

# **Ideal Cardiovascular Health scores and vascular phenotypes in 11- to 12-year-olds and their parents: The Longitudinal Study of Australian Children**

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## AUTHORS' CONTRIBUTIONS

RSL substantially contributed to the conception of the work, and the acquisition, analysis, and interpretation of data, and drafted the initial manuscript.

MW, as principal investigator of CheckPoint, substantially contributed to the conception of the work and the acquisition, analysis, and interpretation of data, drafted and revised the manuscript critically for important intellectual content, and supervised RSL.

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All authors approved the final version to be published and take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

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## FINANCIAL INTERESTS AND DISCLOSURES

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## KEYWORDS

Carotid; intima-media thickness; obesity; hypertension; cardiovascular risk; child

## ABSTRACT

**Background:** Understanding early-life relationships between the Ideal Cardiovascular Health (ICVH) score and vascular phenotypes could inform likely effectiveness and timing of cardiovascular disease prevention strategies. We aimed to describe associations between ICVH scores and vascular phenotypes in 11- to 12-year-old children and their parents.

**Methods and results:** In a cross-sectional study of 1482 Australian parent-child dyads, ICVH scores (range 0-7, higher indicating better health) were derived by summing dichotomized metrics for cholesterol, glucose, blood pressure (BP), body mass index (BMI), diet, physical activity levels and smoking. Scores were constructed for 1235 adults (89% female, mean age 43 years) and 1028 children (48% female, 12 years). The median scores were 4 and 5 for adults and children respectively. Spearman's correlation coefficient between parent and child scores was 0.21 (n=949). In adults, each additional ICVH metric was associated with slower carotid-femoral pulse wave velocity (PWV, -0.32 m/s, 95%CI -0.37 to -0.27), greater carotid elasticity (0.017% per mmHg, 95%CI 0.014 to 0.020) and reduced carotid intima-media thickness (IMT, -7.3  $\mu$ m, 95%CI -12.0 to -2.5). Associations were evident for children's functional phenotypes (PWV -0.07 m/s, 95%CI -0.11 to -0.03; carotid elasticity 0.009% per mmHg, 95%CI 0.004 to 0.015) but not for structural phenotypes (IMT -1.8  $\mu$ m, 95%CI -5.2 to 1.5).

**Conclusion:** Few Australian children and even fewer parents have ideal cardiovascular health. Lower ICVH scores were associated with adverse adult vascular phenotypes and adverse child vascular function. Family-based interventions optimizing ICVH metrics may delay onset and progression of subclinical atherosclerosis and later cardiovascular disease.

## INTRODUCTION

In 2010 the American Heart Association (AHA) proposed the concept of Ideal Cardiovascular Health<sup>1</sup>. A 7-point Ideal Cardiovascular Health (ICVH) score (Supplementary table 1) summarizes an individual's attainment of cardiovascular health metrics and is useful to quantify and monitor population trends in cardiovascular disease (CVD) risk factors.<sup>1,2</sup> In adults, ICVH score is inversely associated with all-cause and CVD-related mortality,<sup>3</sup> CVD events,<sup>4</sup> and other non-communicable diseases including cancer<sup>5</sup> and depression.<sup>6</sup> More importantly, the ICVH score represents a conceptual shift towards primordial prevention,<sup>7</sup> as evidenced by the inclusion of child cut-offs for each metric.<sup>1</sup>

Few studies have examined the ICVH score in children. Limited evidence suggests that by late adolescence a lower ICVH score is associated with worse vascular outcomes.<sup>8</sup> In 190 US youth with type 1 diabetes, lower ICVH scores were associated with adverse vascular function (increased pulse wave velocity, PWV), but not vascular structure (carotid intima-media thickness, IMT), 5 years later.<sup>9</sup> In the Cardiovascular Risk in Young Finns study, worsening ICVH scores over 21 years from childhood to adulthood were associated with increased adult PWV.<sup>10</sup> In another Finnish study of 15- to 19-year-old adolescents, lower ICVH scores were cross-sectionally associated with increased aortic IMT and lower aortic elasticity.<sup>11</sup> Data from earlier in childhood would indicate when associations between ICVH scores and vascular phenotypes become evident. Understanding parent-child relationships in this context would direct family-based interventions.

Here we used national population-derived Australian data to: 1) describe the ICVH score in 11- to 12-year-old children and their parents; 2) examine the relationship between parent and child ICVH scores; and 3) investigate associations of the overall ICVH score with vascular phenotypes among children and their parents. Secondary aims were to explore associations within the individual metrics.

## METHODS

### STUDY DESIGN AND PARTICIPANTS

Data were drawn from the Longitudinal Study of Australian Children (LSAC)<sup>12</sup> and Child Health CheckPoint.<sup>13</sup> Details of the initial two-stage random sampling design (with postcode as primary sampling unit) are outlined elsewhere.<sup>14</sup> Briefly, LSAC recruited a nationally representative sample of 5107 infants<sup>13</sup>, and followed them up in biennial 'waves' of data collection up to 2015 (child age 10-11 years). At the latest visit, families were invited to consent to their contact details being shared with the research team. The child and a parent from consenting families (n=3513) underwent a detailed biophysical assessment (the Child Health CheckPoint) between February 2015 and March 2016. In total 1874 families participated (child age 11-12 years).<sup>13-15</sup> The study was approved by the Human Research Ethics Committees of the Royal Children's Hospital (Melbourne, Australia) (33225D) and the Australian Institute of Family Studies (14-26).

### METRICS FOR IDEAL CARDIOVASCULAR HEALTH SCORE

The study definitions for ICVH score metrics are outlined in Supplementary table 1.<sup>1</sup> Metrics drew on largely cross-sectional (Child Health CheckPoint) data with longitudinal data on smoking habits and socioeconomic position (SEP) from LSAC.

#### CHOLESTEROL, GLUCOSE, AND BLOOD PRESSURE

Semi-fasting (median 4.2 hours postprandial) peripheral blood was collected and processed within 4 hours of collection at an on-site laboratory, with serum aliquots frozen at -80°C for batch analysis. High-throughput proton nuclear magnetic resonance metabolomics (Nightingale Ltd, Vantaa, Finland) quantified serum metabolic biomarkers including glucose and total cholesterol.<sup>16</sup>

Supine brachial blood pressure was measured after a 7-minute rest up to 3 times using the SphygmoCor XCEL (AtCor Medical Pty Ltd., West Ryde, NSW, Australia) and the mean

values used in adult analysis. Mean values were converted to age-sex-height percentiles in children.<sup>17</sup>

#### BODY MASS INDEX, DIET, PHYSICAL ACTIVITY, AND SMOKING

Participant's height was measured without shoes and in light clothing, to the nearest 0.1 cm, in duplicate. A third measurement was taken if the difference of the first 2 measurements was greater than 0.5 cm. The mean of all measurements was used in analyses. An InBody230 bioelectrical impedance analysis scale (Biospace Co. Ltd. Seoul, South Korea) measured weight to the nearest 0.1 kg. BMI was calculated by dividing the weight (kg) by the height squared (m<sup>2</sup>). For children, US Centers for Disease Control growth reference charts provided age- and sex-specific BMI z-scores and percentiles.<sup>18</sup>

A self-administered, modified National Secondary Students' Diet and Activity (NaSSDA)<sup>19</sup> 25-item food frequency diary at CheckPoint assessed dietary patterns in both children and adults. The NaSSDA, where possible, used pre-existing validated measures,<sup>20</sup> shown to have reasonable validity when compared to 24-hour diet recall in adults.<sup>21</sup> A 4-point ideal dietary score was created from participants' responses to 4 questions about approximate intake for vegetable and fruit, fish, wholegrains (bread), and sweetened beverage intake. We subsequently matched approximate intake of the abovementioned available items to Australian dietary guidelines<sup>22</sup> for each category (Supplementary table 2). We were unable to quantify sodium or total caloric intake. We categorized ideal, intermediate and poor diet scores, using a similar approach to studies reporting incomplete diet scores.<sup>23</sup>

Adults self-reported physical activity levels in the LSAC wave 6 questionnaire (approximate 1 year prior to CheckPoint) by response to the question: "About how many days each week do you do at least 30 minutes of moderate or vigorous physical activity (like walking briskly, riding a bike, gardening, tennis, swimming, running, etc?)". Physical activity was categorized as ideal if adults reported 5 or more days with 30-minute sessions of moderate to vigorous physical activity (MVPA).<sup>1</sup>

In children, physical activity was quantified using the Multimedia Activity Recall for Children and Adolescents (MARCA), a computerized recall time diary.<sup>24</sup> A trained interviewer elicited activities over the immediate 24-hour period prior to assessment, detailed into 5-minute intervals. This occurred at both the child's biophysical assessment and up to 3 times afterwards by follow-up telephone calls, including on at least 1 weekday and 1 weekend-day. Children chose from a list of 259 activities, each associated with an energy expenditure metabolic equivalent (MET). The average 'daily MVPA minutes', derived from the sum of reported minutes spent in activities requiring at least 3 METs<sup>25</sup> gave a measure of the physical activity. MARCA has excellent test-retest reliability (intraclass coefficients = 0.88–0.94)<sup>24</sup> and convergent validity with pedometry for physical activity level ( $\rho = 0.54$ ), and is superior to other self-report instruments for children.<sup>26</sup>

Adult smoking was a measure of current smoking, while child smoking was a measure of passive smoke exposure. In adults, the smoking metric was determined by their answer to the question "Are you currently smoking?" in the LSAC wave 6 questionnaire. In children, parent-reported questionnaire quantified the number of smokers at home, including parents and older siblings, at each LSAC wave. Those children with ideal health metric had never been exposed to smoking at home

## THE IDEAL CARDIOVASCULAR HEALTH SCORE

We dichotomized each of the 7 metrics into ideal *versus* not ideal (poor and intermediate combined, see Supplementary table 1) and then summed the number of metrics for which the participant met the ideal criterion to calculate an ICVH score. A higher score indicated better cardiovascular health.

## VASCULAR PHENOTYPES

### CAROTID-FEMORAL PULSE WAVE VELOCITY

Carotid-femoral pulse wave velocity (PWV) was determined using the SphygmoCor XCEL (AtCor Medical, Australia).<sup>27</sup> After a 7-minute rest, assessors obtained velocity



(distance/time) measurements 1-3 times while participants lay supine. Further analyses used the single or mean measurement where available. Simultaneously recorded carotid waveform, using tonometric applanation and femoral waveform using a cuff placed around the upper thigh inflated to subdiastolic pressure, provided the time component of PWV. Distance was measured with a tape measure from the carotid pulse to the suprasternal notch to right femoral pulse (estimated by the crease between thigh and torso when the knee was bent to 90 degrees) to top of the thigh cuff.

#### CAROTID ELASTICITY AND INTIMA-MEDIA THICKNESS

Carotid elasticity and IMT were measured as previously described.<sup>15</sup> Trained ultrasound technicians acquired real-time B mode ultrasound carotid artery images using standardized protocols. Participants lay supine with their head turned 45 degrees to the left to expose the right side of neck. A 10 MHz linear array probe (Vivid-I, GE Healthcare, Chicago, IL, USA) obtained cine-loops of the right common carotid artery, in triplicate. Modified 3-lead electrocardiogram (ECG) captured cardiac cycle information concurrently. All images were transferred to digital storage for archiving and analysis at a core facility in Melbourne.

