Childhood health motivation and adult cardiometabolic health in the Childhood Determinants of Adult Health (CDAH) study

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Abstract

Objective: This research examined if childhood health motivation was associated with adult health behaviors and objectively measured health outcomes.

Methods: Data were from the Childhood Determinants of Adult Health (CDAH) study. Children aged 9 to 15 years in 1985 completed a questionnaire with health motivation items. In 2004-06, when aged 26 to 36, participants completed assessments of health behaviors (smoking, diet, alcohol consumption and physical activity) and cardiometabolic outcomes (body mass index, carotid intima media thickness from ultrasound, and HOMA insulin resistance from fasting blood samples). Structural path regression analyses examined pathways from health motivation in childhood to adult cardiometabolic outcomes, mediated via adult health behaviors measured concurrently, controlling for age, sex and socioeconomic position.

Results: There were 6,230 (49% female) children with data on health motivation. There were two latent constructs: health motivation (4 items: visiting a dentist, visiting a doctor, knowing about your body and eating a good diet) and risk motivation (3 items: not being a smoker, not being fat and not drinking alcohol). Greater health motivation was directly associated with non-smoking, lower carotid intima-media thickness and lower body mass index in adulthood. Greater risk motivation was directly associated with smoking, higher alcohol consumption and poorer diets in adulthood. It was also indirectly associated with higher carotid intima-media thickness and higher HOMA insulin resistance via poorer health behaviors.

Conclusions: Health motivation during childhood appears important to maintain health across the life course. It could be a target for interventions to improve cardiovascular health in children and adults.

Keywords: Longitudinal studies, behavioral medicine, cardiovascular diseases, risk factors

Health behaviors such as smoking, physical activity and dietary habits account for a large proportion of the burden of disease, particularly for cardiovascular diseases (GBD 2015 Risk Factors Collaborators, 2016). These behaviors often originate in childhood and adolescence, providing a rationale for longitudinal studies across the life course to identify modifiable factors to promote healthy lifestyles (Magnussen et al., 2012). One such longitudinal study is the Childhood Determinants of Adult Health (CDAH) study, which is the focus of the present study. The aims of the CDAH study are to examine the childhood origins of cardiovascular disease by examining cardiovascular health of Australian adults originally assessed as children in the 1980s. This study has provided evidence of the impact of a range of lifestyle, physiological and environmental factors in childhood on cardiovascular health, such as blood pressure, blood lipids and pre-clinical measures of atherosclerosis into adulthood (Gall, Jose, Smith, Dwyer, & Venn, 2009). While the effects of risk factors in childhood and adolescence on long-term health behaviors and outcomes is recognized (Laitinen et al., 2013; Pinto Pereira, Li, & Power, 2014) this lifespan approach typically does not include social-cognitive determinants of health behaviors. The childhood assessment in the CDAH study included self-report of health-related cognitions providing a unique opportunity to understand the potential long-term effects of these cognitions on cardiovascular health behaviors and outcomes.

Health-related cognitions, such as beliefs, attitudes, outcome expectancies and intentions, have emerged as one such potentially modifiable influence on both health promoting and health risk behaviors. These determinants can be subsumed under the umbrella term of a reasoned action approach (Conner & Norman, 2015), but generally describe the idea that motivation is key in understanding engagement in health promoting and risk behaviors. In the present study, there were data on children’s opinions on how important it was for them to engage in or avoid 13 health practices, e.g. seeing a dentist, eating a good diet or exercising regularly. These items potentially indicate the intrinsic value or importance that the child placed on their health representing their motivation towards health (Becker, Drachman, & Kirscht, 1972). How and via which mechanisms motivation works to influence health is a matter of ongoing formative research (Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Schwarzer, 2008). In line with general principles of motivation (Heckhausen & Heckhausen, 2008), greater health motivation is operationalized in the present study as encompassing cognitions (e.g. attitudes, beliefs and intentions) focused on actions that can attain or maintain health such as engaging in healthier behaviors (e.g. eating a healthy diet) or avoiding risky behaviors (e.g. not smoking) (Schüz, Wurm, Warner, Wolff, & Schwarzer, 2013).

To date there have been few attempts to link health motivation or even attitudes, beliefs or intentions in children to objectively measured health outcomes in the longer term. Studies of childhood psychosocial predictors of objectively measured health outcomes in adulthood have tended to focus on socioeconomic status, adversity and trauma. Example include that a greater burden of psychosocial risk factors in childhood has been associated with worse cardiovascular health in adulthood, such as greater carotid intima-media thickness (Hakulinen et al., 2016). In contrast, there have been a limited number of longitudinal studies that have measured health-related cognitions in childhood as predictors of health behaviors into adulthood with most studies either focusing on adults or having short follow-up periods. Among longer term studies, Broadbent et al. (2016). in New Zealand found that people that rated oral health promoting behaviors as important at the ages of 15, 18 and 26 years had better self-rated oral health, fewer teeth extractions and lower levels of plaque when aged 26 years (Broadbent et al., 2016). Similarly, Wyszynski et al. (2011)found in a cohort of American high school students that smoking-related cognitions students in the 9th grade predicted daily smoking in 12th grade. Furthermore, these cognitions mediated the effect of parental smoking cessation in the 3rd grade and the child's smoking status in the 12th grade. If, as argued above, motivation is a determinant of behavior, any effects on objective health outcomes would only be evident after prolonged periods of time. Thus, it is of key interest whether health motivation predicts health behaviors or outcomes over longer periods of time in general populations. If health motivation does operate in this way, this would provide evidence for investment in further research and programs to promote health motivation from early in life. This may enhance the long-term benefits of health promotion programs and increase understanding of transitions in health behaviors over time. As such, in the context of the CDAH study, the aim of the present study was to examine the associations between health motivation in childhood and health behaviors and outcomes related to cardio-metabolic health in young adulthood around 25 years later.

