Dietary pattern trajectories across adolescence and young adulthood and their determinants

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Abstract

Background Adolescent dietary patterns (DP) tend to be of poor quality and dominated by discretionary food and drinks. It is unclear whether DPs established in adolescence persist or track into adulthood. We examined trajectories across adolescence and young adulthood for two major DPs and the determinants of these trajectories.

Methods Using data from the Western Australian Pregnancy Cohort (Raine) Study, intakes of 38 major food groups were estimated at 14, 17, 20 and 22 years of age in 1,402 participants (47% male) using evaluated food frequency questionnaires. Using factor analysis, two major DPs ('Healthy' and 'Western') were consistently identified across follow ups. Sex-specific group-based modelling was used to assess the variation in individual's z-scores for each pattern and identify major trajectories in scores between 14 and 22 years of age. Determinants of these trajectories including body mass index (BMI), physical activity levels, early life parental factors and family characteristics were assessed using multivariate logistic regression analysis.

Results Two major trajectory groups were identified for each pattern. Between 14 and 22 years of age, a majority of the cohort (71% males, 78% females) formed a trajectory group with consistently low scores for the 'Healthy' DP. The remainder had trajectories showing either declines in modest scores (females 22%) or consistently modest scores (29% males) for the 'Healthy' DP. For the 'Western' DP, the majority formed trajectories with consistently average scores (78% males) or low scores that declined over time (84% females). However, 22% of males had a trajectory of steady, marked increases in 'Western' DP scores over time. A lower maternal education, higher maternal BMI and parental smoking status was positively associated with consistently lower scores of 'Healthy' DP while a lower family income, family functioning, maternal age, and single parent family structure were positively related to higher scores of 'Western' DP.

Conclusion Poor dietary patterns established in adolescence are likely to track into young adulthood, particularly in males. This study highlights the stage between adolescence and young adulthood as a critical period and the populations most likely to benefit from interventions to improve dietary habits in adolescence.

Background

The transition from adolescence to young adulthood is a critical period in the lifecourse that accompanies significant physical, emotional and social transitions. These transitions bring about increased levels of autonomy, leading to milestones in independence, such as entering the workforce or formal study, generating personal income, or changes in living arrangements (1). These factors can have lasting implications for health behaviours particularly dietary intake (2, 3). Poor diet quality is common during adolescence (4, 5) and has been linked with the early onset of chronic disease risk factors such as obesity and a high abdominal waist circumference (6, 7). During young adulthood, poor lifestyle

behaviours may become embedded (8) and this is a high risk period for excess weight gain (9, 10). In Australia, the prevalence of overweight or obesity in 18-24 year olds increased from 38.9% in 2014-15 to 46.0% in 2017-18 (11). Young adulthood also often heralds first-time parenthood. Therefore, the transition period from adolescence into young adulthood is a critical period for interventions to reduce chronic disease risk and prevent the trans-generational cycle of obesity and related diseases, such as diabetes and cardiovascular disease (8).

The health of adolescents and young adults (ages 18-34 years) is frequently overlooked by researchers and policy makers (12, 13). To date, our understanding of whether dietary intake is maintained or subject to change between adolescence and adulthood, is limited (14-16). A better understanding of dietary patterns and how they track is required to inform public health policy and interventions to support healthy eating across this important life stage (14, 15). The concept of tracking or stability in epidemiological studies refers to the consistency of measurements on an individual over a period of time. While a few studies have assessed the tracking of dietary intake from childhood to adulthood, these have focussed on individual foods or nutrients (3, 17-21). Overall dietary patterns, on the other hand, consider total dietary intake and the summary effects of all foods and beverages typically consumed. A small number of studies have shown that empirically-derived dietary patterns identified using methods such as factor analysis or reduced rank regression may be stable during childhood and adolescence (22-25) however, few studies to date have tracked dietary pattern trajectories across adolescence and into adulthood (22, 26).