Carotid artery lumen-lumen diameter was automatically measured at least 3 times at end-diastole and end-systole (diastolic and systolic lumen diameter respectively) by Carotid Analyzer (Medical Imaging Applications, Coralville, IA, USA) a semi-automatic edge detection software program. These values and concomitant brachial blood pressure were used to measure carotid artery elasticity, in the following formula:

$$\frac{\left(\frac{D_s - D_d}{D_d}\right)}{P_s - P_d} \times 100\%$$

where  $D_d$  is the diastolic diameter;  $D_s$ , the systolic diameter;  $P_s$ , systolic blood pressure; and  $P_d$ , diastolic blood pressure, and expressed as a percentage per mmHg, by multiplying by 100.<sup>11,28</sup>

Six raters further measured carotid IMT in the ultrasound images using Carotid Analyzer software. Carotid IMT was measured  $\approx 10$  mm proximal to the carotid bulb, over a distance of 5-10 mm. We reported maximum carotid IMT, calculated as the mean of 3-5 still frames, timed at the R-wave by ECG, of the largest thickness measurement in this 5-10 mm window. The within-observer and between-observer coefficients of variation were 5% and 6% respectively.<sup>15</sup>

## AGE, SEX, AND FAMILY SOCIOECONOMIC POSITION

Directed acyclic graphs identified covariates that would likely confound our analyses; age, sex of the parents and children, family SEP and assessment center attended by the family (Supplementary figure 1). We obtained self-reported sex and age at assessment. Family SEP, collected at LSAC wave 6<sup>29,30</sup> summarized parent-reported combined household income, current or most recent occupation of each parent, and highest educational qualification of each parent. Each component was scaled and an unweighted average was calculated and standardized within the wave to have a mean 0 and standard deviation (SD) of 1.

## STATISTICAL ANALYSIS

The primary analyses examined associations of overall ICVH scores with vascular phenotypes, using multivariable linear regression models. We examined whether individual parent scores were associated with child scores using Spearman's correlation coefficients. Further exploratory analyses examined associations of individual metrics (ideal compared to non-ideal) with vascular phenotypes. We then explored whether individual parent ICVH metrics were associated with their respective child ICVH metrics using logistic regression models. Child metrics were dichotomized into ideal vs non-ideal, and the odds of a child having a non-ideal value for each metric, given the parent's metric status was calculated. All models included the following covariates; parent and child age and sex, family SEP and assessment center attended, where relevant.

Analyses used survey weights obtained for the assessment center sample,<sup>31</sup> taking into account the initial complex multi-level sampling of LSAC, and adjusted for non-response and loss to follow-up over the 6 waves of data collection. We also used multiple imputation with the method of chained equations<sup>32</sup> to examine any biases introduced by data assumed to be missing at random. Variables included in the imputation models were all ICVH metrics and/or the ICVH score, adult and child vascular phenotypes, and covariates (adult and child age, sex, maximum carotid artery lumen diameter, family SEP, postcode, sampling stratum, sampling weight and assessment center). Eight models were specified for 1) the ICVH score using continuous variables for each metric, 2) the dichotomous variables for each metric, and 3-8) each adult-child metric pair (apart from the smoking metric). Twenty imputed datasets were generated for each model. When compared with complete case analyses, multiple imputation did not substantially alter our results or conclusions. We present the complete case data and provide the multiple imputation results in the online supplement.

#### SENSITIVITY ANALYSIS

We further explored the robustness of our results in sensitivity analyses using the continuous variable of each metric in both complete case and multiple imputation models.

Analyses were performed using Stata 14.2 (StataCorp LP, TX, USA), with *svy* and *mi chained* packages.

## RESULTS

### PARTICIPANTS AND MISSING DATA

The analytical sample contained 1482 of 1874 families who attended CheckPoint (Supplementary figure 2). Participants were excluded because they had home visits where carotid ultrasound was not available, or because the attending adult was not a biological parent. The sample characteristics of participants who were excluded were not substantially different to the characteristics of those included (Supplementary table 3). Within the analytic sample, complete data on all 7 metrics of the ICVH score were available for 1028 (69%) children, 1235 (83%) adults, and 949 (64%) parent-child dyads (Table 1). Missing data were most prevalent in the blood-derived, blood pressure, and elasticity measures (Supplementary table 4). Outcomes in those with missing data were not substantially different from those with data (Supplementary table 5). The main reasons for missingness were refusal of blood sampling or insufficient quantity of blood drawn, and insufficient time in the cardiovascular assessment.

### IDEAL CARDIOVASCULAR HEALTH IN CHILDREN AND ADULTS

A perfect ICVH score (i.e. 7/7) was present in 16 adults (1%) and 76 (7%) children, whereas 124 (10%) adults and 406 (39%) children achieved ideal levels in 6 or more metrics. The median ICVH score was lower in adults (4 metrics) than children (5). After applying survey weights, prevalence estimates were largely unchanged (Supplementary figure 3).

Compared to children, the prevalence of ideal values was equivalent or lower in adults for all individual ICVH metrics except smoking (Supplementary figure 4). The exception in smoking was likely due to the adult definition related to current smoking. Of the ICVH metrics, the prevalence of ideal scores differed the most between children and adults for physical activity (absolute unit difference 52%), followed by blood pressure (42%). Ideal diet was the metric least likely to be attained both by adults (17%) and children (16%).

## ASSOCIATIONS BETWEEN PARENT AND CHILD CARDIOVASCULAR HEALTH METRICS

There was a moderate correlation between adult and child ICVH scores in parent-child dyads (Supplementary table 6, Spearman's rank correlation coefficient = 0.21). Children whose parent had non-ideal health in any given metric had substantially higher odds for non-ideal health in that metric, for all ICVH metrics except for physical activity and serum glucose (Table 2). Use of multiple imputation models did not substantially alter results (Supplementary table 7).

## ASSOCIATIONS OF IDEAL HEALTH SCORES WITH VASCULAR PHENOTYPES

The adult data strongly supported an association between overall ICVH score and all vascular phenotypes (Figure 1, Supplementary table 8). In linear regression analyses using survey weights and adjusted for age, sex, family SEP and assessment center, an increased ICVH score was associated with a favorable vascular phenotype, e.g. slower PWV (-0.32 m/s, 95%CI -0.37 to -0.27,  $P<0.001$ ), higher arterial elasticity (0.017% per mmHg, 0.014 to 0.020,  $P<0.001$ ) and a smaller carotid IMT (-7.3  $\mu\text{m}$ , -12.0 to -2.5,  $P=0.003$ ). In children, associations between the ICVH score and each of the vascular phenotypes were smaller in magnitude (Figure 1, Supplementary table 8). In linear regression models adjusted for age, sex and family SEP, a higher ICVH score was associated with better vascular function (PWV -0.07 m/s per extra ideal health metric, -0.11 to -0.03,  $P<0.001$ ; and carotid elasticity 0.009% per mmHg, 0.004 to 0.015,  $P=0.001$ ), but not with vascular structure (carotid IMT -1.8  $\mu\text{m}$ , -5.2 to 1.5,  $P=0.28$ ). Sensitivity analyses using continuous variables and multiple imputation models did not substantially alter results (Supplementary tables 9 and 10).

In exploratory analyses, adult blood pressure and BMI were associated with all vascular outcomes in models adjusted for age, sex, family SEP and assessment center (Table 3). Childhood BMI and blood pressure metrics were associated with child measures of artery stiffness and elasticity, and to a lesser extent, carotid IMT. This was replicated when using

multiple imputation, and/or continuous versions of the metric (Supplementary table 9 and 10). Overall, the magnitudes of associations were smaller in children than adults (Table 3). The correlation between metrics in adults and children is reported in Supplementary table 11.

## DISCUSSION

We report a low prevalence of perfect ICVH scores in this relatively advantaged population of Australian children and adults. Parental and child attainment of individual ICVH metrics were correlated. Lower ICVH scores were associated with adverse structural and functional adult vascular phenotypes. For the first time, we report associations between ICVH and functional phenotypes (PWV and carotid elasticity) in children, and between two specific ICVH metrics (blood pressure and BMI) and adverse vascular phenotypes.

Our adult data are in keeping with previous studies,<sup>10,23,33,34</sup> suggesting the associations in children are robust. The reported overall prevalence of an ICVH score of 6 or higher in adults varied from < 1% in an African American population<sup>35</sup> to 15% in a large Chinese corporation.<sup>36</sup> Our reported prevalence in adults (8% for a score of 6 or greater) is comparable to scores reported from other national Australian data.<sup>23</sup> Despite our relatively strict definition of ideal smoking behavior, our Australian children had a higher prevalence of perfect ICVH scores (6%) than previous studies; < 1% in US<sup>37</sup> and < 2% in European adolescents.<sup>38</sup> This may be partly due to the higher frequency of ideal diet in our cohort than previously reported.<sup>37,38</sup> In addition, as our sample is younger than those in previous studies, our results may reflect a decrease in ICVH score with age.

The age-dependence of some associations suggests critical periods when traditional risk factors differentially affect functional and structural vascular phenotypes. In adults, a higher ICVH score was associated with favorable vascular phenotypes: slower PWV, higher carotid elasticity and reduced carotid IMT. At age 11-12 years, a higher ICVH score was associated with better functional measures (PWV and carotid elasticity), but not convincingly with structural measures (carotid IMT). The structural phenotype association strengthened marginally when using multiple imputation. Overall, however, the lack of strong evidence for an association in children between the ICVH score and vascular structure is consistent with a hypothesis that discernable changes to functional vascular phenotype may occur prior to

structural phenotype.<sup>39</sup> A plausible alternative explanation could be that early structural changes are below the resolution limit of ultrasound measurement (~100µm).<sup>40</sup>

Of the 7 ICVH metrics, non-ideal BMI and blood pressure were robustly associated with both structural and functional vascular phenotypes. High quality meta-analysis of randomized trial evidence shows that a reduction of 5 mmHg systolic blood pressure in adults leads to a 17% reduction in hazard for major cardiovascular events,<sup>41</sup> and observational and Mendelian randomization studies posit a causal role for obesity in CVD events<sup>42</sup> and adverse vascular phenotypes.<sup>43</sup> Our associations between these metrics and vascular phenotypes were independent of other metrics in multivariable models, and were largely invariant to parent or child status, use of continuous measures, and multiple imputation models— consistent with a causal relationship of these risk factors with vascular phenotypes.

To our knowledge this is the first study to examine adult and child associations with the breadth of exposures summarized in the ICVH score. Previous research has examined intergenerational transmission of individual metrics such as dietary patterns<sup>44</sup> and body weight.<sup>45</sup> Our exploratory analysis suggests opportunities for family-based behavioral interventions aimed at both children and their parents across a number of metrics, some of which are modestly correlated (Supplementary table 11).

Some limitations warrant consideration. We are unable to comment on the long-term consequences of adverse vascular phenotypes in our cohort as data are primarily cross-sectional. We aimed to address substantial missing data (> 5% of the total sample for some variables; Supplementary table 4) with multiple imputation models and survey weighting. Despite this, the adult sample is not generalizable to the general adult population, as it mainly comprised mothers, under-represented socioeconomically disadvantaged families, and survey weights were centered around the child as the base unit. Replication in other populations and settings is warranted.