Methods

Participants

The participants were from the Childhood Determinants of Adult Health (CDAH) study. CDAH began in 1985 as the Australian Schools Health and Fitness Survey (ASHFS) that included 8,498 children aged 7 to 15 years. The aims of CDAH are to understand the contribution of sociodemographic, health and environmental factors in childhood on cardiovascular health into adulthood. (Gall et al., 2009). Data on all health motivation items were available for children aged 9 to 15 years. In 2004-06, participants aged 26 to 36 years completed questionnaires and clinics concurrently as part of the study. Women who were pregnant were excluded from analyses as their cardiometabolic measures may have been affected by pregnancy. There were 6,230 people that were not pregnant in adulthood with data on all covariates and the relevant health motivation items (see below) (Figure 1). The numbers with data on each behavior or outcome are included in Table 1.

Figure 1 about here

Measures

Childhood health motivation. Health motivation was operationalized using children's answers to 13 items asking their opinion on how important it was for them to do several health-related activities, including engaging in health promoting and preventative behaviors. These items were considered to be indicative of children's underlying motivation towards health in line with previous research (Gochman, 1972; Lau, Hartman, & Ware, 1986; Schüz et al., 2013). These 13 activities were found to load on five factors in an exploratory factor analysis performed on a random half of the sample. In an iterative process, six items were excluded due to substantial cross-loadings on two or more factors: "have a good night's sleep", "have a good body/figure", "exercise regularly", "have friends", "not be stressed and worried", "know about fitness and how to stay fit". Ultimately, a two factor model with seven of the initial 13 items fitted the data best and was tested in a confirmatory factor analyses using the other random half of the sample; χ^2 (13) = 158.81, $p < .0001$, CFI/TLI = 0.95/0.92, RMSEA = .06 (90% CI 0.05, 0.06), SRMR = .035. The two factors can generally be described as a "*health motivation*" factor including the items "see a dentist once a year", "have a doctor's check-up", "know about your body and how it works", "eat a good diet" (responses: 1 = 'not important', 2 = 'of little importance', 3 = 'of some importance' and 4 = 'very important' with higher values on this factor indicating greater motivation for health promoting behavior), and a "*risk motivation*" factor, including the items "be a non-smoker", "not be fat", "not drink alcohol or only drink a little" (responses: 1 = 'very important', 2 = 'of some importance', 3 = 'of little importance' and 4 = 'not important' with higher values on this factor indicating lesser motivation to avoid health risks or, conversely, greater motivation to engage in risky behaviors).

Adult health behaviors. Questionnaires gathered data on health behaviors in adulthood. Smoking status was assessed on a five point Likert scale (1 = never, 5 = daily). Physical activity was measured as the mean number of steps per day, using Yamax Digiwalker SW-200 pedometers worn for 7 days. The Dietary Guideline Index (DGI) was calculated from a 127 item Food Frequency Questionnaire and a food habits questionnaire using method described, in detail, elsewhere (McNaughton, Ball, Crawford, & Mishra, 2008). The DGI uses questionnaire items to calculate 15 components reflecting adherence to the Dietary Guidelines for Australian Adults. Each component (e.g. dietary variety; adequate consumption of core food groups; limited consumption of saturated fat, salt and sugar) is scored proportionally from 0 (does not meet recommendation) to 10 (fully meets recommendation) with the full score ranging from 0 to 150 with higher values meaning a better diet. It has been validated in an Australian sample (McNaughton et al., 2008). Daily alcohol consumption in grams was estimated from the frequency (nine options ranging from 'never' to '6 or more times per day') of consumption of 10 types of alcoholic beverages multiplied by the average alcohol concentration of a standard drink of each beverage (e.g. estimated alcohol concentration of red wine is 13.5%) (National Health and Medical Research Council, 2001).

Adult health outcomes. Health outcomes of carotid intima-media thickness , insulin resistance with the HOMA index, and body mass index were selected due to their contribution to the burden of cardiovascular disease and that they are causally-related to the health behaviors measured in the study (GBD 2015 Risk Factors Collaborators, 2016). These outcomes were measured in health clinics by trained data collectors around the same time as questionnaires were completed on health behaviors in 2004-06.

Insulin resistance with HOMA-IR. Blood samples (32 ml) were collected after an overnight fast. Assays were conducted in a central laboratory to measure fasting insulin (mIU/l) and glucose (mmol/l) that were used to estimate insulin resistance using the HOMA-IR online calculator with higher values denoting worse insulin resistance (http://www.dtu.ox.ac.uk).

Carotid intima media thickness. This was measured using b-mode ultrasound using a Cypress portable ultrasound machine with a 7 MHz linear array tranducer with the details of measurement are published elsewhere (Quan et al., 2013). Greater carotid intima-media thickness is associated with a higher risk of cardiovascular disease.

