</td>
<td>15.3(0.4)***</td>
</tr>
<tr>
<td>Obese</td>
<td>-0.31(0.11)**</td>
<td>0.26(0.11)*</td>
<td>0.10(0.11)NS</td>
<td>0.02(0.11)NS</td>
<td>-0.04(0.11)NS</td>
</tr>
<tr>
<td>Overweight</td>
<td>-0.04(0.07)NS</td>
<td>0.25(0.08)**</td>
<td>0.17(0.08)*</td>
<td>0.12(0.08)NS</td>
<td>0.09(0.08)NS</td>
</tr>
<tr>
<td>Normal</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Parameter</td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
<td>Model 5</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>性别 (F)</td>
<td>-0.31(0.06)***</td>
<td>-0.25(0.06)***</td>
<td>-0.26(0.06)**</td>
<td>-0.27(0.06)***</td>
<td>-0.27(0.06)***</td>
</tr>
<tr>
<td>年龄</td>
<td>0.02(0.00)***</td>
<td>-0.02(0.00)***</td>
<td>-0.01(0.00)***</td>
<td>-2.1E-3(0.9E-3)*</td>
<td>1.3E-3(8.5E-4)NS</td>
</tr>
<tr>
<td>年龄^X</td>
<td>2.2E-4(7.8E-6)***</td>
<td>1.0E-7(4.2E-8)*</td>
<td>4.7E-9(1.6E-10)*</td>
<td>2.4E-11(8.6E-13)***</td>
<td></td>
</tr>
<tr>
<td>年龄*性别</td>
<td>0.01(0.00)***</td>
<td>1.6E-3(1.9E-3)NS</td>
<td>3.2E-3(1.4E-3)*</td>
<td>3.6E-3(1.2E-3)</td>
<td>3.7E-3(1.1E-3)</td>
</tr>
<tr>
<td>年龄^X*性别</td>
<td>2.7E-5(1.0E-5)**</td>
<td>1.0E-7(4.2E-8)*</td>
<td>5.2E-10(2.1E-10)*</td>
<td>2.9E-12(1.1E-12)*</td>
<td></td>
</tr>
<tr>
<td>年龄*肥胖</td>
<td>0.07(0.00)***</td>
<td>0.03(0.00)***</td>
<td>0.04(0.00)***</td>
<td>0.05(0.00)***</td>
<td>0.05(0.00)***</td>
</tr>
<tr>
<td>年龄*超重</td>
<td>0.03(0.00)***</td>
<td>0.01(0.00)**</td>
<td>0.02(0.00)***</td>
<td>0.02(0.00)***</td>
<td>0.02(0.00)***</td>
</tr>
<tr>
<td>年龄*正常</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>年龄^X*肥胖</td>
<td>2.8E-4(1.9E-5)***</td>
<td>1.1E-6(7.8E-8)***</td>
<td>4.9E-9(3.9E-10)***</td>
<td>2.5E-11(2.1E-12)***</td>
<td></td>
</tr>
<tr>
<td>年龄^X*超重</td>
<td>1.4E5(1.3E-5)***</td>
<td>5.3E-7(5.4E-8)***</td>
<td>2.4E-9(2.7E-10)***</td>
<td>1.2E-11(1.5E-12)***</td>
<td></td>
</tr>
<tr>
<td>年龄^X*正常</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
</tbody>
</table>

Note. Standard errors are in parentheses. ^X=the nominated age transformation for that model shown at the top of the column. Variable*variable indicates an interactions between those variables; F=female; NS=not significant. Ref= the reference group for that variable. ‘.’=a very small number not reported by output for fixed effects.