The Western Australian Pregnancy Cohort (Raine) Study began in 1989 with 2900 pregnant women (Generation 1) (27). A total of 2868 infants (Generation 2) born to these women have been repeatedly followed up, from birth. Two empirically-derived dietary patterns were identified in Generation 2 at 14 and 17 years of age using factor analysis: a ‘Healthy’ and a ‘Western’ dietary pattern (28). In this cohort, a higher score for the ‘Western’ dietary pattern has been positively associated with: non-alcoholic fatty liver disease (NAFLD) (29); markers of the metabolic syndrome (30); depression and mental health problems (31); attention deficit hyperactivity disorder (ADHD) (32); cognitive performance (33); and lifestyle and family psychosocial factors (28) during adolescence.

Using extended follow up data from this contemporary cohort, we report trajectories in ‘Western’ and ‘Healthy’ dietary pattern scores at four time points (14, 17, 20 and 22 years of age) in Generation 2, to examine whether dietary patterns established during adolescence persist into adulthood. We also report on the modifiable antecedents of these trajectories.

Methods

Study population

The Western Australian Pregnancy Cohort (Raine) Study has been described in detail elsewhere (34). In brief, the Raine Study is a multigenerational cohort study which began with the recruitment of 2900 pregnant women (Generation 1) through the public antenatal clinic and local private clinics in Perth, Western Australia between 1989 and 1991, for an initial study to investigate the effects of repeated ultrasounds on fetal growth (27). Their 2868 births (Generation 2) have been followed up since birth and approximately biennially thereafter. To date, comprehensive dietary assessments have been undertaken at follow ups conducted at 14, 17, 20 and 22 years of age.

This analysis uses dietary data collected at 14, 17, 20 and 22 y and covariates measured at 14 y, including body mass index (BMI), physical activity and fitness level, sedentary behaviour, parental socio-economic status and family functioning status in Generation 2 of the Raine Study.

Dietary assessments

At 14 and 17 y of age a semi-quantitative food frequency questionnaire (FFQ) designed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia was administered to assess usual food and nutrient intakes (35). The FFQ collected information on usual frequency of consumption and serving sizes (in household units) of 227 food and beverage items. Nutrient intakes estimated by the CSIRO FFQ have been shown to be comparable with those estimated using a 3-day diet record at 14 y in this cohort (36).

As the CSIRO FFQ was not available for use at the 20 and 22 y follow ups, usual dietary intake at 20 and 22 y was estimated using the 74-item semi-quantitative Dietary Questionnaire for Epidemiological Studies (DQESV2) FFQ, developed by the Cancer Council of Victoria (CCV), Australia (37). The DQESV2 FFQ has been found to be reproducible and suitable for ranking respondents according to their estimated nutrient intakes and comparable to the CSIRO FFQ (38, 39). The DQESV2 collects information on the usual frequency of consumption of food and drinks, and usual serve sizes using pictorial examples.

Unlike the CSIRO FFQ, the DQESV2 FFQ did not include a comprehensive list of beverages therefore, a semi-quantitative beverage questionnaire was administered at 20 and 22 y. The DQESV2 FFQ included fruit juice, flavoured milk, milk and alcohol intakes. The semi-quantitative beverage questionnaire listed other beverages that were included in the CSIRO FFQ including: water, ‘fizzy drink’, diet ‘fizzy drink’, energy drink, diet energy drink, tea, herbal tea, green tea, instant coffee, and ground coffee. Estimates of usual

serve size were collected (with examples of typical serve sizes provided) along with the usual frequency of consumption.

The FFQs were completed with assistance from a parent or caregiver at 14 y (2003-2006) and by the study respondents at 17 y (2006-2009), 20 y (2010-2012) and 22 y (2012-2014). All FFQs were checked by a research nurse and missing and unclear responses were corrected with the study respondent at the time of their physical assessment. Australian Food Composition Tables were used to estimate usual nutrient intakes and total energy intake (21).

Food Groupings

To conduct dietary pattern analyses, all food and beverage items listed in the FFQs were assigned to 38 pre-defined major food groups based on nutrient profile and culinary usage (30). Although the two FFQs were highly similar, a small number of food groups in the CSIRO FFQ were not captured by the DQESV2 FFQ, including: meat-based mixed dishes, milk-based dishes, soups, sauces, and dried fruit.