Physical activity, diet and smoking data were self- or parent-reported, which have well-described limitations.<sup>2,46</sup> Balancing precise measurement with the logistics of a multi-domain population study is difficult. For example, in the physical activity metric, precision could be improved with accelerometry data, but this would put the score out of reach of busy clinicians. Measuring cotinine levels could capture complete smoking exposure more precisely,<sup>2</sup> for small additional cost to existing blood analyses. At time of writing, we are not aware of any highly accurate dietary measures that could feasibly be used in large-scale, multi-domain population studies. Steinberger et al. have questioned the role of the diet metric in the ICVH score, citing the very low prevalence of ideal health in the diet metric in studies, and unclear additional value in stratifying risk.<sup>2</sup>

The size of association between different components of the ICVH score and the vascular phenotypes varies (Table 3), suggesting that contributions of each metric towards the score may not be equal. Weighting each metric to reflect this, however, could undermine the original purpose of the score as a simple tool to easily assess patients' health and set future health goals. While additional research would be required to ascertain appropriate weightings, the current iteration of the ICVH score has been robustly associated with CVD-related mortality<sup>3</sup> and CVD events.<sup>4</sup>

Few children and fewer parents have ideal cardiovascular health in high income countries, including Australia. Lower ICVH scores were associated with adverse structural and functional adult vascular phenotypes, and robustly associated with adverse functional but not structural phenotypes in children. Specifically, BMI and blood pressure were strongly associated with vascular phenotypes. Optimizing blood pressure and reducing obesity in childhood could delay onset and progression of subclinical atherosclerosis and may reduce later cardiovascular disease. Focus on family-wide interventions may have additional benefit for child cardiovascular health.

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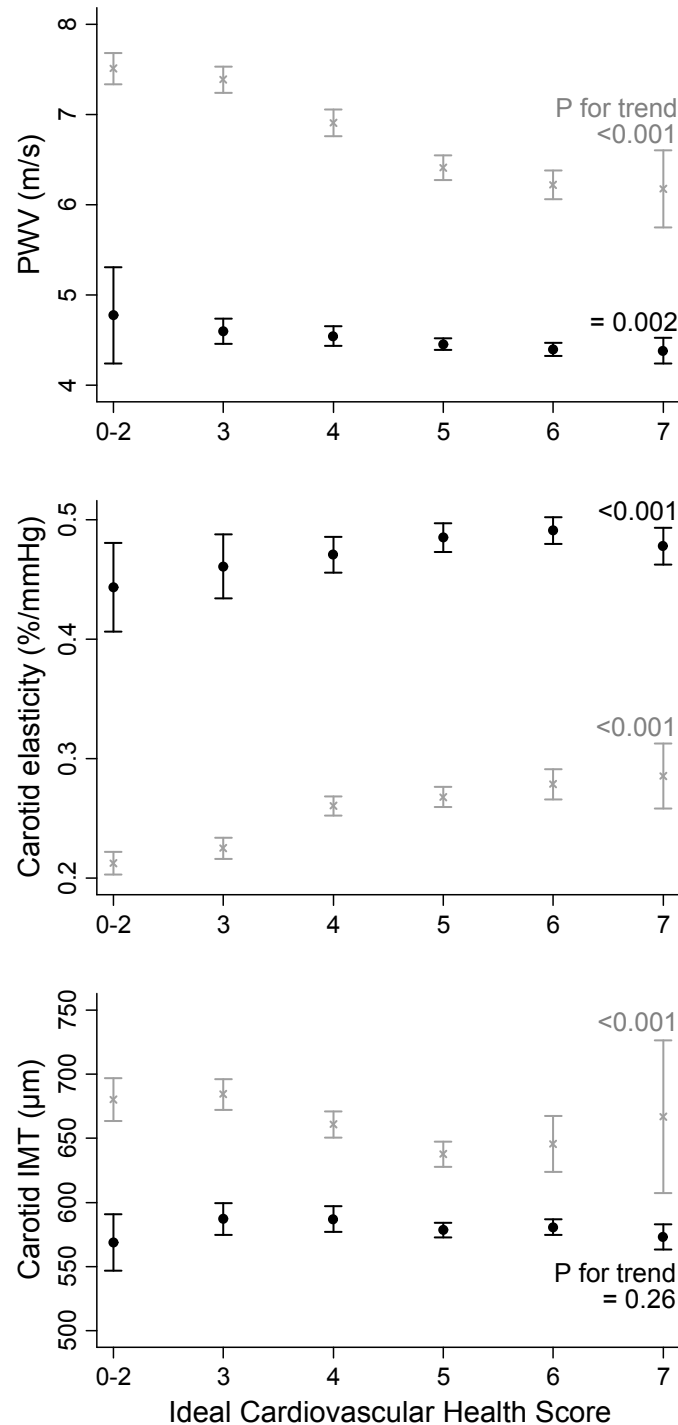
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## TABLES AND FIGURES

**Figure 1. Ideal Cardiovascular Health score associations with vascular phenotypes – PWV, carotid elasticity and carotid IMT – in adults (gray) and children (black).**

Those with scores 0-2 grouped together due to small numbers. P value for trends are derived from linear regression models using survey weights and complete cases, adjusted for age, sex, SEP and assessment center, modelling the ICVH score as a categorical variable with 6 categories, from 1 (0-2 group) up to 6 (7 group). Symbol color indicates adult (gray) and child (black) models. Crosses (x) and dots (•) represent point estimates, and vertical bars the 95% confidence interval for a predicted outcome, given the ICVH score. PWV indicates pulse wave velocity; IMT, intima-media thickness; ICVH, Ideal Cardiovascular Health; SEP, socioeconomic position.



**Table 1. Sample characteristics stratified by ICVH score, where values are expressed as survey-weighted mean (SD) or unweighted n (survey-weighted %).**

Characteristic	By ICVH Score						Total
	0-2 <sup>a</sup>	3	4	5	6	7	
<b>ADULT</b>	n=196	n=316	n=335	n=264	n=108	n=16	n=1235
Age, years	43.6 (5.2)	44.0 (5.7)	42.7 (5.5)	43.4 (4.9)	43.5 (5.5)	45.1 (3.1)	43.4 (5.5)
Male	39 (21%)	44 (12%)	35 (9%)	22 (7%)	7 (6%)	1 (3%)	148 (11%)
Family socioeconomic position, z-score	-0.32 (1.00)	-0.11 (0.88)	-0.02 (0.96)	0.21 (0.90)	0.46 (0.90)	0.49 (0.57)	-0.01 (0.97)
BMI, kg/m <sup>2</sup>	32.8 (5.3)	31.1 (6.1)	27.3 (5.1)	24.5 (4.5)	22.8 (2.1)	23.1 (1.3)	28.4 (6.3)
Total cholesterol, mmol/L <sup>b</sup>	5.35 (0.97)	4.91 (0.82)	4.61 (0.83)	4.47 (0.75)	4.36 (0.66)	4.17 (0.59)	4.77 (0.89)
Glucose, mmol/L <sup>b</sup>	5.56 (1.87)	4.99 (1.25)	4.80 (0.75)	4.60 (0.57)	4.58 (0.54)	4.64 (0.43)	4.93 (1.22)
Blood pressure							
Systolic pressure, mmHg	131 (10)	126 (11)	119 (13)	112 (8)	111 (7)	113 (4)	121 (13)
Diastolic pressure, mmHg	80 (7)	77 (8)	73 (9)	69 (7)	68 (6)	66 (5)	74 (9)
Ideal diet							
Parent Diet Score	1.4 (0.7)	1.7 (0.8)	1.6 (0.8)	1.9 (0.8)	2.3 (0.8)	3.0 (0.2)	1.7 (0.8)
Fruit & vegetables >7 serves per day	1 (1%)	14 (6%)	7 (3%)	12 (5%)	22 (21%)	7 (52%)	63 (6%)
Fish ≥2 times per week	90 (41%)	167 (51%)	182 (53%)	161 (59%)	85 (76%)	15 (96%)	700 (54%)
Wholegrain bread ≥2 slices per day	36 (20%)	80 (25%)	78 (22%)	90 (37%)	45 (39%)	11 (57%)	340 (27%)
Sweetened beverages <4 cups per week	152 (74%)	276 (89%)	296 (86%)	244 (92%)	101 (94%)	16 (100%)	1085 (86%)
Est. weekly MVPA							
No exercise	28 (16%)	45 (16%)	28 (9%)	15 (5%)	1 (1%)	0 (0%)	117 (11%)
<150 min/wk	166 (83%)	233 (70%)	234 (67%)	152 (55%)	31 (25%)	0 (0%)	816 (64%)
>150 min/wk	2 (0%)	38 (14%)	73 (24%)	97 (40%)	76 (75%)	16 (100%)	302 (25%)
Current smoker	39 (28%)	31 (13%)	22 (8%)	11 (7%)	0 (0%)	0 (0%)	103 (12%)
PWV, m/s	7.56 (1.17)	7.39 (1.15)	6.91 (1.13)	6.41 (0.87)	6.22 (0.84)	6.18 (0.74)	6.97 (1.19)
Carotid elasticity, %/mmHg	0.212 (0.048)	0.225 (0.051)	0.260 (0.066)	0.267 (0.059)	0.278 (0.058)	0.285 (0.062)	0.247 (0.063)
Carotid IMT, μm	680.3 (97.7)	684.0 (105.1)	660.7 (89.3)	638.6 (81.0)	645.6 (104.1)	666.9 (97.4)	664.9 (99.1)
	<b>0-2<sup>a</sup></b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>Total</b>
<b>CHILD</b>	n=14	n=61	n=173	n=374	n=330	n=76	n=1028
Age, years	11.8 (0.2)	11.8 (0.3)	11.9 (0.4)	11.9 (0.4)	11.9 (0.4)	11.9 (0.4)	11.9 (0.4)
Male	6 (48%)	27 (50%)	85 (52%)	167 (44%)	150 (46%)	50 (69%)	485 (48%)

Family socioeconomic position, z-score	-0.37 (0.87)	-0.38 (0.67)	-0.26 (0.95)	-0.01 (0.88)	0.22 (0.89)	0.69 (0.95)	0.02 (0.95)
BMI z-score (CDC)	1.62 (0.32)	1.26 (0.68)	0.57 (1.06)	0.30 (0.91)	-0.03 (0.89)	0.12 (0.62)	0.34 (1.00)
Total cholesterol, mmol/L	4.78 (0.58)	4.46 (0.53)	4.27 (0.67)	4.07 (0.67)	3.82 (0.56)	3.77 (0.47)	4.06 (0.67)
Glucose, mmol/L	5.16 (1.17)	4.95 (0.52)	4.98 (0.49)	4.90 (0.70)	4.89 (0.87)	4.82 (0.44)	4.91 (0.70)
Blood pressure							
Systolic BP, age-sex-height percentile	83.1 (16.9)	70.1 (17.3)	60.4 (22.8)	53.2 (22.8)	46.0 (21.3)	53.6 (24.4)	54.4 (23.9)
Diastolic BP, age-sex-height percentile	69.0 (18.1)	60.5 (13.6)	53.3 (16.9)	49.5 (16.3)	46.6 (18.9)	48.9 (22.5)	50.5 (18.3)
Systolic pressure, mmHg	125 (13)	114 (7)	111 (8)	108 (7)	106 (7)	108 (7)	109 (8)
Diastolic pressure, mmHg	70 (6)	66 (4)	64 (6)	63 (5)	62 (6)	63 (7)	63 (6)
Ideal Diet							
Child Diet Score	1.4 (0.7)	1.4 (0.6)	1.2 (0.7)	1.5 (0.8)	1.7 (1.0)	3.1 (0.4)	1.6 (0.9)
Fruit & vegetables >7 serves per day	0 (0%)	6 (8%)	14 (7%)	44 (13%)	62 (19%)	43 (54%)	169 (15%)
Fish ≥2 times per week	4 (24%)	22 (43%)	37 (22%)	120 (32%)	134 (40%)	64 (81%)	381 (36%)
Wholegrain bread ≥2 slices per day	3 (32%)	14 (24%)	42 (23%)	118 (29%)	125 (34%)	58 (80%)	360 (32%)
Sweetened beverages <4 cups per week	12 (87%)	39 (62%)	131 (70%)	290 (76%)	262 (79%)	75 (98%)	809 (76%)
Daily MVPA, minutes	64 (52)	67 (49)	101 (78)	121 (73)	144 (75)	149 (65)	120 (78)
Ever exposed to smoke at home	11 (78%)	37 (64%)	66 (46%)	80 (25%)	4 (1%)	0 (0%)	198 (25%)
PWV, m/s	4.79 (0.75)	4.60 (0.40)	4.54 (0.58)	4.45 (0.56)	4.40 (0.57)	4.38 (0.61)	4.47 (0.58)
Carotid elasticity, %/mmHg	0.433 (0.072)	0.461 (0.078)	0.474 (0.089)	0.485 (0.087)	0.491 (0.095)	0.478 (0.084)	0.482 (0.091)
Carotid IMT, μm	574.8 (38.0)	587.1 (39.0)	586.8 (49.2)	578.5 (46.6)	580.7 (51.8)	573.2 (44.6)	581.0 (49.1)

<sup>a</sup>Adults and children with 0-2 ideal ICVH metrics were grouped together due to small numbers.

