

Supporting Information

Parental Pre-Pregnancy BMI is a Dominant Early-Life Risk Factor Influencing BMI of Offspring in Adulthood.

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Table of Contents for Supporting Information

Raine Study: Protocol for Height and Weight Measurements (Children Ages 0 to 22)

Raine Study: Comparison of BMI with body composition at age 20

Table S1. Prevalence of obesity among Australian children of European-descent between the ages of 1 and 22 years (1989-2013) for selected early-life factors.

Table S2. Results from the mixed-effects regression analyses for Male & Female longitudinal BMI z-scores.

The Raine Study (<http://www.rainestudy.org.au/>)

The Western Australian Pregnancy Cohort (Raine) Study is one of the largest successful prospective cohorts of pregnancy, childhood, adolescence and now early adulthood to be carried out anywhere in the world. The cohort was established between 1989 and 1991 to determine how events during pregnancy and childhood influence health in later life. 2900 pregnant women entered the study and 2868 live births were recruited into the Raine Study cohort. Follow up assessment of the cohort has been conducted at birth, 1, 2, 3, 5, 8, 10, 13, 16, 18, and 20 years of age. The cohort completed the 22 year review in June 2014, concentrating on sleep and asthma.

Protocol for Height and Weight Measurements (Children Ages 0 to 22)

Birth

The neonatal examination was conducted between 24 and 72 hours following birth.

Birth weight

Weight was measured to the nearest 100g, using calibrated hospital scales at birth.

Birth length

Length was measured by two people using the Harpenden Neonatometer (Holtain Ltd. Crosswell, United Kingdom) to the nearest 0.1cm. Infants were laid in supine position, with their head held by one person against a curved head plate in mid-line. The other person stretched the legs straight, knees held together, ankle flexed at right angles to the lower leg, moving the mobile plate to rest against the baby's feet. Length was measured to the nearest 0.1 cm.

Follow up assessment at ages 1, 2 and 3

Assessments were conducted at follow up clinic assessments by a trained child health nurse. Follow up assessment for at ages 1, 2 and 3 were conducted in clinic rooms at Princess Margaret Hospital (TVW Telethon Institute for Child Health Research). Where two people were involved in taking the measurements, the second person was generally the mother or caregiver.

Age 1 (infants)

Weight: Measured using Wedderburn digital chair scales (Wedderburn, Summerhill, New South Wales, Australia) to the nearest 100g. Measurements were conducted without a nappy.

Length: Length was measured using Harpenden Neonatometer (Holtain Ltd. Crosswell, United Kingdom). Infants were laid in supine position, with their head held by one person against a curved head plate in mid-line. The other person stretched the legs straight, knees held together, ankle flexed at right angles to the lower leg, moving the mobile plate to rest against the baby's feet. Length was measured to the nearest 0.1 cm.

Age 2 and 3

Weight: Children are weighed in their underwear. Year 2 may be weighed in their underwear including dry nappies). Scales are calibrated routinely. Weight is recorded to the nearest 100g on Wedderburn Digital Chair Scales (Wedderburn, Summerhill, New South Wales, Australia).

Length: Children were standing in the anatomical position, palms facing forward. Each area was measured at least twice in sequence with measures within one centimetre. Measures were taken at

expiration. Height was measured using a Holtain stadiometer (Holtain Ltd. Crosswell, United Kingdom). Length was measured to the nearest 0.1 cm.

Years 5 and 8

Assessments were conducted at follow up clinic assessment by a trained research assistant.

Follow up assessments were conducted in clinic rooms at the Telethon Institute for Child Health Research. Measurements were performed in light clothing with shoes removed.

Weight: Weight is recorded to the nearest 100g. Equipment: Wedderburn Chair scales (Wedderburn, Summerhill, New South Wales, Australia). Permanently located in one assessment room. Children were weighed in their underwear or light clothing. Scales are calibrated routinely.

Height: Measured to the nearest 0.1cm.

Equipment: Wall mounted Holtain stadiometer (Holtain Ltd. Crosswell, United Kingdom).

Children were standing in the anatomical position, palms facing forward. Measures were taken at expiration. Height was measured using a Holtain stadiometer (Holtain Ltd. Crosswell, United Kingdom).

Exclusion: If subjects weren't able to stand on their own (ie wheel chair bound) they were not tested

Year 10 and 14

Assessments were conducted at follow up clinic assessment by a trained research assistant. Follow up assessments were conducted in clinic rooms at the Telethon Institute for Child Health Research.

Participants were weighed and measured in light clothing (running shorts and t-shirts), shoes removed.

Weight: Recorded to the nearest 100g.

