

ChocHealth for Kids! A pilot randomised controlled trial of dark chocolate health effects in healthy children

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Introduction

- Risk of cardiovascular mortality and morbidity rises across the entire range of blood pressure (BP) in adults, starting from normal values above 115/75mmHg.¹
- Childhood BP has strong predictive associations with adult hypertension.²
- Strategies that could sustain a lower childhood BP could have important benefits at a population level, even if the absolute reduction is small.
- Regular dark chocolate intake lowers BP in hypertensive and normotensive adults,^{3,4} but its effects have not been studied in children.
- Feasibility and acceptability data are needed before launching a fully powered randomised trial.

Aims

To conduct a pilot randomised trial to determine:

- Feasibility and acceptability to children, parents and teachers, of
 - daily dark chocolate, compared to no extra chocolate, in a school setting,
 - recruitment, baseline and outcome measurement methods.
- Pilot data on the intervention's possible benefits and/or harms.

Methods

Design

Pilot randomised controlled trial (ISRCTN60409644).

Participants

Convenience sample of all Grades 5 and 6 students at two primary schools in Melbourne.

Exclusion criteria

- Previous anaphylaxis to nuts or dairy.
- Pharmacological treatment for hypertension.
- Significant health condition limiting participation in study.
- Member of class with class consent rate below 65%.

Randomisation

- Cluster unit of randomisation = the class.
- Classes stratified by school and year level.
- Classes in each stratum randomised at a maximum ratio of two intervention classes to one control class.
- Randomisation followed baseline measurements, conducted by an independent statistician.

Intervention

- Commercially available dark chocolates were analysed at an independent laboratory for antioxidants (catechin and epicatechin) by sequential extraction and high-performance liquid chromatography.
- The chocolate with the highest antioxidant content was chosen for use as intervention.
- Students in intervention classes received 7g of dark chocolate (2.8mg catechin and 8.4mg epicatechin) every school day over seven weeks.
- Students in control classes received no extra chocolate.

Sample characteristics

Table 1: Demographic and household characteristics of sample

	Intervention (%)	Control (%)
Child		
Male sex	41.9	54.3
Age (years), mean (SD)	11.5 (0.7)	11.6 (0.5)
Socioeconomic background and lifestyle		
Living with both parents	92.7	94.1
Main language English	90.8	95.5
One or both parents has tertiary degree education	72.1	77.9
One or both parents employed full time	98.4	97.1
Screen time more than 2 hours a day		
On school days	45.5	42.0
On non-school days	86.2	85.5
One or more smokers at home	4.0	4.3

Table 2: Students' baseline physical and well-being characteristics

	Intervention Mean (SD)	Control Mean (SD)
Blood pressure (BP)		
Systolic BP (mmHg)	107.5 (9.6)	106.8 (9.2)
Diastolic BP (mmHg)	72.6 (10.2)	69.5 (9.4)
Body mass index (kg/m²)		
Overweight/obese	14.2%	13.4%
Body fat (%)	20.6 (6.6)	19.7 (6.1)
Waist circumference (cm)	64.4 (7.0)	63.8 (6.8)
Health-related quality of life		
Total health summary	85.3 (9.0)	83.3 (10.1)
Physical health summary	87.8 (10.1)	88.0 (9.2)
Psychosocial health summary	83.9 (10.1)	80.7 (11.8)
Body dissatisfaction	0.21 (1.0)	0.23 (0.9)
Self-perception profile	1.7 (0.4)	1.7 (0.4)