ICVH indicates Ideal Cardiovascular Health; BMI, body mass index; CDC, the Centers for Disease Control and Prevention; BP, blood pressure; MVPA, moderate to vigorous physical activity; IMT, intima-media thickness.



**Table 2. Odds ratios for a child having a non-ideal ICVH metric (poor or intermediate), given parent category for ICVH metric.**

Child metric <sup>a</sup>	Parent metric category <sup>b</sup>	n	% <sup>d</sup>	OR (95% CI) for trend	P value
Cholesterol	Ideal	770	69	1.0	<0.001
	Intermediate	279	25	2.0 (1.4, 3.0)	
	Poor	71	6	3.3 (1.9, 5.7)	
Glucose	Ideal	981	88	1.0	0.09
	Intermediate	108	10	2.0 (0.9, 4.9)	
	Poor	30	3	1.7 (0.5, 6.4)	
Blood Pressure	Ideal	743	55	1.0	<0.001
	Intermediate	492	36	2.4 (1.3, 4.5)	
	Poor	116	9	5.9 (2.6, 13.4)	
BMI	Ideal	567	38	1.0	<0.001
	Intermediate	481	33	2.1 (1.4, 3.0)	
	Poor	428	29	3.0 (2.0, 4.7)	
Diet	Ideal	250	18	1.0	<0.001
	Intermediate	634	45	1.8 (1.2, 2.7)	
	Poor	516	37	4.0 (2.4, 6.7)	
Physical Activity	Ideal	355	25	1.0	0.22
	Intermediate	946	66	1.2 (0.8, 1.7)	
	Poor	134	9	1.4 (0.8, 2.5)	

<sup>a</sup>Smoking excluded as non-ideal parental health perfectly predicts non-ideal child health according to definitions.

<sup>b</sup>Metric category definitions found in supplementary online material (Supplementary table 1).

<sup>c</sup>Logistic regression models use survey weights and complete cases, adjusted for parent and child age and sex, SEP and assessment center.

<sup>d</sup>Unweighted n and unweighted % reported here.

ICVH indicates Ideal Cardiovascular Health; SEP, socioeconomic position; BMI, body mass index; OR, odds ratio; CI, confidence interval.

**Table 3. The survey-weighted mean values (SD) and per metric difference for PWV, carotid elasticity, and IMT in those who fulfil ideal criteria compared to those who do not fulfil criteria, for a) the ICVH score overall (6 or higher), and b) a given ICVH metric (definitions from Supplementary table 1).**

Outcome and Metric	Adults				Children			
	Mean (SD) <sup>a</sup>		Adjusted per metric difference (95% CI) <sup>c</sup>	P	Mean (SD) <sup>a</sup>		Adjusted per metric difference (95% CI) <sup>b</sup>	P
	Ideal	Non-ideal			Ideal	Non-ideal		
<b>PWV, m/s</b>	<b>N=1149</b>				<b>N=1019</b>			
<b>ICVH score</b>	<b>6.22 (0.83)</b>	<b>7.05 (1.16)</b>	<b>-0.32 (-0.37, -0.27)</b>	<b>&lt;0.001</b>	<b>4.39 (0.58)</b>	<b>4.50 (0.56)</b>	<b>-0.07 (-0.11, -0.03)</b>	<b>0.002</b>
Total cholesterol	6.86 (1.15)	7.25 (1.19)	-0.08 (-0.22, 0.06)	0.28	4.45 (0.57)	4.47 (0.54)	-0.03 (-0.12, 0.05)	0.43
Glucose	6.93 (1.16)	7.33 (1.21)	-0.17 (-0.39, 0.04)	0.12	4.47 (0.57)	4.39 (0.55)	0.05 (-0.10, 0.20)	0.54
Blood pressure	6.47 (0.88)	7.57 (1.17)	-0.83 (-0.98, -0.67)	<0.001	4.46 (0.56)	4.83 (0.63)	-0.35 (-0.56, -0.14)	0.001
BMI	6.53 (1.00)	7.25 (1.17)	-0.44 (-0.57, -0.31)	<0.001	4.42 (0.57)	4.67 (0.53)	-0.27 (-0.36, -0.18)	<0.001
Diet	6.81 (1.15)	7.00 (1.16)	-0.08 (-0.25, 0.09)	0.37	4.41 (0.56)	4.49 (0.58)	-0.06 (-0.14, 0.02)	0.16
Physical activity	6.82 (1.20)	7.01 (1.15)	-0.13 (-0.28, 0.03)	0.11	4.49 (0.57)	4.46 (0.58)	0.06 (-0.03, 0.16)	0.19
Smoking	6.99 (1.21)	6.83 (0.85)	0.22 (-0.03, 0.47)	0.09	4.48 (0.60)	4.48 (0.49)	0.06 (-0.03, 0.16)	0.19
<b>Carotid elasticity, %/mmHg</b>	<b>N=1028</b>				<b>N=974</b>			
<b>ICVH score</b>	<b>0.279 (0.059)</b>	<b>0.244 (0.061)</b>	<b>0.017 (0.014, 0.020)</b>	<b>&lt;0.001</b>	<b>0.489 (0.094)</b>	<b>0.479 (0.087)</b>	<b>0.009 (0.004, 0.015)</b>	<b>0.001</b>
Total cholesterol	0.251 (0.063)	0.233 (0.058)	0.002 (-0.005, 0.010)	0.56	0.482 (0.086)	0.485 (0.097)	-0.004 (-0.017, 0.010)	0.61
Glucose	0.249 (0.061)	0.216 (0.061)	0.024 (0.013, 0.035)	<0.001	0.483 (0.091)	0.483 (0.068)	0.010 (-0.012, 0.032)	0.37
Blood pressure	0.272 (0.064)	0.216 (0.051)	0.036 (0.028, 0.044)	<0.001	0.483 (0.089)	0.417 (0.085)	0.050 (0.023, 0.077)	<0.001
BMI	0.268 (0.065)	0.234 (0.061)	0.026 (0.017, 0.035)	<0.001	0.486 (0.093)	0.458 (0.080)	0.030 (0.013, 0.047)	<0.001
Diet	0.253 (0.065)	0.247 (0.065)	0.003 (-0.008, 0.014)	0.62	0.489 (0.102)	0.476 (0.088)	0.009 (-0.007, 0.026)	0.27
Physical activity	0.254 (0.062)	0.247 (0.065)	0.005 (-0.004, 0.014)	0.28	0.479 (0.090)	0.478 (0.090)	-0.003 (-0.018, 0.013)	0.74
Smoking	0.248 (0.066)	0.244 (0.052)	0.006 (-0.009, 0.022)	0.43	0.479 (0.095)	0.478 (0.075)	0.002 (-0.016, 0.019)	0.86
<b>Carotid IMT, µm</b>	<b>N=1211</b>				<b>N=1016</b>			
<b>ICVH score</b>	<b>648.8 (103.5)</b>	<b>666.5 (96.6)</b>	<b>-7.3 (-12.0, -2.5)</b>	<b>0.003</b>	<b>579.5 (51.0)</b>	<b>581.8 (46.5)</b>	<b>-1.8 (-5.2, 1.5)</b>	<b>0.28</b>
Total cholesterol	664.7 (98.1)	669.5 (97.4)	10.6 (-2.0, 23.3)	0.10	582.2 (49.9)	580.2 (43.5)	-5.0 (-11.8, 1.9)	0.15
Glucose	661.4 (94.0)	699.7 (117.4)	-20.4 (-41.6, 0.8)	0.06	580.8 (47.3)	591.6 (57.4)	-5.3 (-22.3, 11.8)	0.54
Blood pressure	643.5 (82.4)	683.4 (104.6)	-22.7 (-33.5, -11.9)	<0.001	581.7 (50.1)	591.9 (43.5)	0.8 (-11.4, 12.9)	0.90
BMI	644.3 (91.7)	674.2 (97.5)	-19.9 (-31.8, -8.0)	0.001	579.5 (49.0)	593.0 (49.7)	-6.9 (-15.6, 1.7)	0.12
Diet	660.3 (99.7)	664.4 (96.7)	-4.8 (-19.1, 9.5)	0.51	583.0 (44.9)	583.0 (50.5)	7.7 (0.0, 15.4)	0.05
Physical activity	666.6 (100.2)	660.4 (94.3)	12.4 (0.0, 24.8)	0.05	583.4 (48.6)	582.6 (53.0)	0.4 (-9.5, 10.3)	0.93
Smoking	663.6 (99.6)	662.0 (76.3)	2.9 (-16.3, 22.1)	0.77	581.5 (51.7)	587.8 (43.3)	-2.4 (-11.2, 6.5)	0.60

<sup>a</sup>Estimates derived from survey-weighted complete case analyses which were otherwise unadjusted.

<sup>b</sup>Adjusted mean difference is the estimated per one metric difference for the ICVH score, or the estimated difference for fulfilling criteria for each individual metric. Multivariable models use survey weights and complete cases, and are adjusted for participant age, sex, socioeconomic position, and assessment center. In secondary analyses of individual metrics, models are additionally adjusted for other ICVH metrics. Sample size of the multivariable model listed at the top of each outcome.

ICVH indicates Ideal Cardiovascular Health; SD, standard deviation; CI, confidence interval; BMI, body mass index; PWV, pulse wave velocity; IMT, intima-media thickness; SEP, socioeconomic position.

## **Author Agreement Form – International Journal of Cardiology**

**Manuscript Title: Ideal Cardiovascular Health scores and vascular phenotypes in 11- to 12-year-olds and their parents: The Longitudinal Study of Australian Children**

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## Online Data Supplement

### **Ideal Cardiovascular Health scores and vascular phenotypes in 11- to 12-year-olds and their parents: The Longitudinal Study of Australian Children**

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Supplementary Figure 4. Estimated proportion of participants meeting each of the seven ICVH metric ideal criteria, in adults (white) and children (black), using survey weights and methods.