Equipment: Wedderburn Chair scales (Wedderburn, Summerhill, New South Wales, Australia). Permanently located in one assessment room. Scales are calibrated routinely.

Height: Measured to the nearest 0.1cm

Equipment: Wall mounted Holtain Stadiometer (Holtain Ltd. Crosswell, United Kingdom). Permanently attached to wall. Children were standing in the anatomical position, palms facing forward, heels, butt and head touching board of stadiometer, chin lifted. Measures were taken at expiration.

Exclusions:

If study participant could not sit on scales on their own.

If study participant were unable to stand unassisted (eg wheelchair bound).

If arm or leg plaster, ie for broken limb.

Year 17 and 18

Assessments were conducted at follow up clinic assessment by a trained research assistant. Follow up assessments were conducted in clinic rooms at the Telethon Institute for Child Health Research and King Edward Memorial Hospital Perth. Participants were weighed and measured in running shorts and t-shirts with shoes removed.

Weight: Recorded to the nearest 100g.

Equipment: Wedderburn Chair scales (Wedderburn, Summerhill, New South Wales, Australia). Permanently located in one assessment room. Scales are calibrated routinely.

Height: Measured to the nearest 0.1cm

Equipment: Wall mounted Holtain Stadiometer (Holtain Ltd. Crosswell, United Kingdom). Permanently attached to wall. Adolescents were standing in the anatomical position, palms facing forward, heels, butt and head touching board of stadiometer, chin lifted. Measures were taken at expiration.

Year 20

The 20 year cohort follow up was undertaken in clinic rooms in the Lions Eye Institute and Pulmonary Physiology Department at Sir Charles Gairdner Hospital. All measurements were taken by trained research assistants at assessment. Participant removed shoes, heavy clothing and contents of pockets.

Weight: A and D Company Personal Precision scales UC-321 (to check and referenced) Located in the Pulmonary Physiology Dept, SCGH. Participant removed shoes and heavy clothing. Measurement to nearest 100 g.

Height: Equipment: Wall mounted Seca 202. SECA stadiometer CE 216 (to check and referenced).

Participants were standing in the anatomical position, palms facing forward chin lifted. Measures were taken at expiration.

Year 22:

The 22 year cohort follow up was undertaken in the Centre for Sleep Science at the University of Western Australia. All measurements were taken by trained research assistants at assessment. Participant removed shoes, heavy clothing and contents of pockets.

Weight: Nuweigh CHR 286 (Nuweigh, New South Wales, Australia) , (to check and referenced) located in the Pulmonary Physiology Dept, SCGH. Participant removed shoes and heavy clothing. Measurement to nearest 100 g.

Height: Equipment: Wall mounted SECA stadiometer CE 216 (ECOMED, NSW).

Adolescents were standing in the anatomical position, palms facing forward chin lifted. Measures were taken at expiration. Measured to the nearest 0.1cm

Comparison of BMI with body composition at age 20 in Raine Study

An analysis of the association of BMI with total body fat mass (kg) and fat mass index (FMI, fat mass/height²) was undertaken for the purposes of this report. A strong correlation between BMI and both total body fat mass (females r= 0.930, males r=0.845, both P<0.001) and FMI (females r= 0.949, males r=0.852, both P<0.001) was observed.

TABLE S1. Prevalence of obesity among Australian children of European-descent between the ages of 1 and 22 years (1989-2013)