Body Mass Index. This was calculated as kilograms of weight per square meter of height from weight measured to the nearest 0.1 kg (with shoes, socks, and bulky clothing removed) and height measured to the nearest 0.1 cm (with shoes and socks removed) using a stadiometer.

Statistical analyses

Path analyses with latent variables were performed within the general structural equation modeling (SEM) approach in Mplus 7.31 (Muthén & Muthén, 1998-2012). Model fit for health motivation was assessed using the chi-square goodness of fit index, RMSEA, CFI, TLI, and SRMR in preliminary analyses. Three path analyses were run, one for each health outcome, testing the indirect effect of the childhood health and risk motivation factors on the three health outcomes in adulthood via four adulthood lifestyle components: ‘diet’ from the dietary guideline index, ‘alcohol’ from daily alcohol intake in grams, ‘smoking’, and ‘activity’ from the daily number of steps taken. Statistical mediation was tested using the MODEL INDIRECT procedure in Mplus with bias-corrected bootstrapped confidence intervals around the indirect effects (Preacher & Hayes, 2008). All analyses controlled for childhood gender (1=males, 2=females), age (continuous) and area-level socioeconomic position (higher values denote lower socioeconomic position) from an Australian Bureau of

Statistics index including postcode-level information on employment, occupations, education and economic resources from the 1986 Census of Population and Housing.

As full information maximum likelihood information was used which allows for estimation of missing values, all available participant records were used for analyses (note that age, gender, and socioeconomic position were exogenous variables in the models, thus missing values for these variables were not estimated). Thus, the number of participants included in the analyses was 6,230.

Ethics

In childhood, parents provided written informed consent for children to participate. In adulthood, participants gave written informed consent. The Southern Tasmania Health and Medical Human Research Ethics Committee approved the study.

Results

Table 1 provides childhood characteristics for the 6,230 participants with health and risk motivation items, adult (53% female, mean age ± SD 32.7 ± 2.1) health behaviors and outcomes. The distribution of responses for all health/risk motivation items are provided in the online supplementary material. The health/risk motivation factors correlated modestly with each other ($r = -0.43$, $p < 0.001$).

Path analysis with latent variables was used to regress the cardiometabolic risk indicators in adulthood on adult diet, alcohol intake, smoking status, and pedometer-measured activity, which in turn were predicted by the two latent childhood health/risk motivation factors. In total, three path analyses were run, one for each latent variable.

Carotid Intima-Media Thickness

Figure 2 shows the path model with completely standardized path coefficients and standard errors for carotid intima-media thickness (IMT in figure) as an outcome. This model showed an acceptable fit, $\chi^2(74) = 1080.71$, $p < 0.001$ compared to the independence model; RMSEA = 0.05 (90% CI 0.04, 0.05), CFI = 0.85, TLI = 0.79.

Figure 2 about here

Direct effects. There was a direct effect of health motivation on carotid intima-media thickness: Childhood health motivation was negatively associated with carotid intima-media thickness during adulthood (β = -0.09, *SE* = .04, 95% CI -0.16, -0.01, $p = 0.026$). Health motivation during childhood was positively associated with smoking (β = 0.10, *SE* = .03, 95% CI 0.04, 0.15, $p = 0.001$) but not to any of the other three adult health behaviors. Higher childhood risk motivation was not directly related to carotid intima-media thickness, but was significantly associated with meeting fewer dietary guidelines (β = -0.13, *SE* = .04, 95% CI -0.21, -0.04, $p = 0.003$), drinking more alcohol (β = 0.13, *SE* = .04, 95% CI 0.04, 0.21, $p = 0.002$), and smoking (β = 0.27, *SE* = .03, 95% CI 0.21, 0.33, $p < 0.001$) during adulthood. None of the adult health behaviors were significantly related to carotid intima-media thickness.

Indirect effects. The total indirect effects (completely standardized indirect effects (Preacher & Kelley, 2011), of childhood risk motivation on adult carotid intima-media thickness via poorer adult health behaviors was significant (β = 0.02, *SE* = 0.01, 95% CI 0.0004, 0.04; $p = 0.027$), whereas the total indirect effect of health motivation was not (β = 0.006, *SE* = 0.004, 95% CI -0.001, 0.01; $p = 0.120$). This means that for one standard deviation increase in risk motivation, the carotid intima-media thickness would increase by 0.02 mm, which is partially explainable via meeting fewer dietary guidelines, higher alcohol intake, and smoking (the three adult health behaviors significantly associated with risk motivation). In all three models, there were significant but small effects of the covariates age (negative associations with health motivation and positive association with risk motivation), gender (males were more likely to endorse risk motivation, females were more likely to endorse health motivation), and SES (positive associations with risk motivation).

Insulin resistance

Figure 3 shows the SEM including standardized regression coefficients and standard errors for the model using insulin resistance (HOMA in figure) as an outcome. This model also had an acceptable fit, $\chi^2(74) = 1046.07$, $p < 0.001$ compared to the independence model; RMSEA = 0.05 (90% CI 0.04, 0.05), CFI = 0.85, TLI = 0.80.

Figure 3 about here

Direct effects. Neither health nor risk motivation in childhood had a significant direct effect on insulin resistance in adulthood. However, scores on the DGI, alcohol intake, and physical activity in adulthood were significantly negatively related to insulin resistance in adulthood (see Figure 2).