**Supplementary Table 1. Measures contributing to ICVH score metrics.**

Metric	Age	Thresholds used in study			Equipment/platform used	Source	Year collected
		Ideal	Not ideal				
			Intermediate	Poor			
Glucose <sup>a</sup> (non-fasting)	Child Adult	< 100 mg/dL	100 to 125 mg/dL	> 125 mg/dL	Proton NMR metabolomics	CheckPoint	2015
Cholesterol <sup>a</sup> (non-fasting)	Child Adult	< 170 mg/dL < 200 mg/dL	170 to 200 mg/dL 200 to 240 mg/dL	≥ 200 mg/dL ≥ 240 mg/dL	Proton NMR metabolomics	CheckPoint	2015
Blood pressure	Child	< 90 <sup>th</sup> percentile	90 <sup>th</sup> to 95 <sup>th</sup> percentile	> 95 <sup>th</sup> percentile	Sphygmocor XCEL & <i>The Fourth Report</i> reference values for children	CheckPoint	2015
	Adult	< 120 / < 80 mmHg	≥ 120/80 and < 140/90 mmHg	≥ 140 mmHg systolic OR ≥ 90 mmHg diastolic			
BMI	Child	< 85 <sup>th</sup> percentile	85 <sup>th</sup> to 95 <sup>th</sup> percentile	> 95 <sup>th</sup> percentile	Stadiometer (height) & InBody230 BIA scale (weight) & CDC reference values for children	CheckPoint	2015
	Adult	< 25kg/m <sup>2</sup>	25 to 30 kg/m <sup>2</sup>	≥ 30 kg/m <sup>2</sup>			
Physical Activity	Child	≥ 60 min/d MVPA	< 60 min/d MVPA	No activity	MARCA questionnaire	CheckPoint	2015
	Adult	> 150 min/wk MVPA	≤ 150 min/wk MVPA	No activity	Self-reported questionnaire	LSAC wave 6	2014
Diet	Child Adult	3-4 components <sup>b</sup>	2 components	0-1 components	Modified NaSSDA questionnaire	CheckPoint	2015
Smoking	Child	Never exposed to passive smoking	NA	Exposed to passive smoking at least once previously	Parent-reported questionnaires	LSAC wave 1-6	2004-14
	Adult	Not currently smoking	NA	Currently smoking	Self-reported questionnaire	LSAC wave 6	2014

<sup>a</sup>Multiply mg/dL values to obtain mmol/L, by 0.0259 for cholesterol, and by 0.0555 for glucose.

<sup>b</sup>Components listed in Supplementary Table 2

NMR indicates nuclear magnetic resonance; BIA, bio-impedance analysis; MVPA, moderate to vigorous physical activity; MARCA, The Multimedia Activity Recall for Children and Adolescents; NaSSDA, National Secondary Students' Diet and Activity.

**Supplementary Table 2. Ideal diet criteria and proportion of adult and child fulfilled, using self-reported data.**

Diet Metric (criteria) <sup>a</sup>	Adult		Child	
	n	Ideal (%) <sup>b</sup>	n	Ideal (%) <sup>b</sup>
Fruit & vegetables >7 serves per day	1480	76 (5)	1452	229 (15)
Fish ≥2 times per week <sup>c</sup>	1477	833 (53)	1444	523 (36)
Wholegrain bread ≥2 slices per day	1473	411 (27)	1449	498 (31)
Sweetened beverage <4 cups per week	1472	1203 (85)	1450	1119 (74)

<sup>a</sup>Criteria adapted to available National Secondary Students Diet and Activity questionnaire data, Australian government dietary guidelines and American Heart Association recommendations.

<sup>b</sup>Unweighted n and survey-weighted %.

<sup>c</sup>Vegetarian and related diets may still achieve an ideal diet score (3 or 4) without eating fish.

**Supplementary Table 3. Sample characteristics of all CheckPoint adults and children, excluded and included (n=1874).**

Characteristics	Adults		Children	
	Excluded	Included	Excluded	Included
Sample size, n	392	1482	392	1482
Age, years	44.0 (5.8)	44.2 (5.0)	12.2 (0.4)	11.9 (0.4)
Male	34 (9%)	196 (13%)	216 (55%)	739 (50%)
<b>Puberty Development Category</b>				
Prepubertal	-	-	26 (7%)	139 (10%)
Early Pubertal	-	-	95 (27%)	350 (26%)
Midpubertal	-	-	170 (48%)	713 (52%)
Late Pubertal	-	-	61 (17%)	168 (12%)
Postpubertal	-	-	5 (1%)	4 (<1%)
Socioeconomic position, z-score	-0.12 (1.04)	0.25 (0.97)	-0.12 (1.04)	0.25 (0.97)
BMI, kg/m <sup>2</sup>	28.09 (6.67)	27.74 (5.99)	19.59 (3.79)	19.12 (3.33)
BMI, z-score (CDC)	-	-	0.34 (1.04)	0.30 (0.97)
Serum total cholesterol, mmol/L	4.43 (0.75)	4.77 (0.88)	3.83 (0.39)	4.07 (0.65)
Serum glucose, mmol/L	5.05 (1.00)	4.88 (1.05)	4.83 (0.44)	4.94 (0.78)
<b>Blood Pressure</b>				
Systolic, mmHg	118.1 (12.4)	120.2 (12.8)	107.8 (8.5)	108.2 (8.0)
Diastolic, mmHg	71.3 (8.3)	73.6 (8.6)	60.5 (6.3)	62.9 (5.7)
Systolic percentile	-	-	49.4 (24.4)	53.2 (23.0)
Diastolic percentile	-	-	40.8 (19.4)	49.3 (17.7)
<b>Diet score (out of 4)</b>	1.8 (0.8)	1.8 (0.8)	1.6 (0.9)	1.6 (1.0)
Ideal fruit and vegetable intake	18 (5%)	76 (5%)	48 (12%)	229 (16%)
Ideal fish intake	215 (56%)	833 (56%)	127 (33%)	523 (36%)
Ideal wholemeal intake	120 (32%)	411 (28%)	134 (35%)	498 (34%)
Ideal sugary drink intake	324 (86%)	1283 (87%)	298 (78%)	1119 (77%)
<b>Physical activity</b>				
Calculated MVPA time, min	-	-	119.1 (85.2)	122.8 (75.4)
Self-reported MVPA time				
No exercise	37 (10%)	134 (9%)	-	-
<150 min/wk	242 (65%)	950 (66%)	-	-
>150 min/wk	96 (26%)	357 (25%)	-	-
<b>Smoking</b>				
Ever exposed to smoke at home	-	-	106 (27%)	296 (20%)
Current smoker	61 (16%)	124 (8%)	-	-
<b>Vascular phenotypes</b>				
Pulse wave velocity, m/s	6.53 (1.19)	6.96 (1.15)	4.45 (0.64)	4.46 (0.55)
Carotid artery distensibility, %/mmHg	0.23 (0.05)	0.25 (0.06)	0.48 (0.09)	0.48 (0.09)
Carotid intima-media thickness, $\mu$ m	696 (135)	663 (97)	585 (45)	581 (47)

Values are unweighted means (SD), or n (percentage) where indicated.

BMI indicates body mass index; CDC Centers for Disease Control and Prevention; MVPA, moderate to vigorous physical activity; SD, standard deviation.



**Supplementary Table 4. Amount of missing data in analytic sample (n=1482), expressed as unweighted n (%).**

Variable	Number with missing data (%)		
	Adult	Child	Dyad
Ideal Cardiovascular Health score	249 (17)	454 (31)	535 (36)
<b>Score Metrics</b>			
Total cholesterol	175 (12)	317 (21)	357 (24)
Glucose	179 (12)	315 (21)	358 (24)
Blood pressure	13 (1)	119 (8)	127 (9)
Body mass index	0 (0)	1 (<1)	1 (<1)
Diet	21 (1)	60 (4)	79 (5)
Physical activity	41 (3)	2 (<1)	43 (3)
Smoking	2 (<1)	0 (0)	2 (<1)
<b>Outcomes</b>			
Pulse wave velocity	103 (7)	17 (1)	116 (8)
Carotid elasticity	267 (18)	190 (13)	395 (27)
Carotid intima-media thickness	31 (2)	20 (1)	48 (3)
<b>Covariates</b>			
Age	0 (0)	0 (0)	0 (0)
Sex	0 (0)	0 (0)	0 (0)
Puberty	-	108 (7)	108 (7)
Socioeconomic position	5 (<1)	5 (<1)	5 (<1)
Assessment center	0 (0)	0 (0)	0 (0)

**Supplementary Table 5. The survey-weighted mean values for vascular phenotypes in those who fulfil ideal criteria compared to those who do not fulfil criteria and those missing the data, for a) the ICVH score overall (6 or higher), and b) a given ICVH metric (some data reproduced from Table 3).**

Outcome and Metric <sup>a</sup>	Adults						Children					
	Ideal		Non-ideal		Missing		Ideal		Non-ideal		Missing	
	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
<b>PWV, m/s</b>												
<b>ICVH score</b>	<b>124</b>	<b>6.22 (0.83)</b>	<b>1025</b>	<b>7.05 (1.16)</b>	<b>230</b>	<b>6.99 (1.17)</b>	<b>404</b>	<b>4.39 (0.58)</b>	<b>618</b>	<b>4.50 (0.56)</b>	<b>443</b>	<b>4.51 (0.57)</b>
Total cholesterol	832	6.86 (1.15)	378	7.25 (1.19)	169	6.90 (1.13)	823	4.45 (0.57)	331	4.47 (0.54)	311	4.55 (0.58)
Glucose	1058	6.93 (1.16)	148	7.33 (1.21)	173	6.94 (1.14)	1064	4.47 (0.57)	91	4.39 (0.55)	310	4.55 (0.58)
Blood pressure	763	6.47 (0.88)	609	7.57 (1.17)	7	6.36 (1.63)	1276	4.46 (0.56)	80	4.83 (0.63)	109	4.43 (0.56)
BMI	560	6.53 (1.00)	819	7.25 (1.17)	-	-	1127	4.42 (0.57)	337	4.67 (0.53)	1	3.26 (0.00)
Diet	240	6.81 (1.15)	1121	7.00 (1.16)	18	7.06 (1.62)	256	4.41 (0.56)	1149	4.49 (0.58)	60	4.47 (0.48)
Physical activity	341	6.82 (1.20)	1001	7.01 (1.15)	37	7.44 (1.11)	1147	4.49 (0.57)	316	4.46 (0.58)	2	4.11 (0.70)
Smoking	1269	6.99 (1.21)	109	6.83 (0.85)	1	7.60 (0.00)	1173	4.48 (0.60)	292	4.48 (0.49)	-	-
<b>Carotid elasticity, %/mmHg</b>												
<b>ICVH score</b>	<b>115</b>	<b>0.279 (0.059)</b>	<b>912</b>	<b>0.244 (0.061)</b>	<b>188</b>	<b>0.248 (0.076)</b>	<b>395</b>	<b>0.489 (0.094)</b>	<b>582</b>	<b>0.479 (0.087)</b>	<b>315</b>	<b>0.470 (0.091)</b>
Total cholesterol	744	0.251 (0.063)	333	0.233 (0.058)	138	0.261 (0.079)	730	0.482 (0.086)	286	0.485 (0.097)	276	0.466 (0.092)
Glucose	946	0.249 (0.061)	126	0.216 (0.061)	143	0.259 (0.079)	942	0.483 (0.091)	75	0.483 (0.068)	275	0.465 (0.092)
Blood pressure	701	0.272 (0.064)	514	0.216 (0.051)	-	-	1222	0.483 (0.089)	69	0.417 (0.085)	1	0.460 (0.000)
BMI	510	0.268 (0.065)	705	0.234 (0.061)	-	-	1016	0.486 (0.093)	275	0.458 (0.080)	1	0.460 (0.000)
Diet	208	0.253 (0.065)	989	0.247 (0.065)	18	0.213 (0.046)	229	0.489 (0.102)	1016	0.476 (0.088)	47	0.507 (0.082)
Physical activity	303	0.254 (0.062)	881	0.247 (0.065)	31	0.208 (0.057)	1008	0.479 (0.090)	283	0.478 (0.090)	1	0.455 (0.000)
Smoking	1113	0.248 (0.066)	101	0.244 (0.052)	1	0.213 (0.000)	1038	0.479 (0.095)	254	0.478 (0.075)	-	-
<b>Carotid IMT, µm</b>												
<b>ICVH score</b>	<b>124</b>	<b>648.8 (103.5)</b>	<b>1086</b>	<b>666.5 (96.6)</b>	<b>241</b>	<b>656.8 (94.1)</b>	<b>403</b>	<b>579.5 (51.0)</b>	<b>616</b>	<b>581.8 (46.5)</b>	<b>443</b>	<b>587.7 (52.5)</b>
Total cholesterol	879	664.7 (98.1)	403	669.5 (97.4)	169	645.0 (87.2)	822	582.2 (49.9)	333	580.2 (43.5)	307	588.5 (53.7)
Glucose	1117	661.4 (94.0)	161	699.7 (117.4)	173	645.7 (86.2)	1068	580.8 (47.3)	88	591.6 (57.4)	306	588.5 (53.8)
Blood pressure	769	643.5 (82.4)	669	683.4 (104.6)	13	702.4 (98.6)	1266	581.7 (50.1)	78	591.9 (43.5)	118	591.4 (49.6)
BMI	563	644.3 (91.7)	888	674.2 (97.5)	-	-	1118	579.5 (49.0)	343	593.0 (49.7)	1	594.0 (0.0)
Diet	254	660.3 (99.7)	1176	664.4 (96.7)	21	643.7 (65.6)	256	583.0 (44.9)	1147	583.0 (50.5)	59	586.6 (48.4)
Physical activity	353	666.6 (100.2)	1057	660.4 (94.3)	41	703.9 (112.7)	1143	583.4 (48.6)	318	582.6 (53.0)	1	572.0 (0.0)
Smoking	1327	663.6 (99.6)	122	662.0 (76.3)	2	673.3 (76.1)	1171	581.5 (51.7)	291	587.8 (43.3)	-	-