Variable	No. of Children	Prevalence (%) of obesity (95% CI)			
		Aged 3	Aged 5	Aged 14	Aged 22
All Children	1355	5.0 (3.6, 6.4)	5.2 (3.9, 6.5)	9.4 (7.7, 11.1)	12.8 (10.7, 14.9)
Full-term	1228	3.8 (2.5, 5.1)	4.5 (3.3, 5.7)	6.4 (4.9, 7.9)	12.0 (9.9, 14.1)
Pre-term	125	5.2 (0.3, 10.1)	5.3 (1.2, 9.4)	9.7 (4.1, 15.3)	12.9 (6.1, 19.7)
Maternal non-diabetic	1302	4.4 (3.0, 5.8)	5.0 (3.7, 6.3)	9.1 (7.4, 10.8)	12.4 (10.3, 14.5)
Maternal diabetic	52	20 (6.7, 33.3)	10.6 (1.8, 19.4)	18.6 (7.0, 30.2)	23.1 (9.9, 36.3)
Maternal non-anemia	977	5.2 (3.4, 6.8)	5.3 (3.8, 6.8)	8.9 (7.0, 10.8)	11.7 (9.4, 14.0)
Maternal anemia	345	5.1 (2.4, 8.0)	5.5 (2.9, 8.1)	12.1 (8.3, 15.9)	16.8 (12.3, 21.3)
Maternal weight gain to 34 wk gestation					
<15 kg	807	5.4 (3.5, 7.3)	5.4 (3.7, 7.1)	10 (7.7, 12.3)	12.5 (9.9, 15.1)
≥15 & <20 kg	316	4.0 (1.3, 6.7)	3.6 (1.4, 5.8)	7.1 (4.0, 10.2)	10.8 (6.9, 14.7)
≥20 kg	148	7.4 (2.5, 12.3)	10.2 (4.9, 15.5)	14.5 (8.3, 20.7)	23.3 (15.1, 31.5)
Vaginal delivery	1065	4.2 (2.7, 5.7)	4.5 (3.2, 5.8)	8.3 (6.5, 10.1)	11.6 (9.4, 13.8)
Cesarian section	286	8.0 (4.2, 11.8)	7.7 (4.5, 10.9)	13.6 (9.3, 17.9)	17.3 (12.4, 22.2)
Only breast milk					
< 3 months	356	4.6 (1.9, 7.3)	7.1 (4.2, 10.0)	13 (9.1, 16.9)	18.6 (13.7, 23.5)
3 to <6 months	278	7.5 (3.7, 11.3)	5.9 (3.0, 8.8)	9.0 (5.4, 12.6)	11.1 (6.7, 15.5)
6 to <9 months	280	4.7 (1.7, 7.7)	4.3 (1.8, 6.8)	7.2 (4.0, 10.4)	10.8 (6.7, 14.9)
9+ months	193	4.9 (1.3, 8.5)	4.5 (1.4, 7.6)	10.4 (5.7, 15.1)	11.5 (6.5, 16.5)

For further breakdown of age groups, please contact corresponding author
wk=week

TABLE S2. Mixed effects regression analyses for Male & Female BMI z-scores

BMI z-score (SDs)	MALES			FEMALES		
	Estimate	SE	P-value	Estimate	SE	P-value
Intercept	-5.898	0.445	<2x10 ⁻¹⁶	-6.529	0.451	<2x10 ⁻¹⁶
Age (years)	-0.188	0.064	.003	0.017	0.059	.77
Age ² (years ²)	0.060	0.005	<2x10 ⁻¹⁶	0.031	0.005	2x10 ⁻¹⁰
Age ³ (years ³)	-0.004	0.0003	<2x10 ⁻¹⁶	-0.002	0.0003	9x10 ⁻¹⁵
Age ⁴ (years ⁴)	0.0001	0.00001	<2x10 ⁻¹⁶	0.00004	0.00001	2x10 ⁻¹⁴
Pre-pregnancy Maternal BMI (kg/m ²)	0.007	0.009	.46	0.016	0.010	.11
Pre-pregnancy Paternal BMI (kg/m ²)	-0.002	0.012	.89	0.008	0.012	.52
Birth weight (kg)	0.0005	0.0001	4x10 ⁻¹⁴	0.001	0.0001	<2x10 ⁻¹⁶
Change in weight over first year of life (kg)	0.656	0.034	<2x10 ⁻¹⁶	0.641	0.034	<2x10 ⁻¹⁶
Maternal smoker during pregnancy	0.188	0.072	.009	0.253	0.069	3x10 ⁻⁴
Gestational weight gain at 18 weeks (kg)	-	-	-	0.018	0.006	.004
Age:Pre-preg. Maternal BMI interaction	0.006	0.001	1x10 ⁻⁵	0.005	0.001	3x10 ⁻⁵
Age ² :Pre-preg. Maternal BMI interaction	-0.0001	0.0001	.01	-0.0001	0.00005	.01
Age:Pre-preg. Paternal BMI interaction	0.008	0.002	2x10 ⁻⁶	0.005	0.002	9x10 ⁻⁴
Age ² :Pre-preg. Paternal BMI interaction	-0.0002	0.0001	7x10 ⁻⁵	-0.0002	0.0001	.004
Age:Change in weight over first year interaction	-0.056	0.005	<2x10 ⁻¹⁶	-0.059	0.004	<2x10 ⁻¹⁶
Age ² :Change in weight over first year interaction	0.002	0.0002	<2x10 ⁻¹⁶	0.002	0.0002	<2x10 ⁻¹⁶
Age:Birth Weight interaction	-0.00002	0.000004	2x10 ⁻⁵	-0.00002	0.000004	3x10 ⁻⁶
	MALES			FEMALES		
Number of observations	4472			4425		
Number of individuals	517			510		
Residual SD	0.648			0.695		
Compound symmetry Rho	-0.100			-0.100		

SE = standard error, BMI = body mass index