Body mass index = weight/height²

Primary outcomes

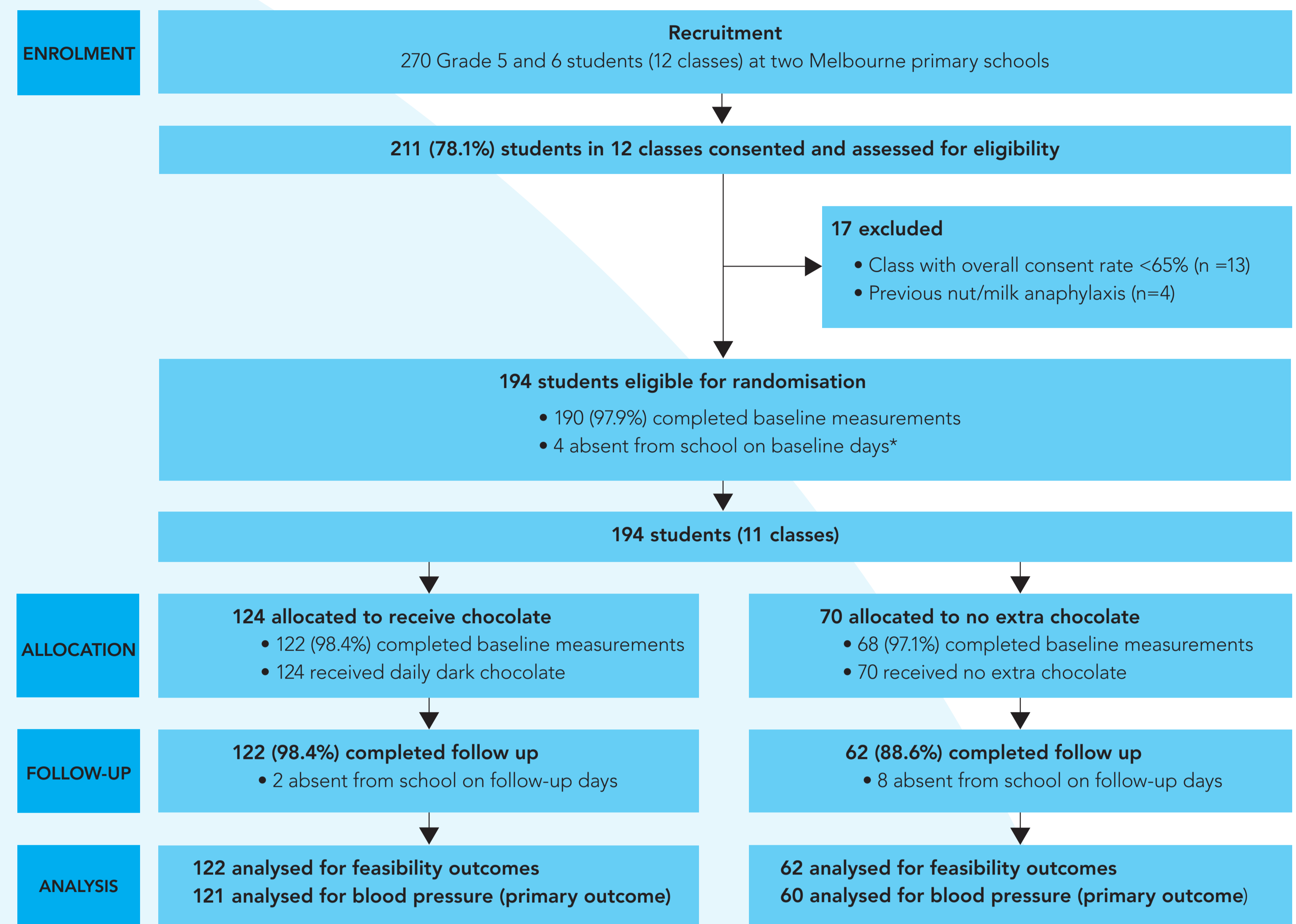
- Study participation rates
- Feedback response (students and teachers)
- Blood pressure (mmHg) measured by automated sphygmomanometer

Secondary outcomes

- Measured body mass index (kg/m²)
- Body fat (%) by two-limb bioelectrical impedance analysis
- Waist circumference (cm)
- Self-reported health-related quality of life – Pediatric Quality of Life Inventory⁵
- Body dissatisfaction – Collins Body Figure Rating Scale⁶
- Self-perception profile – modified Harter Scale⁷

Procedures

Figure 1: CONSORT flow diagram



*Non-participation in baseline measurements did not exclude student from participation in study

Statistical analysis

- Acceptability and feasibility described by:
 - Study participation rates
 - Feedback response (follow-up questionnaire).
- Pilot data analysed on intention-to-treat principle.
- Unadjusted and adjusted linear regression analysis of BP and all secondary outcomes.
- Analyses adjusted for confounders chosen a priori (age, gender, parent education) and for corresponding baseline value.