Dietary patterns

The Raine Study 'Healthy' and 'Western' DPs have been described in detail previously (30). In brief, all 38 major food groups were entered into a factor analysis and varimax rotation applied, to achieve uncorrelated factors or dietary patterns, using PROC FACTOR in SAS (SAS Institute, Cary, North Carolina, USA). The resulting factor solution identified two major dietary patterns that explained the greatest amount of total variance in food group intakes (21.5% in total) (40). The total variance of the food intakes explained by the individual dietary patterns was 13% for 'Western' dietary pattern and 8.5% for 'Healthy' dietary pattern (40). Each participant received a z-score for the 'Healthy' and the 'Western' dietary pattern (calculated using PROC SCORE, SAS), which indicated how close their reported dietary intake corresponded with the pattern, relative to the rest of the study sample (z-score mean=0; SD=1).

For each dietary pattern, the factor solution generated factor loadings for each food group, indicating their 'weighting' in each dietary pattern (30). Foods with a factor loading greater than an absolute value of 0.30 were considered the most influential in each pattern. At 14 y, the 'Healthy' dietary pattern was characterised by high intakes of wholegrain cereals, fresh fruit, legumes, steamed, grilled or canned fish and all vegetables, except potatoes (30). The 'Western' dietary pattern consisted of positive factor loadings for takeaway foods, red meats, processed meats, full-fat dairy products, fried potato, refined

grains, soft drinks, confectionery, and crisps (30). This pattern showed strong correlations with intake of energy, total fat, saturated fat, cholesterol and refined sugar (32). 'Healthy' and 'Western' dietary pattern z-scores estimated using the CSIRO FFQ have been shown to be comparable to those estimated using a 3-day diet record in this cohort, at 14 y (36).

The exploratory factor analysis described above was repeated using food group intakes estimated at 17, 20 and 22 y. This identified two major dietary patterns consistent with the 'Healthy' and 'Western' dietary patterns identified at 14 y, at each age. Apart from some minor variations, the factor loadings were similar across 14, 17, 20 and 22 y (Supplementary Table 1). As these both dietary patterns were consistent over time at the population level, a longitudinal analysis of z-scores for the 'Healthy' and 'Western' dietary patterns was deemed appropriate. However, to score individuals for exactly the same dietary patterns over time, applied dietary pattern scores were estimated. These were calculated by applying the factor scoring coefficients for each food group identified at 14 y, to dietary intakes at 17, 20 and 22 y (confirmatory analysis) using PROC SCORE in SAS. Those five food groups not captured by DQESV2 FFQ (meat-based mixed dishes, milk-based dishes, soups, sauces and dried fruit) did not load strongly on either pattern at 14 or 17 y (see Supplementary Table 1) and were therefore excluded from the confirmatory factor analyses. Despite this difference, exploratory and applied dietary pattern scores were highly correlated ($r>0.94$).

Covariates

Height was measured using a Holtain stadiometer without shoes and weight was recorded using a Wedderburn digital chair scale with light clothing to calculate BMI (kg/m^2) at 14 y. Self-reported physical activity levels were estimated by asking the respondents to report the number of times they exercised enough to sweat, when they were not at school (excluding compulsory school physical education sessions). Respondents were asked to choose one option from five categories ranging from exercising once a month or less, through to exercising every day. These data were used to create an ordinal variable: low (exercising once per month); medium (exercising 1-3 times per week); and high (exercising more than 4 times per week). Self-reported physical activity levels have been shown to be highly correlated with an aerobic fitness data measured objectively using a Physical Working Capacity (PWC-170) on ergometer bicycle, in this cohort (30). However, only self-reported physical activity was used in this analysis, as more respondents completed this questionnaire than the ergometer bicycle test.

Maternal factors during pre-pregnancy and pregnancy, such as maternal body weight may have a direct or indirect (e.g. as a lifestyle marker) influence on the development of childhood obesity and other metabolic risks (41). Information on maternal self-reported pre-pregnancy weight (kg) was collected at

enrolment into the study (~18 weeks of gestation). Height (cm) was measured at the first physical assessment (16-20 weeks of gestation). Maternal age at child birth was recorded upon birth of the study child.