Indirect effects. The total indirect effects of health/risk motivation via adult health behaviors on insulin resistance were not significant (β = -0.004, *SE* = .006, 95% CI -0.03, 0.03; $p = 0.507$ and β = -0.006, *SE* = .01, 95% CI -0.02, 0.005, $p = 0.576$ respectively). However, there were specific indirect effects of childhood risk motivation on insulin resistance via dietary guidelines (β = 0.031, *SE* = .006, 95% CI 0.003, 0.07;$p = 0.011$) and alcohol intake (β = -0.023, *SE* = .005, , 95% CI -0.06, -0.003; $p = 0.017$).

Body Mass Index

Standardized regression coefficients and standard errors for the model with body mass index as outcome are shown in Figure 4.

Figure 4 about here

Model fit again was acceptable, $\chi^2(74) = 1126.92$, $p < 0.001$ compared to the independence model; RMSEA = 0.05 (90% CI 0.045, 0.05), CFI = 0.84, TLI = 0.79.

Direct effects. There was a direct effect of health motivation on Body Mass Index (β = -0.052, *SE* = .025, 95% CI -0.10, -0.003, $p = 0.04$), but no direct effect of risk motivation (β = 0.03, *SE* = .029, 95% CI 0.00, 0.09, $p = 0.31$). The former effect indicates that, as childhood health motivation increases by one standard deviation, Body Mass Index decreases by 0.052 units, independent of the adulthood health behaviors tested in the model. In unstandardized coefficients, this would translate to a 0.54 units decrease in Body Mass Index for every unit increase in childhood health motivation. Meeting dietary guidelines and physical activity were negatively associated with Body Mass Index. Alcohol intake and smoking were not significantly related to Body Mass Index.

Indirect effects. The total indirect effects of health and risk motivation on Body Mass Index via adult health behaviors were not significant (β = -0.001, *SE* = 0.005, 95% CI -0.01, 0.009, $p = 0.824$ and β = 0.001, *SE* = 0.008, 95% CI -0.02, 0.02, $p = 0.869$ respectively). However, there was a significant specific indirect effect of risk motivation on Body Mass Index via dietary guidelines (β = 0.01, *SE* = 0.005, 95% CI 0.0002, 0.02, $p = 0.027$).

Discussion

Using unique data collected across the life course, health motivation in childhood has been shown to be associated with several health behaviors in adulthood. There were also small but significant association between health and risk motivation and cardio-metabolic health in young adulthood. There was a direct association between health motivation in childhood with adult Body Mass Index and carotid intima-media thickness as well as indirect associations from risk motivation to carotid intima-media thickness and HOMA-measured insulin resistance. These were mediated via diet, alcohol consumption, and for carotid intima-media thickness only, smoking among those with risk motivation as children.

There were small, but statistically significant, direct associations from childhood health motivation to adult Body Mass Index and carotid intima-media thickness, but mediation tests suggested were not mediated by the adult health behaviors. One explanation is our examination of health behaviors at a single point in time. Others have shown that Body Mass Index (Kim et al., 2017) and carotid intima-media thickness reflect trajectories of health behaviors, including in combination (Hakulinen et al., 2016), over the life course. In contrast, our measures were taken at a single point in time and were examined individually so their effect may not have been captured well. The magnitude of effect for health motivation predicting Body Mass Index was very small and unlikely to be clinically significant. However, the effect from health motivation to adult carotid intima-media thickness was similar to other risk factors from childhood, such as vitamin D (Juonala et al., 2015).

There were also indirect effects from childhood risk motivation to adult carotid intima-media thickness, Body Mass Index and HOMA-measured insulin resistance. The children that did not think it was important to avoid health risks, deemed risk motivation in this study, had a range of worse health behaviors in adulthood that were associated with cardio-metabolic risk factors in adulthood. Importantly, there are known pathophysiological pathways from these health behaviors to these cardiovascular and metabolic risk factors (Hansen et al., 2016; Sala-Vila et al., 2014; Schrieks, Heil, Hendriks, Mukamal, & Beulens, 2015). These findings provide unique longitudinal evidence of social-cognitive factors operating from childhood to adulthood and affecting physical health. In support of the current findings, researchers in New Zealand found that people that rated oral health promoting behaviors as important at the ages of 15, 18 and 26 years had better self-rated oral health, fewer teeth extractions and lower levels of plaque when aged 26 years (Broadbent et al., 2016). Similarly, other researchers have targeted social-cognitive factors as part of the Health Belief Model to improve management in people with diabetes (Akbar, Anderson, & Gallegos, 2015) and bone mineral density in women (Jeihooni, Hidarnia, Kaveh, Hajizadeh, & Askari, 2015).

One consideration is whether it is the health motivation itself shaping health behavior or the factors influencing health motivation that are more important. If the health motivation is directly linked to the behavior then health promotion programs focused on changing these in children may well have a long lasting impact on their health. Indeed, some researchers have shown that sustained education-based programs can have such an effect (Oranta et al., 2013; Pahkala et al., 2013). In the Special Turku Coronary Risk Factor Intervention Project, children and their parents participated in individual dietary counselling intervention at least twice a year from the age of 2 to 20 years that was associated with reduced carotid intima-media thickness and insulin resistance up to 20 years later (Pahkala et al., 2013). It is also likely that antecedents to children's health motivation, such as the health-related cognitions and behaviors of family members, could also be important in driving health motivation and behavior over time (Lau et al., 1986; McGee et al., 2015). The ability to alter health motivation may be affected by a child's age with other researchers suggesting that health motivation increases over childhood reaching levels similar to those in adults by late adolescence (Lau et al., 1986). As the current study only captured health motivation at a single point in time among children ranging from 9 to 15 years we cannot explore this in detail. Further research examining the effects of psychosocial predictors of health such as health motivation at different developmental stages is warranted to best inform potential interventions.