ICVH indicates Ideal Cardiovascular Health; CI, confidence interval; IMT, intima-media thickness; BMI, body mass index; CDC, Centers for Disease Control and Prevention; MVPA, moderate to vigorous physical activity.

**Supplementary Table 6. Correlation between parent and child ICVH scores, according to number of dyads in each corresponding category (n=949).**

Child ICVH score	Parent ICVH score							
	0	1	2	3	4	5	6	7
0	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-
2	-	2	2	3	2	2	1	-
3	2	4	9	15	18	8	2	-
4	1	1	32	44	43	28	10	-
5	-	11	36	94	94	79	24	2
6	-	4	30	75	86	74	33	5
7	-	-	3	11	19	15	21	4

ICVH indicates Ideal Cardiovascular Health.

**Supplementary Table 7. Odds ratios for a child having a non-ideal ICVH metric (poor or intermediate), given parent category for ICVH metric, comparing complete case and multiple imputation models.**

Child metric <sup>a</sup>	Parent metric category <sup>b</sup>	Complete case <sup>c</sup>		Imputation <sup>d</sup>	
		OR (95% CI)	P <sup>e</sup>	OR (95% CI)	P <sup>e</sup>
Cholesterol	Ideal	1.0	<0.001	1.0	<0.001
	Intermediate	2.0 (1.4, 3.0)		2.1 (1.4, 3.1)	
	Poor	3.3 (1.9, 5.7)		3.1 (1.7, 5.4)	
Glucose	Ideal	1.0	0.09	1.0	0.03
	Intermediate	2.0 (0.9, 4.9)		2.2 (1.0, 4.9)	
	Poor	1.7 (0.5, 6.4)		2.0 (0.5, 8.5)	
Blood Pressure	Ideal	1.0	<0.001	1.0	<0.001
	Intermediate	2.4 (1.3, 4.5)		2.4 (1.3, 4.6)	
	Poor	5.9 (2.6, 13.4)		5.5 (2.4, 12.3)	
BMI	Ideal	1.0	<0.001	1.0	<0.001
	Intermediate	2.1 (1.4, 3.0)		2.0 (1.4, 2.9)	
	Poor	3.0 (2.0, 4.7)		2.8 (1.9, 4.3)	
Diet	Ideal	1.0	<0.001	1.0	<0.001
	Intermediate	1.8 (1.2, 2.7)		1.7 (1.2, 2.6)	
	Poor	4.0 (2.4, 6.7)		3.9 (2.3, 6.5)	
Physical Activity	Ideal	1.0	0.22	1.0	0.26
	Intermediate	1.2 (0.8, 1.7)		1.1 (0.8, 1.7)	
	Poor	1.4 (0.8, 2.5)		1.4 (0.8, 2.4)	

<sup>a</sup>Smoking excluded as non-ideal parental health perfectly predicts non-ideal child health according to definitions.

<sup>b</sup>Metric category definitions found in supplementary online material (Supplementary Table 1).

<sup>c</sup>Logistic regression models use survey weights and are adjusted for parent and child age and sex, SEP and assessment center.

<sup>d</sup>Multiple imputation models use survey weights and are adjusted as per complete case analysis (footnote c), imputation model specification outlined in Methods section; each metric represents a separate model.

<sup>e</sup>P value for trend over the three parent categories.

ICVH indicates Ideal Cardiovascular Health; SEP, socioeconomic position; BMI, body mass index; OR, odds ratio; CI, confidence interval.

**Supplementary Table 8. Data table for Figure 1.**

ICVH score	Estimate	Lower limit	Upper limit	Outcome	Child/Parent
0-2	568.9039	546.8819	590.9259	Carotid IMT	Child
3	587.1019	574.6102	599.5936	Carotid IMT	Child
4	587.0494	577.085	597.0138	Carotid IMT	Child
5	578.445	572.9057	583.9842	Carotid IMT	Child
6	580.6858	574.6184	586.7532	Carotid IMT	Child
7	573.1732	563.4205	582.9259	Carotid IMT	Child
0-2	4.775776	4.240598	5.310954	Carotid-femoral PWV	Child
3	4.599635	4.458992	4.740277	Carotid-femoral PWV	Child
4	4.544733	4.436433	4.653034	Carotid-femoral PWV	Child
5	4.454962	4.390714	4.51921	Carotid-femoral PWV	Child
6	4.397393	4.327377	4.467408	Carotid-femoral PWV	Child
7	4.383083	4.242118	4.524048	Carotid-femoral PWV	Child
0-2	0.443399	0.40609	0.480707	Carotid Elasticity	Child
3	0.46088	0.434165	0.487596	Carotid Elasticity	Child
4	0.470763	0.455859	0.485667	Carotid Elasticity	Child
5	0.485069	0.473026	0.497113	Carotid Elasticity	Child
6	0.490972	0.479911	0.502034	Carotid Elasticity	Child
7	0.477837	0.462455	0.493218	Carotid Elasticity	Child
0-2	680.3095	663.5908	697.0283	Carotid IMT	Parent
3	684.2472	672.2281	696.2662	Carotid IMT	Parent
4	660.7326	650.5305	670.9347	Carotid IMT	Parent
5	637.6447	627.8925	647.3968	Carotid IMT	Parent
6	645.6063	623.9632	667.2494	Carotid IMT	Parent
7	666.8669	607.3416	726.3923	Carotid IMT	Parent
0-2	7.51198	7.339484	7.684477	Carotid-femoral PWV	Parent
3	7.387326	7.240802	7.533849	Carotid-femoral PWV	Parent
4	6.909093	6.761111	7.057075	Carotid-femoral PWV	Parent
5	6.413286	6.276637	6.549936	Carotid-femoral PWV	Parent
6	6.222746	6.063849	6.381643	Carotid-femoral PWV	Parent
7	6.177944	5.749893	6.605995	Carotid-femoral PWV	Parent
0-2	0.212367	0.202719	0.222015	Carotid Elasticity	Parent
3	0.224724	0.215966	0.233481	Carotid Elasticity	Parent
4	0.260265	0.252089	0.268442	Carotid Elasticity	Parent
5	0.267641	0.25919	0.276092	Carotid Elasticity	Parent
6	0.278422	0.265872	0.290973	Carotid Elasticity	Parent
7	0.285428	0.258202	0.312655	Carotid Elasticity	Parent

**Supplementary Table 9. The survey-weighted per metric difference for vascular phenotypes in those who fulfil ideal criteria compared to those who do not fulfil criteria, in complete case analysis and using multiple imputation, for a) the ICVH score overall (6 or higher), and b) a given ICVH metric (some data reproduced from Table 3).**