Since several studies have suggested that parental socio-economic factors are closely associated with children's dietary intake, we investigated the potential role of socio-economic factors in determining an individual's dietary pattern trajectory (42-45). A standardised questionnaire was used to obtain information on parental socioeconomic status (SES) at 14 y. This included categories of maternal education represented by highest school year (<10 y, 10-12 y and >12 y), family income in Australian dollars (≤35k, >35-50k, >50-70k, >70-104k and >104k), family structure (two-parent or single-parent, with de facto parents considered a two-parent family structure), parental smoking status (yes or no) and family functioning (General Functioning Scale (GFS) from the McMaster Family Assessment Device (46)). The GFS comprised questions on family communication, affective responsiveness and behaviour control, with higher scores representing better family functioning. The GFS scores were classified into quartiles ('0'= quartile 1(scores ≤ 25), '1'=quartile 2 (scores between 26 and 28), '2'=quartile 3 (scores between 29 and 33) and '3'=quartile 4 (scores between 34 and 39).

Statistical analyses

Summary statistics for the eligible study sample at 14 years of age (n=2424) and individuals included in the trajectory analyses i.e. individuals with at least two outcome measures (n=1402) were summarised and compared using Chi-square and t-test for categorical and continuous variables, respectively (34). Summary statistics are provided for 'Healthy' and 'Western' dietary pattern scores at each time point, with means and standard deviations, and the medians and ranges as well as missing numbers (Supplementary Table 2).

Group-based trajectory modelling was used to assess variation in the developmental course of z-scores for both the dietary patterns and separately for males and females, using PROC TRAJ in SAS V9.4. Z-scores for 'Healthy' and 'Western' dietary patterns from each respondent were used as dependent variables and their ages at each follow-up were applied as independent variables (47). Groups were determined based on interpretability and an information criterion approach and the degree of the polynomial trajectory was determined by statistical significance. Based on the results of the trajectory modelling, two groups or trajectories for each dietary pattern (and sex) had the best model fit.

Multivariable logistic regression, with group membership as the outcome (Group 1 vs. Group 2 of trajectories), was carried out to examine the relationships between dietary pattern trajectory and: maternal education level; maternal age at birth; maternal pre-pregnancy BMI; whether the parents smoked, whether the father lives with the family, family income, family functioning status; and sex, BMI and self-reported physical activity. Multivariate odds ratios (ORs) and 95% confidence intervals (CIs) are presented with p-values for those variables significant in the model. All analysis was carried out using SAS V9.4.

Results

Baseline characteristics

Table 1 presents characteristics of Generation 1 (parents) and Generation 2 (adolescents) who provided data at the 14 year follow up (n=1605). Those who provided dietary data for at least at two follow-ups were included in the trajectory modelling (1414 individuals, 47.2% males). Those included in the trajectory modelling were more likely to be female, to live in two-parent families and have slightly older mothers at birth (Table 1). There were no significant differences in adolescent self-reported physical activity level or BMI, maternal education level, maternal pre-pregnancy BMI, family functioning score, family income, or parent smoking status (Table 1).

Dietary patterns

Summary statistics for the 'Healthy' and 'Western' z-scores over each follow-up are shown in Supplementary Table 2. The distribution of the mean, median and ranges of dietary pattern z-scores was comparable across the ages between the eligible cohort at 14 years and those with at least two follow-ups. A reduction in mean z-scores was observed for both 'Healthy' and 'Western' dietary patterns with increasing age.

'Healthy' dietary pattern trajectories

Figure 1 (panels A and B) presents the two group trajectory solution obtained for the 'Healthy' dietary pattern. Both males and females formed a trajectory group with consistently below-average 'Healthy' pattern z-scores over the follow up period (Group 1, solid line); these groups included the majority of males (71%) and females (78%). The remaining 29% of males (Group 2, dotted line) had above average 'Healthy' dietary pattern z-scores throughout, which showed small declines from 16 years onward. The

remaining 22% of females formed a trajectory group (Group 2, dotted line) showing well above average 'Healthy' dietary pattern z-scores however, these declined considerably between 16 and 22 years of age.

'Western' dietary pattern trajectories

Figure 1 (panels C and D) shows the two group trajectory solution for the 'Western' dietary pattern. The majority of males (78%) had relatively stable, close to average z-scores for this pattern across all ages (Group 1, solid line). The remaining males (22%) had a trajectory of 'Western' dietary pattern z-scores that increased substantially with age (Group 2, dotted line). In females, the majority of females (84%) formed a trajectory group with below-average 'Western' pattern scores that declined over time (Group 1, solid line). A small proportion of females (16%) showed a less stable trajectory of 'Western' pattern z-scores that initially declined up to 17 y but increased thereafter (Group 2, dotted line).