Strengths and limitations

The strengths of the study are the large national dataset with follow-up to 25 years after baseline assessments. The measurement of markers of health motivation in childhood with long-term follow-up and robustly measured physical measurement of cardio-metabolic risk factors and a variety of health behaviors is unique worldwide. The potentially confounding effects of age, sex and area-level socioeconomic position in childhood were included in models.

The study does have limitations. The items used to model health motivation were governed by those included in the questionnaire in 1985. Only half of the items were included in the final factors with items on physical activity and fitness excluded. The health and risk motivation factors would therefore be less likely to predict outcomes strongly related to physical activity or fitness. There has been a debate on the use of SEM techniques in epidemiologic research (Arlinghaus, Lombardi, Willetts, Folkard, & Christiani, 2012; Vanderweele, 2012). It needs to be appreciated that these models are only incomplete attempts at modelling reality. As noted above, the mediating effect of adult health behaviors was modelled at a single point in time concurrent with the physical outcome measures. It is likely that the tracking of behaviors over time, as well as the accumulation of multiple behaviors, is also important. The loss to follow-up between childhood and adulthood is a further limitation. As reported elsewhere for this cohort, the adult cohort had similar characteristics in terms of never smoking, overweight and obesity and some dietary markers but was, on average, of higher socioeconomic position than the general population of a similar age (Gall, Abbott-Chapman, Patton, Dwyer, & Venn, 2010). How this might have affected our results is unclear but it is likely to have biased our results towards the null given that lower socioeconomic position is associated with worse health behaviors. Furthermore, recent studies have shown that sample attrition resulting in bias towards higher socioeconomic position individuals does not affect the direction and magnitude of associations in longitudinal cohort studies (Carter, Imlach-Gunasekara, McKenzie, & Blakely, 2012). Further, SEM with Full-Information Maximum Likelihood Estimation allowed for estimating the covariance structure with missing data thereby accounting for missingness. While the effect sizes observed were small, the fact that associations were seen even with measures taken at a single point approximately 25 years prior suggests they may be robust.

Conclusion

Health and risk motivation in childhood were found to be associated with a range of health behaviors and cardiometabolic health markers in adulthood. The effects on the cardiometabolic health markers were modest and were largely mediated by the worse health behaviors in those with higher risk motivation. These results demonstrate the importance of health motivation in the maintenance of health across the life course and suggest potential targets for interventions to improve cardiovascular health in children and adults.

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Conflicts

The authors have no conflicts to declare.

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Table 1

Characteristics of participants in childhood (1985) and adulthood (2004-06)

Characteristic	N (%) or mean (*SD*)	
Childhood (1985)		
Covariates		
Age	6,230	11.9 (2.0)
Gender		
Male	3,195	(51)
Female	3,035	(49)
Area-level SES		
Q1 (high)	1,467	(24)
Q2	1,781	(29)
Q3	2,402	(39)
Q4 (low)	580	(9)
Health motivation items		
How important is it to you to:		
See a dentist once a year?		
Very important	3,974	(64)
Of some importance	1,602	(26)
Of little importance	448	(7)
Not important	199	(3)
Have a doctor's check-up?		
Very important	3,746	(60)
Of some importance	1,707	(27)
Of little importance	573	(9)
Not important	200	(3)
Know about your body and how it works?		
Very important	3,456	(56)
Of some importance	2,013	(33)
Of little importance	544	(9)
Not important	191	(3)
Eat a good diet?		
Very important	4,503	(72)

Of some importance	1,313	(21)
Of little importance	259	(4)
Not important	145	(2)
Risk motivation items		
How important is it to you to:		
Be a non-smoker?		
Very important	4,763	(77)
Of some importance	693	(11)
Of little importance	289	(5)
Not important	469	(8)
Not be fat?		
Very important	4,069	(65)
Of some importance	1,436	(23)
Of little importance	439	(7)
Not important	276	(4)
Not drink alcohol or only drink a little bit?		
Very important	3,671	(59)
Of some importance	1,343	(22)
Of little importance	609	(10)
Not important	586	(9)
Adulthood (2004-06)		
Health behaviors		
Smoking	1,524	(52)
Never		
Former	709	(24)
Occaisional	96	(3)
Regular	75	(3)
Daily	537	(18)
Pedometer-measured physical activity (steps/day)	1,722	9140 (3361)
Diet quality with Dietary Guideline Index	2,020	100.3 (19.5)
Alcohol consumption (grams/day)	2,153	9.8 (13.9)
Health outcomes		
Carotid intima media thickness (mm)	1,541	0.6 (0.1)

HOMA- insulin resistance	1,809	1.6 (1.1)
Body Mass Index	3,724	25.8 (5.0)

Note. Numbers are those with completed data on characteristics, health/risk motivation and covariates. SD: standard deviation, mm: millimeters, SES: socioeconomic status