* p<.05, **p<.01, ***p<.001.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 2</th>
<th>Model 6</th>
<th>Model 7</th>
<th>Model 8</th>
<th>Model 9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$age^2$</td>
<td>$age^2$ and Log(age)</td>
<td>$age^2$ and Sqrt(age)</td>
<td>$age^2$, log(age) and Sqrt(age)†</td>
<td>age centred (ageC) and ageC²†</td>
</tr>
<tr>
<td>AIC</td>
<td>32355.637</td>
<td>31003.349</td>
<td>31067.667</td>
<td>30318.473</td>
<td>30457.010</td>
</tr>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Weight Status</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>NS</td>
<td>***</td>
</tr>
<tr>
<td>Gender</td>
<td>***</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>***</td>
</tr>
<tr>
<td>Age</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>$age^2$</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>log(age)</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sqrt(age)</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age*gender</td>
<td>NS</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>NS</td>
</tr>
<tr>
<td>Age^2*gender</td>
<td>**</td>
<td>NS</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>log(age)*gender</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sqrt(age)*gender</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age*weight status</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Age^2*weight status</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>NS</td>
<td>***</td>
</tr>
<tr>
<td>Parameter</td>
<td>Model 2</td>
<td>Model 6</td>
<td>Model 7</td>
<td>Model 8</td>
<td>Model 9</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>age^2</td>
<td>age^2 and Log(age)</td>
<td>age^2 and Sqrt(age)</td>
<td>age^2, log(age) and Sqrt(age)†</td>
<td>age centred (ageC) and ageC^2†</td>
</tr>
<tr>
<td>X(age)*weight status</td>
<td>NS</td>
<td>NS</td>
<td>''</td>
<td>''</td>
<td>*** AR</td>
</tr>
<tr>
<td>Sqrt(age)*weight status</td>
<td>NS</td>
<td>NS</td>
<td>''</td>
<td>''</td>
<td>***</td>
</tr>
<tr>
<td>Estimates</td>
<td>Intercept</td>
<td>15.54(0.05)***</td>
<td>14.12(0.06)***</td>
<td>14.18(0.06)***</td>
<td>13.99(0.06)***</td>
</tr>
<tr>
<td>Obese</td>
<td>0.26(0.11)*</td>
<td>0.30(0.14)*</td>
<td>0.32(0.14)*</td>
<td>0.23(0.14)NS</td>
<td>0.61(0.10)***</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.25(0.08)**</td>
<td>0.21(0.09)*</td>
<td>0.22(0.09)*</td>
<td>0.17(0.09)NS</td>
<td>0.34(0.07)***</td>
</tr>
<tr>
<td>Normal</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Gender (F)</td>
<td>-0.25(0.06)***</td>
<td>-0.05(0.07)NS</td>
<td>-0.06(0.07)NS</td>
<td>-0.03(0.07)NS</td>
<td>-0.23(0.05)***</td>
</tr>
<tr>
<td>Age</td>
<td>-0.02(0.00)***</td>
<td>-0.12(0.00)***</td>
<td>-0.20(0.00)***</td>
<td>0.48(0.03)***</td>
<td>-0.65(0.02)***</td>
</tr>
<tr>
<td>Age^2</td>
<td>2.2E-4(7.8E-6)***</td>
<td>6.1E-4(1.1E-5)***</td>
<td>7.3E-4(1.4E-5)***</td>
<td>-3.3E-4(4.6E-5)***</td>
<td>0.06(0.00)***</td>
</tr>
<tr>
<td>log(age)</td>
<td>1.54(0.03)***</td>
<td>1.36(0.03)***</td>
<td>-10.11(0.48)***</td>
<td>12.69(0.53)***</td>
<td></td>
</tr>
<tr>
<td>sqrt(age)</td>
<td>1.6E-3(1.9E-3)NS</td>
<td>0.02(0.00)***</td>
<td>0.03(0.01)***</td>
<td>-0.11(0.04)**</td>
<td>0.03(0.02)NS</td>
</tr>
<tr>
<td>Age*gender</td>
<td>0.02(0.00)***</td>
<td>0.03(0.01)***</td>
<td>-0.11(0.04)**</td>
<td>0.03(0.02)NS</td>
<td>0.03(0.02)NS</td>
</tr>
<tr>
<td>Parameter</td>
<td>Model 2</td>
<td>Model 6</td>
<td>Model 7</td>
<td>Model 8</td>
<td>Model 9</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>age^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(age)</td>
<td>-2.7E-5(1.0E-5)**</td>
<td>-2.7E-5(1.5E-5)NS</td>
<td>-4.2E-5(1.8E-5)*</td>
<td>1.8E-4(6.1E-5)**</td>
<td>3.8E-3(1.5E-3)*</td>
</tr>
<tr>
<td>sqrt(age)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age^2*gender</td>
<td>2.7E-5(1.0E-5)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(age)*gender</td>
<td>-0.22(0.04)***</td>
<td></td>
<td></td>
<td>-2.6(0.70)***</td>
<td></td>
</tr>
<tr>
<td>sqrt(age)*gender</td>
<td></td>
<td>-0.19(0.04)***</td>
<td></td>
<td>2.2(0.63)***</td>
<td></td>
</tr>
<tr>
<td>Age*obese</td>
<td>0.03(0.00)***</td>
<td>0.03(0.01)***</td>
<td>0.03(0.01)**</td>
<td>0.34(0.07)***</td>
<td>0.39(0.04)***</td>
</tr>
<tr>
<td>Age*overweight</td>
<td>0.01(0.00)**</td>
<td>5.5E-3(4.5E-3)NS</td>
<td>5.3E-3(7.2E-3)NS</td>
<td>0.17(0.05)***</td>
<td>0.13(0.03)***</td>
</tr>
<tr>
<td>Age*normal</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Age^2*obese</td>
<td>2.8E-4(1.9E-5)***</td>
<td>2.7E-4(2.8E-5)***</td>
<td>2.6E-4(3.4E-5)***</td>
<td>-2.3E-4(1.2E-4)*</td>
<td>0.04(0.00)***</td>
</tr>
<tr>
<td>Age^2*overweight</td>
<td>1.4E5(1.3E-5)***</td>
<td>1.4E4(1.9E-5)***</td>
<td>1.4E4(2.3E-5)***</td>
<td>-1.2E-4(7.9E-5)NS</td>
<td>0.02(0.00)***</td>
</tr>
<tr>
<td>Age^2*normal</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>log(age)*obese</td>
<td>-0.04(0.08)NS</td>
<td></td>
<td></td>
<td></td>
<td>5.89(1.33)***</td>
</tr>
<tr>
<td>log(age)*overweight</td>
<td>0.03(0.06)NS</td>
<td></td>
<td></td>
<td></td>
<td>3.11(0.90)***</td>
</tr>
<tr>
<td>log(age)*normal</td>
<td>Ref</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sqrt(age)*obese</td>
<td>-0.05(0.07)NS</td>
<td></td>
<td></td>
<td>-5.38(1.21)***</td>
<td></td>
</tr>
<tr>
<td>sqrt(age)*overweight</td>
<td>0.02(0.05)NS</td>
<td></td>
<td></td>
<td>-2.79(0.82)***</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Model 2</td>
<td>Model 6</td>
<td>Model 7</td>
<td>Model 8</td>
<td>Model 9</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>age(^2)</td>
<td>age(^2) and Log(age)</td>
<td>age(^2) and Sqrt(age)</td>
<td>age(^2), log(age) and Sqrt(age)†</td>
<td>age centred (ageC) and ageC(^2)†</td>
<td></td>
</tr>
<tr>
<td>Sqrt(age)*normal</td>
<td>Ref</td>
<td>Ref</td>
<td></td>
<td></td>
<td>3.64(0.05)***</td>
</tr>
</tbody>
</table>