Outcome and Metric	Adult				Child			
	Complete case <sup>a</sup>		Multiple imputation <sup>b</sup>		Complete case <sup>a</sup>		Multiple imputation <sup>b</sup>	
	Adjusted per metric difference (95% CI) <sup>c</sup>	P	Adjusted per metric difference (95% CI) <sup>c</sup>	P	Adjusted per metric difference (95% CI) <sup>c</sup>	P	Adjusted per metric difference (95% CI) <sup>c</sup>	P
<b>PWV, m/s</b>	<b>N=1149</b>		<b>N=1482</b>		<b>N=1019</b>		<b>N=1482</b>	
<b>ICVH score &gt;5</b>	<b>-0.32 (-0.37, -0.27)</b>	<b>&lt;0.001</b>	<b>-0.33 (-0.39, -0.28)</b>	<b>&lt;0.001</b>	<b>-0.07 (-0.11, -0.03)</b>	<b>0.002</b>	<b>-0.08 (-0.12, -0.04)</b>	<b>&lt;0.001</b>
Ideal total cholesterol	-0.08 (-0.22, 0.06)	0.28	-0.11 (-0.25, 0.02)	0.10	-0.03 (-0.12, 0.05)	0.43	-0.04 (-0.12, 0.05)	0.42
Ideal glucose	-0.17 (-0.39, 0.04)	0.12	-0.20 (-0.43, 0.02)	0.07	0.05 (-0.10, 0.20)	0.54	0.02 (-0.13, 0.16)	0.79
Ideal blood pressure	-0.83 (-0.98, -0.67)	<0.001	-0.84 (-0.98, -0.70)	<0.001	-0.35 (-0.56, -0.14)	0.001	-0.29 (-0.47, -0.12)	0.001
Ideal BMI	-0.44 (-0.57, -0.31)	<0.001	-0.43 (-0.55, -0.32)	<0.001	-0.27 (-0.36, -0.18)	<0.001	-0.23 (-0.31, -0.16)	<0.001
Ideal diet	-0.08 (-0.25, 0.09)	0.37	-0.16 (-0.32, 0.01)	0.06	-0.06 (-0.14, 0.02)	0.16	-0.06 (-0.14, 0.02)	0.16
Ideal physical activity	-0.13 (-0.28, 0.03)	0.11	-0.09 (-0.23, 0.05)	0.20	0.06 (-0.03, 0.16)	0.19	0.06 (-0.02, 0.14)	0.17
Ideal non-smoking	0.22 (-0.03, 0.47)	0.09	0.19 (-0.02, 0.41)	0.08	0.06 (-0.03, 0.16)	0.19	0.04 (-0.05, 0.12)	0.39
<b>Carotid elasticity, %/mmHg</b>	<b>N=1028</b>		<b>N=1482</b>		<b>N=974</b>		<b>N=1482</b>	
<b>ICVH score &gt;5</b>	<b>0.017 (0.014, 0.020)</b>	<b>&lt;0.001</b>	<b>0.018 (0.015, 0.022)</b>	<b>&lt;0.001</b>	<b>0.009 (0.004, 0.015)</b>	<b>0.001</b>	<b>0.011 (0.005, 0.017)</b>	<b>&lt;0.001</b>
Ideal total cholesterol	0.002 (-0.005, 0.010)	0.56	0.004 (-0.005, 0.013)	0.42	-0.004 (-0.017, 0.010)	0.61	-0.002 (-0.017, 0.013)	0.80
Ideal glucose	0.024 (0.013, 0.035)	<0.001	0.020 (0.009, 0.032)	<0.001	0.010 (-0.012, 0.032)	0.37	0.006 (-0.019, 0.030)	0.64
Ideal blood pressure	0.036 (0.028, 0.044)	<0.001	0.041 (0.033, 0.049)	<0.001	0.050 (0.023, 0.077)	<0.001	0.066 (0.040, 0.092)	<0.001
Ideal BMI	0.026 (0.017, 0.035)	<0.001	0.025 (0.017, 0.032)	<0.001	0.030 (0.013, 0.047)	<0.001	0.027 (0.012, 0.042)	<0.001
Ideal diet	0.003 (-0.008, 0.014)	0.62	0.005 (-0.005, 0.015)	0.34	0.009 (-0.007, 0.026)	0.27	0.012 (-0.003, 0.028)	0.12
Ideal physical activity	0.005 (-0.004, 0.014)	0.28	0.001 (-0.007, 0.010)	0.76	-0.003 (-0.018, 0.013)	0.74	0.000 (-0.014, 0.013)	0.99
Ideal non-smoking	0.006 (-0.009, 0.022)	0.43	0.008 (-0.006, 0.021)	0.26	0.002 (-0.016, 0.019)	0.86	-0.001 (-0.015, 0.014)	0.93
<b>Carotid IMT, µm</b>	<b>N=1211</b>		<b>N=1482</b>		<b>N=1016</b>		<b>N=1482</b>	
<b>ICVH score &gt;5</b>	<b>-7.3 (-12.0, -2.5)</b>	<b>0.003</b>	<b>-7.3 (-12.1, -2.6)</b>	<b>0.003</b>	<b>-1.8 (-5.2, 1.5)</b>	<b>0.28</b>	<b>-3.4 (-7.1, 0.3)</b>	<b>0.07</b>
Ideal total cholesterol	10.6 (-2.0, 23.3)	0.10	8.6 (-3.8, 21.0)	0.17	-5.0 (-11.8, 1.9)	0.15	-0.6 (-8.3, 7.2)	0.88
Ideal glucose	-20.4 (-41.6, 0.8)	0.06	-19.8 (-39.5, 0.0)	0.05	-5.3 (-22.3, 11.8)	0.54	-5.1 (-20.4, 10.1)	0.50
Ideal blood pressure	-22.7 (-33.5, -11.9)	<0.001	-19.2 (-29.2, -9.1)	<0.001	0.8 (-11.4, 12.9)	0.90	-5.5 (-18.1, 7.1)	0.39
Ideal BMI	-19.9 (-31.8, -8.0)	0.001	-20.9 (-32.7, -9.2)	<0.001	-6.9 (-15.6, 1.7)	0.12	-9.9 (-17.3, -2.6)	0.008
Ideal diet	-4.8 (-19.1, 9.5)	0.51	-5.5 (-19.0, 8.0)	0.42	7.7 (0.0, 15.4)	0.05	2.8 (-3.7, 9.3)	0.39
Ideal physical activity	12.4 (0.0, 24.8)	0.05	9.1 (-3.0, 21.3)	0.14	0.4 (-9.5, 10.3)	0.93	-2.4 (-10.4, 5.6)	0.56
Ideal non-smoking	2.9 (-16.3, 22.1)	0.77	-0.7 (-18.1, 16.7)	0.94	-2.4 (-11.2, 6.5)	0.60	-2.3 (-9.9, 5.4)	0.56

<sup>a</sup>Multivariable complete case models use survey weights, and are adjusted for participant age, sex, SEP, and assessment center. In secondary analyses of individual metrics, models are additionally adjusted for other ICVH metrics. Sample size of the multivariable model listed at the top of each outcome.

<sup>b</sup>Multiple imputation model uses survey weights and multiple imputation, and are adjusted for covariates listed in footnote a. The imputation model used to derive the ICVH score was constructed with continuous versions of each metric variable. Secondary analysis of individual dichotomous variables use a separate imputation model constructed with dichotomous variables only.

<sup>c</sup>Adjusted mean difference is the estimated per one metric difference for the ICVH score, or the estimated difference for fulfilling criteria for each individual metric.

ICVH indicates Ideal Cardiovascular Health; SD, standard deviation; CI, confidence interval; BMI, body mass index; PWV, pulse wave velocity; IMT, intima-media thickness; SEP, socioeconomic position.

**Supplementary Table 10. Regression coefficients per-unit-more-ideal for each health factor or behavior, using non-dichotomized measures of ICVH metrics, survey weights and multiple imputation.**

Outcome and Metric <sup>b</sup>	Adult				Child			
	Complete case		Multiple imputation <sup>a</sup>		Complete case		Multiple imputation <sup>a</sup>	
	Adjusted per metric difference <sup>c</sup> (95% CI)	P	Adjusted per metric difference <sup>c</sup> (95% CI)	P	Adjusted per metric difference <sup>c</sup> (95% CI)	P	Adjusted per metric difference <sup>c</sup> (95% CI)	P
<b>PWV, m/s</b>								
Total cholesterol, mmol/L	-0.04 (-0.12, 0.04)	0.36	-0.04 (-0.12, 0.03)	0.23	-0.02 (-0.08, 0.04)	0.53	-0.03 (-0.09, 0.03)	0.39
Glucose, mmol/L	-0.06 (-0.11, -0.01)	0.02	-0.08 (-0.13, -0.02)	0.009	0.00 (-0.04, 0.05)	0.95	-0.01 (-0.07, 0.05)	0.73
Systolic blood pressure, 5 mmHg/decile <sup>d</sup>	-0.25 (-0.28, -0.21)	<0.001	-0.24 (-0.28, -0.21)	<0.001	-0.04 (-0.06, -0.02)	<0.001	-0.05 (-0.07, -0.03)	<0.001
BMI, 5 kg/m <sup>2</sup> /decile <sup>e</sup>	-0.07 (-0.14, 0.01)	0.07	-0.08 (-0.15, -0.01)	0.02	-0.03 (-0.05, -0.02)	<0.001	-0.03 (-0.04, -0.02)	<0.001
Diet Score, unit	-0.03 (-0.10, 0.05)	0.49	-0.05 (-0.12, 0.03)	0.20	-0.04 (-0.08, 0.00)	0.05	-0.01 (-0.05, 0.02)	0.51
Weekly MVPA, 75 min/wk	-0.14 (-0.26, -0.01)	0.03	-0.13 (-0.24, -0.03)	0.02	0.03 (-0.01, 0.07)	0.10	0.02 (-0.01, 0.05)	0.18
Non-smoking status	0.19 (-0.04, 0.42)	0.10	0.16 (-0.04, 0.37)	0.11	0.08 (-0.02, 0.17)	0.11	0.04 (-0.04, 0.13)	0.31
<b>Carotid elasticity, %/mmHg</b>								
Total cholesterol, mmol/L	0.003 (-0.001, 0.007)	0.12	0.003 (-0.001, 0.008)	0.15	0.001 (-0.008, 0.010)	0.83	0.001 (-0.008, 0.010)	0.79
Glucose, mmol/L	0.001 (-0.004, 0.007)	0.66	0.001 (-0.004, 0.007)	0.60	0.000 (-0.006, 0.007)	0.94	0.001 (-0.007, 0.008)	0.87
Systolic blood pressure, 5 mmHg/decile <sup>d</sup>	0.011 (0.009, 0.012)	<0.001	0.012 (0.010, 0.014)	<0.001	0.013 (0.009, 0.016)	<0.001	0.014 (0.011, 0.017)	<0.001
BMI, 5 kg/m <sup>2</sup> /decile <sup>e</sup>	0.008 (0.003, 0.013)	0.002	0.007 (0.002, 0.011)	0.003	0.003 (0.001, 0.005)	0.008	0.002 (0.001, 0.004)	0.01
Diet Score, unit	0.001 (-0.004, 0.006)	0.61	0.001 (-0.003, 0.006)	0.58	0.003 (-0.003, 0.009)	0.30	0.005 (0.000, 0.011)	0.07
Weekly MVPA, 75 min/wk	0.007 (0.000, 0.014)	0.07	0.006 (-0.001, 0.013)	0.11	-0.003 (-0.010, 0.003)	0.28	-0.003 (-0.009, 0.002)	0.21
Non-smoking status	0.003 (-0.012, 0.018)	0.68	0.009 (-0.005, 0.022)	0.19	-0.003 (-0.019, 0.014)	0.74	-0.006 (-0.021, 0.008)	0.38
<b>Carotid IMT, <math>\mu</math>m</b>								
Total cholesterol, mmol/L	-0.8 (-8.3, 6.8)	0.84	-0.2 (-7.1, 6.6)	0.94	-2.3 (-6.8, 2.2)	0.31	-0.2 (-4.9, 4.4)	0.93
Glucose, mmol/L	-8.7 (-12.9, -4.4)	<0.001	-8.5 (-12.6, -4.3)	<0.001	-2.2 (-6.5, 2.2)	0.32	-2.2 (-7.8, 3.3)	0.42
Systolic blood pressure, 5 mmHg/decile <sup>d</sup>	-8.8 (-11.7, -5.8)	<0.001	-7.6 (-10.2, -4.9)	<0.001	-0.5 (-2.1, 1.0)	0.50	-1.3 (-2.8, 0.3)	0.11
BMI, 5 kg/m <sup>2</sup> /decile <sup>e</sup>	-5.8 (-11.9, 0.4)	0.07	-5.3 (-10.9, 0.2)	0.06	-1.6 (-2.9, -0.3)	0.01	-2.0 (-3.2, -0.8)	<0.001
Diet Score, unit	-1.1 (-9.1, 6.9)	0.78	0.2 (-6.8, 7.1)	0.96	3.5 (0.3, 6.8)	0.03	0.6 (-2.3, 3.4)	0.70
Weekly MVPA, 75 min/wk	8.4 (-3.7, 20.4)	0.17	7.7 (-3.9, 19.3)	0.19	1.0 (-3.0, 5.0)	0.63	-0.5 (-3.4, 2.4)	0.73
Non-smoking status	5.7 (-14.4, 25.8)	0.58	-4.1 (-23.1, 14.9)	0.67	-2.7 (-11.7, 6.2)	0.55	-2.0 (-9.7, 5.6)	0.60

<sup>a</sup>Results derived from multiple imputation models (see Methods section for detailed model specification) using continuous (where available) measures of metrics.

<sup>b</sup>Note that the regression coefficients are in the same direction as Table 2, in all metrics including diet and physical activity, and expressed in per-unit-more-ideal, e.g. for cholesterol: per mmol/L lower, or diet: per 1 unit higher.