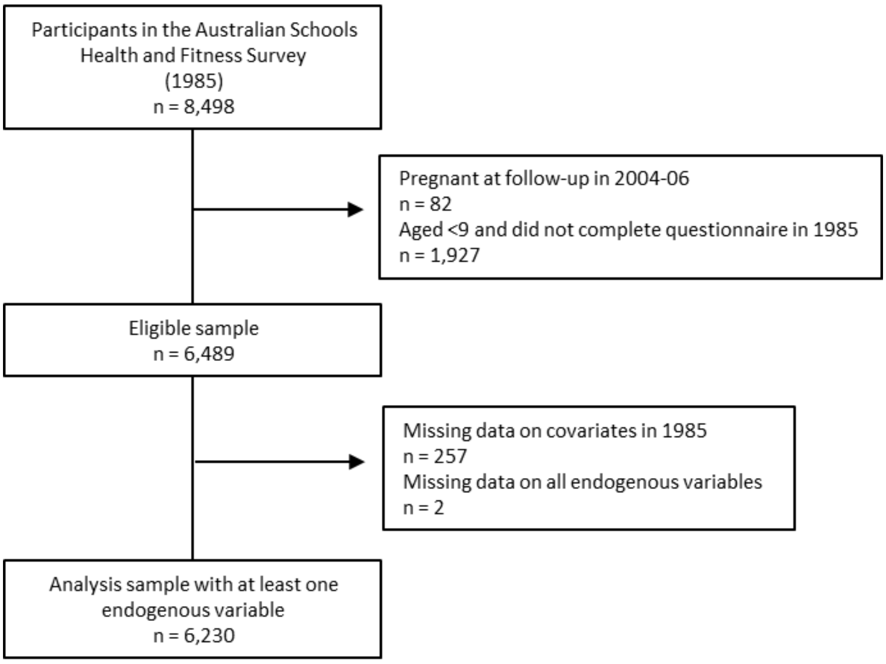

Figure 1. Participation flow chart for the CDAH study

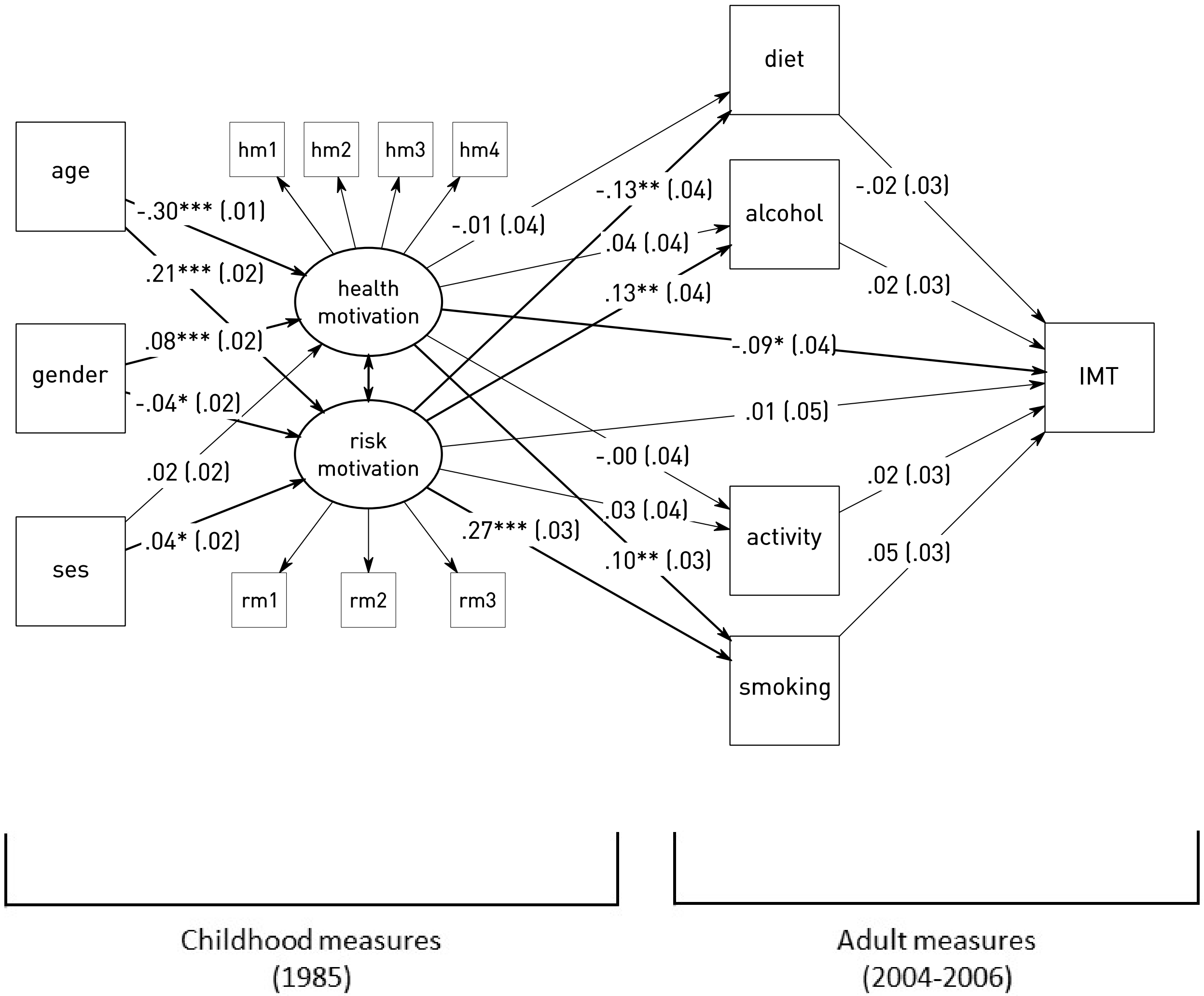
age
gender
ses
hm1
hm2
hm3
hm4
health motivation
risk motivation
rm1
rm2
rm3
diet
alcohol
activity
smoking
IMT
-.30*** (.01)
.21*** (.02)
.08*** (.02)
-.04* (.02)
.02 (.02)
.04* (.02)
-.01 (.04)
-.13** (.04)
.04 (.04)
.13** (.04)
-.09* (.04)
.01 (.05)
-.00 (.04)
.03 (.04)
.27*** (.03)
.10** (.03)
-.02 (.03)
.02 (.03)
.02 (.03)
.05 (.03)
Childhood measures
(1985)
Adult measures
(2004-2006)