Determinants of 'Healthy' dietary pattern

In females, the likelihood of being classified into Group 1, (having consistently lower 'Healthy' pattern z-scores over the follow up) compared to Group 2 was lower among those whose mother had a higher level of education (OR: 0.5; 95%CI: 0.3, 0.9 for 10 to 12 y of total education; OR: 0.3; 95%CI: 0.1, 0.5 for more than 12 y of education) (Table 2). For males, the odds of membership in Group 1 (having consistently lower 'Healthy' pattern z-scores over the follow up) compared to Group 2, increased with a higher maternal pre-pregnancy BMI (OR: 1.1; 95%CI: 1.0, 1.1) and if the parent was a smoker (OR: 2.1; 95% CI: 1.1-4.0) (Table 2).

Determinants of 'Western' dietary pattern

In females, the odds of being in Group 1, which showed a decline in 'Western' pattern z-scores over the follow-up period increased with a higher maternal age at birth (OR: 1.1; 95%CI: 1.0, 1.1); with a higher family functioning score (OR: 1.5; 95%CI: 1.7, 1.8); and with a family income greater than AUD$ 104 000 (OR: 4.6; 95%CI: 1.5, 14.0), compared to Group 2 (with increasing 'Western' pattern scores) (Table 2). In males, the odds of being in Group 1 was higher if they were from a two-parent family (Table 2).

Discussion

Two consistent dietary patterns were observed in this cohort at 14, 17, 20 and 22 y of age: a 'Healthy' and a 'Western' dietary pattern. Longitudinal modelling of individual z-scores identified two major trajectories for each dietary pattern, across adolescence and into young adulthood. A majority of males and females

fell into a trajectory of consistently below average 'Healthy' pattern scores. The remaining males and females had less stable trajectories in 'Healthy' pattern scores that, although started out well above average, showed modest declines after late adolescence, with this most evident in females. Of most concern was the trajectory in which 'Western' pattern scores showed year on year increases from the age of 16 y onward (in males). Females also showed increases in 'Western' dietary pattern scores in later adolescence.

In terms of dietary quality, these findings suggest that the majority of adolescents did not maintain a 'Healthy' dietary pattern over adolescence and into adulthood. A minority of adolescents (29% males; 22% females), started with above average 'Healthy' dietary pattern scores at 14 y but these declined over the course of adolescence and into adulthood (although a later return to healthier habits in early adulthood was suggested). Concerningly, those with the poorest diets at 14 y (22% males; 16% females) demonstrated a worsening in diet quality across adolescence and into adulthood, particularly among males. The age of 17 y heralded increases in 'Western' pattern scores (22% males; 16% females) and declines in 'Healthy' pattern scores (22% females). Collectively, these findings highlight the importance of establishing healthy dietary habits as early as possible in childhood.

Other studies have examined individual food intakes between adolescence and early adulthood and observed poor intakes of whole grains, fruit and vegetables and high intakes of sugar-sweetened beverages and other snacks during this period (14, 15, 48). However, only a small number of studies to date have assessed the stability or trajectories in overall dietary patterns between adolescence and young adulthood stage (22, 26). Mikkila *et al*. reported tracking of 'traditional Finnish' and 'health-conscious' dietary patterns in the Cardiovascular Risk in Young Finns Study (22). Tracking in this study was assessed using the proportion of participants remaining in the same quintile for dietary pattern score six and 21 years after baseline. The cohort was grouped into 3-12 y olds and 15-18 y olds. Tracking was strongest for the 'traditional Finnish' dietary pattern and was slightly stronger for 15-18 y olds.