<sup>c</sup>Multivariable models are adjusted for participant age, sex, SEP, assessment center, and all other ideal ICVH metrics.

<sup>d</sup>Adult coefficient expressed as per 5 mmHg lower, child coefficient is per age-sex-height decile lower.

<sup>e</sup>Adult coefficient expressed as per 5 kg/m<sup>2</sup> lower, child coefficient is per age-sex decile lower.

SEP indicates socioeconomic position; ICVH, Ideal Cardiovascular Health; CI, confidence interval; IMT, intima-media thickness; BMI, body mass index; CDC, Centers for Disease Control and Prevention; MVPA, moderate to vigorous physical activity.

**Supplementary Table 11. Pearson's correlation coefficients for adult and child ICVH metrics.**

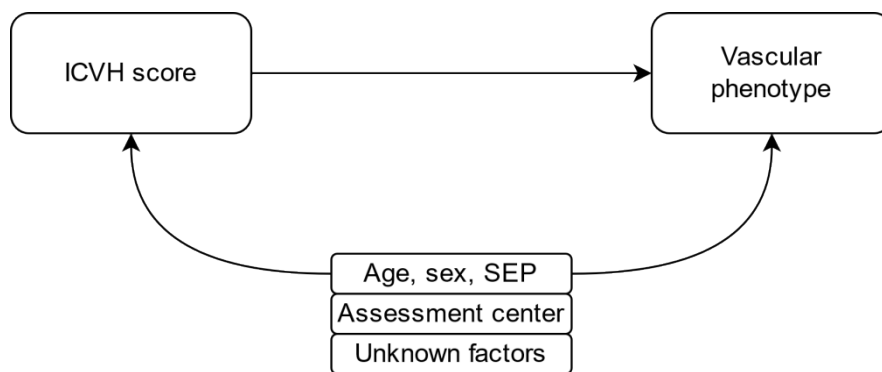
A. ADULT Correlations (n = 1243)								B. CHILD Correlations (n = 1035)							
	BMI, kg/m <sup>2</sup>	Blood pressure, mmHg	Glucose, mg/dL	Total cholesterol, mg/dL	Smoking status, Y/N	Diet score, 1-4	Weekly MVPA, categories		BMI, CDC percentile	Blood pressure, percentile	Glucose, mg/dL	Total cholesterol, mg/dL	Passive smoking, Y/N	Diet score, 1-4	MVPA time, hours
BMI, kg/m <sup>2</sup>	1.00	0.50	0.18	0.09	0.06	-0.11	-0.17	BMI, CDC percentile	1.00	0.30	0.00	0.03	0.08	0.02	-0.02
Blood pressure, mmHg		1.00	0.16	0.14	-0.01	-0.03	-0.07	Blood pressure, percentile		1.00	0.01	0.03	0.10	-0.04	-0.03
Glucose, mg/dL			1.00	0.01	0.01	0.02	-0.04	Glucose, mg/dL			1.00	-0.03	-0.01	0.02	0.00
Total cholesterol, mg/dL				1.00	0.03	0.00	0.00	Total cholesterol, mg/dL				1.00	0.00	0.03	-0.05
Smoking status, Y/N					1.00	-0.04	-0.01	Passive smoking, Y/N					1.00	-0.14	-0.02
Diet score, 1-4						1.00	0.11	Diet score, 1-4						1.00	0.09
Weekly MVPA, categories							1.00	MVPA time, hours							1.00

Correlation coefficients derived from unweighted, complete case dataset.

ICVH indicates Ideal Cardiovascular Health; BMI, body mass index; CDC, Centers for Disease Control and Prevention; MVPA, moderate to vigorous physical activity.

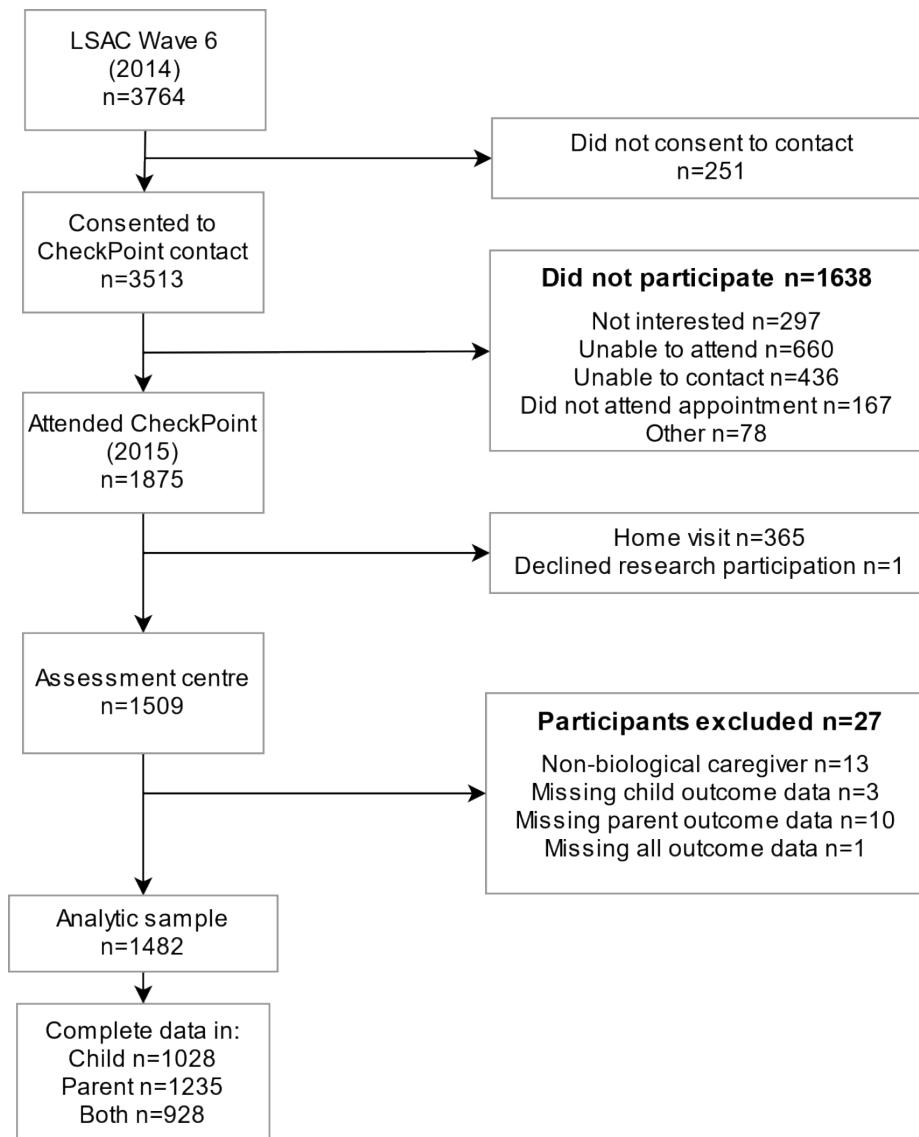


**Supplementary Figure 1. Directed acyclic graph for model construction and covariate selection.**



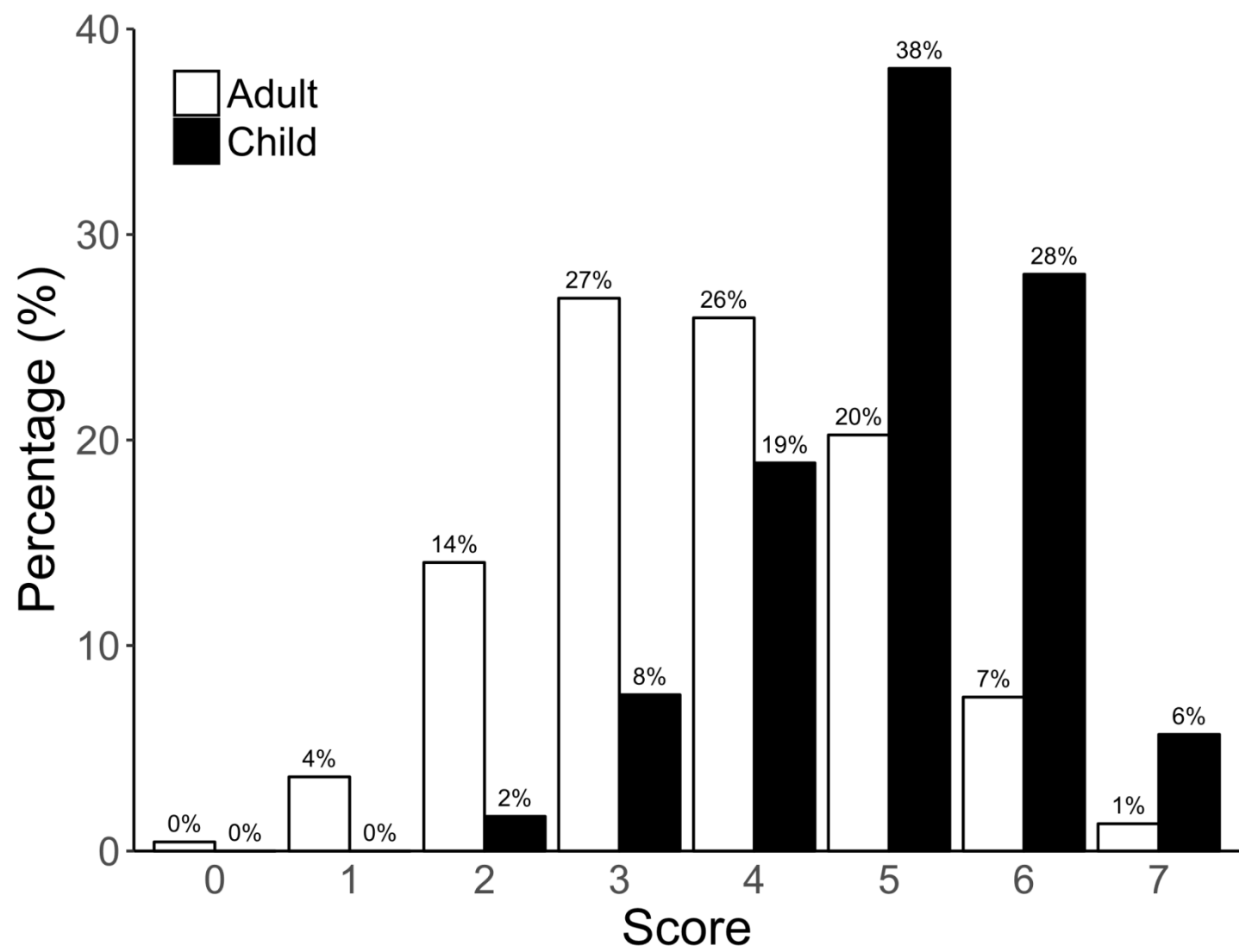
Direction of arrow indicates hypothesized causal direction of relationship between two factors, e.g. the assessment center is hypothesized to cause changes in the measurement of the ICVH score and vascular phenotype, making it a likely confounding variable. ICVH indicates Ideal Cardiovascular Health; SEP, socioeconomic position.

**Supplementary Figure 2. Flow diagram outlining participation at each step of the study.**



LSAC indicates the Longitudinal Study of Australian Children; CheckPoint, Child Health CheckPoint.

Supplementary Figure 3. Survey-weighted distribution of ICVH scores in adults (white) and children (black).



**Supplementary Figure 4. Estimated proportion of participants meeting each of the seven ICVH metric ideal criteria, in adults (white) and children (black), using survey weights and methods.**