Figure 2. Structural equation model for adult carotid intima-media thickness (IMT) regressed onto adult health behaviors and childhood health/risk motivation with control for age, gender and SES in childhood. * $p < .05$; ** $p < .01$; *** $p < .001$.

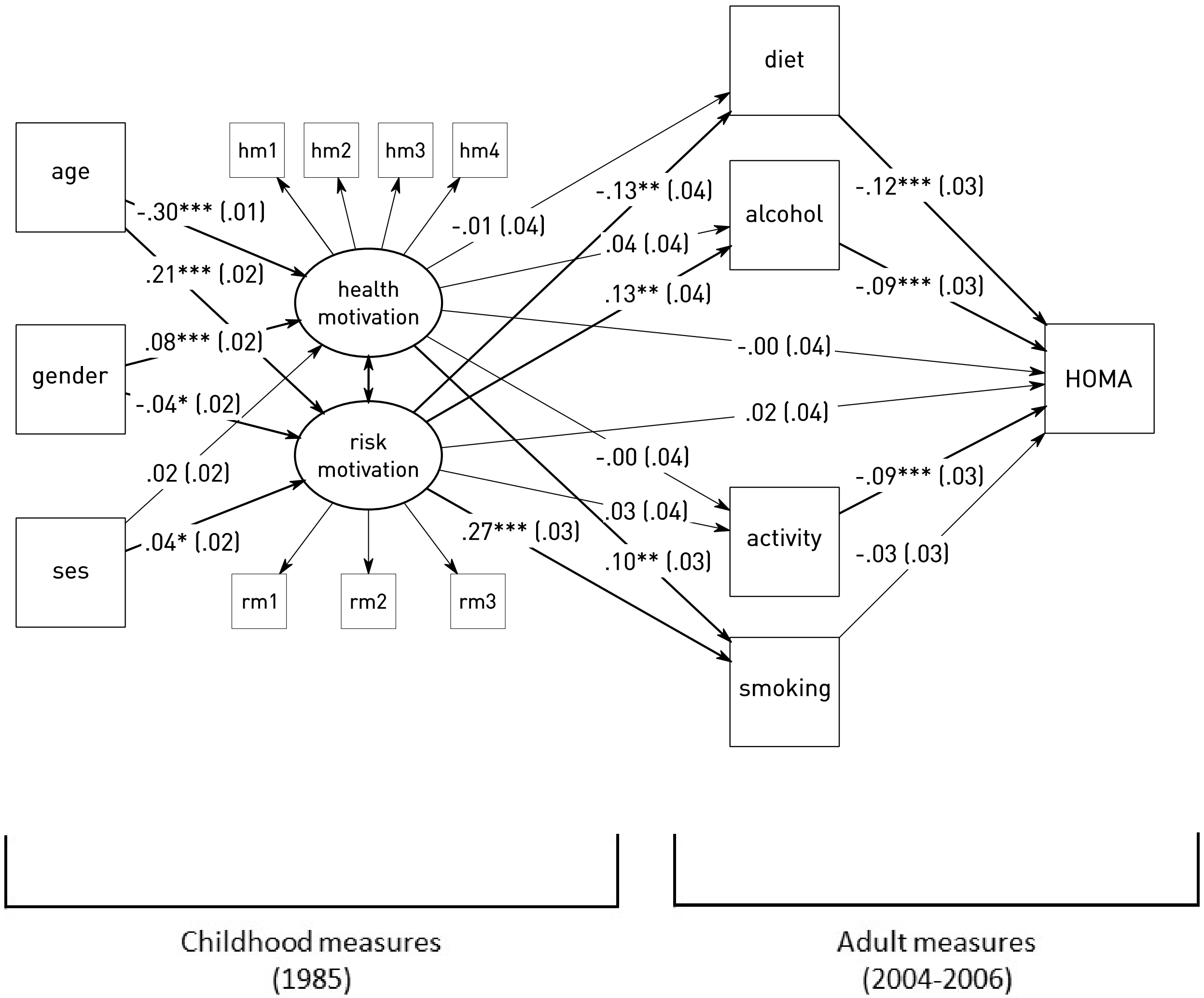
age
gender
ses
hm1
hm2
hm3
hm4
health motivation
risk motivation
rm1
rm2
rm3
diet
alcohol
activity
smoking
HOMA
-.30*** (.01)
.21*** (.02)
.08*** (.02)
-.04* (.02)
.02 (.02)
.04* (.02)
-.01 (.04)
-.13** (.04)
.04 (.04)
.13** (.04)
-.00 (.04)
.02 (.04)
-.00 (.04)
.03 (.04)
.27*** (.03)
.10** (.03)
-.12*** (.03)
-.09*** (.03)
-.09*** (.03)
-.03 (.03)
Childhood measures
(1985)
Adult measures
(2004-2006)

Figure 3. Structural equation model for adult insulin resistance (HOMA) regressed onto adult health behaviors and childhood health motivation with control for age, gender and SES in childhood. * $p < .05$; ** $p < .01$; *** $p < .001$.