Note. Standard errors are in parentheses. \(^2\)=age to the power of two; Log(age)=natural log of age; Sqrt(age)=square root of age; variable*variable indicates an interactions between those variables; F=female; NS=not significant; Ref= the reference group for that variable; ′.=a very small number not reported by output for fixed effects. AR=adiposity rebound factor, time<1=0, time≥1=0).

* p<.05, **p<.01, p<.001.
†Although both Model 8 and 9 provided better model fit (AIC), based on null results for fixed effects (Model 8) and the complexity (Model 8 and 9), the decision was made to revert to the simpler model with best model fit.
### Table 3

*Results of the Information Criteria Comparison of the Covariance Structure Type for the Final Linear Mixed Model*

<table>
<thead>
<tr>
<th>Covariance Structure Type</th>
<th>Information Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Restricted Log Likelihood</td>
</tr>
<tr>
<td>ARMA (1,1)</td>
<td>32650.874</td>
</tr>
<tr>
<td>Compound Symmetry Correlation Metric</td>
<td>33984.985</td>
</tr>
<tr>
<td>Compound Symmetry</td>
<td>33984.985</td>
</tr>
<tr>
<td>Compound Symmetry Heterogenous</td>
<td>33064.182</td>
</tr>
<tr>
<td>Diagonal</td>
<td>35215.189</td>
</tr>
<tr>
<td>Factor Analytic Heterogeneous</td>
<td>31847.131</td>
</tr>
<tr>
<td>First-Order Ante-dependence</td>
<td>31205.815</td>
</tr>
<tr>
<td>First-Order Autoregressive</td>
<td>32667.438</td>
</tr>
<tr>
<td>First-Order Factor Analytic</td>
<td>32592.594</td>
</tr>
<tr>
<td>Heterogeneous First-Order</td>
<td>31854.966</td>
</tr>
<tr>
<td>Autoregressive</td>
<td></td>
</tr>
<tr>
<td>Huynh-Feldt†</td>
<td>34384.656</td>
</tr>
<tr>
<td>Scaled Identity</td>
<td>36045.400</td>
</tr>
<tr>
<td>Toeplitz</td>
<td>32631.567</td>
</tr>
<tr>
<td>Heterogeneous Toeplitz</td>
<td>31819.372</td>
</tr>
<tr>
<td><strong>Unstructured correlation metric</strong></td>
<td><strong>30882.625</strong></td>
</tr>
<tr>
<td><strong>Unstructured</strong></td>
<td><strong>30882.625</strong></td>
</tr>
</tbody>
</table>

*Note.* Information criteria on model fit where smaller is better form.

† Iteration was terminated but convergence has not been achieved. The MIXED procedure continues despite this warning. Subsequent results produced are based on the last iteration. Validity of the model fit is uncertain.
Figure 1. Normal Q-Q plot of residuals for the final BMI linear mixed model, separated by gender and IOTF weight status groups.


Physiol, 87 (6), 2230-2236.
http://jap.physiology.org/cgi/content/abstract/87/6/2230

Ashwell, M., & Lejeune, S. (1996). Ratio of waist circumference to height may be better indicator of need for weight management. BMJ, 312 (7027), e377. doi:


Bland, J. M. *How do i compare methods of measurement which give results in different units?*. Retrieved 19 February 2009, from http://www-users.york.ac.uk/~mb55/meas/diffunit.htm


Garson, G. D. *Structural equation modeling*. [http://www2.chass.ncsu.edu/garson/pa765/structur.htm](http://www2.chass.ncsu.edu/garson/pa765/structur.htm)


McIntyre, F. (2009). *A longitudinal examination of the contribution of perceived motor competence and actual motor competence to physical activity in 6 to


WHO. *Obesity*. Retrieved May/14/2007, from [http://www.wpro.who.int/health_topics/obesity](http://www.wpro.who.int/health_topics/obesity)