Results

- Students generally enjoyed participating in the study (Table 3).
- Dark chocolate was very acceptable to students (Table 3).
- The future frequency of eating dark chocolate was similar in the two groups.
- 64% of teachers (n=11) would recommend the study to others.
- Teachers found measurements at baseline (45%) and at follow up (36%) fairly disruptive.
- BP and anthropometric measures were similar in the two groups at 7 weeks (Table 4).

Table 3: Student feedback

	Intervention (%)	Control (%)	p value*
Would participate again	99	88	0.001
Would recommend to friend	94	77	0.001
Perceives dark chocolate as...			
Yummy	71	65	0.3
Healthy	44	36	0.3
Bad for you	3	2	0.5
Bitter	28	34	0.4
Sweet	27	32	0.5
Yukky	7	8	0.9

*p values derived from Pearson chi-squared test

Table 4: Physical and anthropometric outcomes

	Intervention Mean (SD)	Control Mean (SD)	Adjusted*	
			Mean difference (95%CI)	p value
Blood pressure (BP)				
Systolic BP (mmHg)	106.0 (11.0)	104.6 (9.8)	1.7 (-0.6 to 4.1)	0.1
Diastolic BP (mmHg)	67.2 (7.3)	67.8 (8.1)	-1.1 (-3.6 to 1.3)	0.3
BMI (kg/m²)				
Overweight/obese	18.6 (2.6)	18.4 (2.9)	-0.02 (-0.3 to 0.2)	0.9
Body fat (%)	19.9 (6.8)	18.8 (6.7)	0.2 (-1.4 to 1.7)	0.8
Waist circumference (cm)	65.1 (7.5)	64.7 (7.2)	0.3 (-0.5 to 1.1)	0.4
Health-related quality of life				
Total health summary	86.5 (9.9)	84.8 (9.6)	1.0 (-0.8 to 2.8)	0.3
Physical summary	89.3 (10.1)	89.2 (7.8)	0.9 (-1.2 to 2.9)	0.4
Psychosocial summary	85.0 (10.7)	82.4 (11.2)	1.1 (-1.0 to 3.3)	0.3
Body dissatisfaction	0.4 (1.1)	0.1 (1.3)	0.4 (0.01 to 0.7)	0.04
Self-perception profile	1.7 (0.4)	1.8 (0.3)	-0.03 (-0.09 to 0.03)	0.3

Body mass index = weight/height²

* Adjusted for age, gender, parent education and corresponding baseline value

Discussion

- This is the first trial examining the effects of daily dark chocolate on children's health.
- Uptake and retention were excellent, and the intervention was well received.
- A definitive trial would need to consider:
 - Longer duration of chocolate
 - Higher antioxidant (but more bitter) chocolate
 - Weekend and holiday administration
- There was no evidence of harm to intervention students.

Conclusion

A larger definitive trial appears acceptable and feasible in the school setting. Further research is required to determine if daily dark chocolate affects children's blood pressure.



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REFERENCES

- Lewington S et al. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet*. 2002.
- Chen X et al. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. *Circulation*. 2008.
- Desch S et al. Effect of cocoa products on blood pressure: systematic review and meta-analysis. *American journal of hypertension*. 2010.
- Ried K et al. Does chocolate reduce blood pressure? A meta-analysis. *BMC Med*. 2010.
- Varni JW et al. How young can children reliably and validly self-report their health-related quality of life? An analysis of 8,591 children across age subgroups with the PedsQL 4.0 Generic Core Scales. *Health Qual Life Outcomes*. 2007.
- Collins ME. Body figure perceptions among preadolescent children. *Int J Eat Dis*. 1991.
- Harter S. Manual for the Self-Perception Profile for Children. Denver. 1985.