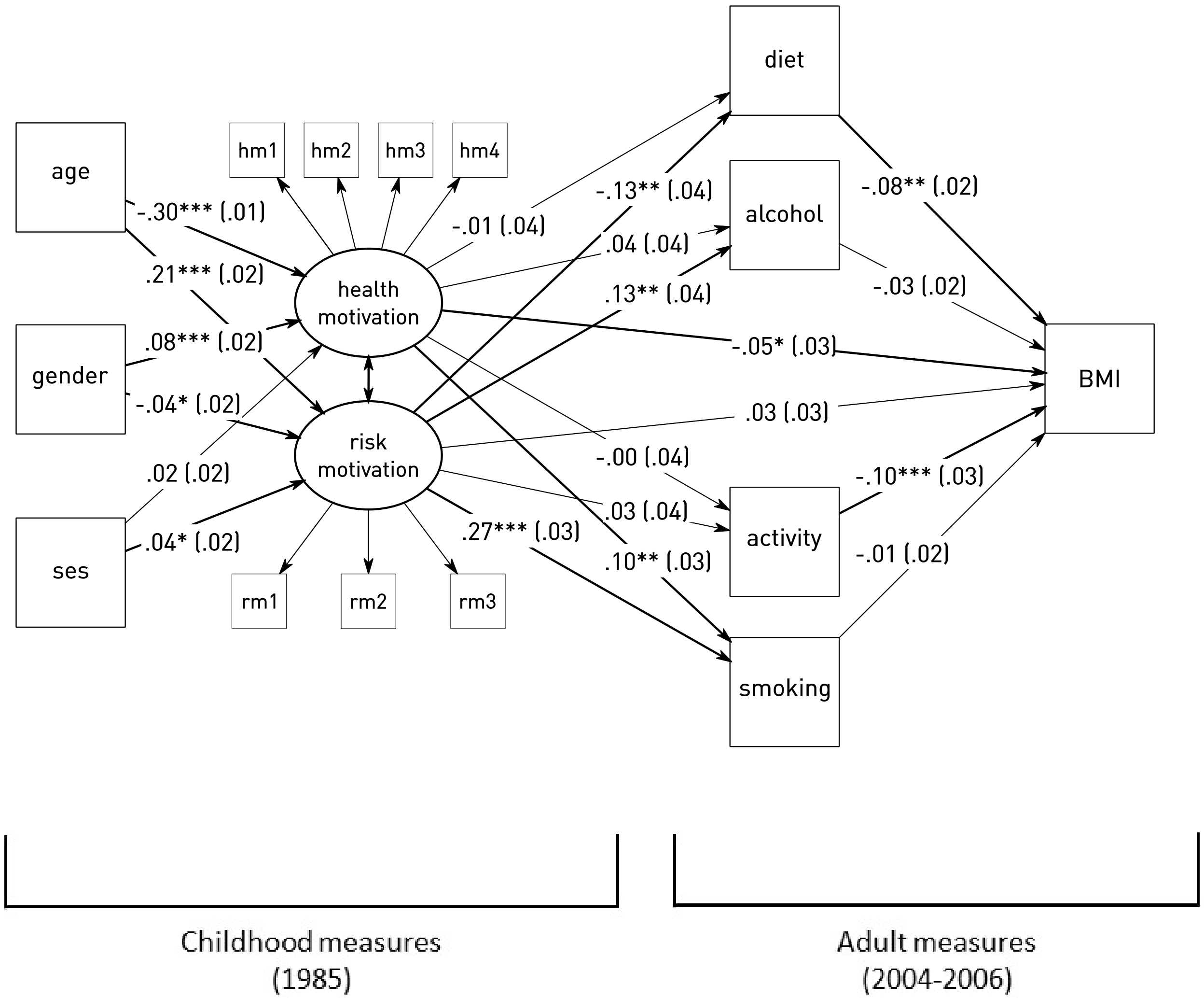
age
gender
ses
hm1
hm2
hm3
hm4
health motivation
risk motivation
rm1
rm2
rm3
diet
alcohol
activity
smoking
BMI
-.30*** (.01)
.21*** (.02)
.08*** (.02)
-.04* (.02)
.02 (.02)
.04* (.02)
-.01 (.04)
-.13** (.04)
.04 (.04)
.13** (.04)
-.05* (.03)
.03 (.03)
-.00 (.04)
.03 (.04)
.27*** (.03)
.10** (.03)
-.08** (.02)
-.03 (.02)
-.10*** (.03)
-.01 (.02)
Childhood measures
(1985)
Adult measures
(2004-2006)

Figure 4. Structural equation model for adult Body Mass Index (BMI) regressed onto adult health behaviors and childhood health motivation with control for age, gender and SES in childhood. * $p < .05$; ** $p < .01$; ***$p < .001$.