The Canadian Saskatchewan Pediatric Bone Mineral Accrual Study tracked a 'Western-like' dietary pattern characterised by high intakes of refined grains and processed meat from childhood through adolescence and into adulthood (between 8 and 34 y) (26). In this study, beta coefficients assessed using generalized estimating equations (GEE) were used to indicate tracking between baseline dietary pattern scores and subsequent follow-up dietary pattern scores. The overall change in dietary pattern scores between childhood and adulthood showed an increasing trend for 'Western-like' dietary pattern (β=0.028; 95%CI=0.011, 0.045), particularly in males, while no significant tracking was indicated for females (26). Nevertheless, this study differed by age at baseline, period of follow-up, a lower sample size (n=130), and different statistical methods to derive dietary patterns and tracking. Notwithstanding these design

differences, these results corroborate with an increasing score for a 'Western' dietary pattern over time in the current study, particularly among males. We have also previously reported tracking coefficients for an 'energy dense, high fat and low dietary fibre' dietary pattern among males (r= 0.51) than in females (r=0.45), $p<0.05$, between 14 and 17 y of age in the Raine Study (49).

This study indicates family factors as having potentially important influences on dietary pattern trajectories. For instance, males who showed consistently lower scores for a 'Healthy' dietary pattern over time were more likely to have mothers with a higher pre-pregnancy BMI or a parent who smokes. Maternal factors such as a higher maternal pre-pregnancy BMI, could influence adolescent's dietary intakes through transferred behaviour and attitudes, and shared home environment e.g. less healthy food preferences (50). Several observational studies suggest that the children of smokers are less likely to consume a diet that aligns with dietary recommendations, compared to children of non-smokers (51-53). Similar to the present study, a cross-sectional analysis in the Raine study concluded that adolescents with non-smoking parents had a higher score for a 'Healthy' dietary pattern at 14 y (30). Whereas, greater maternal education was associated with a trajectory of consistently higher 'Healthy' dietary pattern scores, in females, which corresponds with a previous analysis in the Raine cohort as well as the Avon Longitudinal Study of Parents and Children (ALSPAC) study in the UK (6, 28).

Having a consistently lower 'Western' dietary pattern over time was associated with a two-parent family structure in majority of males, in the current study. Family structure may play an important role in dietary behaviours and intake of adolescents through mechanisms such as family income and social support (54). In females, an overall reduction in the 'Western' dietary pattern scores with increasing family income is consistent with that reported in this cohort at 14 y whereby adolescents from families in the highest income group showed a significantly lower mean score (β=-0.11, $p=0.05$) for the 'Western' dietary pattern (28). This suggests a relationship between higher food spending and healthier food purchasing in more affluent households (55).

A higher maternal age and family function score were both inversely related to scores for the 'Western' dietary pattern in females in the current study. This is not surprising as nutrition knowledge and expertise in food preparation is likely to accumulate with age (45). Poor family function has previously been linked with obesogenic environments (56) and emerging evidence suggests a direct relationship between poor family functioning and family diet quality in children (28, 57).

Our study has several strengths. The analysis of empirical dietary patterns allows an assessment of total dietary intake, rather than a focus on isolated foods or nutrients only. Our dietary pattern analysis

identified two consistent dietary patterns across adolescence and into young adulthood. The timings when dietary information was collected in the Raine study, concurred with an important stage of life; adolescence through emerging adulthood. This is one of the largest studies to assess trajectories in empirical dietary patterns during this key transition period. Additionally, the representation of dietary pattern scores as intercepts and slopes allowed for an exploration of changes in diet over time and identification of determinants that influenced change.

A limitation of our study as with all cohort studies, is data attrition, particularly of study participants from lower income families and with lower maternal education. As such, these results may not be generalisable to all populations. Self-reported food intakes are subject to error and reporting bias, regardless of the dietary assessment tool. Furthermore, dietary patterns derived using a data driven technique such as factor analysis are specific to the population under study. However, energy-dense, high fat, low fibre empirical dietary patterns such as the 'Western' dietary pattern observed in our study, have been reproduced in different cohorts and consistently associated with greater adiposity during childhood (43). Finally, despite adjusting for several individual and family factors, residual confounding cannot be ruled out.

Conclusions

Poor dietary patterns established in adolescence are likely to track into young adulthood, particularly in males. This study highlights the stage between adolescence and young adulthood as a critical period and the populations most likely to benefit from interventions to improve dietary habits in adolescence.

Abbreviations

(ADHD): Attention deficit hyperactivity disorder; (BMI): Body mass index; (CCV): Cancer Council of Victoria; (CSIRO): Commonwealth Scientific and Industrial Research Organisation; (DQESV2): Dietary Questionnaire for Epidemiological Studies; (FFQ): Food frequency questionnaire; (GEE): Generalised estimating equation; (GFS): General Functioning Scale; (NAFLD): Non-alcoholic fatty liver disease; (PCA): Principal component analysis; (Raine study): The Western Australian Pregnancy Cohort; (SES): Socio-economic status; (Y): Years

Declarations

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Availability of data and materials

The data used to support the conclusion of this study are available from rainestudy.org.au. Restrictions apply to the availability of these data, however requests may be made through study management.

Ethics approval and consent to participate

All data collection for the Raine Study has been conducted in accordance with the Australian National Health and Medical Research Council Guidelines for Ethical Conduct in Human Research and was approved by the ethics committees of King Edward Memorial Hospital for Women and Princess Margaret Hospital for Children, Perth, Western Australia. Written informed consent was obtained from both the primary caregivers (at 14 and 17 y) and study respondents (at 20 and 22 y).

Consent for publication

Not applicable.

Competing interests

All authors declare no competing interests.

Author contributions

GA planed the analysis, drafted and prepared the manuscript for publication; KM performed the analysis and interpreted the results; GT was responsible for the coding of dietary data and interpretation of study findings; WHO was a principle investigator for collection of dietary data and provided critical review of the manuscript; GLA developed the concept for this paper, contributed to interpretation of the results and drafting of the manuscript; and all authors read and approved the final manuscript.

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Tables

Due to technical limitations, tables are only available as a download in the supplemental files section

Figures

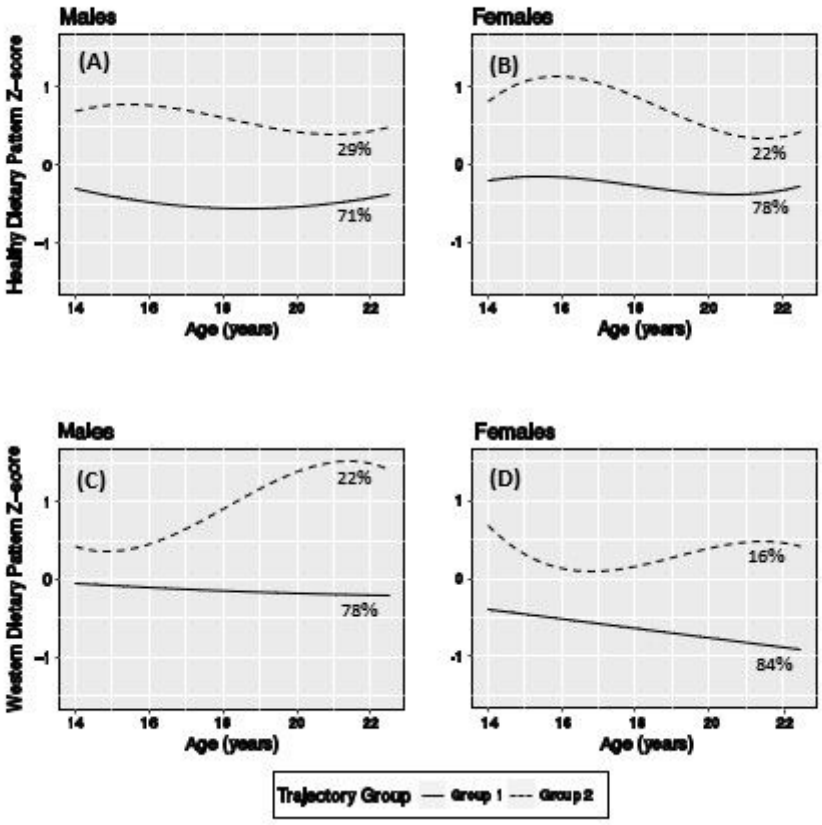

Figure 1

Healthy' (panels A and B) and 'Western' (panels C and D) dietary pattern trajectories. Males: Group 1 and 2 'Healthy' pattern trajectories comprised 71% and 29% of individuals, respectively; Females: Group 1 and 2 'Healthy' pattern trajectories comprised 78% and 22% of individuals, respectively; Males: Group 1 and 2 'Western' pattern trajectories comprised 78% and 22% of individuals, respectively; Females: Group 1 and 2 'Western' pattern trajectories comprised 84% and 16% of individuals, respectively.

Supplementary Files

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